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StandardSpecification for High-Octane Unleaded Fuel[1]

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1. Scope*

1.1 This specification covers formulating specifications for purchases of a high-octane (MON) unleaded fuel under contract and is intended solely for use by purchasing agencies.[2]

1.2 This specification defines a specific type of high-octane (MON) unleaded fuel for use as an aviation spark-ignition fuel. It does not include all fuels 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 This specification, unless otherwise provided, prescribes the required properties of unleaded fuel at the time and place of delivery.

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

1.5 *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:*[3]

D86 Test Method for Distillation of Petroleum Products at Atmospheric Pressure
D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
D323 Test Method for Vapor Pressure of Petroleum Products (Reid Method)
D873 Test Method for Oxidation Stability of Aviation Fuels (Potential Residue Method)
D1094 Test Method for Water Reaction of Aviation Fuels
D1266 Test Method for Sulfur in Petroleum Products (Lamp Method)
D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
D1319 Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption
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
D2700 Test Method for Motor Octane Number of Spark-Ignition Engine Fuel
D3237 Test Method for Lead in Gasoline by Atomic Absorption Spectroscopy
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
D4306 Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination
D4809 Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)
D4814 Specification for Automotive Spark-Ignition Engine Fuel
D5006 Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels
D5059 Test Methods for Lead in Gasoline by X-Ray Spectroscopy
D5191 Test Method for Vapor Pressure of Petroleum Products (Mini Method)
D6733 Test Method for Determination of Individual Components in Spark Ignition Engine Fuels by 50-Metre Capillary High Resolution Gas Chromatography
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

[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 on Aviation Fuels.

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[2] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1721.

[3] 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**

3. Terminology

3.1 *Definitions:*

3.1.1 *aviation gasoline fuel, n*—fuel possessing specific properties suitable for operating aircraft powered by reciprocating spark-ignition engines.

3.1.2 *binary, adj*—characterized by, or consisting of, two components.

3.1.3 *biomass, n*—biological material including any material other than fossil fuels which is or was a living organism or component or product of a living organism.

3.1.4 *high-octane, adj*—possessing a Motor octane number (MON) greater than 100.

4. General

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

5. Classification

5.1 One grade of high-octane unleaded fuel is provided, known as UL102.

6. Materials and Manufacture

6.1 High-octane unleaded fuel, except as otherwise specified in this specification, shall consist of blends of refined reformate hydrocarbons. The sources for these hydrocarbons include biomass, natural gas, or crude petroleum.

6.1.1 See Appendix X1 for one particular composition that meets the parameters of Table 1.

6.2 *Additives*—These can be added to each grade of high-octane unleaded aviation fuel in the amount, and of the composition, specified in the following list of approved materials:

6.2.1 *Dyes*—The total maximum concentration of dye in the fuel is 6.0 mg/L.

6.2.1.1 The only blue dye present in the finished fuel shall be essentially 1,4-dialkylaminoanthraquinone.

6.2.1.2 The only yellow dyes in the finished fuel shall be essentially p-diethylaminoazobenzene (Color Index No. 11021) or 1,3-benzenediol 2,4-bis [(alkylphenyl)azo-].

6.2.1.3 The only red dye present in the finished fuel shall be essentially alkyl derivatives of azobenzene-4-azo-2-naphthol.

6.2.1.4 The only orange dye present in the finished fuel shall be essentially benzene-azo-2-napthol (Color Index No. 12055).

6.2.2 *Other Additives*—These may be added in the amount and of the composition specified in the following list of approved materials. The quantities and types shall be declared by the manufacturer. Additives added after the point of manufacture shall also be declared.

6.2.2.1 *Antioxidants*—The following oxidation inhibitors 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 litre 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.

TABLE 1 Detailed Requirements for High-Octane Unleaded Fuel

Octane Ratings		Grade UL102	ASTM Test Method
Knock value, Motor Octane Number	min	102.2	D2700
Density at 15 °C, kg/m^3	min	790	D1298 or D4052
	max	825	
Distillation			D86
Initial boiling point, °C	Report		D86
Fuel Evaporated			D86
10 volume % at °C	max	75	D86
40 volume % at °C	min	75	D86
50 volume % at °C	max	165	D86
90 volume % at °C	max	165	D86
Final boiling point, °C	max	180	D86
Sum of 10 % + 50 % evaporated temperatures, °C	min	135	D86
Recovery, volume %	min	97	D86
Residue, volume %	max	1.5	D86
Loss, volume %	max	1.5	D86
Vapor pressure, 37.8 °C, kPa	min	38.0	D323 orD5191
	max	49.0	
Freezing point, °C	max	-58	D2386
Sulfur, mass %	max	0.05	D1266 or D2622
Net heat of combustion, MJ/kg	min	41.5	D4809
Corrosion, copper strip, 2 h at 100 °C	max	No. 1	D130
Oxidation stability (5 h aging)			D873
Potential gum, mg/100 mL	max	6	
Water reaction			D1094
Volume change, mL	max	±2	
Electrical conductivity, pS/m	max	450	D2624
Tetraethyl Lead, g Pb/L	max	0.013	D3237 or D5059
Total Aromatics, vol %	min	70	D1319 or D6733