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An American National Standard

Standard Specification for Fuel Ethanol (Ed75-Ed85) for Automotive Spark-Ignition Engines[1]

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1. Scope

1.1 This specification covers a fuel blend, nominally 75 to 85 volume % denatured fuel ethanol and 25 to 15 additional volume % hydrocarbons for use in ground vehicles with automotive spark-ignition engines. Appendix X1 discusses the significance of the properties specified.

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

1.3 The following precautionary caveat pertains only to the test method portion, Annex A1 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents [2]

2.1 *ASTM Standards:*

D 86 Test Method for Distillation of Petroleum Products[3]

D 130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test[3]

D 381 Test Method for Existent Gum in Fuels by Jet Evaporation[3]

D 512 Test Methods for Chloride Ion in Water[4]

D 525 Test Method for Oxidation Stability of Gasoline (Induction Period Method)[3]

D 1266 Test Method for Sulfur in Petroleum Products (Lamp Method)[3]

D 1613 Test Method for Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products[5]

D 1688 Test Methods for Copper in Water[4]

D 2622 Test Method for Sulfur in Petroleum Products by X-Ray Spectrometry Method[3]

D 2988 Test Method for Water-Soluble Halide Ion in Halogenated Organic Solvents and Their Admixtures[6]

D 3120 Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry[3]

D 3231 Test Method for Phosphorus in Gasoline[7]

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products[7]

D 4806 Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel[7]

D 4814 Specification for Automotive Spark-Ignition Engine Fuel[7]

D 4815 Test Method for Determination of MTBE, ETBE, TAME, DIPE, *tertiary*-Amyl Alcohol and C_1 to C_4 Alcohols in Gasoline by Gas Chromatography[7]

D 4929 Test Methods for Determination of Organic Chloride Content in Crude Oil[7]

D 4953 Test Method for Vapor Pressure of Gasoline and Gasoline-Oxygenate Blends (Dry Method)[7]

D 5059 Test Method for Lead in Gasoline by X-ray Spectroscopy[7]

D 5190 Test Method for Vapor Pressure of Petroleum Products (Automatic Method)[7]

D 5191 Test Method for Vapor Pressure of Petroleum Products (Mini Method)[7]

D 5453 Test Method for the Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence[8]

D 5501 Test Method for the Determination of Ethanol Content of Denatured Fuel Ethanol by Gas Chromatography[8]

D 6423 Test method for Determination of pH_e of Ethanol, Denatured Fuel Ethanol, and Fuel Ethanol (Ed75–Ed85)[9]

E 203 Test Method for Water Using Karl Fischer Titration[6]

E 1064 Test Method for Water in Organic Liquids by

[1] This specification is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is under the direct responsibility of Subcommittee D02.A on Gasoline and Oxygenated Fuels.

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[2] Reference to the following documents is to be the latest issue unless otherwise specified.

[3] *Annual Book of ASTM Standards*, Vol 05.01.

[4] *Annual Book of ASTM Standards*, Vol 11.01.

[5] *Annual Book of ASTM Standards*, Vol 06.04.

[6] *Annual Book of ASTM Standards*, Vol 15.05.

[7] *Annual Book of ASTM Standards*, Vol 05.02.

[8] *Annual Book of ASTM Standards*, Vol 05.03.

[9] *Annual Book of ASTM Standards*, Vol 05.04.

Coulometric Karl Fischer Titration[6]

3. Terminology

3.1 *Definitions:*

3.1.1 *ethanol*, *n*—ethyl alcohol, the chemical compound C_2H_5OH.

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *aliphatic ether*—an oxygen-containing, ashless, organic compound in which the oxygen atom is interposed between two carbon atoms (organic groups), has the general formula $C_nH_{2n+2}O$ with *n* being 5 to 8, and in which the carbon atoms are connected in open chains and not closed rings.

3.2.1.1 *Discussion*—Aliphatic compounds can be straight or branched chains and saturated or unsaturated. The term aliphatic ether, as used in this specification, refers only to the saturated compounds.

3.2.2 *denaturants*—natural gasoline, gasoline components, unleaded gasoline, or toxic or noxious materials added to fuel ethanol to make it unsuitable for beverage use but not unsuitable for automotive use.

3.2.3 *denatured fuel ethanol*—fuel ethanol made unfit for beverage use by the addition of denaturants.

3.2.4 *fuel ethanol*—ethanol with impurities common to its production (including water but excluding denaturants).

3.2.5 *fuel ethanol (Ed75-Ed85)*—blend of ethanol and hydrocarbon of which the ethanol portion is nominally 70 to 85 volume % denatured fuel ethanol.

3.2.6 *higher alcohols*—aliphatic alcohols of general formula $C_nH_{2n+1}OH$ with N being 3 to 8.

3.2.7 *hydrocarbon*—those components in an ethanol-hydrocarbon blend containing only hydrogen and carbon.

3.2.8 pH_e—a measure of the acid strength of alcohol fuels.

4. Fuel Ethanol (Ed75-Ed85) Performance Requirements

4.1 Fuel ethanol (Ed75-Ed85) shall conform to the requirements of Table 1.

NOTE 1—Most of the requirements cited are based on the best technical information currently available. Requirements for sulfur, phosphorus, and lead are based on the use of gasoline defined in Specification D 4814 and the understanding that control of these elements will affect catalyst lifetime. The lead maximum is limited for Class 1 and Class 2 fuels to the lower limit of the test method. As greater experience is gained from field use of Ed75-Ed85 vehicles and further vehicle hardware developments for the use of ethanol content fuels occurs, it is expected that many of these requirements will change.

TABLE 1 Requirements for Fuel Ethanol (Ed75-Ed85)

Properties	Class 1[A]	Class 2	Class 3
Ethanol + higher alcohols, min, volume %	79	74	70
Hydrocarbon/aliphatic ether, volume %	17–21	17–26	17–30
Vapor pressure, kPa	38–59	48–65	66–83
(psi)	5.5–8.5	7.0–9.5	9.5–12.0
Lead, max, mg/L	2.6	2.6	3.9
Phosphorus, max, mg/L	0.2	0.3	0.4
Sulfur, max, mg/kg	210	260	300
		All Classes	
Methanol, volume %, max		0.5	
Higher alcohols (C_3–C_8), max, volume %		2	
Acidity, (as acetic acid CH3COOH), mass % (mg/L), max		0.005 (40)	
Solvent-washed gum content, max, mg/100 mL		5	
pH_e		6.5 to 9.0	
Unwashed gum content, max, mg/100 mL		20	
Total chlorine as chlorides, max, mg/kg		2	
Inorganic chloride, max, mg/kg		1	
Copper, max, mg/L		0.07	
Water, max, mass %		1.0	
Appearance	This product shall be visibly free of suspended or precipitated contaminants (clear and bright). This shall be determined at ambient temperature or 21°C (70°F), whichever is higher.		

[A] See 4.1.1 for volatility class criteria.

4.1.1 Vapor pressure is varied for seasonal and climatic changes by providing three vapor pressure classes for fuel ethanol (Ed75-Ed85). The seasonal and geographical distribution for three vapor pressure classes is shown in Table 2. Class 1 encompasses geographical areas with 6-h tenth percentile minimum ambient temperature of greater than 5°C (41°F). Class 2 encompasses geographical areas with 6-h tenth percentile minimum ambient temperature of greater than −5°C (23°F) but less than +5°C (41°F). Class 3 encompasses geographical areas with 6-h tenth percentile minimum ambient temperature less than or equal to −5°C (23°F).

TABLE 2 Seasonal and Geographical Volatility Specifications for Fuel Ethanol (Ed75-Ed85)

NOTE 1—This schedule, subject to agreement between the purchaser and the seller, denotes the vapor pressure class of the fuel at the time and place of bulk delivery to fuel-dispensing facilities for the end user. Shipments should anticipate this schedule.

State	Jan	Feb	March	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Alabama	2	2	2	2	2/1	1	1	1	1	1/2	2	2
Alaska												
Southern Region	3	3	3	3	3/2	2/1	1	1/2	2/3	3	3	3
South Mainland	3	3	3	3	3/2	2/1	1/2	2	2/3	3	3	3
Arizona												
N of 34° Latitude	3	3	3	3/2	2	2/1	1	1	1/2	2/3	3	3
S of 34° Latitude	2	2	2	2/1	1	1	1	1	1	1/2	2	2
Arkansas	3	3	3/2	2/1	1	1	1	1	1/2	2	2/3	3
California[A]												
North Coast	2	2	2	2	2	2/1	1	1	1	1/2	2	2
South Coast	3/2	2	2	2	2/1	1	1	1	1	1/2	2/3	3