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Standard Test Method for Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration[1]

This standard is issued under the fixed designation D6217; 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 test method covers the determination of the mass of particulate contamination in a middle distillate fuel by filtration. This test method is suitable for all No. 1 and No. 2 grades in Specifications D396, D975, D2880 and D3699 and for grades DMA and DMB in Specification D2069.

1.2 This test method is not suitable for fuels whose flash point as determined by Test Methods D56, D93 or D3828 is less than 38 °C.

NOTE 1—Middle distillate fuels with flash points less than 38 °C have been ignited by discharges of static electricity when the fuels have been filtered through inadequately bonded or grounded membrane filter systems. See Test Methods D2276 and D5452 for means of determining particulate contamination in Specification D1655 aviation turbine fuels and other similar aviation fuels. See Guide D4865 for a more detailed discussion of static electricity formation and discharge.

1.3 This test method has not been validated for testing biodiesel, such as meeting Specification D6751 or blends of middle distillates and biodiesel, such as meeting Specification D7467, or both. Test Method D7321 has been determined to be suitable for testing B100 and all blends of middle distillates and biodiesel.

NOTE 2—No. 1 and No. 2 grades in Specifications D396 or D975 currently allow up to 5% biodiesel meeting Specification D6751. Samples containing biodiesel can result in partial dissolution or compromise of the membrane filters and give erroneous results.

1.4 The precision of this test method is applicable to particulate contaminant levels between 0 g/m^3 to 25 g/m^3 provided that 1 L samples are used and the 1 L is filtered completely. Higher levels of particulate contaminant can be measured, but are subject to uncertain precision.

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

1.6 *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]

D56 Test Method for Flash Point by Tag Closed Cup Tester
D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester
D396 Specification for Fuel Oils
D975 Specification for Diesel Fuel Oils
D1193 Specification for Reagent Water
D1655 Specification for Aviation Turbine Fuels
D2069 Specification for Marine Fuels (Withdrawn 2003)[3]
D2276 Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling
D2880 Specification for Gas Turbine Fuel Oils
D3699 Specification for Kerosine
D3828 Test Methods for Flash Point by Small Scale Closed Cup Tester
D4057 Practice for Manual Sampling of Petroleum and Petroleum Products
D4865 Guide for Generation and Dissipation of Static Electricity in Petroleum Fuel Systems
D5452 Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
D6751 Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels
D7321 Test Method for Particulate Contamination of Biodiesel B100 Blend Stock Biodiesel Esters and Biodiesel Blends by Laboratory Filtration
D7467 Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.14 on Stability and Cleanliness of Liquid 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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

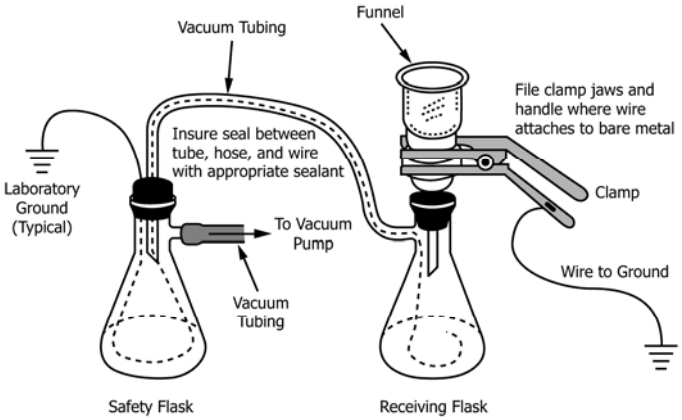

FIG. 1 Schematic of Filtration System

3. Terminology

3.1 *Definitions:*

3.1.1 *bond, v*—to connect two parts of a system electrically by means of a conductive wire to eliminate voltage differences.

3.1.2 *ground, v*—to connect electrically with earth.

3.1.3 *membrane filter, n*—a porous article of closely controlled pore size through which a liquid is passed to separate matter in suspension.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *control membrane, n*—the lower of the two stacked membrane filters used in this test method.

3.2.2 *filtered flushing fluids, n*—either of two solvents, heptane or 2,2,4-trimethylpentane, filtered through a nominal 0.45 µm membrane filter.

3.2.3 *test membrane, n*—the upper of the two stacked membrane filters used in this test method.

4. Summary of Test Method

4.1 A measured volume of about 1 L of fuel is vacuum filtered through one or more sets of 0.8 µm membranes. Each membrane set consists of a tared nylon test membrane and a tared nylon control membrane. When the level of particulate contamination is low, a single set will usually suffice; when the contamination is high or of a nature that induces slow filtration rates, two or more sets may be required to complete filtration in a reasonable time.

4.2 After the filtration has been completed, the membranes are washed with solvent, dried, and weighed. The particulate contamination level is determined from the increase in the mass of the test membranes relative to the control membranes, and is reported in units of g/m^3 or its equivalent mg/L.

5. Significance and Use

5.1 This is the first ASTM standard test method for assessing the mass quantity of particulates in middle distillate fuels. Test Method D5452 and its predecessor Test Method D2276 were developed for aviation fuels and used 1 gal or 5 L of fuel sample. Using 1 gal of a middle distillate fuel, which can contain greater particulate levels, often required excessive time to complete the filtration. This test method used about a quarter of the volume used in the aviation fuel methods.

5.2 The mass of particulates present in a fuel is a significant factor, along with the size and nature of the individual particles, in the rapidity with which fuel system filters and other small orifices in fuel systems can become plugged. This test method provides a means of assessing the mass of particulates present in a fuel sample.

5.3 The test method can be used in specifications and purchase documents as a means of controlling particulate contamination levels in the fuels purchased. Maximum particulate levels are specified in several military fuel specifications.

6. Apparatus

6.1 *Filtration System*—Arrange the following components as shown in Fig. 1.

6.1.1 *Funnel and Funnel Base,* with filter support for a 47 mm diameter membrane, and locking ring or spring action clip.

6.1.2 *Ground/Bond Wire,* 0.912 mm to 2.59 mm (No. 10 through No. 19) bare stranded flexible, stainless steel or copper installed in the flasks and grounded as shown in Fig. 1.

NOTE 3—The electrical bonding apparatus described in Test Method D5452 or other suitable means of electrical grounding which ensure safe operation of the filtration apparatus and flask can be used. If the filtrate is to be subsequently tested for stability it is advisable not to use copper as copper ions catalyze gum formation during the stability test.

6.1.3 *Receiving Flask,* 1.5 L or larger borosilicate glass vacuum filter flask, which the filtration apparatus fits into, equipped with a sidearm to connect to the safety flask.

6.1.4 *Safety Flask,* 1.5 L or larger borosilicate glass vacuum filter flask equipped with a sidearm to connect the vacuum system. A fuel and solvent resistance rubber hose through which the grounding wire passes shall connect the sidearm of the receiving flask to the tube passing through the rubber stopper in the top of the safety flask.

6.1.5 *Vacuum System,* either a water aspirated or a mechanical vacuum pump may be used if capable of producing a vacuum of 1 kPa to 100 kPa below atmospheric pressure when measured at the receiving flask.