



Standard Specification for Grade 82 Unleaded Aviation Gasoline¹

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1. Scope

1.1 Grade 82 unleaded aviation gasoline defined by this specification is for use only in engines and associated aircraft that are specifically approved by the engine and aircraft manufacturers, and certified by the National Certifying Agencies to use this fuel. This fuel is not considered suitable for use in other engines and associated aircraft that are certified to use aviation gasolines meeting Specification D 910.

1.2 A fuel may be certified to meet this specification by a producer as Grade 82 UL aviation gasoline, only if blended from component(s) approved for use in Grade 82 UL aviation gasoline by the refiner(s) of such components because only the refiner(s) can attest to the component source and processing, absence of contamination, and the additives used and their concentrations. Consequently, re-classifying of any other product to Grade 82 UL aviation gasoline does not meet this specification.

1.3 Appendix X1 contains an explanation for the rationale of the specification. Appendix X2 details the reasons for the individual specification requirements.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are provided for information only.

2. Referenced Documents

2.1 ASTM Standards:

- D 86 Test Method for Distillation of Petroleum Products at Atmospheric Pressure²
- D 130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test²
- D 357 Method of Test for Knock Characteristics of Motor Fuels Below 100 Octane Number by the Motor Method³
- D 381 Test Method for Gum Content in Fuels by Jet Evaporation²
- D 873 Test Method for Oxidation Stability of Aviation Fuels (Potential Residue Method)²

- D 909 Test Method for Knock Characteristics of Aviation Gasolines by the Supercharge Method⁴
- D 910 Specification for Aviation Gasolines²
- D 1266 Test Method for Sulfur in Petroleum Products (Lamp Method)²
- D 2386 Test Method for Freezing Point of Aviation Fuels²
- D 2392 Test Method for Color of Dyed Aviation Gasolines²
- D 2622 Test Method for Sulfur in Petroleum Products by X-Ray Spectrometry²
- D 2700 Test Method for Motor Octane Number of Spark-Ignition Engine Fuel⁴
- D 3120 Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry²
- D 3231 Test Method for Phosphorus in Gasoline⁵
- D 3237 Test Method for Lead in Gasoline by Atomic Absorption Spectroscopy⁵
- D 3338 Test Method for Estimation of Heat of Combustion of Aviation Fuels⁵
- D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products⁵
- D 4171 Specification for Fuel System Icing Inhibitors⁵
- D 4294 Test Method for Sulfur in Petroleum Products by Energy Dispersive X-Ray Fluorescence Spectroscopy⁵
- D 4529 Test Method for Estimate of Net Heat of Combustion of Aviation Fuels⁵
- D 4809 Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Intermediate Precision Method)⁵
- D 4815 Test Method for Determination of MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol, and C₁ to C₄ Alcohols in Gasoline by Gas Chromatography⁵
- D 4953 Test Method for Vapor Pressure of Gasoline and Gasoline Oxygenate Blends (Dry Method)⁵
- D 5059 Test Method for Lead in Gasoline by X-Ray Spectroscopy⁵
- D 5190 Test Method for Vapor Pressure of Petroleum Products (Automatic Method)⁵
- D 5191 Test Method for Vapor Pressure of Petroleum Products (Mini Method)⁵
- D 5453 Test Method for Determination of Total Sulfur in

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.J0.02 on Aviation Gasoline Specifications.

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² *Annual Book of ASTM Standards*, Vol 05.01.

³ Discontinued 1969, See *Annual Book of ASTM Standards*, Part 17, Replaced by D 2700.

⁴ *Annual Book of ASTM Standards*, Vol 05.05.

⁵ *Annual Book of ASTM Standards*, Vol 05.02.

Light Hydrocarbons, Motor Fuels, and Oils by Ultra Violet Fluorescence⁶

D 5482 Test Method for Vapor Pressure of Petroleum Products (Mini Method/Atmospheric)⁶

D 5599 Test Method for Determination of Oxygenates in Gasoline by Gas Chromatography and Oxygen Selective Flame Ionization Detection⁶

D 5845 Test Method for Determination of MTBE, ETBE, TAME, DIPE, Methanol, Ethanol, and *tert*-Butanol in Gasoline by Infrared Spectroscopy⁶

D 5983 Specification for Methyl *tertiary*-Butyl Ether (MTBE) for Downstream Blending for Use in Automotive Spark-ignition Engine Fuel⁶

D 6469 Guide for Microbial Contamination in Fuel and Fuels Systems⁷

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁸

2.2 *Military Standard*:⁹

MIL-PRF-25017F Performance Specification for Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble

QPL-25017 Qualified Products List of Products Qualified Under Performance Specification MIL-PRF-25017F

3. Terminology

3.1 Definitions:

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

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

4. Grades

4.1 The specification covers one grade of unleaded aviation gasoline designated Grade 82 UL. Grade 82 UL is the only aviation gasoline defined by this specification and the grade shows the minimum motor octane rating.

5. General

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

6. Material

6.1 Aviation gasoline, except as otherwise specified in this specification, shall consist of blends of refined hydrocarbons derived from crude petroleum, natural gasoline or blends, thereof, with specific aliphatic ethers, synthetic hydrocarbons, or aromatic hydrocarbons. When applicable, methyl *tertiary*-butyl ether (MTBE) shall conform to the requirements of Specification D 5983. Types and quantities of trace alcohols shall meet the requirements of Table 1 and 6.2.4.2.

6.2 Only additives approved by this specification are permitted. In addition to identification dyes, corrosion inhibitors, antioxidants, and metal deactivators, fuel system icing inhibitor additives are permitted under 6.2.4. Permitted additives may be added to aviation gasoline in the amount and of the composition specified in the following list of approved materials.

6.2.1 *Antioxidants*— The following oxidation inhibitors may be added to the gasoline separately or in combination in total concentration not to exceed 12 mg of inhibitor (not including weight of solvent) per litre of fuel.

6.2.1.1 2,6 - ditertiary-butyl-phenol.

6.2.1.2 2,6 - ditertiary-butyl-4-methyl-phenol.

6.2.1.3 2,4 - dimethyl - 6 - tertiary-butyl - phenol.

6.2.1.4 2,6 - ditertiary - butyl - phenol, 75 % min.

Tertiary and tritertiary - butyl - phenols, 25 % max.

6.2.1.5 2,4-dimethyl-6-tertiary-butyl-phenol, 55 % min; 4-methyl-2,6-ditertiary-butyl phenol 15 % min; the remainder as a mixture of monomethyl and dimethyl-tertiary-butyl-phenols.

6.2.1.6 2,4 - dimethyl-6-tertiary-butyl-phenol, 72 % min.

Mixture of tertiary-butyl-methyl-phenols and tertiary-butyl-dimethyl-phenols, 28 % max.

6.2.1.7 2,6-ditertiary-butyl-4-methyl-phenol, 35 % min.

Mixed methyl, ethyl, and dimethyl tertiary-butyl-phenols, 65 % max

6.2.1.8 2,4-di-tertiary butyl-phenol, 60 % min.

Mixed tertiary-butyl-phenol, 40 % max.

6.2.1.9 Butylated ethyl-phenols, 55 % min.

Butylated methyl and dimethyl-phenols, 45 % max.

6.2.1.10 Mixture of a di- and tri-isopropyl-phenols, 75 % min.

Mixture of di- and tri-tertiary butyl-phenols, 25 % max.

6.2.1.11 N,N' di-secondary butyl-para phenylene diamine.

6.2.1.12 N,N' di-isopropyl-para-phenylene-diamine.

6.2.1.13 N-secondary butyl, N'- phenyl ortho - phenylene-diamine.

6.2.2 *Metal Deactivators*—A metal deactivator, N,N' - disalicylidene - 1,2- propane diamine may be added to the gasoline in an amount not to exceed 3.0 mg/L.

6.2.3 *Corrosion Inhibitors*—Corrosion inhibitors that conform to MIL-PRF-25017F may be added to the gasoline in amounts not exceeding the maximum allowable concentrations listed in the latest revision of QPL-25017.

6.2.4 *Fuel System Icing Inhibitor*:

6.2.4.1 Diethylene glycol monomethyl ether, conforming to the requirements of Specification D 4171 (Type III), may be used in concentrations of 0.10 to 0.15 volume %.

6.2.4.2 Isopropyl alcohol conforming to the requirements of Specification D 4171 (Type II) may be used in concentrations recommended by the aircraft manufacturers when required by the aircraft owner operator.

7. Detailed Requirements

7.1 The aviation gasoline shall conform to the requirements in Table 1.

8. Workmanship

8.1 The finished fuel shall be visually free of water, sediment, and suspended matter.

⁶ Annual Book of ASTM Standards, Vol 05.03.

⁷ Annual Book of ASTM Standards, Vol 05.04.

⁸ Annual Book of ASTM Standards, Vol 14.02.

⁹ Available from Standardization Document Order Desk, 700 Robbins Ave., Bldg. 4D, Philadelphia, PA 19111-5094 Attn: NPODS.

TABLE 1 Requirements for Grade 82 UL Aviation Gasoline^A

Property	Requirement	ASTM Test Method ^B
Knock value, lean mixture		D 2700
Motor method octane number, min	82.0	
Color	purple	D 2392
Dye content ^C		
Blue dye ^D , mg/L, max	7.5	
Red dye ^E , mg/L, max	1.9	
Distillation temperature, °C (°F) at % evaporated		D 86
10 volume %, max	70 (158)	
50 volume %	66 (150)- 121 (250)	
90 volume %, max	190 (374)	
End point, max	225 (437)	
Residue, volume % max	2	
Distillation recovery, volume %, min	95	
Distillation loss, volume %, max	3.0	
Net heat of combustion, min MJ/kg (BTU/lb)	40.8 (17 540)	D 3338 ^F , D 4529 ^F , or D 4809 ^G
Freezing point, °C (°F), max	-58 (-72)	D 2386
Vapor pressure, kPa (psi), max	62 (9.0) ^H	D 4953, D 5190, D 5191, or D 5482
kPa (psi), min	38 (5.5)	
Lead content, g/L (g/U.S. gal), max ^I	0.013 (0.05)	D 3237 or D 5059
Copper strip corrosion, 3 h at 50°C (122°F), max	No. 1	D 130
Sulfur, mass %, max	0.07	D 1266, D 2622, D 3120, D 4294, or D 5453
Potential gum (5-h aging), max, mg/100mL ^J	6	D 873
Alcohols and ether content ^{K,L}		D 4815, D 5599, or D 5845
Total combined methanol and ethanol, mass %, max	0.3	
Combined aliphatic ethers, methanol, and ethanol, as mass % oxygen, max	2.7	

^AThe requirements stated herein are subject to rounding in accordance with Practice E 29 and are not subject to correction for tolerance of the test method.

^BThe test methods indicated in this table are referred to in Section 10.

^CThe maximum dye concentrations shown do not include solvent in dyes supplied in liquid form.

^DEssentially 1,4- dialkylamino - anthraquinone.

^EEssentially alkyl derivatives of azobenzene - 4 - azo - 2 - naphthol.

^FUse either Eq 1 or Table 1 in Test Method D 4529, or Eq 2 in Test Method D 3338. See X2.7.2 for limitations and oxygen corrections required when Test Methods D 3338 and D 4529 are applied to fuels blended with aliphatic ethers.

^GTest Method D 4809 may be used as an alternative. In case of dispute, Test Method D 4809 shall be used.

^HFuel with a vapor pressure greater than 62 kPa (9.0 psi) but not exceeding 93 kPa (13.5 psi) is permissible, if the ambient temperature is not more than 29°C (85°F) at the time and place of delivery and all federal and local regulations are met. The vapor pressure of permissible fuel exceeding 62 kPa (9.0 psi) shall be shown on all product transfer documents, including the delivery document to the aircraft.

^ISee X2.10.1 for maximum limits for lead and phosphorus in unleaded gasoline.

^JD 381 existent gum test can provide a means of detecting deteriorated quality or contamination, or both, with heavier products following distribution from refinery to airport; refer to X2.9.1.

^KNo deliberate addition of alcohols is allowed except for isopropyl alcohol which is allowed as an additive (see 6.2.4.2)

^LFor additional information and limitations, see X2.8

NOTE 1—See Practice D 4057 for appropriate sampling procedures.

9. Reports

9.1 The type and number of reports to ensure conformance with the requirements of this specification shall be mutually agreed to by the purchaser and the supplier of the aviation gasoline.

10. Test Methods

10.1 The requirements enumerated in this specification shall be determined in accordance with the following ASTM test methods:

10.1.1 *Motor Octane*— Test Method D 2700.

10.1.2 *Color*—Test Method D 2392.

10.1.3 *Distillation*— Test Method D 86.

10.1.4 *Net Heat of Combustion*—Test Method D 3338, D 4529, or D 4809.

10.1.5 *Freezing Point*— Test Method D 2386.

10.1.6 *Vapor Pressure*— Test Method D 4953, D 5190, D 5191 or D 5482.

10.1.7 *Lead Content*— Test Method D 3237 or D 5059 (Test Method C).

10.1.8 *Copper Strip Corrosion*—Test Method D 130 (3 h at 50°C (122°F)).

10.1.9 *Sulfur*—Test Method D 1266, D 2622, D 3120, D 4294, or D 5453.

10.1.10 *Potential Gum*— Test Method D 873, except that wherever the letter X occurs (referring to oxidation time), insert the number 5, designating the number of hours prescribed in this specification.

10.1.11 *Alcohols/Ethers Detection*—Test Method D 4815, D 5599, or D 5845.

11. Keywords

11.1 aviation gasoline; ether, fuel; gasoline/alcohol blends; gasoline/ether blends; gasoline/oxygenate blends, octane requirement; unleaded aviation gasoline