Designation: E3050 – 22

Standard Specification for Denatured Ethanol for Use as Cooking and Appliance Fuel[1]

This standard is issued under the fixed designation E3050; 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.

1. Scope

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

1.1.1 This product is intentionally denatured as an additional deterrent to consumption and to avoid beverage alcohol use.

1.1.2 This specification allows for various denaturants to be used for the intended purpose of cooking or appliance fuel. Jurisdictions may vary in their regulatory requirement for the allowable or prohibited types of denaturants, chemical composition of the denaturant or concentration of denaturant needed to denature the ethanol.

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

1.3 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.

1.4 The application and intent of this product is for household cooking fuel and not for on-road motor fuel use (see D4806).

1.5 *Units*—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, 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

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

D4806 Specification for Denatured Fuel Ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel

D4815 Test Method for Determination of MTBE, ETBE, TAME, DIPE, tertiary-Amyl Alcohol and C_1 to C_4 Alcohols in Gasoline by Gas Chromatography

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

D7345 Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure (Micro Distillation Method)

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

E300 Practice for Sampling Industrial Chemicals

[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.A0 on Product Specifications.

Current edition approved Sept. 15, 2022. Published September 2022. Originally approved in 2016. Last previous edition approved in 2021 as E3050 – 21. DOI: 10.1520/E3050-22.

[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.

E1064 Test Method for Water in Organic Liquids by Coulometric Karl Fischer Titration

2.2 *CGSB Standard:*[3]

CAN/CGSB 3.516 Denatured Fuel Ethanol for use in Automotive Spark-ignition Fuels

3. Terminology

3.1 *Definitions:*

3.1.1 *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.

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

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

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

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

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

4. Fuel Specifications

4.1 Denatured ethanol for use as cooking and appliance fuel shall conform to the specifications in Table 1.

4.2 *Discussion on Denaturant and Colored Dye—*

4.2.1 While a denaturant and a colored dye can be used to indicate a tax liability status, the two products are not identical functionally. A denaturant may or may not add color to ethanol while rendering the ethanol unpotable. A colored dye intentionally adds color for a visual indication.

4.2.2 There may be denaturing requirements to avoid liquor tax liability. In this case, the denaturant concentration must conform to Table 2.[4]

4.2.3 The denaturant is added as deterrent to consumption. The denatonium benzoate addition is recommended in an amount that meets the minimum and maximum requirements listed in Table 2.

4.2.4 The addition of a colored dye is also recommended. The colored dye must be added in a concentration sufficient to enable the visual detection of the color in the fuel but should not render the fuel non-translucent.

4.2.5 The colored dye can be added to visually indicate that the product is not potable.

4.2.6 Small amounts of the same or similar hydrocarbons absorbed by the denatured fuel ethanol as it moves through the distribution system is not denaturant.

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.

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

[3] Available from Canadian General Standards Board (CGSB), 11 Laurier St., Phase III, Place du Portage, Gatineau, Quebec K1A 0S5, Canada, http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb.

[4] U.S. Department of the Treasury, Alcohol Tobacco Tax and Trade Bureau, Title 27 Alcohol, Tobacco Products and Firearms. Part 21 Formulas for Denatured Alcohol and Rum.

TABLE 1 Denatured Ethanol Cooking and Appliance Fuel Specifications

Property	Units	Grade A Limit	Grade B Limit	Min/Max	Test Method
Ethanol	volume %	90	90	Min	D5501
Water	volume %	10	10	Max	E203, E1064, or D7923
Higher Alcohols (C_3–C_8)	volume %	2	0.6	Max	D4815
Final Boiling Point, Maximum	ºC, (ºF)	225, (437)	225, (437)	Max	D86, D7345
Acidity (as acetic acid)	mg/Kg	40	40	Max	D7795
Denaturant	Volume %	Report	Report		Document addition must conform toTable 2
Colored Dye[A]	Visual	Report	Report		Document Addition

[A] See 4.2.3: Denaturant Addition