INTERNATIONAL

Designation: ~~D1655 – 19a~~ D1655 – 20

An American National Standard

Standard Specification for Aviation Turbine Fuels[1]

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 and military operated engines and ~~aircrafts.~~aircraft. Specification D1655 ~~is directed at civil applications, and maintained as such, but may be adopted for military, government or other specialized uses. Guidance information for these other~~ was developed initially for civil applications, but has also been adopted for military aircraft. Guidance information regarding the use of Jet A and Jet A-1 in specialized applications is available in the appendix.

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.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *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.*

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)

[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.

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

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)
D613 Test Method for Cetane Number of Diesel Fuel Oil
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
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 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
D4625 Test Method for Middle Distillate Fuel Storage Stability at 43 °C (110 °F)
D4737 Test Method for Calculated Cetane Index by Four Variable Equation
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 and Liquid Fuels (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

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

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
D6866 Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis
D6890 Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber
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)
D7170 Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils—Fixed Range Injection Period, Constant Volume Combustion Chamber Method (Withdrawn 2019)[3]
D7224 Test Method for Determining Water Separation Characteristics of Kerosine-Type Aviation Turbine Fuels Containing Additives by Portable Separometer
D7344 Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure (Mini 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
D7619 Test Method for Sizing and Counting Particles in Light and Middle Distillate Fuels, by Automatic Particle Counter
D7668 Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils—Ignition Delay and Combustion Delay Using a Constant Volume Combustion Chamber Method
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
D7945 Test Method for Determination of Dynamic Viscosity and Derived Kinematic Viscosity of Liquids by Constant Pressure Viscometer
D7959 Test Method for Chloride Content Determination of Aviation Turbine Fuels using Chloride Test Strip
D8073 Test Method for Determination of Water Separation Characteristics of Aviation Turbine Fuel by Small Scale Water Separation Instrument
D8267 Test Method for Determination of Total Aromatic, Monoaromatic and Diaromatic Content of Aviation Turbine Fuels Using Gas Chromatography with Vacuum Ultraviolet Absorption Spectroscopy Detection (GC-VUV)
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

2.2 *EI Standards:*[4]

EI 1550 Handbook on equipment used for the maintenance and delivery of clean aviation fuel
EI 1583 Laboratory tests and minimum performance levels for aviation fuel filter monitors
EI/JIG 1530 Quality assurance requirements for the manufacture, storage and distribution of aviation fuels to airports
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 method
IP 342 Petroleum products—Determination of thiol (mercaptan) sulfur in light and middle distillate fuels—Potentiometric method

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

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 564 Determination of the level of cleanliness of aviation turbine fuel—Laboratory automatic particle counter method
IP 565 Determination of the level of cleanliness of aviation turbine fuel—Portable automatic particle counter method
IP 577 Determination of the level of cleanliness of aviation turbine fuel—Automatic particle counter method using light extinction
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-1[8]
IATA Guidance Material on Microbiological Contamination in Aircraft Fuel Tanks Ref. No: 9680-02[9]
IATA Guidelines for Sodium Chloride Contamination Troubleshooting and Decontamination of Airframe and Engine Fuel Systems, 2nd Ed., February 1998[9]
EN14214 Automotive Fuels—Fatty Acid Methyl Esters (FAME) for Diesel Engines—Requirements and Test Methods[10]
Bulletin Number 65 MSEP Protocol[11]
ATA-103 Standard for Jet Fuel Quality Control at Airports[12]
ICAO 9977 Manual on Civil Aviation Jet Fuel Supply[13]
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[14]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

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[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.iataonline.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.
[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.

3.1.1 *co-hydroprocessed esters and fatty acids, n*—synthetic hydrocarbons derived from the hydroprocessing of bio-derived mono-, di-, and triglycerides, free fatty acids, and fatty acid esters with conventional hydrocarbons in accordance with the requirements of ~~A1.2.2~~A1.2.2.1.

3.1.2 *co-hydroprocessed Fischer-Tropsch hydrocarbons, n*—synthetic hydrocarbons derived from the hydroprocessing of hydrocarbons derived from Fischer-Tropsch synthesis to paraffinic syncrude with conventional hydrocarbons in accordance with the requirements of A1.2.2.2.

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

3.1.4 *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 kerosene type.

5.2 Jet A and Jet A-1 represent two grades of kerosene 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 Specification 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. Where it is necessary to dilute an additive for handling purposes, a refined hydrocarbon stream from a refinery, produced in accordance with Materials and Manufacture requirements of Specification D1655, or a reagent grade (or better) hydrocarbon or hydrocarbon mixture (excluding non-hydrocarbons) from a chemical supplier shall be used. Since not all additives and diluents are compatible (for example, an additive may drop-out if diluted with alkylate versus reformate), the additive manufacturer should be consulted regarding the preferred diluent. Reporting does not change when dilution is used; additive package content as received or active ingredient content as described in Table 2 is the concentration to be reported.

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[C] or D8267
2. Aromatics, percent by volume	max	26.5	*D6379/IP 436*
Sulfur, mercaptan,[D] percent by mass	max	0.003	*D3227/IP 342*
Sulfur, total percent by mass	max	0.30	D1266, D2622, D4294, D5453, or IP 336

TABLE 1 *Continued*

Property		Jet A or Jet A-1	Test Methods[B]
VOLATILITY			
Distillation temperature, °C:			*D86*,[E] D2887/IP 406,[F] D7344, [G, H] D7345,[G] IP 123[E]
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[I]	*D56*,D93,[J] D3828,[J] IP 170[J] or IP 523[J]
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[K,L]	D5972/IP 435, D7153/IP 529, D7154/IP 528, or *D2386/IP 16*
		–47 Jet A-1[K,L]	
Viscosity –20 °C, mm^2/s[M]	max	8.0	*D445/IP 71, Section 1*,D7042,[N] or D7945
COMBUSTION			
Net heat of combustion, MJ/kg	min	42.8[O]	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*[P] */IP 323*[P]
Tube rating: One of the following requirements shall be met:[Q]			
(*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
Microseparometer,[R] Rating			*D3948*
Without electrical conductivity additive	min	85	
With electrical conductivity additive	min	70	
ADDITIVES		See 6.2	
Electrical conductivity, pS/m		[S]	*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. The referee test methods are *italicized* where applicable.
[C] In analyzing Aviation Turbine Fuel by Test Method D1319 or IP 156, users shall not report results obtained using any of the following lot numbers of Fluorescent Indicator Dyed Gel: 3000000975, 3000000976, 3000000977, 3000000978, 3000000979, and 3000000980.
[D] The mercaptan sulfur determination may be waived if the fuel is considered sweet by the doctor test described in Test Method D4952.
[E] *D86* and IP 123 distillation of jet fuel is run at Group 4 conditions, except Group 3 condenser temperature is used.
[F] 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.
[G] Results from Test Method D7344 and D7345 shall be corrected for relative bias as described in each of the test methods.
[H] Data supporting inclusion of the Test Method D7344 methodology is on file at ASTM International Headquarters and can be obtained by requesting Research Reports RR:D02-1621 and RR:D02-1855. Contact ASTM Customer Service at service@astm.org.
[I] A higher minimum flash point specification can be agreed upon between purchaser and supplier.
[J] 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*.
[K] Other freezing points can be agreed upon between supplier and purchaser.
[L] During downstream distribution if the freezing point of the fuel is very low and cannot be determined within the ASTM D2386/IP 16 lowest achievable temperature of minus 65 °C, if no crystals appear during cooling of the fuel and when the thermometer indicates a temperature of minus 65 °C, the freezing point shall be recorded as below minus 65 °C. This limit does not apply if the freezing point is measured by D5972/IP 435, D7153/IP 529, or D7154/IP 528.
[M] 1 mm^2/s = 1 cSt.
[N] 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).
[O] 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.

[P] 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.

[Q] 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.

[R] At point of manufacture. See X1.13 for guidance concerning the application of microseparometer results in fuel distribution.

[S] 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.

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

TABLE 2 Detailed Information for Additives for Aviation Turbine Fuels

Additive	Dosage
Fuel Performance Enhancing Additives	
Antioxidants[A, B]	24.0 mg/L max[C]
One of the following:	
2,6 ditertiary-butyl phenol	
2,6 ditertiary-butyl-4-methyl phenol	
2,4 dimethyl-6-tertiary-butyl-phenol	
75 % minimum, 2,6 ditertiary-butyl phenol plus 25 % maximum mixed tertiary and tritertiary butyl-phenols	
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	
72 % minimum 2,4 dimethyl-6-tertiary-butyl phenol plus 28 % maximum monomethyl and dimethyl-tertiary-butyl-phenols	
Metal Deactivator (MDA)[A]	
N,N-disalicylidene-1,2-propane diamine	
On initial blending	2.0 mg/L max[C, D]
After field reblending cumulative concentration	5.7 mg/L max
Fuel System Icing Inhibitor[E, F, G, H]	0.07 % by volume, min[I]
Diethylene Glycol Monomethyl Ether (see Specification D4171 Type III)	0.15 % by volume, max
Fuel Handling and Maintenance Additives	
Electrical Conductivity Improver[J]	
One of the following:	
AvGuard SDA[K, L]	
On initial blending	3 mg/L max
After field reblending, cumulative concentration	5 mg/L max
Stadis 450[L, M]	
On initial blending	3 mg/L max
After field reblending, cumulative concentration	5 mg/L max
If the additive concentrations are unknown at time of retreatment, additional concentration is restricted to 2 mg/L max	
Leak Detection Additive Tracer A (LDTA-A)[N]	1 mg/kg max
Biocidal Additives[E, O, P]	
Biobor JF[Q]	
Kathon FP1.5[R]	
Corrosion Inhibitor/Lubricity Improvers[S]	
One of the following:	
HiTEC 580[T]	23 mg/L max
Innospec DCI-4A[U]	23 mg/L max
Nalco 5403	23 mg/L max

[A] The active ingredient of the additive must meet the composition specified.

[B] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1125. Contact ASTM Customer Service at service@astm.org.

[C] Active ingredient (not including weight of solvent).

[D] At the point of manufacture, Metal Deactivator Additive (MDA) may be added to improve thermal oxidative stability subject to the following limitations:
(*1*) No more than 5 % of the jet fuel batches produced in a 12 month period may be treated with MDA to meet Table 1 thermal oxidative stability requirements (260 °C test temperature).
(*2*) The batch of fuel shall pass Table 1 thermal oxidative stability requirements at a test temperature of 245 °C prior to any MDA addition.
(*3*) The fuel batch after MDA addition (2.0 mg/L maximum MDA) shall pass Table 1 thermal oxidative stability requirements at a test temperature of 275 °C.
(*4*) The thermal oxidative stability test result at 245 °C prior to MDA addition, the original test result at 260 °C and the test result at 275 °C (post MDA addition) and the concentration of MDA added shall be reported on the Refinery Certificate of Quality.

Initial addition of more than 2.0 mg/L MDA to jet fuel that meets Table 1 thermal oxidative stability requirements (260 °C test temperature) prior to MDA addition is permitted when fuel will be transported in supply chains where copper contamination can occur: the maximum cumulative addition in this table still applies.

MDA may be added to jet fuel in the distribution system to recover thermal oxidative stability performance lost during distribution (after refinery release). The Certificate of Quality shall show the initial thermal oxidative stability test result, the result after the addition of the MDA and the concentration of MDA added.

[E] The quantity shall be declared by the fuel supplier and agreed to by the purchaser.

[F] The lower FSII concentration limit allowable in Jet Fuel is based on research by the U.S. Air Force as documented in report AFRL-RQ-WP-TR-2013-0271. Some engines and aircraft as certified require higher minimum concentrations of icing inhibitor than the lower limit in this jet fuel specification. When fueling an aircraft, the fuel should be additized to the concentration levels specified in the appropriate engine and aircraft manual.

[G] DiEGME content can by analyzed by Test Method D5006.

[H] DiEGME is not suitable for use in systems that will later use EI 1583 filter monitors, which are commonly used at the point of aircraft fueling. Additional guidance is provided in EI 1550 Chapter 9.

[I] Some aircraft require higher levels than 0.07 % by volume.

[J] If electrical conductivity improver 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 pS/m to 600 pS/m under the conditions at point of delivery. 1 pS/m=$1 \times 10^{-12}\ \Omega^{-1} m^{-1}$

[K] AvGuard is a trademark of Afton Chemical Corporation, 500 Spring Street Richmond, VA 23219. Supporting documentation for this additive is found in RR:D02-1861.

[L] Electrical conductivity improver content can be analyzed by Test Method D7524.

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

[N] Tracer A (LDTA-A) is a registered trademark of Praxair Services, Inc., Tucson, AZ 85705.

[O] 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.

[P] Refer to the Aircraft Maintenance Manual (AMM) to determined if either biocide is approved for use and for their appropriate use and dosage.

[Q] Biobor JF is a registered trademark of Hammonds Technical Services, Inc. 910 Rankin Rd., Houston, TX 77073.

[R] KATHON is a trademark of The Dow Chemical Company (“Dow”) or an affiliated company of Dow, 2030 Dow Center, Midland, MI 48674.

[S] More information concerning minimum treat rates of corrosion inhibitor/lubricity improver additives is contained in X1.10.2.

[T] HiTEC 580 is a trademark of Afton Chemical Corp., 500 Spring St., Richmond, VA 23219.

[U] Innospec DCI-4A is available from Innospec Inc., Innospec Manufacturing Park, Oil Sites Road, Ellesmere Port, Cheshire, CH65 4EY, UK.

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.

TABLE 3 Identified Incidental Materials

Material	Permitted Level	Test Methods[A]
Fatty Acid Methyl Ester (FAME),[B] max	50 mg/kg[C,D]	D7797/IP 583, *IP 585*, IP 590, IP 599
Pipeline Drag Reducing Additive (DRA),[E] max	72 µg/L[F]	*D7872*

[A] The referee test methods are *italicized* where applicable.

[B] For the purpose of meeting this requirement FAME is defined as material meeting the limits of EN14214 or Specification D6751. Fatty acid methyl esters that fail to meet the biodiesel quality standards are not permitted in aviation turbine fuel.

[C] On an emergency basis, up to 100 mg/kg FAME is permitted in jet fuel when authorized by the airframe and engine manufacturers and managed in compliance with airframe and engine manufacturer requirements.

[D] Subcommittee J intends to evaluate field experience in December 2016 to determine if a ballot to increase the FAME content limit to 100 mg/kg is supported by the absence of significant FAME-related problems.

[E] Active polymer ingredient.

[F] DRA is not approved as an additive for jet fuel. This level is accepted by approval authorities as the functional definition of “nil addition.”

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.

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 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:

10.2.1 The designation of each test method used,

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

10.2.3 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."

11. Test Methods

NOTE 2—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. In case of dispute among measurements, the test methods *italicized* in Table 1 and Table 3 and in Section 11 shall be the referee 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, D7344, 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 D7344 and D7345 shall be corrected for bias by applying the GRP4 corrections in each of the test method's Precision and Bias section.

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

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. An interlaboratory study (RR: D02–1572[15]) 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 freezing 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 are within the specification limit.

11.1.5 *Viscosity*—Test Method *D445/IP 71 Section 1*,D7042, or D7945. Results from Test Method D7042 shall be reported as bias-corrected kinematic viscosity results by application of the correction in Test Method D7042, relative bias for jet fuel at –20 °C (currently subsection 15.4.4).

11.1.6 *Net Heat of Combustion*—Test Method D4529, D3338, *D4809*, or IP 12.

11.1.7 *Corrosion (Copper Strip)*—Test Method *D130/IP 154*.

11.1.8 *Total Acidity*—Test Method *D3242/IP 354*.

11.1.9 *Sulfur*—Test Method D1266, D2622, D4294, D5453, or IP 336.

11.1.10 *Mercaptan Sulfur*—Test Method *D3227/IP 342*.

11.1.11 *Water Separation*—Test Method *D3948*.

[15] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1572. Contact ASTM Customer Service at service@astm.org.

11.1.12 *Existent Gum*—Test Method *D381* or IP 540. Test Method *D381*, using steam jet operating conditions, shall be the referee test method.

11.1.13 *Thermal Stability*—Test Method *D3241/IP 323*.

11.1.14 *Aromatics*—Test Method *D1319*, IP 156, ~~or~~ D6379/IP ~~436.~~ 436, or D8267.

11.1.14.1 In analyzing Aviation Turbine Fuel by Test Method D1319 or IP 156, users shall not report results obtained using any of the following lot numbers of Fluorescent Indicator Dyed Gel: 3000000975, 3000000976, 3000000977, 3000000978, 3000000979, and 3000000980.

11.1.15 *Smoke Point*—Test Method *D1322/IP 598*.

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

11.1.17 *Electrical Conductivity*—Test Method *D2624/IP 274*.

12. Keywords

12.1 aviation turbine fuel; avtur; Jet A; Jet A-1; jet fuel; turbine fuel

ANNEX

(Mandatory Information)

A1. FUELS FROM NON-CONVENTIONAL SOURCES

A1.1 Introduction

A1.1.1 Jet fuel has contained synthesized hydrocarbons since the inception of Specification D1655. However, these synthesized materials are generated from petroleum, oil sand or shale derived feedstocks in the refinery and exhibit properties substantially similar to historically refined kerosene. The fuel property requirements defined in Specification D1655, Table 1 are batch-to-batch quality control tests which historically have provided fit-for-purpose jet fuel but assume that the jet fuel has a composition that is substantially similar to historical compositions. There is no basis to assume that fuels having novel compositions provide fit-for-purpose performance in current aviation hardware even if they appear to satisfy Specification D1655, Table 1 requirements. While the use of synthesized hydrocarbons is known and an acceptable practice, the use of synthesized hydrocarbon blend stocks from new sources requires specific guidance. This guidance can be found in Specification D7566.

A1.1.2 Specification D7566 was developed by Subcommittee D02.J0 to provide control for jet fuel produced with non-petroleum, non-shale, non-oil sands derived synthesized components. This specification guides the preparation of fuel blends that are compositionally similar to the refined fuels generated to Specification D1655 and can be controlled thereby in the distribution system. Aviation turbine fuels with synthetic components produced in accordance with Specification D7566 meet the requirements of Specification D1655. Specification D7566 does not yet include all fuels from non-conventional sources, so as an interim solution, it has been deemed necessary to recognize, on an individual basis, fuels from non-conventional sources whose performance complies with the intent of this specification and that have been approved by a coordinated specification authority.

A1.2 Acceptable Fuels from Non-Conventional Sources

A1.2.1 *SASOL:*

A1.2.1.1 The SASOL semi-synthetic fuel, a blend of conventionally produced kerosene and a synthetic iso-paraffinic kerosene by itself or as combined with SASOL heavy naphtha #1 and specified in Defence Standard (Def Stan) 91-91, is recognized as meeting the requirements of Specification D1655.

A1.2.1.2 The SASOL fully synthetic fuel, a blend of up to five synthetic streams, specified in D.4.3 of Defence Standard (Def Stan) 91-91, is recognized as meeting the requirements of Specification D1655.

A1.2.2 *Co-processing:* [16,17]

[16] A task force studied the impact of co-hydroprocessing esters and fatty acids at up to 5 % by volume with crude oil derived middle distillates following Specification D7566 Annex 2 approval. Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1886. Contact ASTM Customer Service at service@astm.org.

A1.2.2.1 Co-processing of mono-, di-, and triglycerides, free fatty acids, and fatty acid esters producing co-hydroprocessed hydrocarbon synthetic kerosene is recognized as being acceptable for jet fuel manufacture. Other feedstocks Feedstocks other than those defined in A1.2.2.1 or A1.2.2.2 are excluded from jet fuel co-processing. The co-processing refinery units where process streams are used for jet production shall not exceed 5 % by volume of mono-, di-, and triglycerides, free fatty acids, and fatty acid esters in feedstock volume with the balance (>= 95 % by volume) being conventionally sourced hydrocarbons as described in 6.1.

(1) Co-processing of mono-, di-, and triglycerides, free fatty acids, and fatty acid esters shall include hydrocracking or hydrotreating and fractionation. Processing may also include other conventional refinery processes. The final product is limited to 5 % by volume of co-hydroprocessed synthesized kerosene in any jet batch. Refer to X1.15.5 for a discussion of biobased carbon content and identification of the applicable test method.

A1.2.2.2 Co-processing of hydrocarbons derived from synthesis gas via the Fischer-Tropsch process using iron or cobalt catalyst producing co-hydroprocessed hydrocarbon synthetic kerosene is recognized as being acceptable for jet fuel manufacture. The co-processing refinery units where process streams are used for jet production shall not exceed 5 % by volume of Fischer-Tropsch hydrocarbons in feedstock volume with the balance (≥95 % by volume) being conventionally sourced hydrocarbons as described in 6.1. Co-processing of Fischer-Tropsch hydrocarbons shall include hydrocracking and fractionation. Processing may also include other conventional refinery processes. The final product is limited to 5 % by volume of co-hydroprocessed synthesized kerosene in any jet batch. Refer to X1.15.5 for a discussion of biobased carbon content and identification of the applicable test method.

A1.2.2.3 For semi-synthetic kerosene manufactured by co-hydroprocessed esters and fatty acids, acids or Fischer-Tropsch hydrocarbons, the following additional requirements and Table A1.1 limits apply:

(1) An initial management of change (MOC) study shall be undertaken and documented for sites manufacturing semi-synthetic kerosene by coprocessing. Changes that impact the conversion process shall require an updated MOC. Specific changes that may have to be managed during initial and subsequent ongoing commercial operation include, but are not limited to, feedstock (for

TABLE A1.1 Extended Requirements of Aviation Turbine Fuels Containing Co-hydroprocessed Esters and Fatty Acids or Fischer-Tropsch Hydrocarbons[A, B]

Property		Jet A or Jet A-1	Test Methods
THERMAL STABILITY[C, D] (2.5 h at control temperature of 280 °C min)			
Filter pressure drop, mm Hg	max	25	D3241/IP 323
Tube rating: One of the following requirements shall be met:[E]			
(*1*) Annex A1 VTR, VTR Color Code	Less than	3 No peacock or abnormal color deposits	
(*2*) Annex A2 ITR or Annex 3 ETR, nm average over area of 2.5 mm^2	max	85	
Viscosity –40 °C mm^2/s[F]	max	12.0	D445/IP 71, Section 1 ,[G] or D7945
Freezing point °C		Table 1 freezing point limits apply	D5972/IP 435,[H] D7153/IP 529, D7154/IP 528
Unconverted esters and fatty acids[I]	max	15 mg/kg	D7797/IP 583[I]

[A] Applies at the point of manufacture only.
[B] Applies for the finished batch of jet fuel as opposed to the product of the refinery hydroprocessing unit which is used to blend the finished batch of jet fuel.
[C] A D3241 test temperature of 280 °C has been selected to help ensure that reactive compounds introduced through co-hydroprocessed of esters and fatty acids are limited. Research is ongoing on the actual requirement for a more restrictive thermal stability limit.
[D] Metal Deactivator (MDA), as described in Table 2 and the associated footnotes, may not be used to meet this requirement.
[E] Refer to Table 1, Footnote N.
[F] The kinematic viscosity specification of 12.0 mm^2/s at –40 °C maximum mitigates the potential risk of increased viscosity due to n-paraffin enrichment. Compared to conventional hydrocarbons, a co-hydroprocessed esters and fatty acids stream may contain a higher concentration of n-paraffins. Research is ongoing on how n-paraffin enrichment from co-hydroprocessed esters and fatty acids impact low temperature viscosity. The results of that research will be used to confirm the necessity of and possibly adjust this requirement.
[G] D445 or IP 71, Section 1 allows measuring the viscosity at –40 °C, however the precision values were determined down to –20 °C. Data correlating test results at –40 °C for D445 and other related ASTM test methods is provided in Research Report RR:D02-1776. A revision to Test Method D445 to specify measurement precision at –40 °C is in process.
[H] D5972/IP 435 is the referee method.
[I] The ability for Applies only D7797/IP 583 to identify carbonyl containing compounds in addition to FAMEs is acknowledged. The reported value may be corrected for a local sample-specific bias related to trace carbonyl species inherent in aviation turbine fuel derived from conventional sources (as per to co-processing esters and fatty acids A1.2.2.2 (1)). Corrected values shall be identified as such.

[17] Supporting data concerning co-processing of hydrocarbons derived from synthesis gas via the Fischer-Tropsch process has been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1929. Contact ASTM Customer Service at service@astm.org.