



Standard Specification for Aviation Certification Turbine Fuel¹

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1. Scope

1.1 This specification covers the use of purchasing agencies in formulating specifications for purchases of aviation turbine fuel under contract.

1.2 This specification defines one specific type of aviation turbine fuel for civil use in the certification of aircraft. The specification can be used as a standard in describing the quality of this aviation fuel from the refinery to the aircraft.

1.3 This specification does not include the fuels that are commonly used in aviation turbine engines. Those are listed in Specification D1655.

1.4 The aviation turbine fuel defined by this specification may be used in other than turbine engines that are specifically designed and certified for this fuel.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 ASTM Standards:²

- D56 Test Method for Flash Point by Tag Closed Cup Tester
- D86 Test Method for Distillation of Petroleum Products at Atmospheric Pressure
- D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- D381 Test Method for Gum Content in Fuels by Jet Evaporation
- D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- D1094 Test Method for Water Reaction of Aviation Fuels
- D1266 Test Method for Sulfur in Petroleum Products (Lamp Method)

- D1298 Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- D1319 Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption
- D1322 Test Method for Smoke Point of Kerosine and Aviation Turbine Fuel
- D1655 Specification for Aviation Turbine Fuels
- D1840 Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry
- D2386 Test Method for Freezing Point of Aviation Fuels
- D2622 Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry
- D2624 Test Methods for Electrical Conductivity of Aviation and Distillate Fuels
- D2887 Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography
- D3227 Test Method for (Thiol Mercaptan) Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method)
- D3241 Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedure)
- D3242 Test Method for Acidity in Aviation Turbine Fuel
- D3338 Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
- D3828 Test Methods for Flash Point by Small Scale Closed Cup Tester
- D4052 Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
- D4057 Practice for Manual Sampling of Petroleum and Petroleum Products
- D4171 Specification for Fuel System Icing Inhibitors
- D4294 Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry
- D4306 Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination
- D4529 Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
- D4809 Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)
- D4952 Test Method for Qualitative Analysis for Active

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

Sulfur Species in Fuels and Solvents (Doctor Test)

- D5001** Test Method for Measurement of Lubricity of Aviation Turbine Fuels by the Ball-on-Cylinder Lubricity Evaluator (BOCLE)
- D5006** Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels
- D5191** Test Method for Vapor Pressure of Petroleum Products (Mini Method)
- D5453** Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
- D5972** Test Method for Freezing Point of Aviation Fuels (Automatic Phase Transition Method)
- D6469** Guide for Microbial Contamination in Fuels and Fuel Systems
- E29** Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

3. General

3.1 This specification, unless otherwise provided, prescribes the required properties of aviation certification turbine fuel at the time and place of delivery.

4. Classification

4.1 One type of aviation turbine fuel is provided, as follows:

4.1.1 *Jet C-1*—A relatively wide boiling range volatile distillate.

5. Materials and Manufacture

5.1 Aviation turbine fuel, except as otherwise specified in this specification, shall consist of blends of refined hydrocarbons derived from conventional sources including crude oil, natural gas liquid condensates, heavy oil, shale oil, and oil sands. The use of jet fuel blends, containing components from other sources, is only permitted on a specific, individual basis (see Annex A1 on fuels from non-conventional sources in Specification **D1655**).

5.1.1 Fuels used in engines and aircraft are ultimately approved by the certifying authority subsequent to formal submission of evidence to the authority as part of the type certification program for that aircraft and engine model. Additives to be used as supplements to an approved fuel must also be similarly approved on an individual basis (see Specification **D1655**).

5.2 *Additives*—May be added to this aviation turbine fuel in the amount and of the composition specified in the following list of approved material:³

5.2.1 *Antioxidants*—In amounts not to exceed 24.0 mg/L active ingredients (not including weight of solvent):

5.2.1.1 2,6-ditertiary-butyl phenol.

5.2.1.2 2,6-ditertiary-butyl-4-methyl phenol.

5.2.1.3 2,4-dimethyl-6-tertiary-butyl phenol.

5.2.1.4 75 % minimum 2,6-ditertiary-butyl phenol, plus 25 % maximum mixed tertiary and tritertiary-butyl phenols.

5.2.1.5 55 % minimum 2,4-dimethyl-6-tertiary-butyl phenol, plus 15 % minimum 2,6-ditertiary-butyl-4-methyl phenol, remainder as monomethyl and dimethyl tertiary-butyl phenols.

5.2.1.6 72 % minimum 2,4-dimethyl-6-tertiary-butyl phenol, 28 % maximum monomethyl and dimethyl-tertiary-butyl phenols.

5.2.2 *Metal Deactivator Additive (MDA)*, in amount not to exceed 2.0 mg/L (not including weight of solvent) on initial fuel manufacture at the refinery. Higher initial concentrations are permitted in circumstances where copper contamination is suspected to occur during distribution. Cumulative concentration of MDA when retreating the fuel shall not exceed 5.7 mg/L:

5.2.2.1 *N,N*-disalicylidene-1,2-propane diamine.

5.2.3 *Electrical Conductivity Additive*—Stadis 450⁴ not to exceed 3 mg/L.

5.2.3.1 When loss of fuel conductivity necessitates retreatment with electrical conductivity additive, the following concentration limits apply:

At Manufacture:	
Stadis 450	3 mg/L, max
Retreatment:	
Stadis 450	cumulative total 5 mg/L, max

5.2.4 *Leak Detection Additive*—Tracer A (LDTA-A)⁵ may be added to the fuel in amounts not to exceed 1 mg/kg.

5.2.5 Other additives are permitted. These include fuel system icing inhibitor and special purpose additives such as biocides. The quantities and types must be declared by the fuel supplier and agreed to by the purchaser. Only additives approved by the aircraft certifying authority are permitted in the fuel on which an aircraft is operated.

5.2.5.1 Biocidal additives are available for controlled usage. Where such an additive is used in the fuel, the approval status of the additive and associated conditions must be checked for the specific aircraft and engines to be operated.

5.2.5.2 *Fuel System Icing Inhibitor*: **m-d7223-05**

(1) *Diethylene Glycol Monomethyl Ether (DIEGME)*, conforming to the requirements of Specification **D4171**, Type III, may be used in concentrations of 0.10 to 0.15 volume %.

(2) Test Method **D5006** may be used to determine the concentration of DIEGME in aviation fuels.

5.3 Guidance material is presented in Appendix X3 of Specification **D1655** concerning the need to control processing additives in jet fuel production.

6. Detailed Requirements

6.1 The aviation turbine fuel shall conform to the requirements prescribed in **Table 1**.

6.2 Test results shall not exceed the maximum or be less than the minimum values specified in **Table 1**. No allowance shall be made for the precision of the test methods. To determine conformance to the specification requirement, a test result may be rounded to the same number of significant figures

³ Supporting data (Guidelines for Approval or Disapproval of Additives) have been filed at ASTM International Headquarters and may be obtained by requesting Research Report D02-1125.

⁴ Stadis 450 is a registered trademark marketed by Innospec Inc., Innospec Manufacturing Park, Oil Sites Road, Ellesmere Port, Cheshire, CH65 4EY, UK.

⁵ Tracer A (LDTA-A) is a registered trademark of Tracer Research Corp., 3755 N. Business Center Dr., Tucson, AZ 85705.

TABLE 1 Detailed Requirements of Aviation Certification Turbine Fuel^A

Property		Jet C-1	ASTM Test Method ^E
Acidity, total mg KOH/g	max	0.10	D3242
Aromatics, vol %	min/max	8 to 25	D1319
Sulfur, mercaptan ^C , weight %	max	0.003	D3227
Sulfur, total weight %	max	0.30	D1266, D2622, D4294 or D5453
Distillation temperature, °C (°F):			
Initial boiling point, temperature	min/max	70/100 (158/212)	D2887, D86 ^D
5 % recovered, temperature	min/max	80/110 (176/230)	D2887, D86 ^D
10 % recovered, temperature	min/max	90/120 (194/248)	D2887, D86 ^D
20 % recovered, temperature	min/max	105/140 (221/284)	D2887, D86 ^D
50 % recovered, temperature	min/max	150/195 (302/383)	D2887, D86 ^D
90 % recovered, temperature	min/max	215/255 (419/491)	D2887, D86 ^D
Final boiling point, temperature	min/max	240/290 (464/554)	D2887, D86 ^D
Flash Point, °C (°F)	report		D56, D3828
Density at 15°C, kg/m ³		750 to 840	D1298, D4052
Vapor pressure ^E			
at 25°C, kPa (psi)	report	3.0 (0.44) to 5.5 (0.80)	D5191 ^F
at 38°C, kPa (psi)	report	5.6 (0.8) to 8.2 (1.2)	D5191 ^F
at 50°C, kPa (psi)	min/max	10.0 (1.45) to 12.5 (1.82)	D5191 ^F
at 100°C, kPa (psi)	report	56 (8.1) to 60 (8.7)	D5191 ^F
Freezing point, °C	max	-35	D2386, D5972 ^G
Viscosity at -20°C, mm ² /s ^H	max	8.0	D445
Net heat of combustion, MJ/kg	min	42.8 ^I	D4529, D3338, or D4809
One of the following requirements shall be met:			
(1) Smoke point, mm, or	min	25	D1322
(2) Smoke point, mm, and	min	18	D1322
Naphthalenes, vol, %	max	3.0	D1840
Copper strip, 2 h at 100°C	max	No. 1	D130
Thermal stability:			
Filter pressure drop, mm Hg	max	25 ^J	D3241 ^K
Tube deposit less than		3	D3241
Existent gum, mg/100 mL	max	7	D381
Water reaction:			
Interface rating	max	1b	D1094
Lubricity ^L – BOCLE WSD, mm	max	0.85	D5001 ^L
Additives:			see 5.2
Electrical conductivity, pS/m	required	50 to 450	D2624
Other	optional		

^A For compliance of test results against the requirements of Table 1, see 6.2.

^B The test methods indicated in this table are referred to in Section 10.

^C The mercaptan sulfur determination may be waived if the fuel is considered sweet by the doctor test described in Test Method D4952.

^D If Test Method D2887 is used, use correlation procedure (Appendix X5) in Test Method D2887 to convert D2887 temperatures to D86 equivalent temperatures. Both minimums and maximums shall be met.

^E Absolute vapor pressure is the primary property to be controlled; Cyclohexane and toluene, as cited in 7.2 and 7.7 of Test Method D5191, shall be used as calibrating reagents. 1.0 kPa = 0.145 psi.

^F Record absolute vapor pressure.

^G Test Method D5972 may produce a higher (warmer) result than that from Test Method D2386. In case of dispute, Test Method D2386 shall be the referee method.

^H 1 mm²/s = 1 cSt.

^I Use either Eq 1 or Table 1 in Test Method D4529 or Eq 2 in Test Method D3338. Test Method D4809 may be used as an alternative. In case of dispute, Test Method D4809 shall be used.

^J Preferred SI units are 3.3 kPa, max.

^K Thermal stability test (JFTOT) shall be conducted for 2.5 h at a control temperature of 260°C. Tube deposits shall always be reported by the Visual Method: a rating by the Tube Deposit Rating (TDR) optical density method is desirable but not mandatory. No peacock or abnormal colored tube deposits are permitted.

^L Lubricity test can be waived with purchaser's agreement.

as in Table 1 using Practice E29. Where multiple determinations are made, the average result, rounded according to Practice E29, shall be used.

6.3 If any additives are used, the aviation turbine fuel shall conform to the Table 2 listed requirements.

7. Workmanship, Finish and Appearance

7.1 The aviation turbine fuel herein specified shall be visually free of undissolved water, sediment, and suspended matter. The odor of the fuel shall not be nauseating or irritating.

No substance of known dangerous toxicity under usual conditions of handling and use shall be present, except as permitted in this specification.

8. Sampling

8.1 Because of the importance of proper sampling procedures in establishing fuel quality, use the appropriate procedures in Practice D4057.

8.2 A number of jet fuel properties including thermal stability, water separation, electrical conductivity, and others