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An American National Standard

Standard Specification for Methyl Tertiary-Butyl Ether (MTBE) for Downstream Blending for Use in Automotive Spark-Ignition Engine Fuel[1]

This standard is issued under the fixed designation D 5983; 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 requirements for fuel grade methyl *tertiary*-butyl ether utilized in commerce, terminal blending, or downstream blending with fuels for spark-ignition engines. Other MTBE grades may be available for blending that are not covered by this specification.

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

2. Referenced Documents

2.1 *ASTM Standards:*

D 130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test[2]

D 156 Test Method for Saybolt Color of Petroleum Products (Saybolt Chromometer Method)[2]

D 381 Test Method for Gum Content in Fuels by Jet Evaporation[2]

D 1298 Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method[2]

D 4045 Test Method for Sulfur in Petroleum Products by Hydrogenolysis and Rateometric Colorimetry[3]

D 4052 Test Method for Density and Relative Density of Liquids by Digital Density Meter[3]

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products[3]

D 4176 Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)[3]

D 4953 Test Method for Vapor Pressure of Gasoline and Gasoline-Oxygenate Blends (Dry Method)[3]

D 5441 Test Method for Analysis of Methyl tert-Butyl Ether (MTBE) by Gas Chromatography[4]

E 203 Test Method for Water Using Volumetric Karl Fischer Titration[5]

E 300 Practice for Sampling Industrial Chemicals[6]

E 1064 Test Method for Water in Organic Liquids by Coulometric Karl Fischer Titration[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *methanol*, *n*—the chemical compound CH_3OH.

3.1.2 *methyl tertiary-butyl ether (MTBE)*, *n*—the chemical compound $(CH_3)_3COCH_3[C_5H_{12}O]$.

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

4. Performance Requirements

4.1 Methyl *tertiary*-butyl ether utilized in commerce, terminal blending, or downstream blending with fuels for ground vehicles equipped with spark-ignition engines shall conform to the requirements of Table 1.

NOTE 1—Individual applications may require a more restrictive sulfur limit. These requirements are to be negotiated between buyer and seller.

5. Workmanship

5.1 The MTBE shall be visually free of undissolved water, sediment, and suspended matter. It shall be clear and bright at the ambient temperature or 21°C (70°F), whichever is higher.

5.2 The specification defines only a basic purity for this product. The product shall be free of any adulterant or contaminant that may render the material unacceptable for its commonly used applications.

6. Sampling

6.1 Samples may be obtained by an appropriate procedure of Practice D 4057 or Practice E 300. Do not use soldered metal containers although they are specified in 11.3 of Practice E 300, because the soldering flux in the containers may contaminate the sample. Some soldered cans, such as those conforming to the requirements of 7.1 of Practice D 4057 are

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

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

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

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

[6] Discontinued. See 2000 *Annual Book of ASTM Standards*, Vol 15.05.

TABLE 1 Performance Requirements

Property	Limits
Appearance	Clear and bright
Color, Saybolt, min	+ 5
Sulfur, mg/kg, max	300
Solvent-washed gum content, mg/100 mL, max	5.0
Copper strip corrosion, max	1
MTBE, mass %, min	95.0
Methanol, mass% , max	0.5
Vapor pressure, kPa (psi), max	62 (9.0)
Water, mass %, max	0.10
API gravity at 15.6°C (60°F) or density at 15°C, kg/l	Report

acceptable, but because they cannot readily be distinguished from cans which do not meet this specification, the use of metal containers is to be avoided.

6.2 *Sample Size*—A minimum of about 2 L or 2 U.S. quarts is recommended.

6.3 *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 The scope of some of the test methods specified below do not include MTBE. The precision of those test methods may differ from the reported precisions when testing MTBE.

7.2 *Appearance*—Test Method D 4176, Procedure 1.

7.3 *Sulfur*—Test Method D 4045 (see Note 2).

7.4 *Solvent-Washed Gum Content*—Test Method D 381, air-jet apparatus.

7.5 *MTBE*, mass %—Test Method D 5441.

7.6 *Methanol*, mass %—Test Method D 5441.

7.7 *API Gravity at 15.6°C (60°F)*—Practice D 1298.

7.8 *Density at 15°C*—Practice D 1298 or Test Method D 4052.

7.9 *Copper Strip Corrosion*—Test Method D 130, 3 h at 50°C (122°F).

7.10 *Water Content*—Test Methods E 203 or E 1064.

7.11 *Vapor Pressure*—Test Method D 4953.

7.12 *Color, Saybolt*—Test Method D 156.

NOTE 2—Test Method D 4045 may require dilution of the sample with a sulfur-free diluent.

8. Keywords

8.1 automotive spark-ignition engine fuel; blending; corrosion; impurities; methanol; methyl *tertiary*-butyl ether; oxygenate; water content

APPENDIX

(Nonmandatory Information)

X1. SIGNIFICANCE OF ASTM SPECIFICATION FOR MTBE FOR DOWNSTREAM BLENDING FOR USE IN AUTOMOTIVE SPARK-IGNITION ENGINE FUEL

X1.1 General

X1.1.1 Methyl *tertiary*-butyl ether may be used as a blending component for automotive spark-ignition engine fuel to meet the oxygenate content requirements or improve the antiknock quality, or both, of certain types of fuels. MTBE purchased under this specification will assist terminal or downstream blenders in the use of MTBE as a blending component.

X1.1.2 The composition of unleaded fuel is subject to the rules, regulations, and Clean Air Act waivers of the U.S. Environmental Protection Agency (EPA). The use of oxygenates in blends with unleaded gasoline is described under Section 211(f) (1) of the Clean Air Act. The performance requirements of this specification were established to help ensure that the addition (in appropriate amounts) of MTBE as described in this specification would not be detrimental to the properties of the fuel blend.

X1.2 Appearance

X1.2.1 Methyl *tertiary*-butyl ether as covered by this specification is a relatively pure material. Suspended materials, sediments, or contaminants in the MTBE which cause a cloudy or colored appearance may adversely affect the performance of the finished fuel blend in automotive spark-ignition engines. Also, a cloudy or colored appearance may indicate excessive water or contamination by materials not directly measured under this specification.

X1.3 Sulfur

X1.3.1 Sulfur and sulfur-containing compounds contribute to engine wear, deterioration of engine oil, exhaust catalyst deactivation, and corrosion of exhaust system parts in spark-ignition engine systems. The limit on sulfur is included to ensure that the finished blend of fuel is not detrimental to these systems.

X1.4 Solvent-Washed Gum Content

X1.4.1 The test for solvent-washed gum content measures the amount of residue after evaporation of the fuel component and following a heptane wash. The heptane wash removes the heptane-soluble, nonvolatile material such as additives, carrier oils used with additives, and diesel fuels. Solvent-washed gum consists of fuel-insoluble gum and fuel-soluble gum. The fuel-insoluble portion can clog fuel filters. Both can be

deposited on surfaces when the fuel evaporates. The solvent-washed gum content test may also indicate contamination of the methyl *tertiary*-butyl ether during shipping and storage. The limit is included to ensure that finished blends of gasoline do not contain excess solvent-washed gum and handling contamination is minimized.

X1.4.2 Solvent-washed gum can contribute to deposits on the surfaces of carburetors, fuel injectors, and intake manifolds, ports, valves, and valve guides. The impact of solvent-washed gum on malfunctions of modern engines is not well established, and the current limit has been assumed from the historic gasoline limit rather than from any recent correlative work. It depends on where the deposits form, the presence of other deposit precursors such as airborne debris, blowby and exhaust gas, recirculation gases, and oxidized engine oil, and the amount of deposits.

X1.4.3 Because the precision statements for Test Method D 381 were developed using only data on hydrocarbons, they may not be applicable to MTBE.

X1.5 Copper Strip Corrosion

X1.5.1 Fuels must pass the copper strip corrosion test to minimize corrosion in fuel systems due to sulfur compounds in the fuel. This limit is included to ensure that the methyl *tertiary*-butyl ether does not contribute to copper corrosion.

X1.6 Methyl Tertiary-Butyl Ether Purity

X1.6.1 The methyl *tertiary*-butyl ether minimum purity level limits the quantities of contaminants. Some organic compounds other than MTBE may adversely affect the properties of finished fuel blends.

X1.7 Methanol Content

X1.7.1 Methanol is one of the reactants in the production of MTBE and is a potential contaminant. Methanol contributes to vapor pressure increase and poorer water tolerance of finished fuel blends. The U.S. EPA *substantially similar rule* limits the methanol content of unleaded fuels. Therefore, it is necessary to limit the methanol content of MTBE.

X1.8 Water Content

X1.8.1 Blends of MTBE and hydrocarbon gasoline have a limited solvency for water. This solvency will vary with the chemical composition, temperature, and MTBE content of the fuel. Excess water (which may be soluble in the MTBE) may not be soluble in the gasoline-MTBE blend and could result in a hazy fuel that does not meet the *clear and bright* requirement of Specification D 4814. The water content of MTBE used for blending with hydrocarbon gasoline is limited to reduce the risk of haze formation.

X1.9 Vapor Pressure

X1.9.1 The vapor pressure of a finished fuel blend must be high enough to ensure ease of engine starting. Excessive vapor pressure, however, may contribute to vapor lock or high evaporative emissions and running losses.

X1.9.2 The vapor pressure of MTBE is controlled to prevent adversely affecting the vapor pressure of the finished blend. A vapor pressure in excess of the value specified in Section 4 may indicate contamination by a light hydrocarbon. Therefore, the vapor pressure must be controlled.