



Designation: D7666 – 12 (Reapproved 2019)

## Standard Specification for Triglyceride Burner Fuel<sup>1</sup>

This standard is issued under the fixed designation D7666; 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 two grades of burner fuel consisting of triglycerides and naturally occurring constituents of triglycerides including monoglycerides, diglycerides, and free fatty acids and distinguished by the pour point. The grade designation (TBF) identifies them as triglyceride burner fuels.

1.2 The triglyceride burner fuels specified are intended for use in commercial or industrial air or steam-atomized fuel oil burning equipment manufactured from materials compatible with fuels having an acid number as specified in [Table 1](#) and under various climatic and operating conditions for the purposes of heat generation. The fuels specified herein are not intended for blending with conventional fuel oils for this purpose. They are not intended for use in burners  $<0.32$  GJ/h ( $0.3 \times 10^6$  BTU/h) such as residential burners or small pressure atomization burners nor are they intended for use in internal combustion engines or marine applications.

NOTE 1—For information on the significance of the terminology and test methods used in this specification, see [Appendix X1](#).

1.3 This specification does not address the frequency with which any particular test shall be run.

1.4 Nothing in this specification shall preclude observance of national or local regulations, which can be more restrictive.

1.5 The *text* of this standard references notes and footnotes that provide explanatory material and shall not be considered as requirements of the standard. The *table* in this standard references footnotes, and these are to be considered as requirements of the standard.

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

1.7 *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*

*appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *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:<sup>2</sup>

- D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
- D95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation
- D97 Test Method for Pour Point of Petroleum Products
- D128 Test Methods for Analysis of Lubricating Grease
- D240 Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter
- D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- D473 Test Method for Sediment in Crude Oils and Fuel Oils by the Extraction Method
- D482 Test Method for Ash from Petroleum Products
- D664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration
- D974 Test Method for Acid and Base Number by Color-Indicator Titration
- D1266 Test Method for Sulfur in Petroleum Products (Lamp Method)
- D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- D1552 Test Method for Sulfur in Petroleum Products by High Temperature Combustion and Infrared (IR) Detection or Thermal Conductivity Detection (TCD)
- D1796 Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure)

<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.P0 on Recycled Products.

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<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.

**TABLE 1 Detailed Requirements for Triglyceride Burner Fuels**

Properties	Test Method <sup>A</sup>	Limits <sup>B</sup>	
		TBF5	TBF6
<i>Physical:</i>			
Pour point °C (°F)	D97	<21 (70)	≥21 (70)
Flash point, °C (°F), min	D93	93 (200)	93 (200)
Water and sediment, % vol, max	D1796	2.0	2.0
Kinematic viscosity at 100 °C, mm <sup>2</sup> /s <sup>C</sup>	D445	Report	Report
Density, kg/m <sup>3</sup> @ 15 °C <sup>D</sup>	D1298	Report	Report
Titer, °C	D1982	Report	Report
<i>Chemical:</i>			
Acid Number, mg KOH/g, max	D664	30.0	30.0
Ash, wt %, max	D482	0.15	0.15
Sulfur, wt % <sup>E</sup>	D4294	Report	Report
Insolubles, %mass	D128	2	2
<i>Performance:</i>			
Gross heating value, MJ/kg (BTU/lb <sup>F</sup> ), min	D240	36.1 (15 500)	36.1 (15 500)

<sup>A</sup> The test methods indicated are the approved referee methods. Other acceptable methods are indicated in Section 8.

<sup>B</sup> Units given in parentheses are for informational purposes only.

<sup>C</sup> 1 mm<sup>2</sup>/s = 1 cSt.

<sup>D</sup> Density in kg/L at 15°C multiplied by 1000 = kg/m<sup>3</sup>.

<sup>E</sup> Local jurisdictions may limit the sulfur content in burner fuels.

<sup>F</sup> Assumes 7.6 lb/US gal.

- D1982 Test Method for Titer of Fatty Acids
- 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
- D3228 Test Method for Total Nitrogen in Lubricating Oils and Fuel Oils by Modified Kjeldahl Method
- D3245 Test Method for Pumpability of Industrial Fuel Oils (Withdrawn 2010)<sup>3</sup>
- D3339 Test Method for Acid Number of Petroleum Products by Semi-Micro Color Indicator Titration
- D3828 Test Methods for Flash Point by Small Scale Closed Cup Tester
- D4007 Test Method for Water and Sediment in Crude Oil by the Centrifuge Method (Laboratory Procedure)
- 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 Products, Liquid Fuels, and Lubricants
- 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

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

- D4629 Test Method for Trace Nitrogen in Liquid Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection
  - D5185 Test Method for Multielement Determination of Used and Unused Lubricating Oils and Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)
  - D5291 Test Methods for Instrumental Determination of Carbon, Hydrogen, and Nitrogen in Petroleum Products and Lubricants
  - D5347 Test Method for Determination of the Ash Content of Fats and Oils
  - D5355 Test Method for Specific Gravity of Oils and Liquid Fats
  - 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
  - D5949 Test Method for Pour Point of Petroleum Products (Automatic Pressure Pulsing Method)
  - D5950 Test Method for Pour Point of Petroleum Products (Automatic Tilt Method)
  - D6448 Specification for Industrial Burner Fuels from Used Lubricating Oils
  - D6823 Specification for Commercial Boiler Fuels With Used Lubricating Oils
  - D6892 Test Method for Pour Point of Petroleum Products (Robotic Tilt Method)
  - D7042 Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)
- 2.2 American Oil Chemists' Society:<sup>4</sup>
- Cd 22–91 Determination of Polymerized Triglycerides by Gel-Permeation HPLC

### 3. Terminology

3.1 For definitions of other terms used in this specification, refer to Terminology D4175.

#### 3.2 Definitions:

3.2.1 *commercial boiler, n*—indirect heating units which transfer thermal energy to water or other fluids or gases for use in heating and having a heat input between 0.32 GJ/h to 10.5 GJ/h (0.3 to 10 × 10<sup>6</sup> BTU/h). **D6823**

3.2.2 *industrial burner, n*—device that produces heat for industrial use through the combustion of fuel.

3.2.2.1 *Discussion*—Industrial burners are typically designed for one of two applications: (1) *industrial furnaces*—integral components of manufacturing processes that provide direct heating; for example, in aggregate, cement, lime, or phosphate kilns; coke ovens; or blast, smelting, melting, refining, or drying ovens and (2) *industrial boilers*—large indirect heating units that transfer thermal energy to water or other fluids or gases for use in heating in industrial settings and manufacturing processes. These boilers can be classified as

<sup>4</sup> Available from American Oil Chemists' Society (AOCS), 2710 S. Boulder, Urbana, IL 61802-6996, USA. [www.aocs.org/goto/methods/](http://www.aocs.org/goto/methods/)

utility/large industrial boilers with a heat input greater than 105 GJ/h (100 × 10<sup>6</sup> BTU/h) or small industrial boilers with a heat input of between 10.5 GJ/h to 105 GJ/h (10 to 100 × 10<sup>6</sup> BTU/h). **D6448**

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

3.3.1 *triglyceride burner fuel, n*—any triglyceride, including recycled and unused cooking oil, greases, animal fats, and naturally occurring constituents of triglycerides including monoglycerides, diglycerides, and free fatty acids, suitable for the generation of heat by combustion in a furnace or firebox as a vapor or a spray or a combination of both with little or no preconditioning other than preheating.

## 4. Significance and Use

4.1 This specification specifies the properties and limits for triglyceride burner fuels to provide acceptable performance in liquid fuel burning equipment. It is for use in contracts for the purchase of triglyceride burner fuels and for the guidance of consumers of such fuels. It may also be used by third-party testing agencies in evaluating burner equipment for the purposes of verifying performance and safety of the oil-burning appliances and by regulators of such fuel and equipment use.

## 5. Requirements

5.1 The triglyceride burner fuels shall be homogeneous, consisting primarily of triglycerides and naturally occurring constituents of triglycerides and shall conform to the limiting requirements in **Table 1**.

5.2 Buyer and seller may agree to modifications of limiting requirements to meet special operating conditions provided the modifications fall within the limits specified in **Table 1** for each grade.

NOTE 2—The grades specified may or may not correlate directly with similar grades in other ASTM standards. The usage descriptions of each grade may not describe all the uses but are included as general information.

5.3 The triglyceride burner fuel grades are described as follows:

5.3.1 *Grade TBF5*—A burner fuel comprised of commercial recycled and unused cooking oils, greases and rendered animal fats having a pour point below 21 °C in accordance with Test Method **D97**. The requirements for this type of triglyceride burner fuel are presented in **Table 1**. This grade is intended for use in industrial burners and commercial boilers equipped with devices that use steam or compressed air to atomize fuel oil of higher viscosity. Preheating may be necessary in some types of equipment for burning this fuel and in colder climates for ease of handling.

5.3.2 *Grade TBF6*—A burner fuel comprised of commercial recycled and unused cooking oils, greases and rendered animal fats having a pour point equal to, or higher than, 21 °C in accordance with Test Method **D97**. The requirements for this type of triglyceride burner fuel are presented in **Table 1**. This grade is intended for use in industrial burners and commercial boilers equipped with devices that use steam or compressed air to atomize fuel oil of higher viscosity. The use of this grade may require preheating in the storage tank to permit pumping. Additional preheating at the burner may be necessary to permit

satisfactory atomization. The extra equipment and maintenance required to handle this fuel grade may preclude its use in small or unattended installations, or both.

5.4 Triglyceride burner fuels shall remain homogeneous and uniform in storage and shall not separate by gravity or aging into layers under normal operating conditions.

NOTE 3—Prolonged storage or equipment downtime may necessitate circulation of the fuel oil in tank to prevent such separation.

5.5 The triglyceride burner fuel shall be free of solid or fibrous matter that could cause system handling or maintenance problems.

## 6. Sample Collection and Handling

6.1 Inspection of the material shall be agreed upon between the purchaser and the supplier as part of the purchase order or contract.

6.2 Unless otherwise specified, take a representative sample in accordance with Practice **D4057**, **D4177** or other comparable sampling practices using a clean and appropriate sample container. Containers previously holding a sample or any other type of fluid are not considered appropriate containers.

NOTE 4—In case of dispute, Practice **D4057** is recommended as the referee method.

6.3 A minimum sample size of 1 L is recommended for each sample taken before compositing.

6.4 Sample handling and mixing shall comply with Practice **D5854**.

## 7. Test Properties

7.1 The properties listed in this specification are those of greatest significance in obtaining acceptable performance of the burner.

NOTE 5—See **X1.4** for the significance of test requirements.

## 8. Test Methods

8.1 The requirements enumerated in this specification shall be determined in accordance with the following ASTM test methods except as noted:

8.1.1 *Pour Point*—Test Method **D97**. Test Methods **D5949**, **D5950**, or **D6892** may alternatively be used with the same limits. In case of dispute, Test Method **D97** shall be used as the referee method.

8.1.2 *Flash Point*—Test Method **D93**, Procedure B, except when other methods may be prescribed by law. For both grades, Test Method **D3828** may alternatively be used with the same limits. In case of dispute, Test Method **D93**, Procedure B, shall be used as the referee method.

8.1.3 *Water and Sediment*—Test Method **D1796**. Test Methods **D2709** or **D4007** may be used with the same limit. For non-emulsified samples, Test Methods **D95** and **D473** may also be used with the same limits. In case of dispute, Test Method **D1796** shall be the referee method.

8.1.4 *Viscosity*—Test Method **D445**. For quality control, dynamic viscosity by Test Method **D7042** may be used.

NOTE 6—Information on the significance of viscosity and viscosity ranges of triglyceride fuels and details for converting dynamic viscosity