



Designation: D7618 – 10

Standard Specification for Ethyl Tertiary-Butyl Ether (ETBE) for Blending with Aviation Spark-Ignition Engine Fuel¹

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1. Scope

1.1 This specification covers requirements for fuel grade ethyl *tertiary*-butyl ether (ETBE) that may be used for blending with fuels for aviation spark-ignition engines where permissible. Other ETBE grades available in the marketplace that do not comply with the requirements of this specification, are not suitable for blending with aviation fuels.

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

1.3 *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

- D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
- D156 Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)
- D381 Test Method for Gum Content in Fuels by Jet Evaporation
- D1298 Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- 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
- D4171 Specification for Fuel System Icing Inhibitors

- D4176 Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)
- D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products
- D5441 Test Method for Analysis of Methyl Tert-Butyl Ether (MTBE) by Gas Chromatography
- D5854 Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products
- 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 *ethanol, n*—chemical compound C_2H_5OH .
- 3.1.2 *methanol, n*—chemical compound CH_3OH .
- 3.1.3 *ethyl tertiary-butyl ether (ETBE), n*—chemical compound $CH_3CH_2OC(CH_3)_3$.
- 3.1.4 *tertiary-butyl alcohol (TBA), n*—chemical compound $(CH_3)_3COH$.
- 3.1.5 *methyl tertiary-butyl ether (MTBE), n*—chemical compound $CH_3OC(CH_3)_3$.
- 3.1.6 *oxygenate, n*—oxygen-containing ashless, organic compound, such as an alcohol or ether, which may be used as a fuel or fuel supplement.

4. Detailed Requirements

4.1 ETBE that may be used for blending with fuels for aviation spark-ignition engines shall conform to the requirements of **Table 1**.

5. Workmanship

5.1 The ETBE shall be visually free of undissolved water, sediment, and suspended matter. It shall be clear and bright at the ambient temperature or 21°C, whichever is lower.

5.2 The specification defines only a basic purity for this product. The product shall be free of any adulterant or contaminant that could render the material unacceptable for the intended application.

¹ This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.J0 on Aviation Fuels.

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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.

TABLE 1 Detailed Requirements

Property	Limits	ASTM Test Method ^A
Ethyl tertiary-butyl ether, mass %, min.	95.0	D5441 ^B
Ethanol, mass %, max.	1.5	D5441 ^B
Methanol, mass%, max.	0.3	D5441 ^B
Tertiary-butyl alcohol, mass%, max.	1.5	D5441 ^B
Methyl tertiary-butyl ether, mass%, max.	2.0	D5441 ^B
C ₂ -C ₄ Oxygenates, ^C mass%, max.	1.5	D5441 ^B
C ₄ -C ₆ Hydrocarbons, ^D mass%, max.	1.5	D5441 ^B
C ₈ -C ₁₀ Hydrocarbons, ^E mass%, max.	2.0	D5441 ^B
Unidentified hydrocarbons, mass%, max.	1.0	D5441 ^B
Water, mass %, max.	0.1	E1064 or E203
Copper strip corrosion, max.	1	D130
Appearance	Clear and bright	D4176
Color, Saybolt, min.	+ 16	D156
Existent gum content, mg/100 mL, max.	5.0	D381
Density at 15°C, kg/L	0.735 to 0.755	D1298 or D4052

^A The test methods indicated in this table are referred to in Section 7.

^B Analysis for impurities in ETBE in accordance with Test Method D5441 require the modifications detailed in Annex A1.

^C Oxygenates, excluding alcohols, of combined concentrations of diethyl and dimethyl ethers, acetone and methyl ethyl ketone.

^D Combined concentrations of isopentane, pentane, and hexane paraffins, and isobutylene olefin.

^E Combined concentrations of C₈ isobutylene dimers mainly derived from the dimerization of C₄-C₅ compounds, and iso-octane.

6. Sampling, Containers, and Sample Handling

6.1 The user is strongly advised to review all intended test methods prior to sampling in order 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 of 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 D5854 for procedures on container selection and sample mixing and handling. Where practical, ETBE should be sampled in glass containers. If samples must be collected in metal containers, do not use soldered metal containers. This is because the soldering flux in the containers and the lead in the solder can contaminate the samples. Plastic containers should be avoided.

6.4 *Sample Size*—A minimum of about 2 L is recommended.

7. Test Methods

7.1 The scopes of some of the test methods specified below do not include ETBE, thus the precision of those test methods when testing ETBE can differ from the reported precisions.

7.2 *ETBE, mass %*—See Annex A1 for modification of Test Method D5441.

7.3 *Ethanol, mass %*—Test Method D5441.

7.4 *Methanol, mass %*—Test Method D5441.

7.5 *Water, mass %*—Test Method E1064 or E203.

7.6 *Copper Strip Corrosion*—Test Method D130, 2 h at 100°C.

7.7 *Appearance*—Test Method D4176, Procedure 1.

7.8 *Color, Saybolt*—Test Method D156.

7.9 *Existent Gum Content*—Test Method D381, air-jet apparatus.

7.10 *Density at 15°C, kg/L*—Test Method D1298 or D4052.

8. Keywords

8.1 aviation spark-ignition engine fuel; blending; corrosion; ETBE; ethanol; ethyl tertiary-butyl ether; impurities; methanol; water content

ANNEX

(Mandatory Information)

A1. MODIFICATION TO TEST METHOD D5441

A1.1 Conduct the analysis for impurities in ETBE in accordance with Test Method D5441, with the following modifications:

A1.1.1 Substitute ETBE for MTBE in all cases where MTBE is referred to as the product sample or as the solvent medium for preparing standards to be used for column evaluation, calibration and standardization.

A1.1.2 *Reagents and Materials*—Substitute the following compounds for those listed as Reference Standards (Paragraph 8.5 of Test Method D5441):

- A1.1.2.1 Methanol.
- A1.1.2.2 Ethanol.
- A1.1.2.3 Isopentane.

- A1.1.2.4 Acetone.
- A1.1.2.5 Pentane.
- A1.1.2.6 Tertiary-butyl alcohol.
- A1.1.2.7 Methyl tertiary-butyl ether.
- A1.1.2.8 Methyl ethyl ketone.
- A1.1.2.9 Hexane.
- A1.1.2.10 2,2,4-trimethyl pentane (iso-octane).
- A1.1.2.11 2,4,4-trimethyl-1-pentene (α -diisobutylene).
- A1.1.2.12 2,4,4-trimethyl-2-pentene (β -diisobutylene).
- A1.1.2.13 Ethyl tertiary-butyl ether.
- A1.1.2.14 Diethyl ether.
- A1.1.2.15 Dimethyl ether.
- A1.1.2.16 Isobutylene.