



Standard Specification for Aviation Turbine Fuels¹

This standard is issued under the fixed designation D1655; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

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 the minimum property requirements for Jet A and Jet A-1 aviation turbine fuel and lists acceptable additives for use in civil operated engines and aircrafts. Specification D1655 is directed at civil applications, and maintained as such, but may be adopted for military, government or other specialized uses.

1.3 This specification can be used as a standard in describing the quality of aviation turbine fuel from production to the aircraft. However, this specification does not define the quality assurance testing and procedures necessary to ensure that fuel in the distribution system continues to comply with this specification after batch certification. Such procedures are defined elsewhere, for example in ICAO 9977, EI/JIG Standard 1530, JIG 1, JIG 2, API 1543, API 1595, and ATA-103.

1.4 This specification does not include all fuels satisfactory for aviation turbine engines. Certain equipment or conditions of use may permit a wider, or require a narrower, range of characteristics than is shown by this specification.

1.5 Aviation turbine fuels defined by this specification may be used in other than turbine engines that are specifically designed and certified for this fuel.

1.6 This specification no longer includes wide-cut aviation turbine fuel (Jet B). FAA has issued a Special Airworthiness Information Bulletin which now approves the use of Specification **D6615** to replace Specification D1655 as the specification for Jet B and refers users to this standard for reference.

1.7 The values stated in SI units are to be regarded as standard. However, 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 and Liquid Fuels at Atmospheric Pressure
- D93** Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- D130** Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- D156** Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)
- D240** Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter
- D323** Test Method for Vapor Pressure of Petroleum Products (Reid Method)
- 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 Kerosine and Aviation Turbine Fuel
- D1405** Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
- D1660** Method of Test for Thermal Stability of Aviation Turbine Fuels (Withdrawn 1992)³
- D1840** Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry
- D2276** Test Method for Particulate Contaminant in Aviation

¹ 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 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.

³ The last approved version of this historical standard is referenced on www.astm.org.

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

- 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
- D2887** Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography
- D2892** Test Method for Distillation of Crude Petroleum (15-Theoretical Plate Column)
- D3120** Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry
- 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
- D3242** Test Method for Acidity in Aviation Turbine Fuel
- D3338** Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
- D3343** Test Method for Estimation of Hydrogen Content of Aviation Fuels
- D3701** Test Method for Hydrogen Content of Aviation Turbine Fuels by Low Resolution Nuclear Magnetic Resonance Spectrometry
- 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
- 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)
- 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)
- D4953** Test Method for Vapor Pressure of Gasoline and Gasoline-Oxygenate Blends (Dry Method)
- 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
- D5190** Test Method for Vapor Pressure of Petroleum Products (Automatic Method) (Withdrawn 2012)³
- 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)
- D6045** Test Method for Color of Petroleum Products by the Automatic Tristimulus 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
- D6469** Guide for Microbial Contamination in Fuels and Fuel Systems
- D6615** Specification for Jet B Wide-Cut Aviation Turbine Fuel
- D6751** Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels
- D7042** Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)
- D7153** Test Method for Freezing Point of Aviation Fuels (Automatic Laser Method)
- D7154** Test Method for Freezing Point of Aviation Fuels (Automatic Fiber Optical Method)
- D7345** Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure (Micro Distillation Method)
- D7524** Test Method for Determination of Static Dissipater Additives (SDA) in Aviation Turbine Fuel and Middle Distillate Fuels—High Performance Liquid Chromatograph (HPLC) Method
- D7566** Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons
- D7797** Test Method for Determination of the Fatty Acid Methyl Esters Content of Aviation Turbine Fuel Using Flow Analysis by Fourier Transform Infrared Spectroscopy—Rapid Screening Method
- D7872** Test Method for Determining the Concentration of Pipeline Drag Reducer Additive in Aviation Turbine Fuels
- E29** Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- 2.2 *IP Standards*.⁴
- EI/JIG 1530** Quality Assurance Requirements for the Manufacture, Storage and Distribution of Aviation Fuels to Airports

⁴ Available from Energy Institute, 61 New Cavendish St., London, WIG 7AR, U.K., <http://www.energyinst.org.uk>.

- IP 12** Determination of Specific Energy
- IP 16** Determination of Freezing Point of Aviation Fuels—Manual Method
- IP 71 Section 1** Petroleum Products—Transparent and Opaque Liquids—Determination of Kinematic Viscosity and Calculation of Dynamic Viscosity
- IP 123** Petroleum Products—Determination of Distillation Characteristics at Atmospheric Pressure
- IP 154** Petroleum Products—Corrosiveness to Copper—Copper Strip Test
- IP 156** Petroleum Products and Related Materials—Determination of Hydrocarbon Types—Fluorescent Indicator Adsorption Method
- IP 160** Crude Petroleum and Liquid Petroleum Products—Laboratory Determination of Density—Hydrometer Method
- IP 170** Determination of Flash Point—Abel Closed-Cup Method
- IP 216** Particulate Contaminant in Aviation Fuel
- IP 225** Copper Content of Aviation Turbine Fuel
- IP 227** Silver Corrosion of Aviation Turbine Fuel
- IP 274** Determination of Electrical Conductivity of Aviation and Distillate Fuels
- IP 323** Determination of Thermal Oxidation Stability of Gas Turbine Fuels
- IP 336** Petroleum Products—Determination of Sulfur Content—Energy-Dispersive X-ray Fluorescence Spectrometry
- IP 342** Petroleum Products—Determination of Thiol (Mercaptan) Sulfur in Light and Middle Distillate Fuels—Potentiometric Method
- IP 354** Determination of the Acid Number of Aviation Fuels—Colour-Indicator Titration Method
- IP 365** Crude Petroleum and Petroleum Products—Determination of Density—Oscillating U-tube Method
- IP 406** Petroleum Products—Determination of Boiling Range Distribution by Gas Chromatography
- IP 423** Determination of Particulate Contamination in Aviation Turbine Fuels by Laboratory Filtration
- IP 435** Determination of the Freezing Point of Aviation Turbine Fuels by the Automatic Phase Transition Method
- IP 436** Determination of Aromatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates—High Performance Liquid Chromatography Method with Refractive Index Detection
- IP 523** Determination of Flash Point—Rapid Equilibrium Closed Cup Method
- IP 528** Determination for the Freezing Point of Aviation Turbine Fuels—Automatic Fibre Optic Method
- IP 529** Determination of the Freezing Point of Aviation Turbine Fuels—Automatic Laser Method
- IP 540** Determination of the Existent Gum Content of Aviation Turbine Fuel—Jet Evaporation Method
- IP 583** Determination of the Fatty Acid Methyl Esters Content of Aviation Turbine Fuel Using Flow Analysis by Fourier Transform Infrared Spectroscopy—Rapid Screening Method
- IP 585** Determination of Fatty Acid Methyl Esters (FAME), Derived from Bio-diesel Fuel, in Aviation Turbine Fuel—GC-MS with Selective Ion Monitoring/Scan Detection Method
- IP 590** Determination of Fatty Acid Methyl Esters (FAME) in Aviation Fuel—HPLC Evaporative Light Scattering Detector Method
- IP 598** Petroleum Products—Determination of the Smoke Point of Kerosine, Manual and Automated Method
- IP 599** Determination of Fatty Acid Methyl Esters (FAME) in Aviation Turbine Fuel by Gas Chromatography using Heart-cut and Refocusing
- 2.3 *API Standards:*⁵
- API 1543** Documentation, Monitoring and Laboratory Testing of Aviation Fuel During Shipment from Refinery to Airport
- API 1595** Design, Construction, Operation, Maintenance, and Inspection of Aviation Pre-Airfield Storage Terminals
- 2.4 *Joint Inspection Group Standards:*⁶
- JIG 1** Aviation Fuel Quality Control & Operating Standards for Into-Plane Fuelling Services
- JIG 2** Aviation Fuel Quality Control & Operating Standards for Airport Depots & Hydrants
- 2.5 *ANSI Standard:*⁷
- ANSI 863** Report of Test Results
- 2.6 *Other Standards:*
- Defence Standard (Def Stan) 91-91** Turbine Fuel, Aviation Kerosine Type, Jet A-1⁸
- IATA Guidance Material on Microbiological Contamination in Aircraft Fuel Tanks** Ref. No: 9680-02⁹
- EN14214** Automotive Fuels—Fatty Acid Methyl Esters (FAME) for Diesel Engines—Requirements and Test Methods¹⁰
- Bulletin Number 65** MSEP Protocol¹¹
- ATA-103** Standard for Jet Fuel Quality Control at Airports¹²
- ICAO 9977** Manual on Civil Aviation Jet Fuel Supply¹³

⁵ Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, <http://www.api.org>.

⁶ Available from Joint Inspection Group (JIG), <http://www.jigonline.com>.

⁷ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁸ Available from Procurement Executive DFS (Air), Ministry of Defence, St. Giles Court 1, St. Giles High St., London WC2H 8LD.

⁹ Available from International Air Transport Association (IATA), (Head Office) 800 Place Victoria, PO Box 113, Montreal, H4Z 1M1, Quebec, Canada. www.iata-online.com.

¹⁰ Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, <http://www.cenorm.be>.

¹¹ Available from Joint Inspection Group (JIG), <http://www.jigonline.com>.

¹² Available from Air Transport Association of America, Inc. (ATA) d/b/a Airlines for America, 1275 Pennsylvania Ave. NW, Suite 1300, Washington, D.C. 20004, <http://www.airlines.org>.

¹³ Available from International Civil Aviation Organization (ICAO), 999 University St., Montreal, Quebec H3C 5H7, Canada, <http://www.icao.int>.

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 Aircraft¹⁴

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *identified incidental materials, n*—chemicals and compositions that have defined upper content limits in an aviation fuel specification but are not approved additives.

3.1.2 *metrological method, n*—heater tube deposit rating methods employing an optically-based deposit thickness measurement and mapping technique described in the Test Method **D3241** annexes.

4. General

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

5. Classification

5.1 Two types of aviation turbine fuels are provided, as follows:

5.1.1 *Jet A and Jet A-1*—Relatively high flash point distillates of the kerosine type.

5.2 Jet A and Jet A-1 represent two grades of kerosine fuel that differ in freezing point. Other grades would be suitably identified.

5.3 This specification previously cited the requirements for Jet B. Requirements for Jet B fuel now appear in Specification **D6615**.

6. Materials and Manufacture

6.1 Aviation turbine fuel is a complex mixture predominantly composed of hydrocarbons and varies depending on crude source and manufacturing process. Consequently, it is impossible to define the exact composition of Jet A/A-1. This specification has therefore evolved primarily as a performance specification rather than a compositional specification. It is acknowledged that this largely relies on accumulated experience; therefore the specification limits aviation turbine fuels to those made from conventional sources or by specifically approved processes.

6.1.1 Aviation turbine fuel, except as otherwise specified in this specification, shall consist predominantly 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 in accordance with **Annex A1**.

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

6.1.2 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 **X1.15.1**).

6.2 *Additives*—Only additives approved by the aviation industry (including the aircraft certifying authority) are permitted in the fuel on which an aircraft is operated. The additives approved for use in D1655 jet fuel are shown in **Table 2** and may be used within the concentration limits shown in the table subject to any restrictions described in the table footnotes.

6.3 *Identified Incidental Materials*—**Table 3** lists specific materials that have an agreed limit, known as Identified Incidental Materials. Specification D1655 does not require that each batch of fuel be analyzed for identified incidental materials where there is essentially no risk of contamination exceeding **Table 3** limits. Where a supplier risk assessment suggests that identified incidental materials could exceed **Table 3** limits, jet fuel should be confirmed to comply with **Table 3** limits prior to airport supply because airports generally are not equipped to mitigate identified incidental material content that exceeds specification limits. Further guidance concerning these materials is presented in **X1.16**.

6.4 Guidance material is presented in **Appendix X2** concerning the need to control processing additives in jet fuel production.

7. Detailed Requirements

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

7.2 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.

8. Workmanship, Finish, and Appearance

8.1 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. If the fuel has an odor similar to that of “rotten egg,” please refer to **X1.12.5** for further discussion. No substance of known dangerous toxicity under usual conditions of handling and use shall be present, except as permitted in this specification.

¹⁴ Available from Defense Technical Information Center (DTIC), 8725 John J. Kingman Rd., Ft. Belvoir, VA 22060-6218, <http://www.dtic.mil/dtic>, accession number ADA595127.

TABLE 1 Detailed Requirements of Aviation Turbine Fuels^A

Property		Jet A or Jet A-1	Test Methods ^B
COMPOSITION			
Acidity, total mg KOH/g	max	0.10	D3242/IP 354
1. Aromatics, percent by volume	max	25	D1319 or IP 156
2. Aromatics, percent by volume	max	26.5	D6379/IP 436
Sulfur, mercaptan, ^C percent by mass	max	0.003	D3227/IP 342
Sulfur, total percent by mass	max	0.30	D1266, D2622, D4294, D5453, or IP 336
VOLATILITY			
Distillation temperature, °C:			D86, ^D D2887/IP 406, ^E D7345 ^F , IP 123 ^D
10 % recovered, temperature	max	205	
50 % recovered, temperature		report	
90 % recovered, temperature		report	
Final boiling point, temperature	max	300	
Distillation residue, %	max	1.5	
Distillation loss, %	max	1.5	
Flash point, °C	min	38 ^G	D56, D93, ^H D3828, ^H IP 170 ^H or IP 523 ^H
Density at 15 °C, kg/m ³		775 to 840	D1298/IP 160 or D4052 or IP 365
FLUIDITY			
Freezing point, °C	max	–40 Jet A ^I	D5972/IP 435, D7153/IP 529, D7154/IP 528, or D2386/IP 16
		–47 Jet A-1 ^I	
Viscosity –20 °C, mm ² /s ^J	max	8.0	D445/IP 71, Section 1 or D7042 ^K
COMBUSTION			
Net heat of combustion, MJ/kg	min	42.8 ^L	D4529, D3338, D4809, or IP 12
One of the following requirements shall be met:			
(1) Smoke point, mm, or	min	25.0	D1322/IP 598
(2) Smoke point, mm, and	min	18.0	D1322/IP 598
Naphthalenes, vol, %	max	3.0	D1840
CORROSION			
Copper strip, 2 h at 100 °C	max	No. 1	D130/IP 154
THERMAL STABILITY			
(2.5 h at control temperature of 260 °C min)			
Filter pressure drop, mm Hg	max	25	D3241 ^M /IP 323 ^M
Tube rating: One of the following requirements shall be met: ^N			
(1) Annex A1 VTR, VTR Color Code	Less than	3 (no peacock or abnormal color deposits)	
(2) Annex A2 ITR or Annex A3 ETR, nm average over area of 2.5 mm ²	max	85	
CONTAMINANTS			
Existent gum, mg/100 mL	max	7	D381, IP 540
Microseparator, ^O Rating			D3948
Without electrical conductivity additive	min	85	
With electrical conductivity additive	min	70	
ADDITIVES			
Electrical conductivity, pS/m		See 6.2 ^P	D2624/IP 274

^A For compliance of test results against the requirements of Table 1, see 7.2.

^B The test methods indicated in this table are referred to in Section 11.

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

^D D86 and IP 123 distillation of jet fuel is run at Group 4 conditions, except Group 3 condenser temperature is used.

^E D2887/IP 406 results shall be converted to estimated D86 or IP 123 results by application of the correlation in Appendix X4 on Correlation for Jet and Diesel Fuel in Test Method D2887 or Annex G of IP 406. Distillation residue and loss limits provide control of the distillation process during the use of Test Method D86, and they do not apply to Test Method D2887/IP 406. Distillation residue and loss shall be reported as “not applicable” (N/A) when reporting D2887 results.

^F Results from Test Method D7345 shall be corrected for relative bias as described in Test Method D7345.

^G A higher minimum flash point specification can be agreed upon between purchaser and supplier.

^H Aviation turbine fuel results obtained by Test Method D93 can be up to 1 °C higher than those obtained by Test Method D56. Results obtained by Test Methods D3828, IP 170, and IP 523 can be up to 2 °C lower than those obtained by Test Method D56, which is the preferred method. In case of dispute, Test Method D56 shall apply.

^I Other freezing points can be agreed upon between supplier and purchaser.

^J 1 mm²/s = 1 cSt.

^K Test Method D7042 results shall be converted to bias-corrected kinematic viscosity results by the application of the correction described in Test Method D7042 for jet fuel at –20 °C (currently subsection 15.4.4).

^L For all grades use either Eq 1 or Table 1 in Test Method D4529 or Eq 2 in Test Method D3338. Calculate and report the net heat of combustion corrected for the sulfur content when using Test Method D4529 and D3338 empirical test methods. Test Method D4809 can be used as an alternative. In case of dispute, Test Method D4809 shall be used.

^M **D3241/IP 323 Thermal Stability** is a critical aviation fuel test, the results of which are used to assess the suitability of jet fuel for aviation operational safety and regulatory compliance. The integrity of **D3241/IP 323** testing requires that heater tubes (test coupons) meet the requirements of **D3241** Table 2 and give equivalent **D3241** results to the heater tubes supplied by the original equipment manufacturer (OEM). A test protocol to demonstrate equivalence of heater tubes from other suppliers is on file at ASTM International Headquarters and can be obtained by requesting Research Report RR:D02-1550. Heater tubes and filter kits, manufactured by the OEM (PAC, 8824 Fallbrook Drive, Houston, TX 77064) were used in the development of the **D3241/IP 323** test method. Heater tube and filter kits, manufactured by Falex (Falex Corporation, 1020 Airpark Dr., Sugar Grove, IL, 60554-9585) were demonstrated to give equivalent results (see **D3241** for research report references). These historical facts should not be construed as an endorsement or certification by ASTM International.

^N Tube deposit ratings shall be measured by **D3241** Annex A2 ITR or Annex A3 ETR, when available. If the Annex A2 ITR device reports “N/A” for a tube’s volume measurement, the test shall be a failure and the value reported as >85 nm. Visual rating of the heater tube by the method in **D3241** Annex A1 is not required when Annex A2 ITR or Annex A3 ETR deposit thickness measurements are reported. In case of dispute between results from visual and metrological methods, the referee shall be considered the Annex A3 ETR method if available, otherwise Annex A2 ITR.

^O At point of manufacture. See **X1.13** for guidance concerning the application of microseparator results in fuel distribution.

^P 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.

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

9. Sampling

9.1 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 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.

9.2 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**.

10. Report

10.1 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.

10.2 A suggested form for reporting inspection data on aviation turbine fuels is given in **Appendix X3** as **Fig. X3.1**. This form is optimized for electronic data entry.

10.3 When **Table 1** test results and **Table 2** additive additions are reported at the point of batch origination or at full certification in a form commonly known as a “Certificate of Quality” or “Certificate of Analysis,” at least the following should be included:

10.3.1 The designation of each test method used,

10.3.2 The limits from **Table 1** and **Table 2** for each item reported with units converted as appropriate to those measured and reported, and

10.3.3 The designation of the quality system used by the reporting test laboratory. If no quality system is used then this shall be reported as “None.”

10.4 A suggested, nonmandatory form for reporting inspection data in a Certificate of Quality or Analysis format is given in **Appendix X3** as **Fig. X3.2**.

NOTE 2—This form is appropriate for reporting complete certification results. A different form (not reproduced here) showing original and retest results is more appropriate for reporting test results intended to assess if a specific batch of fuel has changed as it moves through the distribution system.

11. Test Methods

NOTE 3—Where IP test methods are referenced in this specification as alternatives to ASTM test methods, the following nomenclature is used. Where test methods are officially jointed, this is denoted as Dxxxx/IP xxx. Where test methods are technically equivalent or related but not officially jointed, this is denoted as Dxxxx or IP xxx.

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

11.1.1 *Density*—Test Method **D1298/IP 160** or **D4052** or IP 365.

11.1.2 *Distillation*—Test Method **D86** or IP 123. For Jet A and Jet A-1, Test Methods **D2887/IP 406** and **D7345** may be used as an alternative. Results from Test Method **D2887** shall be reported as estimated **D86** results by application of the correlation in Appendix X4 on Correlation for Jet and Diesel Fuel in Test Method **D2887/IP 406**. Results from Test Method **D7345** shall be corrected for bias by applying the GRP4 corrections in the Test Method **D7345** Precision and Bias section. In case of dispute, Test Method **D86** shall be the referee method (see **X1.6.1.1**).

11.1.3 *Flash Point*—Test Method **D56, D93, D3828**, IP 170, or IP 523. Test Method **D56** is the referee method.

11.1.4 *Freezing Point*—Test Method **D5972/IP 435, D7153/IP 529, D7154/IP 528, or D2386/IP 16**. Any of these test methods can be used to certify and recertify jet fuel. However, Test Method **D2386/IP 16** is the referee method. An interlaboratory study (RR: D02-1572¹⁵) that evaluated the ability of freezing point methods to detect jet fuel contamination by diesel fuel determined that Test Methods **D5972/IP 435** and **D7153/IP 529** provided significantly more consistent detection of freeze point changes caused by contamination than Test Methods **D2386/IP 16** and **D7154/IP 528**. It is recommended to certify and recertify jet fuel using either Test Method **D5972/IP 435** or Test Method **D7153/IP 529**, or both, on the basis of the reproducibility and cross-contamination detection reported in RR:D02-1572.¹⁵ The cause of freezing point results outside specification limits by automated methods should be investigated, but such results do not disqualify the fuel from aviation use if the results from the referee method (Test Method **D2386/IP 16**) are within the specification limit.

¹⁵ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1572.