



Designation: D5798 – 21

Standard Specification for Ethanol Fuel Blends for Flexible-Fuel Automotive Spark-Ignition Engines¹

This standard is issued under the fixed designation D5798; 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 reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification covers the requirements for automotive fuel blends of ethanol and gasoline for use in ground vehicles equipped with ethanol fuel blend flexible-fuel spark-ignition engines. Fuel produced to this specification contains 51 % to 83 % by volume ethanol. This fuel is for use in flexible-fuel vehicles and is sometimes referred to at retail as “Ethanol Flex-Fuel.” [Appendix X1](#) discusses the significance of the properties specified.

1.2 The vapor pressure of ethanol fuel blends is varied for seasonal climatic changes. Vapor pressure is increased at lower temperatures to ensure adequate flexible-fuel vehicle operability. Ethanol content and selection of hydrocarbon blendstock are adjusted by the blender to meet these vapor pressure requirements.

1.3 This specification formerly covered Fuel Ethanol (Ed70-Ed85) for Automotive Spark-Ignition Engines, also known commercially as E85. The nomenclature “fuel ethanol” has been changed to “ethanol fuel blends” to distinguish this product from denatured fuel ethanol Specification [D4806](#). To facilitate blending of ethanol fuel blends that meet seasonal vapor pressure requirements, a new lower minimum ethanol content has been established.

1.4 The United States government has established various programs for alternative fuels. Many of the definitions of alternative fuel used by these programs may be more restrictive than the requirements of this specification. See [4.1.2.1](#) for additional information on alternative fuels containing ethanol.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.6 The following safety hazard caveat pertains only to the test method portion, [8.1.8](#), of this specification. *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.

1.7 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 Recommendations 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
- [D381](#) Test Method for Gum Content in Fuels by Jet Evaporation
- [D525](#) Test Method for Oxidation Stability of Gasoline (Induction Period Method)
- [D1613](#) Test Method for Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products
- [D1688](#) Test Methods for Copper in Water
- [D3231](#) Test Method for Phosphorus in Gasoline
- [D4057](#) Practice for Manual Sampling of Petroleum and Petroleum Products
- [D4175](#) Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants
- [D4177](#) Practice for Automatic Sampling of Petroleum and Petroleum Products
- [D4306](#) Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination

¹ This specification is under the jurisdiction of ASTM Committee [D02](#) on Petroleum Products, Liquid Fuels, and Lubricants and is under the direct responsibility of Subcommittee [D02.A0.02](#) on Oxygenated Fuels and Components.

Current edition approved Oct. 1, 2021. Published October 2021. Originally approved in 1996. Last previous edition approved in 2020 as D5798 – 20. DOI: 10.1520/D5798-21.

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.

*A Summary of Changes section appears at the end of this standard

- D4806** Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel
- D4814** Specification for Automotive Spark-Ignition Engine Fuel
- D4953** Test Method for Vapor Pressure of Gasoline and Gasoline-Oxygenate Blends (Dry Method)
- 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
- D5501** Test Method for Determination of Ethanol and Methanol Content in Fuels Containing Greater than 20 % Ethanol by Gas Chromatography
- D5854** Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products
- D6423** Test Method for Determination of pH_e of Denatured Fuel Ethanol and Ethanol Fuel Blends
- D7039** Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry
- D7319** Test Method for Determination of Existent and Potential Sulfate and Inorganic Chloride in Fuel Ethanol and Butanol by Direct Injection Suppressed Ion Chromatography
- D7328** Test Method for Determination of Existent and Potential Inorganic Sulfate and Total Inorganic Chloride in Fuel Ethanol by Ion Chromatography Using Aqueous Sample Injection
- D7667** Test Method for Determination of Corrosiveness to Silver by Automotive Spark-Ignition Engine Fuel—Thin Silver Strip Method
- D7671** Test Method for Corrosiveness to Silver by Automotive Spark-Ignition Engine Fuel—Silver Strip Method
- D7757** Test Method for Silicon in Gasoline and Related Products by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry
- D7795** Test Method for Acidity in Ethanol and Ethanol Blends by Titration
- D7923** Test Method for Water in Ethanol and Hydrocarbon Blends by Karl Fischer Titration
- E203** Test Method for Water Using Volumetric Karl Fischer Titration
- E1064** Test Method for Water in Organic Liquids by Coulometric Karl Fischer Titration

2.2 Government Standards:³

United States Code of Federal Regulations, Title 40, Part 1090

2.3 SAE Papers:⁴

SAE 2007–01–4006 A Model for Estimating Vapor Pressures of Commingled Ethanol Fuels

3. Terminology

3.1 For general terminology, refer to Terminology **D4175**.

3.2 Definitions:

3.2.1 *denaturants*, *n*—materials added to ethanol to make it unsuitable for beverage use under a formula approved by a regulatory agency to prevent the imposition of beverage alcohol tax.

3.2.1.1 *Discussion*—Denaturants are only those materials added by the denaturer to comply with the approved formula; any materials absorbed later are not denaturants. **D4806**

3.2.2 *denatured fuel ethanol*, *n*—fuel ethanol made unfit for beverage use by the addition of denaturants under formula(s) approved by the applicable regulatory agency to prevent the imposition of beverage alcohol tax. **D4806**

3.2.3 *ethanol*, *n*—ethyl alcohol, the chemical compound $\text{CH}_3\text{CH}_2\text{OH}$. **D4806**

3.2.4 *finished fuel*, *n*—a homogeneous mixture of blendstocks and fuel additives meeting all specification and regulatory requirements for its intended use at the location where sold. **D4814**

3.2.5 *flexible-fuel vehicle*, *n*—a vehicle designed to operate on both gasoline and ethanol fuel blends and can operate on any mixture of both.

3.2.5.1 *Discussion*—In the United States, these vehicles have U.S. EPA emissions certifications using gasoline complying with U.S. EPA requirements and ethanol fuel blends that meet the requirements of Specification D5798.

3.2.5.2 *Discussion*—Flex-fuel vehicle and FFV are commonly used synonyms for flexible-fuel vehicle.

3.2.5.3 *Discussion*—The fuels may also contain antioxidants, corrosion inhibitors, metal deactivators, and dyes but do not contain lead additives. A jurisdiction may set limits on lead content from all sources.

3.2.6 *gasoline*, *n*—a volatile mixture of liquid hydrocarbons, generally containing small amounts of additives, suitable for use as a fuel in spark-ignition, internal combustion engines. **D4814**

3.2.7 *hydrocarbon*, *n*—a compound composed solely of hydrogen and carbon.

3.2.8 *methanol*, *n*—methyl alcohol, the chemical compound CH_3OH .

3.2.9 *pH_e*, *n*—a measure of hydrogen ion activity, defined by Test Method **D6423**. **D6423**

3.2.9.1 *Discussion*—The traditional pH measurement of hydrogen ion activity is in an aqueous system but the measurement done in Test Method **D6423** is in a nearly anhydrous environment. **D6423**

3.3 Definitions of Terms Specific to This Standard:

³ A printed copy of the Code of Federal Regulations may be purchased from the U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol Street, N.W., Mail Stop: SDE, Washington, DC 20401 or the online store at <http://bookstore.gpo.gov/>. The Code of Federal Regulations may be browsed online at <http://www.gpoaccess.gov/cfr/index.html>.

⁴ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.