



## Standard Specification for Jet B Wide-Cut Aviation Turbine Fuel<sup>1</sup>

This standard is issued under the fixed designation D6615; 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. This fuel has advantages for operations in very low temperature environments compared with other fuels described in Specification D1655. This fuel is intended for use in aircraft that are certified to use such fuel.

NOTE 1—The technical requirements of this product, at the time of the first publication of this specification, are substantially identical to the requirements of Jet B in Specification D1655.

### 2. Referenced Documents

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

- 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
- D323 Test Method for Vapor Pressure of Petroleum Products (Reid Method)
- D381 Test Method for Gum Content in Fuels by Jet Evaporation
- 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, 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

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.J0.01 on Jet Fuel Specifications.

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<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.

- D1660 Method of Test for Thermal Stability of Aviation Turbine Fuels (Withdrawn 1992)<sup>3</sup>
- D1840 Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry
- D2276 Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling
- 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
- D3227 Test Method for (Thiol Mercaptan) Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method)
- D3240 Test Method for Undissolved Water In Aviation Turbine Fuels
- D3241 Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels
- D3338 Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
- D3948 Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separator
- 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
- D4176 Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)
- 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)

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

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

- D4865 Guide for Generation and Dissipation of Static Electricity in Petroleum Fuel Systems
- 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
- D5191 Test Method for Vapor Pressure of Petroleum Products (Mini Method)
- D5452 Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
- 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)
- D6379 Test Method for Determination of Aromatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates—High Performance Liquid Chromatography Method with Refractive Index Detection
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- 2.2 *IP Standards*:<sup>4</sup>
  - 225 Copper Content of Aviation Turbine Fuel
  - 227 Silver Corrosion of Aviation Turbine Fuel
- 2.3 *Other Standard*:<sup>5</sup>
  - CAN/CGSB 3.22-97 “Aviation Turbine Fuel, Wide Cut Type” includes grade Jet B and NATO grade F-40 fuel
- 2.4 *Military Standard*:<sup>6</sup>
  - MIL-DTL-5624 Turbine Fuel, Aviation, Grades JP-4, JP-5, and JP-5/JP-8 ST

### 3. General

3.1 This specification, unless otherwise provided, prescribes the required properties of Jet B wide-cut aviation 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 B*—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 2**) 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.

**NOTE 2**—Conventionally refined jet fuel contains trace levels of materials which are not hydrocarbons including oxygenates, organosulfur, and nitrogenous compounds.

5.1.1 Fuels used in certified 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 **X1.2.4** and **X1.12.1**).

5.2 *Additives*—May be added to each type of aviation turbine fuel in the amount and of the composition specified in the following list of approved material:<sup>7</sup>

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*, in amount not to exceed 5.7 mg/L (not including weight of solvent):

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

5.2.3 *Electrical Conductivity Additive*—Stadis 450<sup>8</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:

	<i>At Manufacture</i>
Stadis 450	3 mg/L, max
	<i>Retreatment</i>
Stadis 450	cumulative total 5 mg/L, max

5.2.4 *Leak Detection Additive*—Tracer A<sup>9</sup> may be added to the fuel in amounts not to exceed 1 mg/kg.

5.2.5 Other additives are permitted under **5.1** and **Section 7**. These include fuel system icing inhibitor, other anti-oxidants, inhibitors, and special purpose additives. 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.

<sup>4</sup> Available from Directorate of Standardization, Stan 1, Room 5131, Kentigern House, 65 Brown St., Glasgow, G2 8EX, United Kingdom.

<sup>5</sup> Available from the Canadian General Standards Board (CGSB), Ottawa, Canada K1A 1G6.

<sup>6</sup> Available from Dept. of Defense Single Stock Point, Bldg 4D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

<sup>7</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>8</sup> Stadis 450 is a registered trademark marketed by Innospec Inc., Innospec Manufacturing Park, Oil Sites Road, Ellsmere Port, Cheshire, CH65 4EY, UK.

<sup>9</sup> Tracer A (LDTA-A) is a registered trademark of Tracer Research Corp., 3755 N. Business Center Dr., Tucson, AZ 85705.

### 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 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** 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 in accordance with Practice **E29**, shall be used.

## 7. Workmanship, Finish, and Appearance

7.1 The aviation turbine fuel specified in this specification 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** to obtain a representative sample from the batch of fuel for specification compliance testing. This

**TABLE 1 Detailed Requirements of Aviation Turbine Fuels<sup>A</sup>**

Property		Jet B	ASTM Test Method <sup>B</sup>
1. Aromatics, vol %	max	25	<b>D1319</b>
2. Aromatics, vol %	max	26.5	<b>D6379</b>
Sulfur, mercaptan, <sup>C</sup> mass %	max	0.003	<b>D3227</b>
Sulfur, total mass %	max	0.30	<b>D1266, D2622, D4294, or D5453</b>
Distillation temperature, °C:			
20 % recovered, temperature	min	90	<b>D86</b>
20 % recovered, temperature	max	145	
50 % recovered, temperature	min	110	
50 % recovered, temperature	max	190	
90 % recovered, temperature	max	245	
Distillation residue, %	max	1.5	
Distillation loss, %	max	1.5	
Density at 15°C, kg/m <sup>3</sup>		751 to 802	<b>D1298 or D4052</b>
Vapor pressure, 38°C, kPa		14 to 21	<b>D323 or D5191<sup>D</sup></b>
Freezing point, °C	max	-50 <sup>E</sup>	<b>D2386 or D5972<sup>F</sup></b>
Net heat of combustion, MJ/kg	min	42.8 <sup>G</sup>	<b>D4529, D3338, or D4809</b>
One of the following requirements shall be met:			
(1) Smoke point, mm, or	min	25	<b>D1322</b>
(2) Smoke point, mm, and	min	18	<b>D1322</b>
Naphthalenes, vol, %	max	3.0	<b>D1840</b>
Copper strip, 2 h at 100°C		No. 1	<b>D130</b>
Thermal Stability:			
(2.5 h at control temperature of 260°C min):			
Filter pressure drop, mm Hg	max	25	<b>D3241<sup>H</sup></b>
Tube deposits less than		3	
		No <i>Peacock</i> or <i>Abnormal</i> Color Deposits	
Existent gum, mg/100 mL	max	7	<b>D381</b>
ADDITIVES		See <b>5.2</b>	
Electrical conductivity, pS/m		<sup>I</sup>	<b>D2624</b>
Microseparometer Rating <sup>J</sup>			<b>D3948</b>
Without electrical conductivity additive	min	85	
With electrical conductivity additive	min	70	

<sup>A</sup> For compliance of test results against the requirements of **Table 1**, see **6.2**.

<sup>B</sup> The test methods indicated in this table are referred to in Section **10**.

<sup>C</sup> The mercaptan sulfur determination may be waived if the fuel is considered sweet by the doctor test described in Test Method **D4952**.

<sup>D</sup> Cyclohexane and toluene, as cited in 7.2 and 7.7 of Test Method **D5191**, shall be used as calibrating reagents. Test Method **D5191** shall be the referee method.

<sup>E</sup> Other freezing points may be agreed upon between supplier and purchaser.

<sup>F</sup> Test Method **D5972** may produce a higher (warmer) result than that from Test Method **D2386** on wide-cut fuels such as Jet B or JP-4. In case of dispute, Test Method **D2386** shall be the referee method.

<sup>G</sup> 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.

<sup>H</sup> Tube deposits shall always be reported by the Visual Method.

<sup>I</sup> If electrical conductivity additive is used, the conductivity shall not exceed 600 pS/m at the point of use of the fuel. When electrical conductivity additive is specified by the purchaser, the conductivity shall be 50 to 600 pS/m under the conditions at point of delivery.

$$1 \text{ pS/m} = 1 \times 10^{-12} \Omega^{-1} m^{-1}$$

<sup>J</sup> At point of manufacture.

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, which 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 fuels is given in Appendix X4 of 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 Methods **D1298** or **D4052**.

10.1.2 *Distillation*—Test Method **D86**.

10.1.3 *Vapor Pressure*—Test Methods **D323** or **D5191**. Test Method **D5191** shall be the referee test method.

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

10.1.5 *Net Heat of Combustion*—Test Methods **D4529**, **D3338**, or **D4809**.

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

10.1.7 *Sulfur*—Test Methods **D1266**, **D2622**, **D4294**, or **D5453**.

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

10.1.9 *Water Reaction*—Test Method **D1094**.

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

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

10.1.12 *Aromatics*—Test Methods **D1319** or **D6379**. Test Method **D1319** shall be the referee test method.

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

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

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

## 11. Keywords

11.1 aviation turbine fuel; avtag; Jet B; jet fuel; turbine fuel; wide-cut

## APPENDICES

(Nonmandatory Information)

### X1. PERFORMANCE CHARACTERISTICS OF AVIATION TURBINE FUELS

#### X1.1 Introduction

X1.1.1 This appendix describes the performance characteristics of aviation turbine fuels. A more detailed discussion of the individual test methods and their significance is found in ASTM Manual No. 1.<sup>10</sup>

#### X1.2 Significance and Use

X1.2.1 Specification D6615 defines one type of jet fuel for civil use. Limiting values for the two types of fuel covered are placed on fuel properties believed to be related to the performance of the aircraft and engines in which they are most commonly used.

X1.2.2 The safe and economical operation of aircraft requires fuel that is essentially clean and dry and free of any contamination prior to use. It is possible to measure a number of jet fuel characteristics related to quality.

X1.2.3 The significance of standard tests for fuel properties may be summarized for convenience in terms of the technical relationships with performance characteristics as shown in **Table X1.1**.

X1.2.4 The acceptability of additives for use must ultimately be determined by the engine and aircraft type certificate

holder and must be approved by his certifying authority. In the United States of America, the certifying authority is the Federal Aviation Administration.

#### X1.3 Thermal Stability

X1.3.1 Stability to oxidation and polymerization at the operating temperatures encountered in certain jet aircraft is an important performance requirement. The thermal stability measurements are related to the amount of deposits formed in the engine fuel system on heating the fuel in a jet aircraft. Commercial jet fuels should be thermally stable at fuel temperature as high as 163°C (325°F). Such fuels have been demonstrated to have inherent storage stability.

X1.3.2 In 1973, Test Method **D3241** replaced Method of Test **D1660**, known as the ASTM Coker for the determination of oxidative thermal stability. (See CRC Report 450, dated 1969 and revised in 1972. See also Bert and Painter's SAE paper 730385.<sup>11</sup>) Today, a single pass/fail run with the tube temperature controlled at 260°C is used to ensure compliance with the specifications minimum requirements. For a more complete characterization of a fuel's thermal stability, a *breakpoint* can be obtained. The breakpoint is the highest tube temperature at which the fuel still passes the specification

<sup>10</sup> ASTM MNL 1, *Manual on Significance of Tests for Petroleum Products*, ASTM International, W. Conshohocken, 1993.

<sup>11</sup> Bert, J. A., and Painter, L., "A New Fuel Thermal Stability Test (A Summary of Coordinating Research Council Activity)," SAE Paper 730385, Society of Automotive Engineers, Warrendale, PA, 1973.