ASTM Aviation Turbine Fuel Specifications
-
Importance of DOD Effort

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DOD = Medium Size Airline

- The World is Geared to Deliver Large Quantities of Commercial Jet Fuel
- Deviations are Expensive
  - Justifiable for JP-5
  - Hard to Justify JP-8
- DOD Expertise Provides Leverage Beyond Economic Impact
  - Research Stronger Than Dollars

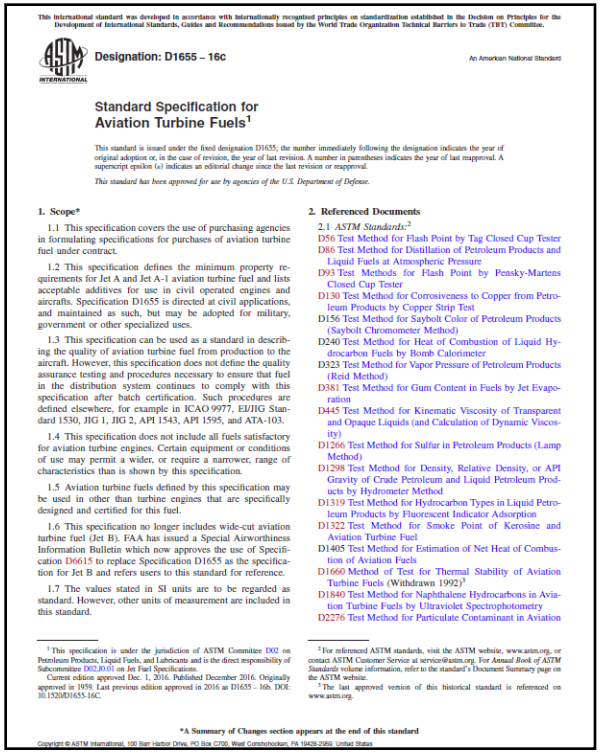
Two Primary Specifications

- Two Primary International Specifications
  - ASTM D1655 – Consensus Standard
  - UK(MOD) DS91-91- Government Standard
- ASTM Consensus Standard is Controlled by the Subcommittee Members
- UK(MOD) Government Standard Seeks Advice for Stakeholders
- DOD Representatives Active in Both Groups

The Nature of Consensus

- Consensus Does Not Mean Unanimous Agreement
- Consensus Means All Stated Positions are Considered Before Progressing
  - This Has Been an Issue

ASTM D1655



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.

Designation: D1655 – 16c

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 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.
Current edition approved Dec. 1, 2016. Published December 2016. Originally approved in 1959. Last previous edition approved in 2016 as D1655 – 16b. DOI: 10.1520/D1655-16C.

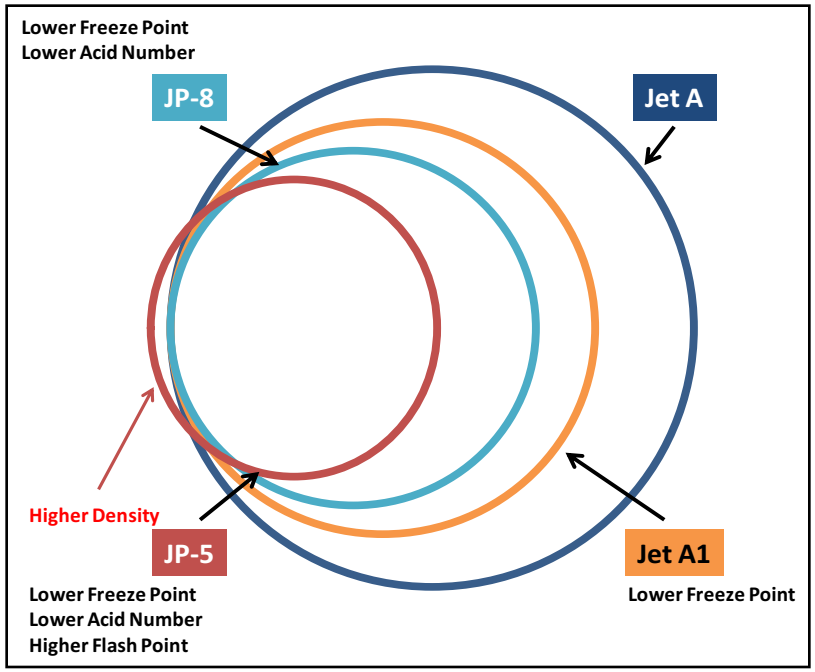
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[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**

- Primary US Commercial Kerosene Fuel Specification Since 1959
- Focused on Providing Best Practice for Commercial Use
  - Supports Long Service Life
    - » 25K Hours min, 46K Hours max
- Only Marginal Differences from JP-8

Essentially, There is Only One Fuel



Kerosene Fuels

- Jet A Base Level
  - Different Grades Involve Regional, Operational Preferences
  - All Kerosene Jet Fuels Interchangeable
  - Must Be True for Air Transport to Work
- Only One Supply at Most Airports
  - No Opportunity for Specialized Differentiation
  - Fact Driver of Jet A Conversion

Success Suggested New Path

- Every Day, DOD Consumes Mass Quantities of Commercial Jet A
- Jet A Significantly Less Expensive than JP-8
  - The Base Cost of Fuel
  - The Specialized Infrastructure Cost
- Could Those Dollars Be Saved for Warfighter Readiness?

DLA-Energy Enlisted Help

- DOD Research Sources
  - USAF – AFRL at Wright Patterson AFB
  - USN – NAWC at Patuxent River NAS
  - USA – TARDEC at TACOM
- ASTM Subcommittee J
  - Constant Review with Fuel Experts
  - Agreement Fuel Can Be Used by Military

DOD Research A+ Rated

- Jet A Conversion Another Instance of DOD Research Advancing Industry
- Proven Track Record in Support of Alternative Fuel Sources
- Effort Dates Back, ’50s Effort to Tame Kerosene into Jet Fuel

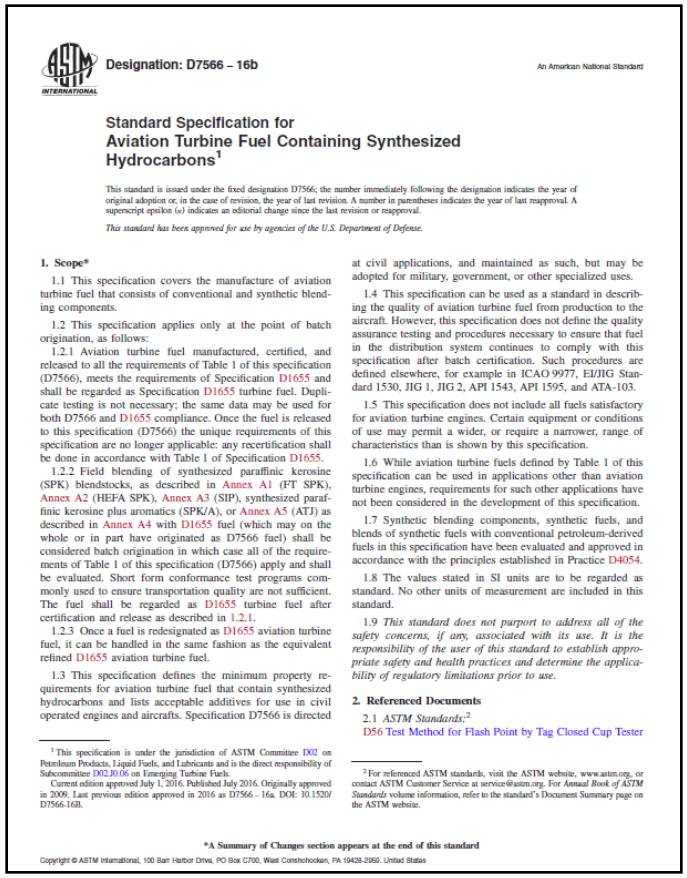
ASTM OK with Military Use

- As Long as Military Understands:
  - Not a Path to Commercial JP-8
  - Changes Good for Airlines Will Not Be Held Back
    - » Relevant Data Always Considered
- Added Words To That Effect to D1655

DOD Key Part of Renewable Fuel Effort

- Jet Fuel Does Not Rely on Marginally Compatible Renewable Components
  - Everything is Kerosene
- Defining the Kerosene Box Required Substantial DOD Research Input
  - More Than Just Fuel
    - » Heat Transfer Fluid
    - » Hydraulic Fluid
- Priming the Renewable Market
  - DARPA Research Programs
  - Service Research Programs
  - DLA-Energy Acquisitions

ASTM D7566 - SynJet



Designation: D7566 – 16b

An American National Standard

Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons[1]

This standard is issued under the fixed designation D7566; 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 manufacture of aviation turbine fuel that consists of conventional and synthetic blending components.

1.2 This specification applies only at the point of batch origination, as follows:

1.2.1 Aviation turbine fuel manufactured, certified, and released to all the requirements of Table 1 of this specification (D7566), meets the requirements of Specification D1655 and shall be regarded as Specification D1655 turbine fuel. Duplicate testing is not necessary; the same data may be used for both D7566 and D1655 compliance. Once the fuel is released to this specification (D7566) the unique requirements of this specification are no longer applicable: any recertification shall be done in accordance with Table 1 of Specification D1655.

1.2.2 Field blending of synthesized paraffinic kerosine (SPK) blendstocks, as described in Annex A1 (FT SPK), Annex A2 (HEFA SPK), Annex A3 (SIP), synthesized paraffinic kerosine plus aromatics (SPK/A), or Annex A5 (ATJ) as described in Annex A4 with D1655 fuel (which may on the whole or in part have originated as D7566 fuel) shall be considered batch origination in which case all of the requirements of Table 1 of this specification (D7566) apply and shall be evaluated. Short form conformance test programs commonly used to ensure transportation quality are not sufficient. The fuel shall be regarded as D1655 turbine fuel after certification and release as described in 1.2.1.

1.2.3 Once a fuel is redesignated as D1655 aviation turbine fuel, it can be handled in the same fashion as the equivalent refined D1655 aviation turbine fuel.

1.3 This specification defines the minimum property requirements for aviation turbine fuel that contain synthesized hydrocarbons and lists acceptable additives for use in civil operated engines and aircrafts. Specification D7566 is directed at civil applications, and maintained as such, but may be adopted for military, government, or other specialized uses.

1.4 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.

1.5 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.

1.6 While aviation turbine fuels defined by Table 1 of this specification can be used in applications other than aviation turbine engines, requirements for such other applications have not been considered in the development of this specification.

1.7 Synthetic blending components, synthetic fuels, and blends of synthetic fuels with conventional petroleum-derived fuels in this specification have been evaluated and approved in accordance with the principles established in Practice D4054.

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

1.9 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D56 Test Method for Flash Point by Tag Closed Cup Tester

[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.J0.06 on Emerging Turbine Fuels.

Current edition approved July 1, 2016. Published July 2016. Originally approved in 2009. Last previous edition approved in 2016 as D7566 – 16a. DOI: 10.1520/D7566-16B.

[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

- Defines Suitable Synthetic Kerosene Components
- Provides QC and Blending Information
- Direct Path into Commercial Specifications
  - ASTM D1655
  - UK(MOD) DS91-91
- Not Possible without DOD

DOD Alternative Fuel Support

- DOD Acted In Concert with FAA to Facilitate US Government Policy
- DARPA Funded Developments
  - Created HEFA SPK Path
  - Supported New Source Path
- Most Critical – Service Research Provided Core Aviation Fuel Understanding
  - USA, USAF and USN Funded Research Fundamental to Generating True Understanding of Aviation Turbine Fuel Properties
  - Considered both Flight and Ground Aspects in Support of Single Fuel Forward Doctrine

Data Shows the Way

- DOD Provided Research Sets An Expectation for Appropriate Alternative Materials
  - Primary Source of Influence in Fuel Specifications
  - Data Always Beats No Data
  - Some Limitations
- Same Research Sets an Expectation for All Aviation Turbine Fuel Developments

Breaking New Ground

- Alternative Fuel Development Cautiously Slow
- Bulk of Data Suggests Big Picture
- AFRL Underwriting Development of Generic Annex
  - Fundamental Properties and Requirements for Process Approval Free Kerosene
  - 10% Max Target

Impact on Refined Fuel

- D7566 Exists to Isolate Refined Fuel from Needless Requirements
  - Facts, However, Are Stubborn
- Lessons Learned from the Alternative Fuel Efforts will Impact Future D1655 Specification Efforts
- Effort Will Pay Dividends Regardless of Long Term Viability of Alternate Sources

Small Budget, Big Power

- Knowledge is the DOD Lever
  - Having an Answer is Half the Battle to Making a Decision
- Most Fuel Improvements for Military Engines Would Make Better Commercial Fuel Too
  - But Is It Monetizable?
- Fuel Supply Costs Balanced Against Service Costs

D1655 Reflects DOD Effort

- Commercial Jet Fuel Progress Joint Effort
  - FAA, OEMs, DOD, Users…
- It is Clear… Current High Quality Not Possible Without DOD Knowledge Input

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