



Designation: D7862 – 15a

# Standard Specification for Butanol for Blending with Gasoline for Use as Automotive Spark-Ignition Engine Fuel<sup>1</sup>

This standard is issued under the fixed designation D7862; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers butanol intended to be blended with gasoline at 1 % to 12.5 % by volume for use as an automotive spark-ignition engine fuel.

1.1.1 Butanol contains 22 % by mass oxygen. The mass percent of oxygen of a butanol blend with gasoline depends on the volume percent of butanol blended, the density of the butanol isomer, and the density of the base blendstock.

1.1.2 The maximum limit on blending is not a performance limit but a current regulatory limit in the United States.

1.2 This specification covers three butanol isomers: 1-butanol, 2-butanol, and 2-methyl-1-propanol. This specification specifically excludes 2-methyl-2-propanol (that is, *tert*-butyl alcohol).

1.2.1 *Tert*-butyl alcohol has different physical properties (melting point, water miscibility) than the other three isomers.

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

1.4 *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:*<sup>2</sup>

D381 Test Method for Gum Content in Fuels by Jet Evaporation

D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

D1613 Test Method for Acidity in Volatile Solvents and Chemical Intermediates Used in Paint, Varnish, Lacquer, and Related Products

D2622 Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry

D3120 Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry

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

D4175 Terminology Relating to Petroleum, Petroleum Products, 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

D4814 Specification for Automotive Spark-Ignition Engine Fuel

D5453 Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence

D5854 Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products

D6299 Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance

D7319 Test Method for Determination of Existent and Potential Sulfate and Inorganic Chloride in Fuel Ethanol and Butanol by Direct Injection Suppressed Ion Chromatography

D7875 Test Method for Determination of Butanol and Acetone Content of Butanol for Blending with Gasoline by Gas Chromatography

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

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

<sup>1</sup> 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.A0 on Gasoline and Oxygenated Fuels.

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<sup>2</sup> 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

### 3. Terminology

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

NOTE 1—The user is advised that the definitions used by various industries, marketers, and regulatory bodies can differ from those specific to this specification. It is the responsibility of the user to ensure that the terms used in a particular context are clearly understood.

#### 3.2 Definitions:

3.2.1 *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**

3.2.2 *oxygenate, n*—an oxygen-containing, ashless, organic compound, such as an alcohol or ether, which may be used as a fuel or fuel supplement. **D4814**

#### 3.3 Definitions of Terms Specific to This Standard:

3.3.1 *butanol, n*—butanol or butyl alcohol refers to 1-butanol, 2-butanol, and 2-methyl 1-propanol, three isomeric alcohols with the molecular formula  $C_4H_9OH$ , either individually or as mixtures.

### 4. Performance Requirements

4.1 *Butanol*—Butanol shall conform to the requirements shown in **Table 1** at the time of blending with a gasoline. (See **Note 2**.)

NOTE 2—Commercial processes used to manufacture butanol from biological feedstock typically yield some fusel oil or alcohols such as pentanol and other higher alcohols.

4.1.1 For purposes of determining conformance with these specification limits, an observed value or a calculated value shall be rounded “to the nearest unit” in the right-most significant digit used in expressing the specification limit, in accordance with the rounding method of Practice **E29**. For a specification limit expressed as an integer, a trailing zero is significant only if the decimal point is specified. For a specified limit expressed as an integer, and the right-most digit is non-zero, the right-most digit is significant without a decimal point being specified. This convention applies to specified limits in **Table 1** and will not be observed in the remainder of this specification.

4.2 *Other Properties*—Limits more restrictive than those specified above, or the specification of additional properties such as color, may be agreed upon between the supplier and the purchaser.

### 5. Workmanship

5.1 At the point of custody transfer, the butanol shall be visually free of sediment, suspended and undissolved matter. It shall be clear and bright at the fuel temperature at the point of custody transfer or at a lower temperature agreed upon by the purchaser and seller.

NOTE 3—Fuel components should be resistant to phase separation or undissolved matter at the lowest temperatures to which it is likely to be subjected, dependent on the time and place of its intended use. See Specification **D4814**, Table X7.1 for guidance.

NOTE 4—Solubility is temperature dependent. As this fuel component cools, water and some high molecular weight additives can become insoluble.

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

5.2.1 Manufacturers and importers of butanol shall avoid butanol contaminated by silicon-containing materials. Silicon contamination of gasoline-oxygenate blends has led to fouled vehicle components (for example, spark plugs, exhaust oxygen sensors, catalytic converters) requiring parts replacement and repairs.

5.2.2 Manufacturers and importers of butanol shall avoid butanol contaminated by acetone. Acetone contamination of gasoline-oxygenate blends can degrade elastomers used in fuel system components as well as paint and/or clearcoat finishes used on vehicles.

### 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

**TABLE 1 Requirements**

Property	Limit	Method
Butanol, % by volume, min	96.0	<b>D7875</b>
1-butanol, % by volume	Report	<b>D7875</b>
2-butanol, % by volume	Report	<b>D7875</b>
2-methyl 1-propanol, % by volume	Report	<b>D7875</b>
Methanol, % by volume, max	0.4	<b>D7875</b>
Water content, % by volume, max	1.0	<b>E203</b> or <b>E1064</b>
Acidity (as acetic acid $CH_3COOH$ ), % by mass (mg/L), max	0.007 (56)	<b>D1613</b>
Inorganic Chloride, mg/kg (mg/L), max	8 (6)	<b>D7319</b>
Solvent-washed gum, mg/100 mL, max	5.0	<b>D381</b>
Sulfur, mg/kg, max	30.	<b>D2622, D5453</b>
Existent sulfate, mg/kg, max	4.	<b>D7319</b>