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Standard Specification for High Octane Unleaded Test Fuel[1]

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INTRODUCTION

This new test fuel specification is for a high-octane unleaded fuel to be used for gathering data toward a commercial research report and specification on an unleaded high-octane aviation gasoline.

A new high-octane unleaded test fuel has been developed which maintains the key performance parameters of existing reciprocating aircraft engines. The two essential performance parameters of MON and VP are inversely related with respect to composition and thus can uniquely define a composition range of the two components. The values for VP and MON in Table 1 reflect the limiting values of the two components. The binary fuel exhibits a higher volumetric energy density (net heat of combustion times density) which is of great performance interest, although not explicitly stated in Table 1. The distillation parameters reflect the binary compositional effects. This is an unleaded fuel, so the limit of TEL in Table 1 is the same as is used in Specification D4814 for mogas and is meant to mitigate unintentional contamination by TEL. Lastly, references to dyes remain in the specification so that test groups may use them as necessary.

1. Scope*

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

1.2 This specification defines a specific type of high octane unleaded test fuel for use as an aviation spark-ignition fuel.

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

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 (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

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

[1] This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products 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.**

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
D5190 Test Method for Vapor Pressure of Petroleum Products (Automatic Method)
D5191 Test Method for Vapor Pressure of Petroleum Products (Mini Method)
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

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*—~~plant material, vegetation, or agricultural waste used as a fuel or energy source.~~ —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 test fuel is provided, known as UL102.

6. Materials and Manufacture

6.1 High octane unleaded test 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 being test 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.

TABLE 1 Detailed Requirements for High Octane Unleaded Test Fuel

Octane Ratings		Grade UL102	ASTM Test Method
Knock value, Motor Octane Number	min	102.2	D2700
Density at 15°C, kg/m3	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, D5190 , or D5191
	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