



Designation: D6751 – 14

# Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels<sup>1</sup>

This standard is issued under the fixed designation D6751; 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 four grades of biodiesel (B100) for use as a blend component with middle distillate fuels. These grades are described as follows:

1.1.1 *Grade No. 1-B S15*—A special purpose biodiesel blendstock intended for use in middle distillate fuel applications which can be sensitive to the presence of partially reacted glycerides, including those applications requiring good low temperature operability, and also requiring a fuel blend component with 15 ppm sulfur (maximum).

1.1.2 *Grade No. 1-B S500*—A special purpose biodiesel blendstock intended for use in middle distillate fuel applications which can be sensitive to the presence of partially reacted glycerides, including those applications requiring good low temperature operability, and also requiring a fuel blend component with 500 ppm sulfur (maximum).

1.1.3 *Grade No. 2-B S15*—A general purpose biodiesel blendstock intended for use in middle distillate fuel applications that require a fuel blend component with 15 ppm sulfur (maximum).

1.1.4 *Grade No. 2-B S500*—A general purpose biodiesel blendstock intended for use in middle distillate fuel applications that require a fuel blend component with 500 ppm sulfur (maximum).

1.2 This specification prescribes the required properties of diesel fuels at the time and place of delivery. The specification requirements may be applied at other points in the production and distribution system when provided by agreement between the purchaser and the supplier.

1.3 Nothing in this specification shall preclude observance of federal, state, or local regulations which may be more restrictive.

NOTE 1—The generation and dissipation of static electricity can create problems in the handling of distillate fuel oils with which biodiesel may be blended. For more information on the subject, see Guide [D4865](#).

<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.E0 on Burner, Diesel, Non-Aviation Gas Turbine, and Marine Fuels.

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

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- [D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester](#)
- [D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test](#)
- [D189 Test Method for Conradson Carbon Residue of Petroleum Products](#)
- [D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids \(and Calculation of Dynamic Viscosity\)](#)
- [D524 Test Method for Ramsbottom Carbon Residue of Petroleum Products](#)
- [D613 Test Method for Cetane Number of Diesel Fuel Oil](#)
- [D664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration](#)
- [D874 Test Method for Sulfated Ash from Lubricating Oils and Additives](#)
- [D974 Test Method for Acid and Base Number by Color-Indicator Titration](#)
- [D975 Specification for Diesel Fuel Oils](#)
- [D976 Test Method for Calculated Cetane Index of Distillate Fuels](#)
- [D1160 Test Method for Distillation of Petroleum Products at Reduced Pressure](#)
- [D1266 Test Method for Sulfur in Petroleum Products \(Lamp Method\)](#)
- [D1796 Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method \(Laboratory Procedure\)](#)
- [D2274 Test Method for Oxidation Stability of Distillate Fuel Oil \(Accelerated Method\)](#)
- [D2500 Test Method for Cloud Point of Petroleum Products](#)

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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

- D2622** Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry
- D2709** Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge
- D2880** Specification for Gas Turbine Fuel Oils
- D3117** Test Method for Wax Appearance Point of Distillate Fuels (Withdrawn 2010)<sup>3</sup>
- D3120** Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry
- D3242** Test Method for Acidity in Aviation Turbine Fuel
- D3828** Test Methods for Flash Point by Small Scale Closed Cup Tester
- D4057** Practice for Manual Sampling of Petroleum and Petroleum Products
- D4177** Practice for Automatic Sampling of Petroleum and Petroleum Products
- D4294** Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry
- D4530** Test Method for Determination of Carbon Residue (Micro Method)
- D4737** Test Method for Calculated Cetane Index by Four Variable Equation
- D4865** Guide for Generation and Dissipation of Static Electricity in Petroleum Fuel Systems
- D4951** Test Method for Determination of Additive Elements in Lubricating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry
- D5453** Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
- D5771** Test Method for Cloud Point of Petroleum Products (Optical Detection Stepped Cooling Method)
- D5772** Test Method for Cloud Point of Petroleum Products (Linear Cooling Rate Method)
- D5773** Test Method for Cloud Point of Petroleum Products (Constant Cooling Rate Method)
- D6217** Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration
- D6450** Test Method for Flash Point by Continuously Closed Cup (CCCFP) Tester
- D6469** Guide for Microbial Contamination in Fuels and Fuel Systems
- D6584** Test Method for Determination of Total Monoglycerides, Total Diglycerides, Total Triglycerides, and Free and Total Glycerin in B-100 Biodiesel Methyl Esters by Gas Chromatography
- D6890** Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber
- D7039** Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry
- D7397** Test Method for Cloud Point of Petroleum Products (Miniaturized Optical Method)
- D7501** Test Method for Determination of Fuel Filter Blocking Potential of Biodiesel (B100) Blend Stock by Cold Soak Filtration Test (CSFT)

## 2.2 Government Standard:

40 CFR Part 79 Registration of Fuels and Fuel Additives Section 211(b) Clean Air Act<sup>4</sup>

## 2.3 Other Documents:

AOCS Standard Procedure Ck 2-09<sup>5</sup> Determination of Various Properties of Biodiesel by the QTA System Method<sup>6</sup>

UOP 389 Trace Metals in Oils by Wet Ashing and ICP-OES<sup>7</sup>

UOP 391–91 Trace Metals in Petroleum Products or Organics by AAS<sup>7</sup>

EN 14105 Fat and oil derivatives – Fatty Acid Methyl Esters (FAME) – Determination of free and total glycerol and mono-, di-, triglyceride contents (Reference method)<sup>8</sup>

EN 14110 Fat and oil derivatives—Fatty acid methyl esters (FAME)—Determination of methanol content<sup>8</sup>

EN 14112 Fat and oil derivatives—Fatty acid methyl esters (FAME)—Determination of oxidation stability (Accelerated oxidation test)<sup>8</sup>

EN 14538 Fat and oil derivatives—Fatty acid methyl esters (FAME)—Determination of Ca, K, Mg and Na content by optical emission spectral analysis with inductively coupled plasma (ICP OES)<sup>8</sup>

EN 15751 Automotive fuels - Fatty acid methyl ester (FAME) fuel and blends with diesel fuel - Determination of oxidation stability by accelerated oxidation method<sup>8</sup>

## 3. Terminology

### 3.1 Definitions:

3.1.1 *biodiesel, n*—fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100.

3.1.1.1 *Discussion—biodiesel*, as defined above, is registered with the U.S. EPA as a fuel and a fuel additive under Section 211(b) of the Clean Air Act (40 CFR Part 79). There is, however, other usage of the term biodiesel in the marketplace. Due to its EPA registration and the widespread commercial use of the term biodiesel in the U.S. marketplace, the term biodiesel will be maintained for this specification.

3.1.1.2 *Discussion—Biodiesel* is typically produced by a reaction of a vegetable oil or animal fat with an alcohol such as methanol or ethanol in the presence of a catalyst to yield mono-alkyl esters and glycerin, which is removed. The finished biodiesel derives approximately 10 % of its mass from the

<sup>4</sup> Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

<sup>5</sup> Available from AOCS Headquarters, 2710 S. Boulder, Urbana, IL 61802–6996. Download Product Code: MC-CK209 from www.aocs.org.

<sup>6</sup> QTA is a registered trademark of the Cognis Corporation, 5051 Estecreek Drive, Cincinnati, OH 45232-1446.

<sup>7</sup> Available from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA. Visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org.

<sup>8</sup> Available from the National CEN Members listed on the CEN website (www.cenorm.be) or from the CEN/TC19 secretariat (astm@nen.nl).

<sup>3</sup> The last approved version of this historical standard is referenced on www.astm.org.

reacted alcohol. The alcohol used in the reaction may or may not come from renewable resources.

3.1.2 *biodiesel blend (BXX), n*—blend of biodiesel fuel with diesel fuel oils.

3.1.2.1 *Discussion*—In the abbreviation BXX, the XX represents the volume percentage of biodiesel fuel in the blend.

3.1.3 *biodiesel fuel, n*—synonym for *biodiesel*.

3.1.4 *diesel fuel, n*—middle petroleum distillate fuel.

3.1.5 *free glycerin, n*—a measure of the amount of glycerin remaining in the fuel.

3.1.6 *Grade S15 B100, n*—a grade of biodiesel meeting ASTM Specification D6751 and having a sulfur specification of 15 ppm maximum.

3.1.7 *Grade S500 B100, n*—a grade of biodiesel meeting ASTM Specification D6751 and having a sulfur specification of 500 ppm maximum.

3.1.8 *middle distillate fuel, n*—kerosines and gas oils boiling between approximately 150°C and 400°C at normal atmospheric pressure and having a closed-cup flash point above 38°C.

3.1.9 *monoglyceride, n*—a partially reacted fat or oil molecule with one long chain alkyl ester group on a glycerin backbone.

3.1.10 *total glycerin, n*—the sum of the free glycerin and the glycerin portion of any unreacted or partially reacted oil or fat.

## 4. Requirements

4.1 The biodiesel specified shall be mono-alkyl esters of long chain fatty acids derived from vegetable oils and animal fats.

4.2 Unless otherwise specified, samples for analysis shall be taken by the procedure described in Practices D4057 or D4177.

4.3 The biodiesel specified shall conform to the detailed requirements shown in Table 1.

NOTE 2—A considerable amount of experience exists in the U.S. with a 20 % blend of biodiesel, primarily produced from soybean oil, with 80 % diesel fuel (B20). Experience with biodiesel produced from animal fat and other oils is similar. Experience with B20 and lower blends in other applications is not as prevalent. Although biodiesel (B100) can be used, blends of over 20 % biodiesel with diesel fuel (B20) should be evaluated on a case by case basis until further experience is available.

NOTE 3—The user should consult the equipment manufacturer or owner's manual regarding the suitability of using biodiesel or biodiesel blends in a particular engine or application.

## 5. Test Methods

5.1 The requirements enumerated in this specification shall be determined in accordance with the following methods.

5.1.1 *Flash Point*—Test Methods D93, except where other methods are prescribed by law. Test Methods D3828 or D6450 can also be used. The precision and bias of Test Methods D3828 and D6450 with biodiesel is not known and is currently under investigation. Test Methods D93 shall be the referee method.

5.1.2 *Water and Sediment*—Test Method D2709. Test Method D1796 may also be used. Test Method D2709 shall be

the referee method. The precision and bias of these test methods with biodiesel is not known and is currently under investigation.

5.1.3 *Viscosity*—Test Method D445.

5.1.4 *Monoglycerides*—Test Method D6584, Test Method EN 14105, and AOCs Standard Procedure Ck 2-09 may be used. Test Method D6584 shall be the referee test method.

5.1.5 *Sulfated Ash*—Test Method D874.

5.1.6 *Oxidation Stability*—Test Method EN 15751. Test Method EN 14112 may also be used. See X1.19.1 for further information. Test Method EN 15751 shall be the referee test method.

5.1.7 *Sulfur*—Test Method D5453. Test Method D7039 may also be used. Other test methods may also be suitable for determining up to 0.05 % (500 ppm) sulfur in biodiesel fuels such as Test Methods D1266, D2622, D3120 and D4294 but may provide falsely high results (see X1.5) although their precision and bias with biodiesel is unknown. Test Method D5453 shall be the referee test method.

5.1.8 *Corrosion*—Test Method D130, 3 h test at 50°C.

5.1.9 *Cetane Number*—Test Method D613. Test Method D6890 may also be used. Test Method D613 shall be the referee method.

5.1.10 *Cloud Point*—Test Method D2500. Test Method D5771, D5772, D5773, D7397, or AOCs Standard Procedure Ck 2-09 may also be used. Test Method D3117 may also be used because it is closely related. Test Method D2500 shall be the referee test method. The precision and bias of Test Method D3117 for biodiesel is not known and is currently under investigation.

5.1.11 *Acid Number*—Test Method D664. Test Methods D3242 or D974 may also be used. Test Method D664 shall be the referee test method.

5.1.12 *Carbon Residue*—Test Method D4530. A 100% sample shall replace the 10 % residual, with percent residue in the original sample reported using the 10 % residual calculation (see X1.9.1). Test Methods D189 or D524 may also be used. Test Method D4530 shall be the referee method.

5.1.13 *Total Glycerin*—Test Method D6584. AOCs Standard Procedure Ck 2-09 may also be used. Test Method D6584 is the referee method.

5.1.14 *Free Glycerin*—Test Method D6584. AOCs Standard Procedure Ck 2-09 may also be used. Test Method D6584 is the referee method.

5.1.15 *Phosphorus Content*—Test Method D4951.

5.1.16 *Distillation Temperature, Reduced Pressure*—Test Method D1160.

5.1.17 *Calcium and Magnesium, combined*—Test Method EN 14538. Test Method UOP 389 may also be used. Test Method EN 14538 shall be the referee test method.

5.1.18 *Sodium and Potassium, combined*—Test Method EN 14538. Test Method UOP 391 may also be used. Test Method EN 14538 shall be the referee test method.

5.1.19 *Cold Soak Filterability*—Test Method D7501. B100 intended for blending into diesel fuels that is expected to give satisfactory vehicle performance at fuel temperatures at or below -12°C shall comply with a cold soak filtration limit of 200 s maximum.

**TABLE 1 Detailed Requirements for Biodiesel (B100) Blend Stocks**

Property	Test Method <sup>A</sup>	Grade No. 1-B		Grade No. 2-B		Grade No. 2-B S500
		S15	S500	S15	S500	
Sulfur, <sup>B</sup> % mass (ppm), max	D5453	0.0015 (15)	0.05 (500)	0.0015 (15)	0.05 (500)	0.05 (500)
Cold soak filterability, seconds, max	D7501	200	200	360 <sup>C</sup>	360 <sup>C</sup>	360 <sup>C</sup>
Monoglyceride content, % mass, max	D6584	0.40	0.40	...	...	...
Calcium and Magnesium, combined, ppm (µg/g), max	EN 14538	5	5	Requirements for All Grades		
Flash point (closed cup), °C, min	D93	93	93	93	93	93
Alcohol control						
One of the following shall be met:						
1. Methanol content, mass %, max	EN 14110	0.2	0.2	0.2	0.2	0.2
2. Flash point, °C, min	D93	130	130	130	130	130
Water and sediment, % volume, max	D2709	0.050	0.050	0.050	0.050	0.050
Kinematic viscosity, <sup>D</sup> mm <sup>2</sup> /s, 40°C	D445	1.9-6.0	1.9-6.0	1.9-6.0	1.9-6.0	1.9-6.0
Sulfated ash, % mass, max	D874	0.020	0.020	0.020	0.020	0.020
Copper strip corrosion, max	D130	No. 3	No. 3	No. 3	No. 3	No. 3
Cetane number, min	D613	47	47	47	47	47
Cloud point, <sup>E</sup> °C	D2500	Report	Report	Report	Report	Report
Carbon residue, <sup>F</sup> % mass, max	D4530	0.050	0.050	0.050	0.050	0.050
Acid number, mg KOH/g, max	D664	0.50	0.50	0.50	0.50	0.50
Free glycerin, % mass, max	D6584	0.020	0.020	0.020	0.020	0.020
Total glycerin, % mass, max	D6584	0.240	0.240	0.240	0.240	0.240
Phosphorus content, % mass, max	D4951	0.001	0.001	0.001	0.001	0.001
Distillation temperature	D1160	360	360	360	360	360
Atmospheric equivalent temperature, 90 % recovered, °C, max						
Sodium and Potassium, combined, ppm (µg/g), max	EN 14538	5	5	5	5	5
Oxidation stability, hours, min	EN 15751	3	3	3	3	3

<sup>A</sup> The test methods indicated are the approved referee methods. Other acceptable methods are indicated in 5.1.

<sup>B</sup> Other sulfur limits may apply in selected areas in the United States and in other countries.

<sup>C</sup> For additional cold weather considerations, see Appendix X3.

<sup>D</sup> See X1.3.1. The 6.0 mm<sup>2</sup>/s upper viscosity limit is higher than petroleum based diesel fuel and should be taken into consideration when blending.

<sup>E</sup> The cloud point of biodiesel is generally higher than petroleum based diesel fuel and should be taken into consideration when blending.

<sup>F</sup> Carbon residue shall be run on the 100 % sample (see 5.1.12).