



## Standard Specification for Aviation Certification Turbine Fuel<sup>1</sup>

This standard is issued under the fixed designation D7223; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 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 use of EI/IP (Energy Institute/Institute of Petroleum) test methods is permitted. The user of this specification is referred to Specification [D1655](#) (latest revision), Specification for Aviation Turbine Fuels, Paragraph 2, Referenced Documents and Table 1, Detailed Requirements of Aviation Turbine Fuels, Column 4, Test Methods, to determine the pairing of the IP test method with the particular detailed requirement, and to Section 11, Test Methods, to identify jointed standards and referee methods.

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

1.6.1 *Exception*—Units of pressure are also given in psi.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee [D02](#) on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee [D02.J0.01](#) on Jet Fuel Specifications.

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### 2. Referenced Documents

#### 2.1 *ASTM Standards*:<sup>2</sup>

- [D56](#) Test Method for Flash Point by Tag Closed Cup Tester
- [D86](#) Test Method for Distillation of Petroleum Products and Liquid Fuels 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)
- [D1266](#) Test Method for Sulfur in Petroleum Products (Lamp Method)
- [D1298](#) Test Method for Density, Relative Density, 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 Kerosene 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, Kerosene, Aviation Turbine, and Distillate Fuels (Potentiometric Method)
- [D3241](#) Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels
- [D3242](#) Test Method for Acidity in Aviation Turbine Fuel
- [D3338](#) Test Method for Estimation of Net Heat of Combustion of Aviation Fuels

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard

- D3828 Test Methods for Flash Point by Small Scale Closed Cup Tester
- D3948 Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer
- 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 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
- 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)
- D6378 Test Method for Determination of Vapor Pressure ( $VP_x$ ) of Petroleum Products, Hydrocarbons, and Hydrocarbon-Oxygenate Mixtures (Triple Expansion Method)
- D7042 Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

## 2.2 Other Standards:

- AFRL-RQ-WP-TR-2013-0271 Determination of the Minimum Use Level of Fuel System Icing Inhibitor (FSII) in JP-8 that will Provide Adequate Icing Inhibition and Biostatic Protection for Air Force Aircraft<sup>3</sup>

## 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 (see **Note 1**) 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 permitted only on a specific, individual basis (see Annex A1 on fuels from non-conventional sources in Specification **D1655**).

**NOTE 1**—Conventionally refined jet fuel contains trace levels of materials which are not hydrocarbons, including oxygenates, organosulfur, and nitrogeous compounds.

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:<sup>4</sup>

5.2.1 *Antioxidants*—In amounts not to exceed 24.0 mg/L active ingredients (not including mass 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 mass 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 450<sup>5</sup> 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:

<sup>4</sup> Supporting data (Guidelines for Approval or Disapproval of Additives) have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1125.

<sup>5</sup> Stadis 450 is a registered trademark marketed by Innospec Inc., Innospec Manufacturing Park, Oil Sites Road, Ellesmere Port, Cheshire, CH65 4EY, UK.

<sup>3</sup> Available from Defense Technical Information Center (DTIC), 8725 John J. Kingman Road, Ft. Belvoir, VA 22060-6218, <http://www.dtic.mil/dtic>, accession number ADA595127.

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)<sup>6</sup> 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:*

(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 % by 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 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 proce-

dures in Practice **D4057** to obtain a representative sample from the batch of fuel for specification compliance testing. This requirement is met by producing fuel as a discrete batch then testing it for specification compliance. This requirement is not satisfied by averaging online analysis results.

8.2 A number of jet fuel properties including thermal stability, water separation, electrical conductivity, and others are very sensitive to trace contamination that can originate from sample containers. For recommended sample containers refer to Practice **D4306**.

## 9. Report

9.1 The type and number of reports to ensure conformance with the requirements of this specification shall be mutually agreed upon by the seller and the purchaser of the aviation turbine fuel.

9.2 A suggested form for reporting inspection data on aviation turbine fuel is given in Specification **D1655**.

## 10. Test Methods

10.1 Determine the requirements enumerated in this specification in accordance with the following ASTM test methods.

10.1.1 *Density*—Test Method **D1298** or **D4052**. Test Method **D4052** shall be the referee test method.

10.1.2 *Distillation*—Test Method **D86** or **D2887** with the conversion to **D86** temperatures given in correlation procedure (Appendix X5) in Test Method **D2887**.

10.1.3 *Vapor Pressure*—Test Method **D6378**. Record absolute vapor pressure (VP<sub>x</sub>).

10.1.4 *Flash Point*—Test Method **D56** or **D3828**. Test Method **D3828** shall be the referee test method.

10.1.5 *Freezing Point*—Test Methods **D2386** or **D5972**. Test Method **D2386** shall be the referee test method.

10.1.6 *Viscosity*—Test Method **D445** or **D7042**. Test Method **D445** shall be the referee test method.

10.1.7 *Net Heat of Combustion*—Test Method **D4529**, **D3338**, or **D4809**. Test Method **D4809** shall be the referee test method.

10.1.8 *Corrosion (Copper Strip)*—Test Method **D130**.

10.1.9 *Total Acidity*—Test Method **D3242**.

10.1.10 *Sulfur*—Test Methods **D1266**, **D2622**, **D4294**, or **D5453**. Test Method **D2622** shall be the referee test method.

10.1.11 *Mercaptan Sulfur*—Test Method **D3227**.

10.1.12 *Microseparator*—Test Method **D3948**.

10.1.13 *Existent Gum*—Test Method **D381**.

10.1.14 *Thermal Stability*—Test Method **D3241**.

10.1.15 *Aromatics*—Test Method **D1319**.

10.1.16 *Smoke Point*—Test Method **D1322**.

10.1.17 *Naphthalene Content*—Test Method **D1840**.

10.1.18 *Electrical Conductivity*—Test Method **D2624**.

10.1.19 *Lubricity*—Test Method **D5001**.

## 11. Keywords

11.1 aviation certification turbine fuel; aviation turbine fuel; Jet C-1; jet fuel; kerosine

<sup>6</sup> Tracer A (LDTA-A) is a registered trademark of Tracer Research Corp., 3755 N. Business Center Dr., Tucson, AZ 85705.