Designation: D7592 – 15a

An American National Standard

Standard Specification for Specification for Grade 94 Unleaded Aviation Gasoline Certification and Test Fuel[1]

1. Scope*

1.1 This specification covers formulating specifications for purchases of aviation gasoline under contract and is intended primarily for use by purchasing agencies.

1.2 This specification defines a specific type of aviation gasoline that contains no lead. 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 This specification, unless otherwise provided, prescribes the required properties of unleaded aviation gasoline at the time and place of delivery.

1.4 The current purpose for the fuel specified herein is for certification and testing of an engine and engine components.

1.5 The UL94 standard is to be used for engine calibration and FAA certification.

1.6 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:*[2]

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)
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of Test for Knock Characteristics of Motor Fuels Below 100 Octane Number by the Motor Method; Replaced by D 2700 (Withdrawn 1969)[3]
D614 Method of Test for Knock Characteristics of Aviation Fuels by the Aviation Method; Replaced by D 2700 (Withdrawn 1970)[3]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)
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of Test for Knock Characteristics of Motor Fuels Above 100 Octane Number by the Motor Method; Replaced by D 2700 (Withdrawn 1968)[3]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
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
D2699 Test Method for Research Octane Number of Spark-Ignition Engine Fuel
D2700 Test Method for Motor Octane Number of Spark-Ignition Engine Fuel
D3237 Test Method for Lead in Gasoline by Atomic Absorption Spectroscopy
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
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

[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 Spark and Compression Ignition Aviation Engine Fuels.

Current edition approved Oct. 1, 2015. Published October 2015. Originally approved in 2010. Last previous edition approved in 2015 as D7592 – 15. DOI: 10.1520/D7592-15A.

[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**

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 in Gasoline by X-Ray Spectroscopy
D5191 Test Method for Vapor Pressure of Petroleum Products (Mini Method)
D6227 Specification for Unleaded Aviation Gasoline Containing a Non-hydrocarbon Component
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 possessing specific properties suitable for fueling 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. Classification

4.1 One grade of unleaded aviation gasoline is provided, known as:

Grade UL94

NOTE 1—The above grade is based on its octane number as measured by Test Method D2700 motor method.

5. Materials and Manufacture

5.1 Unleaded 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 synthetic hydrocarbons or aromatic hydrocarbons, or both.

5.2 *Additives*—These may be added to each grade of unleaded aviation gasoline in the amount and of the composition specified in the following list of approved materials.[4] The quantities and types shall be declared by the manufacturer. Additives added after the point of manufacture shall also be declared.

5.2.1 *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.

5.2.1.1 2, 6-ditertiary butyl-4-methylphenol.

5.2.1.2 2, 4-dimethyl-6-tertiary butylphenol.

5.2.1.3 2, 6-ditertiary butylphenol.

5.2.1.4 75 % minimum 2, 6-ditertiary butylphenol plus 25 % maximum mixed *tertiary* and *tritertiary* butylphenols.

5.2.1.5 75 % minimum di- and tri-isopropyl phenols plus 25 % maximum di- and tri-*tertiary* butylphenols.

5.2.1.6 72 % minimum 2,4-dimethyl-6-tertiary butylphenol plus 28 % maximum monomethyl and dimethyl *tertiary* butylphenols.

5.2.1.7 N,N'-di-isopropyl-para-phenylenediamine.

5.2.1.8 N,N'-di-secondary-butyl-para-phenylenediamine.

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

5.2.2.1 *Isopropyl Alcohol (IPA, propan-2-ol),* in accordance with the requirements of Specification D4171 (Type II). This may be used in concentrations recommended by the aircraft manufacturer when required by the aircraft owner/operator.

NOTE 2—Addition of isopropyl alcohol (IPA) may reduce knock ratings below minimum specification values in a similar manner to Specification D910 Leaded Aviation Gasoline (see X1.2.3).[5]

5.2.2.2 *Di-Ethylene Glycol Monomethyl Ether (Di-EGME),* conforming to the requirements of Specification D4171 (Type III), may be used in concentrations of 0.10 volume % to 0.15 volume % when required by the aircraft owner/operator.

5.2.2.3 Test Method D5006 may be used to determine the concentration of Di-EGME in aviation fuels.

5.2.3 *Electrical Conductivity Additive*—Stadis 450[6] in concentrations up to 3 mg/L is permitted. When loss of fuel conductivity necessitates retreatment with electrical conductivity additive, further addition is permissible up to a maximum cumulative level of 5 mg/L of Stadis 450.[6]

5.2.4 *Corrosion Inhibitor Additive*—The following corrosion inhibitors may be added to the gasoline in concentrations not to exceed the maximum allowable concentration (MAC) listed for each additive.

DCI-4A	MAC = 24.0 g/m^3
DCI-6A	MAC = 15.0 g/m^3
HITEC 580	MAC = 22.5 g/m^3
NALCO 5403	MAC = 22.5 g/m^3
NALCO 5405	MAC = 11.0 g/m^3
UNICOR J	MAC = 22.5 g/m^3
SPEC-AID 8Q22	MAC = 24.0 g/m^3
TOLAD 351	MAC = 24.0 g/m^3
TOLAD 4410	MAC = 22.5 g/m^3

6. Detailed Requirements

6.1 The unleaded aviation gasoline shall conform to the requirements prescribed in Table 1.

6.2 Test results shall not exceed the maximum or be less than the minimum values specified in Table 1. No allowance shall be made for the precision of the test methods. To determine the conformance to the specification requirement, a test result may be rounded to the same number of significant figures as in Table 1 using Practice E29. Where multiple

[4] Supporting data (guidelines for the approval or disapproval of additives) have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1125.

[5] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1256.

[6] Stadis 450 is a registered trademark marketed by Innospec, Inc., Innospec Manufacturing Park, Oil Sites Road, Ellesmere Port, Cheshire, CH65 4EY, UK.

TABLE 1 Detailed Requirements for Unleaded Aviation Gasoline[A]

Octane Ratings		Grade 94	ASTM Test Method[B]
Knock value, Motor Octane Number[C]	min	94.0	D2700
Knock value, Research Octane Number[C]	min	Report	D2699
Identifying Color		colorless	
Density at 15 °C, kg/m³		Report	D1298 or D4052
Distillation			D86
Initial boiling point, °C		Report	
Fuel Evaporated			
10 volume % at °C	max	75	
40 volume % at °C	min	75	
50 volume % at °C	max	105	
90 volume % at °C	max	135	
Final boiling point, °C	max	170[D]	D86
Sum of 10 % + 50 % evaporated temperatures, °C	min	135	
Recovery volume %	min	97	
Residue volume %	max	1.5	
Loss volume %	max	1.5	
Vapor pressure, 38 °C, kPa	min	38.0	D323 or D5191[E]
	max	49.0	
Freezing point,°C	max	-58[F]	D2386
Sulfur, mass %	max	0.05	D2622
Net heat of combustion, MJ/kg[G]	min	43.5	D4529 or D3338
Corrosion, copper strip, 2 h at 100 °C	max	No. 1	D130
Oxidation stability(5 h aging)[H]			D873
Potential gum, mg/100 mL	max	6	
Water reaction			D1094
Volume change, mL	max	±2	
Electrical conductivity, pS/m	max	450[I]	D2624
Tetraethyl Lead, g Pb/L	max	0.0130	D3237 or D5059

[A] For compliance of test results against the requirements of Table 1, see 6.2.
[B] The test methods indicated in this table are referred to in Section 10.
[C] Knock ratings shall be reported to the nearest 0.1 octane number.
[D] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1801. Contact ASTM Customer Service at service@astm.org.
[E] Test Method D5191 shall be the referee vapor pressure method.
[F] If no crystals have appeared on cooling to –58 °C, the freezing point may be reported as less than –58 °C.
[G] For all grades use either Eq 1 or Table 1 in Test Method D4529 or Eq 2 in Test Method D3338. Test Method D4809 may be used as an alternative. In case of dispute, Test Method D4809 shall be used.
[H] If mutually agreed upon between the purchaser and the supplier, a 16 h aging gum requirement may be specified instead of the 5 h aging gum test; in such case the gum content shall not exceed 10 mg ⁄100 mL. In such fuel the permissible antioxidant shall not exceed 24 mg ⁄L.
[I] Applies only when an electrical conductivity additive is used; when a customer specifies fuel containing conductivity additive, the following conductivity limits shall apply under the condition at point of use:
Minimum 50 pS ⁄m.
Maximum 450 pS ⁄m.
The supplier shall report the amount of additive added.

determinations are made, the average result, rounded according to Practice E29, shall be used.

7. Workmanship, Finish, and Appearance

7.1 The unleaded aviation gasoline specified in this specification shall be free from undissolved water, sediment, and suspended matter. The odor of the fuel shall not be nauseating or irritating. No substances of known dangerous toxicity under usual conditions of handling and use shall be present.

8. Sampling

8.1 Because of the importance of proper sampling procedures in establishing fuel quality, use the appropriate procedures in Practice D4057 or Practice D4177.

8.1.1 Although automatic sampling following Practice D4177 may be useful in certain situations, initial refinery specification compliance testing shall be performed on a sample taken following procedures in Practice D4057.

8.2 A number of unleaded aviation gasoline properties, including copper corrosion, electrical conductivity, and others are very sensitive to trace contamination which can originate from sample containers. For recommended sample containers, refer to Practice D4306.

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 unleaded 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 *Knock Value*—MON (Test Method D2700) and RON (Test Method D2699).

10.1.2 *Density*—Test Methods D1298 or D4052.

10.1.3 *Distillation*—Test Method D86.

10.1.4 *Vapor Pressure*—Test Methods D323 or D5191.

10.1.5 *Freezing Point*—Test Method D2386.

10.1.6 *Sulfur*—Test Method D2622.

10.1.7 *Net Heat of Combustion*—Test Methods D4529 or D3338.

10.1.8 *Corrosion (Copper Strip)*—Test Method D130, 2 h test at 100 °C in bomb.

10.1.9 *Potential Gum*—Test Method D873, except that wherever the letter X occurs (referring to oxidation time) insert the number 5, designating the number of hours prescribed in this specification.

10.1.10 *Water Reaction*—Test Method D1094.

10.1.11 *Electrical Conductivity*—Test Method D2624.

10.1.12 *Lead-Test Methods*—Test Methods D3237 or D5059 (Test Method C).

11. Keywords

11.1 Avgas; aviation gasoline; gasoline; unleaded Avgas; unleaded aviation gasoline

APPENDIX

(Nonmandatory Information)

X1. PERFORMANCE CHARACTERISTICS OF UNLEADED AVIATION GASOLINE

X1.1 Introduction

X1.1.1 Unleaded aviation gasoline is a complex mixture of relatively volatile hydrocarbons that vary widely in their physical and chemical properties. The engines and aircraft impose a variety of mechanical, physical, and chemical environments. The properties of unleaded aviation gasoline (Table X1.1) must be properly balanced to give satisfactory engine performance over an extremely wide range of conditions.

X1.1.2 The ASTM requirements summarized in Table 1 are quality limits established on the basis of the broad experience and close cooperation of producers of unleaded aviation gasoline, manufacturers of aircraft engines, and users of both commodities. The values given are intended to define unleaded aviation gasoline suitable for most types of spark-ignition aviation engines; however, certain equipment or conditions of use may require fuels having other characteristics.

X1.1.3 Specifications covering antiknock quality defines the grade of unleaded aviation gasoline. The other requirements either prescribe the proper balance of properties to ensure satisfactory engine performance or limit components of undesirable nature to concentrations so low that they will not have an adverse effect on engine performance.

X1.2 Combustion Characteristics (Antiknock Quality and Antiknock Compound Identification)

X1.2.1 The fuel-air mixture in the cylinder of a spark-ignition engine will, under certain conditions, ignite spontaneously in localized areas instead of progressing from the spark. This may cause a detonation or knock, usually inaudible in aircraft engines. This knock, if permitted to continue for more than brief periods, may result in serious loss of power and damage to, or destruction of, the aircraft engine. When unleaded aviation gasoline is used in other types of aviation engines, for example, in certain turbine engines where specifically permitted by the engine manufacturers, knock or detonation characteristics may not be critical requirements.

X1.2.2 The MON and RON ratings of UL94 are determined in standardized laboratory knock test engines that are operated under prescribed conditions. Results are expressed as octane numbers up to 100. Octane number is defined arbitrarily as the percentage of *iso*octane in that blend of *iso*octane and *n*-heptane that the gasoline matches in knock characteristics when compared by the procedure specified. The MON of the gasoline can be used as a guide to the amount of knock-limited power that may be obtained in a full-scale engine under

TABLE X1.1 Performance Characteristics of Unleaded Aviation Gasoline

Performance Characteristics	Test Methods	Sections
Combustion characteristics	Knock value (MON and RON)	X1.2
Antiknock quality	Isopropyl alcohol	X1.2.3
Fuel metering and aircraft range	Density	X1.3.1
	Net heat of combustion	X1.3.2
Carburetion and fuel vaporization	Vapor pressure	X1.4.3
	Distillation	X1.4.4
Corrosion of fuel system and engine parts	Copper strip corrosion	X1.5.1
	Sulfur content	X1.5.2
Fluidity at low temperatures	Freezing point	X1.6
Fuel cleanliness, handling, and storage stability	Potential gum	X1.7.1
	Water reaction	X1.7.3

take-off, climb and cruise conditions while the RON is an indicator of antiknock rating for engines operating at full throttle and low engine speed.

X1.2.3 Since isopropyl alcohol is normally added in the field at the point of use, the operator is cautioned that it may impact octane performance. Depending on fuel quality octane grade, the addition of the IPA additive may increase or decrease the motor octane rating.

X1.2.4 *Knock Value, MON (Test Method D2700)*—The specification parameter knock value, lists Motor Octane Number (MON) as determined by Test Method D2700. Historically, aviation lean ratings were determined (from 1941 through 1970) by Test Method D614. An extensive comparison of National Exchange Group data from 1947 through 1964 established that motor octane numbers as determined by Test Methods D357 and D1948 could be converted to equivalent Test Method D614 ratings. A table to convert MON to the corresponding aviation lean rating was included in Test Method D2700, which was first issued in 1968 as a revision, consolidation and intended eventual replacement of Test Methods D357 (Withdrawn 1969), D614 (Withdrawn 1970), and D1948 (Withdrawn 1968). Currently unleaded aviation gasoline ratings are determined as MON, Test Method D2700. The RON (Research Octane Number) is to be determined using Test Method D2699.

X1.2.5 *Dyes*—The law provides that all fuels containing tetraethyl lead must be dyed to denote the presence of the poisonous component. Unleaded fuels do not contain lead and are not dyed. Specification D6227 unleaded fuel has a dye to distinguish it from the colorless UL94 Avgas.

X1.3 Fuel Metering and Aircraft Range

X1.3.1 *Density*—Density is a property of a fluid and is of significance in metering flow and in mass-volume relationships for most commercial transactions. It is particularly useful in empirical assessments of heating value when used with other parameters such as aniline point or distillation.

X1.3.2 *Net Heat of Combustion*—The net heat of combustion provides a knowledge of the amount of energy obtainable from a given fuel for the performance of useful work, in this instance, power. Aircraft design and operation are dependent upon the availability of a certain predetermined minimum amount of energy as heat. Consequently, a reduction in heat energy below this minimum is accompanied by an increase in fuel consumption with corresponding loss of range. Therefore, a minimum net heat of combustion requirement is incorporated in the specification. The determination of net heat of combustion is time consuming and difficult to conduct accurately. This led to the development and use of the aniline point and density relationship to estimate the heat of combustion of the fuel. This relationship is used along with the sulfur content of the fuel to obtain the net heat of combustion for the purposes of this specification. An alternative calculation, Test Method D3338, is based on correlations of aromatics content, density, volatility, and sulfur content. This test method may be preferred at refineries where all these values are normally obtained and the necessity to obtain the aniline point is avoided. The direct measurement method is normally used only as a referee method in cases of dispute.

X1.3.3 No great variation in density or heat of combustion occurs in modern unleaded aviation gasolines, since they depend on hydrocarbon composition that is already closely controlled by other specification properties.

X1.4 Carburetion and Fuel Vaporization

X1.4.1 In many spark-ignition aviation engines, the gasoline is metered in liquid form through the carburetor where it is mixed with air and vaporized before entering the supercharger from which the fuel-air mixture enters the cylinder of the engine. In other types of engines, the fuel may be metered directly into the supercharger, the cylinder, or the combustor. The volatility, the tendency to evaporate or change from a liquid to a gaseous state, is an extremely important characteristic of aviation fuel.

X1.4.2 Gasolines that vaporize too readily may boil in fuel lines or carburetors, particularly as altitude increases, and cause vapor lock with resultant stoppage of fuel flow to the engine. Conversely, fuels that do not completely vaporize may cause engine malfunctioning of other sorts. Therefore, a proper balance of the volatility of the various hydrocarbon components is essential to satisfactory performance of the finished fuel.

X1.4.3 *Vapor Pressure*—The vapor pressure of an unleaded aviation gasoline is the measure of the tendency of the more volatile components to evaporate. Experience has shown that fuels having a Reid vapor pressure no higher than 49 kPa will be free of vapor-locking tendencies under most conditions of aircraft usage. A research report is available.[7]

X1.4.4 *Distillation*—The relative proportions of all the hydrocarbon components of a gasoline are measured in terms of volatility by the range of distillation temperatures. The method is empirical and useful in comparing fuels, but is not intended to separate or identify quantitatively the individual hydrocarbons present in the fuel.

X1.4.4.1 A maximum value is set on the 10 % evaporated point to ensure ease of starting and a reasonable degree of flexibility during the warm-up period. To guard against too high a volatility that might lead to carburetor icing or vapor lock, or both, (also protected against by the vapor pressure test) a minimum value is set for the sum of the 10 % and 50 % evaporated points.

X1.4.4.2 A maximum value is specified for the 50 % evaporated temperature to ensure average volatility sufficient to permit adequate evaporation of the fuel in the engine induction system. Insufficient evaporation may lead to loss of power.

X1.4.4.3 A maximum temperature is prescribed for the 90 % evaporated point to prevent too much liquid fuel being delivered to the cylinders, resulting in power loss, and to prevent poor distribution to the various cylinders. Such a condition might lead to excessive leanness in some cylinders

[7] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1146.

with consequent engine roughness, perhaps accompanied by knocking and damage to the engine. Lowered fuel economy and excessive dilution of the lubricating oil may result from too high a 90 % evaporated point.

X1.4.4.4 A minimum value is stipulated for the 40 % evaporated temperature in an effort to control, indirectly, specific gravity and, consequently, carburetor metering characteristics.

X1.4.4.5 A maximum is placed on the final boiling point (end point) which, together with the maximum prescribed for the 90 % evaporated point, is used to prevent incorporation of excessively high boiling components in the fuel that may lead to poor distribution, spark plug fouling, power loss, lowered fuel economy, and lubricating oil dilution.

X1.4.4.6 The stipulation of a minimum recovery and a maximum loss in this specification in conjunction with the vapor pressure requirement is intended to protect against excessive losses by evaporation in storage, handling, and in the aircraft tank. It is also a check on the distillation test technique.

X1.4.4.7 A maximum value is specified for the distillation residue to prevent the inclusion of undesirable high-boiling components essentially impossible to burn in the combustion chamber, the presence of which may reflect the degree of care with which the product is refined or handled. The amount of residue along with the end point temperature can be used as an indication of contamination with high-boiling materials.

X1.5 Corrosion of Fuel System and Engine Parts

X1.5.1 *Copper Strip*—The requirement that gasoline must pass the copper strip corrosion test provides assurance that the product will not corrode the metal parts of fuel systems.

X1.5.2 *Sulfur*—Total sulfur content of aviation fuels is significant because the products of combustion of sulfur can cause corrosive wear of engine parts.

X1.6 Fluidity at Low Temperatures

X1.6.1 A freezing point requirement is specified to preclude solidification of any hydrocarbon components at extremely low temperatures with consequent interference with fuel flow to the engine.

X1.6.2 *Fuel System Icing Inhibitor*—Isopropyl alcohol (IPA), approved in 5.2.2.1, and diethyleneglycol monomethyl ether (Di-EGME), approved in 5.2.2.2, shall be in accordance with the requirements shown in Specification D4171.

X1.7 Fuel Cleanliness, Handling and Storage Stability

X1.7.1 *Potential Gum*—Fuel must be usable after storage for variable periods under a variety of climatic conditions. The potential gum test, which is an accelerated oxidation method, is used to estimate fuel stability in storage and the effectiveness of oxidation inhibitors. If the fuel is to be stored under relatively mild conditions for short periods, an oxidation period of 5 h is generally considered sufficient to indicate if the desired stability has been obtained, whereas a 16-h period is desirable to provide stability assurance for long periods and severe conditions, such as storage in tropical climates.

X1.7.2 *Permissible Oxidation Inhibitors and Oxidation Inhibitor Content*—Antioxidants are used to prevent the formation of gum in fuel during storage. The efficacy of a given inhibitor determined by the apparent oxidation stability of a fuel does not completely establish its suitability for use in an aircraft engine. Oxidation inhibitors have been found to contribute to excessive induction system deposits; therefore, their acceptability for use must ultimately be determined in the full-scale aircraft engine.

X1.7.2.1 The chemical names of approved inhibitors and the maximum quantities permitted are shown in this specification.

X1.7.3 *Water Reaction*—The water reaction method provides a means of determining the presence of materials readily extractable by water or having a tendency to absorb water. When the fuel consists essentially of hydrocarbon components, there is no measurable change in the volume of the water layer.

X1.7.4 *Electrical Conductivity*—The generation of static electricity can create problems in the handling of unleaded aviation gasolines. Addition of a conductivity improver may be used as an additional precaution to reduce the amount of static electrical charge present during fuel handling. See Guide D4865 for more information.

X1.7.5 *Microbial Contamination*—Uncontrolled microbial contamination in fuel systems may cause or contribute to a variety of problems including corrosion, odor, filter plugging, decreased stability, and deterioration of fuel/water separation characteristics. In addition to system component damage, off-specification fuel can result.

X1.7.6 Guide D6469 provides personnel with limited microbiological background an understanding of the symptoms, occurrence, and consequences of chronic microbial contamination. The guide also suggests means for detection and control. No biocides are approved for unleaded aviation gasoline, therefore engine and airframe manufacturers' guidelines must be followed if they are to be used.

X1.8 Miscellaneous Tests

X1.8.1 *Aromatics Content*—Low boiling aromatics, which are common constituents of unleaded aviation gasolines, are known to affect elastomers to a greater extent than other components in unleaded aviation gasoline. Although Specification D7592 does not include an explicit maximum aromatic limit, other specification limits effectively restrict the aromatic content of unleaded aviation gasolines. Benzene is virtually excluded by the maximum freezing point of –58 °C, while other aromatics are limited by the minimum heating value and the maximum distillation end point. Thus, the heating value limits toluene to about 24 %. Xylenes have a slightly higher heating value and, therefore, would permit somewhat higher aromatic concentrations; however, their boiling points (above 138 °C) limit their inclusion at levels not higher than 10 %. Total aromatic levels above 25 % in unleaded aviation gasoline are, therefore, extremely unlikely.

X1.9 General

X1.9.1 Further detailed information on the significance of all test methods relevant to unleaded aviation gasoline is provided in MNL 1.[8]

[8] MNL 1, *Manual on Significance of Tests for Petroleum Products*, ASTM International, W. Conshohocken, PA.

SUMMARY OF CHANGES

Subcommittee D02.J0.02 has identified the location of selected changes to this standard since the last issue (D7592 – 15) that may impact the use of this standard. (Approved Oct. 1, 2015.)

(1) Revised Final Boiling Point in Table 1 (to 170).

Subcommittee D02.J0.02 has identified the location of selected changes to this standard since the last issue (D7592 – 14) that may impact the use of this standard. (Approved June 1, 2015.)

(1) Revised Final Boiling Point in Table 1 (to 190).

Subcommittee D02.J0.02 has identified the location of selected changes to this standard since the last issue (D7592 – 10) that may impact the use of this standard. (Approved May 1, 2014.)

(1) Removed Test Method D5190 from Section 2, subsection 10.1, and Table 1.