



Standard Specification for Unleaded Aviation Gasoline Test Fuel Containing Organo- metallic Additive¹

This standard is issued under the fixed designation D8434; 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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This specification covers formulating specifications for purchases of an unleaded aviation gasoline test fuel under contract and is intended solely for use by purchasing agencies for testing purposes.

1.2 This specification defines a specific type of aviation gasoline for use as an aviation spark-ignition engine test fuel. It does not include all gasolines satisfactory for reciprocating aviation engines. Certain equipment or conditions of use may permit a wider, or require a narrower, range of characteristics than is shown by this specification.

1.3 The unleaded aviation gasoline test fuel defined by this specification does exhibit similar octane performance to those leaded fuels with which the existing aircraft and ground-based fuel handling equipment have been designed to operate.

1.4 Issuance of this specification does not constitute approval to operate certificated aircraft with this test fuel. 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 a certification program.

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

1.6 This specification, unless otherwise provided, prescribes the required properties of unleaded aviation gasoline test fuel at the time and place of delivery.

1.7 *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.*

1.8 *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 Recom-*

mendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:²

- D86 Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure
- D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- D323 Test Method for Vapor Pressure of Petroleum Products (Reid Method)
- D357 Method of Test for Knock Characteristics of Motor Fuels Below 100 Octane Number by the Motor Method; Replaced by D 2700 (Withdrawn 1969)³
- D381 Test Method for Gum Content in Fuels by Jet Evaporation
- D614 Method of Test for Knock Characteristics of Aviation Fuels by the Aviation Method; Replaced by D 2700 (Withdrawn 1970)³
- D873 Test Method for Oxidation Stability of Aviation Fuels (Potential Residue Method)
- D909 Test Method for Supercharge Rating of Spark-Ignition Aviation Gasoline
- D910 Specification for Leaded Aviation Gasolines
- D1094 Test Method for Water Reaction of Aviation Fuels
- D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- D1948 Method of Test for Knock Characteristics of Motor Fuels Above 100 Octane Number by the Motor Method; Replaced by D 2700 (Withdrawn 1968)³
- D2386 Test Method for Freezing Point of Aviation Fuels
- D2392 Test Method for Color of Dyed Aviation Gasolines
- 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

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.J0.02 on Aviation Piston Engine Fuels.

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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.

- D2700** Test Method for Motor Octane Number of Spark-Ignition Engine Fuel
- D3338** Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
- 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
- D4177** Practice for Automatic Sampling of Petroleum and Petroleum Products
- 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
- D5006** Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels
- D5059** Test Methods for Lead and Manganese in Gasoline by X-Ray Fluorescence Spectroscopy
- D5191** Test Method for Vapor Pressure of Petroleum Products and Liquid Fuels (Mini Method)
- D5453** Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
- D6469** Guide for Microbial Contamination in Fuels and Fuel Systems
- E29** Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

3. Terminology

3.1 Definitions:

3.1.1 *unleaded aviation gasoline, n*—gasoline intended for use in aircraft powered by reciprocating spark ignition engines, where lead is not intentionally added for the purpose of enhancing octane performance.

3.1.1.1 *Discussion*—Principal properties include volatility limits, stability, detonation-free performance in the engine for which it is intended, and suitability for low temperature performance.

4. General

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

5. Classification

5.1 One grade of unleaded aviation gasoline test fuel is provided, known as 100M.

6. Materials and Manufacture

6.1 100M⁴ unleaded aviation gasoline test fuel, except as otherwise specified in this specification, shall consist of blends of refined hydrocarbons derived from crude petroleum, natural gasoline, biomass or blends thereof, with synthetic hydrocarbons or aromatic hydrocarbons, or both.

6.2 *Additives—Mandatory*, shall be added in the amount and of the composition specified in the following list of approved materials.

6.2.1 *AvGuard UL*⁵ Additive Package shall be added in the form of a multifunctional mixture containing not less than 28 % by mass of methylcyclopentadienyl manganese tricarbonyl (MMT®), sufficient phosphorous based scavenger chemistry to provide a stoichiometric ratio of Mn:P from 1:0.1 to 1:10, and oxidation inhibitor in the amount of 1 mg per 12.5 mg Mn/L in the finished fuel. The balance contains no ingredients other than carrier solvent. The maximum manganese concentration limit is specified in **Table 1**.⁶

6.3 *Additives* may be added to the fuel in the amount and of the composition specified in the following list of approved materials.⁷ The quantities and types shall be declared by the manufacturer. Additives added after the point of manufacture shall also be declared.

6.3.1 *Oxidation Inhibitor* may be added to the fuel separately, or in combination, in total concentration not to exceed 12 mg of inhibitor (not including weight of solvent) per liter of fuel.

(1) 2,6-ditertiary butyl-4-methylphenol.

(2) 2,4-dimethyl-6-tertiary butylphenol.

(3) 2,6-ditertiary butylphenol.

(4) 75 % minimum 2,6-ditertiary butylphenol plus 25 % maximum mixed tertiary and tritertiary butylphenols.

(5) 75 % minimum di- and tri-isopropyl phenols plus 25 % maximum di- and tri-tertiary butylphenols.

(6) 72 % minimum 2,4-dimethyl-6-tertiary butylphenol plus 28 % maximum monomethyl and dimethyl tertiary butylphenols.

(7) N,N'-di-isopropyl-*para*-phenylenediamine.

(8) N,N'-di-secondary-butyl-*para*-phenylenediamine.

6.3.2 *Fuel System Icing Inhibitor (FSII)*—One of the following may be used.

6.3.2.1 *Isopropyl Alcohol (IPA, propan-2-ol)*, in accordance with the requirements of Specification **D4171** (Type II). May

⁴ The following fuel, as described in **Table 1** and RR:D02-2026, was used to develop this specification. A test protocol to establish equivalence of high octane unleaded aviation gasoline is on file at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-2026. Contact ASTM Customer Service at service@astm.org.

⁵ AvGuard UL is a trademark of Afton Chemical Corporation, 500 Spring Street, Richmond, VA 23219, and was used in the development of this fuel specification. This is not an endorsement or certification by ASTM International.

⁶ Supporting data pending ASTM balloting and acceptance of Research Report RR:D02-2026. AvGuard ULTM is an essential component in this unleaded aviation fuel to deliver the octane levels required for proper engine performance. The integrity of D8434 fuel requires that the unleaded fuel additive package meet the specifications of D8434 **Table 1** and give equivalent RR:D02-2026 results to the fuel used in the development of this fuel specification.

⁷ 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.