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## Standard Specification for Pyrolysis Liquid Biofuel<sup>1</sup>

This standard is issued under the fixed designation D7544; 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 grades of pyrolysis liquid biofuel produced from biomass intended for use in various types of fuel-burning equipment under various climatic and operating conditions. These grades are described as follows:

1.1.1 Grade G is intended for use in industrial burners equipped to handle the pyrolysis liquid biofuels meeting the requirements listed for Grade G in [Table 1](#). The pyrolysis liquid biofuel listed under Grade G in [Table 1](#) is not intended for use in residential heaters, small commercial boilers, engines, or marine applications.

1.1.2 Grade D is intended for use in commercial/industrial burners requiring lower solids and ash content and which are equipped to handle the pyrolysis liquid biofuels meeting the requirements listed for Grade D in [Table 1](#). The pyrolysis liquid biofuel listed under Grade D in [Table 1](#) is not intended for use in residential heaters, engines, or marine applications not modified to handle these types of fuels.

NOTE 1—For information on the significance of the physical, chemical, and performance properties identified in this specification, see [Appendix X1](#).

1.2 This specification is for use in contracts for the purchase of pyrolysis liquid biofuel and for guidance of consumers of this type of fuel.

1.3 Nothing in this specification should preclude observance of national or local regulations, which may be more restrictive.

NOTE 2—The generation and dissipation of static electricity may create problems in the handling of pyrolysis liquid biofuel. For more information on the subject, see [Guide D4865](#).

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

1.4.1 *Exception*—BTU units are included for information only in [3.1.5.1](#).

1.5 *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>

[D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester](#)

[D97 Test Method for Pour Point of Petroleum Products](#)

[D240 Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter](#)

[D396 Specification for Fuel Oils](#)

[D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids \(and Calculation of Dynamic Viscosity\)](#)

[D482 Test Method for Ash from Petroleum Products](#)

[D4052 Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter](#)

[D4294 Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry](#)

[D4865 Guide for Generation and Dissipation of Static Electricity in Petroleum Fuel Systems](#)

[D5854 Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products](#)

[D6469 Guide for Microbial Contamination in Fuels and Fuel Systems](#)

[D7579 Test Method for Pyrolysis Solids Content in Pyrolysis Liquids by Filtration of Solids in Methanol](#)

[E70 Test Method for pH of Aqueous Solutions With the Glass Electrode](#)

[E203 Test Method for Water Using Volumetric Karl Fischer Titration](#)

### 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *bulk fuel, n*—fuel in the storage facility in quantities over 190 L.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products 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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<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

**TABLE 1 Detailed Requirements for Pyrolysis Liquid Biofuels**

Property	Test Method	Grade G	Grade D
Gross Heat of Combustion, MJ/kg, min	D240	15	15
Water Content, % mass, max	E203	30	30
Pyrolysis Solids Content, % mass, max	D7579	2.5	0.25
Kinematic Viscosity at 40°C, mm <sup>2</sup> /s, max	D445 <sup>A</sup>	125	125
Density at 20°C, kg/dm <sup>3</sup>	D4052	1.1–1.3	1.1–1.3
Sulfur Content, % mass, max	D4294	0.05	0.05
Ash Content, % mass, max	D482	0.25	0.15
pH.	E70	Report	Report
Flash Point, °C, min	D93, Procedure B	45	45
Pour Point, °C, max	D97	–9	–9

<sup>A</sup> Without filtering.

3.1.2 *char, n*—fine carbonaceous powder that is separated from the vapors of biomass during pyrolysis.

3.1.2.1 *Discussion*—Pyrolysis liquid biofuel contains uniformly suspended char.

3.1.3 *commercial burner, n*—device which produces heat for commercial use through the combustion of liquid fuels.

3.1.3.1 *Discussion*—Commercial burners are typically designed for processes that provide direct heating. Commercial boilers or heaters—small to medium indirect heating units which transfer thermal energy to water or other fluids or gases for use in heating in commercial settings, power generation and in manufacturing processes. These boilers can be classified as small or medium commercial boilers with a heat input of between 10.5 to 105 GJ/h (10 to 100 × 10<sup>6</sup> BTU/h).

3.1.4 *fuel degradation products, n*—those materials that are formed in fuel during extended storage or exposure to high temperatures.

3.1.4.1 *Discussion*—During storage, reactive organic compounds in pyrolysis liquid can act together to form larger molecules (fuel degradation products), which can become insoluble or increase the fuel viscosity, or both.

3.1.5 *industrial burner, n*—device which produces heat for industrial use through the combustion of liquid fuels.

3.1.5.1 *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 which transfer thermal energy to water or other fluids or gases for use in heating in industrial settings, power generation and in manufacturing processes. These boilers can be classified as 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 to 105 GJ/h (10 to 100 × 10<sup>6</sup> BTU/h).

3.1.6 *long-term storage*—storage of fuel for longer than 3 months after it is received by the user.

3.1.7 *medium-term storage*—storage of fuel for up to 3 months after it is received by the user.

3.1.7.1 *Discussion*—It is recommended that fuel be consumed within 6 months of receipt.

3.1.8 *pyrolysis, n*—chemical decomposition of organic materials by heating in the absence of oxygen.

3.1.9 *pyrolysis liquid biofuel, n*—liquid product from the pyrolysis of biomass.

3.1.9.1 *Discussion*—Pyrolysis liquid biofuel is comprised of a complex mixture of the decomposition products of renewable resources such as ligno-cellulosic biomass including highly oxygenated organic compounds. It is produced from the pyrolysis of biomass, followed by the rapid condensation of its vapors.

3.1.10 *pyrolysis solids, n*—solid particles contained within the pyrolysis liquid biofuel.

3.1.10.1 *Discussion*—Pyrolysis solids is comprised of ash and char.

## 4. General Requirements

4.1 The pyrolysis liquid biofuel specified in this specification shall remain uniform in medium-term storage and not separate by gravity into layers.

NOTE 3—Long-term storage or equipment down time can necessitate circulation of pyrolysis liquid biofuel in-tank to prevent such separation. The buyer and seller should agree on any requirements for long-term storage. If minor separation occurs during medium-term storage, mild agitation or product circulation should reverse such separation.

## 5. Detailed Requirements

5.1 The various grades of pyrolysis liquid biofuel shall conform to the detailed requirements shown in **Table 1**.

5.2 The properties selected for limitation are those that are believed to be of the greatest significance in obtaining acceptable performance of the burner.

## 6. Sampling

6.1 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. See **Table 2**.

6.2 As indicated in **4.1**, during medium-term storage, pyrolysis liquid biofuel shall remain uniform and not separate into layers. Note, however, that separation may occur during long-term storage. Therefore, samples should be well mixed when transferring from the primary sampling process or container, or both, to another container or analytical apparatus, or both. Sampling from an active circulation loop or a well mixed or agitated tank is preferred. Refer to Practice **D5854** for more guidance on mixing and handling samples.