



Standard Specification for Denatured Ethanol for Use as Cooking and Appliance Fuel¹

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1. Scope

1.1 This specification covers denatured ethanol intended to be used as a cooking or appliance fuel, or both.

1.2 Nothing in this specification shall preclude observance of federal, state, or local regulations.

1.2.1 Denatured ethanol has many regulatory limitations that cover the production, trading, transporting, distributing, wholesale and retail sale, and use of denatured ethanol; this specification does not purport to address the regulatory compliance aspects of these activities.

1.3 The addition of a denatonium benzoate is required in addition to any other denaturants that are added.

1.3.1 The denatonium benzoate is added as an additional deterrent to consumption. The denatonium benzoate must be added in an amount that meets the minimum and maximum requirements listed in [Table 1](#).

1.4 The addition of a colored dye is also required. The colored dye must be added in a concentration sufficient to enable the visual detection of the color in the fuel but in an amount less than the maximum listed in [Table 1](#).

1.4.1 The colored dye is added to visually indicate that the product is not potable.

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

1.6 *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

2.1 ASTM Standards:²

¹ This specification is under the jurisdiction of ASTM Committee E48 on Bioenergy and Industrial Chemicals from Biomass and is the direct responsibility of Subcommittee E48.05 on Biomass Conversion.

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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.

- D381 Test Method for Gum Content in Fuels by Jet Evaporation
- D4057 Practice for Manual Sampling of Petroleum and Petroleum Products
- D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products
- D4306 Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination
- D4815 Test Method for Determination of MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol and C₁ to C₄ Alcohols in Gasoline by Gas Chromatography
- D5854 Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products
- D5501 Test Method for Determination of Ethanol and Methanol Content in Fuels Containing Greater than 20% Ethanol by Gas Chromatography
- D7795 Test Method for Acidity in Ethanol and Ethanol Blends by Titration
- E203 Test Method for Water Using Volumetric Karl Fischer Titration
- E300 Practice for Sampling Industrial Chemicals
- E1064 Test Method for Water in Organic Liquids by Coulometric Karl Fischer Titration

3. Terminology

3.1 Definitions:

3.1.1 *denatured ethanol, n*—ethanol made unfit for beverage use by the addition of toxic or noxious materials.

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

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

4. Fuel Specifications

4.1 Denatured Ethanol for use as cooking and appliance fuel shall conform to the specifications in [Table 1](#).

5. Workmanship

5.1 The product described by this specification shall be visually free of sediment and suspended matter.

5.2 The product described by this specification shall be free of any adulterant or contaminant that can render the material unacceptable for its commonly used applications.

TABLE 1 Denatured Ethanol Cooking and Appliance Fuel Specifications

Property	Units	Limit	Min/Max	Test Method
Ethanol	volume %	90	Min	D5501
Water	volume %	10	Max	E203 or E1064
Higher Alcohols (C ₃ –C ₆)	volume %	2	Max	D4815
Hydrocarbon ^A	volume %	1	Max	Documented Addition
Acidity (as acetic acid)	mg/Kg	40	Max	D7795
Denatonium Benzoate	mg/Kg	10–20	Min–Max	Documented Addition
Colored Dye	mg/Kg	10	Max	Documented Addition

^A The hydrocarbons approved for use under this specification are as follows: gasoline, unleaded gasoline, natural gasoline, heptane, or rubber hydrocarbon solvent.

5.3 Additives beyond the denaturants and colorants are discouraged. Higher molecular weight additives can create issues with combustion or lead to deposits on the fuel canisters at the point of combustion, or both. Monitoring the fuel using Test Method D381 for unwashed gum content is one way to determine if additives other than denaturants and colorants are being added. Such monitoring can provide an early indication of contamination by materials not intended for use in home cooking fuel when unwashed gum values increase beyond the normal range of values established from trends.

5.4 Care should be taken when selecting and adding the colorant. Not all colorants are soluble in ethanol. A prototype sample should be prepared first and the colorant added to test solubility before adding any colorant to the bulk fuel.

6. Sampling, Containers, and Sample Handling

6.1 The user is strongly advised to review all intended test methods prior to sampling to understand the importance and effects of sampling technique, proper containers, and special handling required for each test method.

6.2 Correct sampling procedures are critical to obtain a sample representative of the lot intended to be tested. Use

appropriate procedures in Practice D4057 or Practice E300 for manual method sampling and in Practice D4177 for automatic method sampling, as applicable.

6.3 The correct sample volume and appropriate container selection are important decisions that can impact test results. Refer to Practice D4306 for aviation fuel container selection for tests sensitive to trace contamination. Refer to Practice D5854 for procedures on container selection and sample mixing and handling. All sampling and storage containers should be evaluated for durability, compatibility, and contamination of cooking and appliance fuel prior to use. If samples must be collected in metal containers, do not use soldered metal containers. Soldering flux in the containers and the lead in the solder can contaminate the sample.

6.4 *Sample Size*—A minimum of about 1 L is recommended.

6.5 *Lot Size*—A lot shall normally consist of the amount contained in a tanker compartment or other bulk container in which it is delivered. If this definition does not apply, the definition of a lot must be agreed upon between the supplier and purchaser.

7. Test Methods

7.1 Determine the requirements enumerated in this specification in accordance with the following test methods:

7.1.1 *Ethanol*—Test Method D5501.

7.1.2 *Water*—Test Methods E203 or E1064.

7.1.3 *Higher Alcohols*—Test Method D4815 or other suitable gas chromatography method.

7.1.4 *Acidity*—Test Method D7795.

7.1.5 *Solvent-Washed Gum Content*—Test Method D381, air jet apparatus.

7.1.6 *Documented Addition*—The process of providing written documentation on the specific amount of a substance added.

8. Keywords

8.1 appliance fuel; cooking fuel; denatured ethanol; ethanol; fuel; stove fuel

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