~~Designation:D2068–04~~ Designation: D 2068 – 08

An American National Standard

Standard Test Method for ~~Filter Plugging Tendency of Distillate Fuel Oils~~ Determining Filter Blocking Tendency[1, 2]

This standard is issued under the fixed designation D 2068; 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.

INTRODUCTION

This test method describes 3 procedures using different filter media. The result of any test is dependent on the filter mandated in the procedure. If a specification requires a specific D 2068 procedure, do not substitute a different procedure or filter without agreement from the specifier.

1. Scope*

~~1.1This test method covers a procedure for determining the filter plugging tendency (FPT) of distillate fuel oils where the end use demands an exceptional degree of cleanliness. This test method is applicable to fuels within the viscosity range of 1.50 to 6.00 mm~~

1.1 This test method covers three procedures for the determination of the filter blocking tendency (FBT) and filterability of middle distillate fuel oils and liquid fuels such as biodiesel and biodiesel blends. The 3 procedures and associated filter types, are applicable to fuels within the viscosity range of 1.3 to 6.0 mm^2/s ~~(cSt)~~ at 40°C.

~~NOTE1—ASTM Specification fuels falling within the scope of this test method are Specification D 396 Grade Numbers 1 and 2, Specification D 975 Grades 1-D, low sulfur 1-D, 2-D, and low sulfur 2-D, Specification D 2880 Grades 1-GT and 2-GT and Specification D 3699 kerosine.~~

~~1.2This test method is not applicable to fuels that are not clear and bright because water interferes with the measurement of filter plugging.~~

~~1.3Relative tendency of fuels to plug filters may vary depending on filter porosity and structure, and may not always correlate with results from this test method.~~

~~1.4Annex A1 describes a standard procedure for preparing a test fluid for use in calibrating the apparatus used in this test method.~~

~~1.5~~

~~1.6*This standard does not purport to address all of the safety concerns, if any, associated with its use. It is responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*~~ 1—ASTM specification fuels falling within the scope of this test method are: Specifications D 396 Grades No 1 and 2; Specification D 975 Grades 1-D, low sulfur 1-D and 2-D; Specification D 2880 Grades 1-GT and 2-GT; Specification D 6751.

1.2 This test method is not applicable to fuels that contain free (undissolved) water (see 7.3).

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

1.4 *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:* [3]

D 396 Specification for Fuel Oils

~~D445Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)~~

---

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

Current edition approved ~~Nov.~~July 1, ~~2004.~~2008. Published ~~November 2004.~~August 2008. Originally approved in 1997. Last previous edition approved in ~~2003~~2004 as ~~D2068–97(2003).~~D 2068–04.

~~[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.~~

[2] This standard has been developed through the cooperative effort between ASTM and the Energy Institute, London.

~~[3] The sole source of supply of an assembled unit known to the committee at this time is Unitor ASA, Drammensveien 211, PO Box 300, Skøyen N-0213, Oslo, Norway.~~

[3] 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.

***A Summary of Changes section appears at the end of this standard.**

~~D~~ 975 Specification for Diesel Fuel Oils
D 2880 Specification for Gas Turbine Fuel Oils
~~D1500Test Method for ASTM Color of Petroleum Products (ASTM Color Scale)~~ 4057 Practice for Manual Sampling of Petroleum and Petroleum Products
~~D2880Specification for Gas Turbine Fuel Oils~~ 4176 Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)
~~D3699Specifications for Kerosine~~ 4177 Practice for Automatic Sampling of Petroleum and Petroleum Products
~~D4057Practice for Manual Sampling of Petroleum and Petroleum Products~~ 4860 Test Method for Free Water and Particulate Contamination in Middle Distillate Fuels (Clear and Bright Numerical Rating)
~~D4176Test Method for Free Water and Particulate Contamination in Distillate Fuels (Visual Inspection Procedures)~~ 6426 Test Method for Determining Filterability of Middle Distillate Fuel Oils
~~D4177Practice for Automatic Sampling of Petroleum and Petroleum Products~~ 6751 Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels
2.2 *ISO Standard:*[4]
ISO 5636-5 Paper and Board—Determination of Air Permeance and Air Resistance (Medium Range) Part 5 Gurley Method
2.3 *ASTM Adjuncts:*
D2PP, Determination of Precision and Bias Data for Use in Test Methods for Petroleum Products[5]
CompTM, Standard Practice for Statistical Assessment and Improvement of the Expected Agreement between Two Test Methods that Purport to Measure the Same Property of a Material[6]

3. Terminology

~~3.1*Definitions:*~~
~~3.2For this test method, fuel filter plugging tendency (FPT) can be described in either of the following two ways:~~
~~3.3*filter plugging*—the pressure drop across a 1.6 µm pore size glass fiber filter when 300 mL of fuel is passed at a rate of 20 mL/min.~~
~~3.4*filter plugging*—the volume of fuel passed when a pressure of 105 kPa (15 psi) is reached. This method of report is used when less than 300 mL passes at that pressure drop.~~
3.1 *Definitions of Terms Specific to This Standard:*
3.1.1 *filter blocking tendency (FBT), n— of certain fuels*, a calculated dimensionless value that defines the tendency of particulates in a fuel to plug or block a filter.
3.1.1.1 *Discussion*—The value is calculated using the pressure across the filter or the volume of fuel filtered at the end of the test. Depending on the outcome of the test, one of two equations is applied. See Section 10, Calculation. See 5.6 for interpretation of results.
3.1.2 *filterability*, *n—of certain fuels* , the relationship between the volume of sample filtered and the measured pressure increase across the filter.
3.1.2.1 *Discussion*—The filterability of the fuel can be assessed by recording the pressure when a specific volume of fuel has flowed through the filter, or recording the volume when a specific pressure across the filter has been achieved. This assessment may be assisted by plotting a volume versus pressure graph. See Appendix X1.

4. Summary of Test Method

~~4.1A sample of the fuel to be tested is passed at a constant rate of flow (20 mL/min) through a glass fiber filter medium. The pressure drop across the filter is monitored during the passage of a fixed volume of test fuel. If a prescribed maximum pressure drop is reached before the total volume of fuel is filtered, the actual volume of fuel filtered at the time of maximum pressure drop is recorded.~~
~~4.2Calibration of the apparatus is required at intervals, and a procedure for the preparation of a fluid for calibration is described in Annex A1.~~
4.1 A test portion of the fuel to be analysed is passed at a constant rate of flow (20 mL/min) through a specified filter medium. The pressure difference across the filter, and the volume of fuel passing the filter, are monitored until the pressure reaches 105 kPa or the volume of fuel passing the filter medium reaches 300 mL. The pressure and flow are then used to calculate the filter blocking tendency, where a low number indicates a good fuel (see 5.6).

~~[4] If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.~~
[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.
~~[5] The sole source of supply of the apparatus known to the committee at this time is Millipore Cat. No. XX3001200, available from Millipore Corporate Headquarters, 290 Concord Rd., Billerica, MA 01821.~~
[5] Available from ASTM International Headquarters. Order Adjunct No. ADJ6300.
~~[6] Whatman Grade GF/A, or its equivalent, has been found satisfactory for this purpose.~~
[6] Available from ASTM International Headquarters. Order Adjunct No. ADJ6708. Original adjunct produced in 2005.

4.2 The glass fiber filters specified for Procedures A and B are both 1.6 µm nominal pore diameter; Filter B is a pre-assembled encapsulated type.

4.3 The pre-assembled nylon filter specified for Procedure C has a 5 µm nominal pore diameter.

5. Significance and Use

~~5.1This test method is intended for use in evaluating distillate fuel cleanliness in those applications that demand a high throughput per installed filter.~~

~~5.2A change in filtration performance after storage or pretreatment can be indicative of changes in fuel condition.~~

~~5.3Causes of poor filterability might include fuel degradation products, contaminants picked up during storage or transfer, or interaction of the fuel with the filter media. Any of these could correlate with orifice or filter system plugging, or both.~~

5.1 This test method is intended for use in evaluating the cleanliness of middle distillate fuels, and biodiesel and biodiesel blends for specifications and quality control purposes.

5.2 The filter media specified in the three procedures are all suitable for the materials in the Scope. Specifications calling up this test method should state the procedure required.

5.3 A change in filtration performance after storage or pretreatment can be indicative of changes of fuel condition.

5.4 The filterability of fuels varies depending on filter porosity and structure and therefore results from this test method might not correlate with full scale filtration.

5.5 Causes of poor filterability in industrial/refinery filters include fuel degradation products, contaminants (including water) picked up during storage or transfer, effects due to temperature or composition for bio fuels, incompatibility of commingled fuels, or interaction of the fuel with the filter media. Any of these could correlate with orifice or filter system plugging, or both.

5.6 The results of the FBT test can range from 1 with a fuel with very good filterability, to over 100 for a fuel with poor filterability. The selection of a single FBT number to define a pass or fail criteria is not possible as this will be dependent on the fuel type and applications.

6. Apparatus

~~6.1The apparatus is shown as a diagram in~~

6.1 *General*—The apparatus, as described in Annex A1 and shown in Fig. A1.1, is available as a manufactured unit or can be constructed from individual components.

6.2 *Filter Media and Assemblies* :

6.2.1 *Filter A*, for Procedure A.

6.2.1.1 *Filter Housing,*[7] stainless steel, nominal 13 mm diameter with a Luer fitting at the top where it connects with the filtration apparatus. Fig. 1 ~~and is comprised of the following parts:~~

~~6.1.1*Pump*, capable of delivering fuel at a constant rate of 20 ± 1 mL/min, and incorporating a pulse damping mechanism to produce smooth flow.~~

~~6.1.2*Pressure Gage*— Gage or equivalent pressure recording device calibrated and graduated 0 to 210 kPa (2 kPa graduations, minimum).~~

~~6.1.3*Filter Unit*— Stainless steel body, 13-mm diameter, shown as a diagram in~~ shows the assembly.

6.2.1.2 *Filter Media,*[8] glass fiber, 1.6 µm nominal pore diameter, nominal 13 mm diameter and with an effective filtration area of 63.6 to 78.6 mm^2. Filter media shall be batch selected to have a Gurley time (ISO 5636-5) of between 12.5 and 13.4 s for 300 mL.

6.2.2 *Filter B,*[9] for Procedure B.

6.2.2.1 *Filter Housing*, disposable polypropylene "syringe type" with Luer and taper fittings, and factory fitted filter media. The filter, as shown in Fig. 2.~~4.~~

~~6.1.4*Filter Medium*— Glass fiber filter, nominal pore size 1.6 µm, 13-mm diameter.[4] .~~

~~6.1.5*Fuel Reservoir and Collection Containers*—Graduated glass beakers or cylinders, capable of holding 400mL of fuel.~~

~~6.2*Temperature Measuring Device* , having a range that includes 0 to 60°C. Temperature measuring devices that cover the temperature range of interest, such as ASTM 1C thermometer, or liquid-in-glass thermometers, thermocouples, or platinum resistance thermometers that provide equivalent or better accuracy and precision may be used.~~

~~6.3~~*, is used with an adaptor (6.9) to allow the test portion to input through the taper fitting and exit from the Luer fitting. The filter medium is supported by a coarse glass fiber support pad as shown in Fig. 2.*

~~[7] The sole source of supply of the latex beads known to the committee at this time is Polysciences, Inc. 400 Valley Road, Warrington, PA 18976, or Polysciences Europe, GmbH Handelsstr. 3 D-69214, Eppelheim, Germany.~~

[7] The sole source of supply of the Filter A housing, known to the committee at this time is Millipore Cat No XX3001200, available from Millipore Corporation Headquarters, 290 Concord Road, Billerica, MA 01821. If you are aware of alternative suppliers, please supply this information to ASTM International Headquarters. Your comments will receive careful consideration by a meeting of the responsible technical committee, which you may attend.

[8] Whatman Grade GF/A, has been found satisfactory for this purpose.

[9] The following equipment, as listed in RRSR: IP 387/07 (see Footnote 10), was used to develop the precision statements; Seta MFT Multi Filtration Tester part number 91600, Filter capsule "B" part number 91616-001 and Filter capsule "C" part number 91620. Stanhope-Seta, Chertsey, Surrey, KT16 8AP, UK. This is not an endorsement or certification by ASTM.

FIG. 1 Assembly of Filter A

6.2.2.2 *Filter Media*, glass fiber grade GF/A, 1.6 µm nominal pore diameter and effective filtration area of 63.6 to 78.6 mm^2. The filters shall be batch selected (one or more filters from a batch are tested) and quality controlled (using a procedure and a fluid with a known pressure/flow characteristic, for example, ISO 5636-5) for equivalence with the assembled Filter A.

6.2.3 *Filter C,*[9] for Procedure C.

6.2.3.1 *Filter Housing*, disposable polypropylene "syringe type" filter housing, as shown in Fig. 3, which has Luer and taper fittings, and factory fitted filter media. The test portion inputs via the Luer fitting. The filter medium is held above concentric/segmented ribbed channels and the exit port is recessed and segmented to eliminate localized filter blocking.

6.2.3.2 *Filter Media*, nylon, 5 µm nominal pore diameter and effective filtration area of 143.2 to 165.2 mm^2. The filters shall be batch selected (one or more filters from a batch are tested) and quality controlled (using a procedure and a fluid with a known pressure/flow characteristic, for example, ISO 5636-5).

6.3 *Measuring Cylinder*~~, nominal capacity 500 mL.~~

~~6.4*Forceps*, spade ended.~~ , 25 mL, glass or other suitable transparent material, with graduations every 0.5 mL, for verifying the flow rate.

6.4 *Measuring Cylinder*, 500 mL, glass or other suitable transparent material, with graduations every 5 mL, for verifying the flow rate, and for measuring the volume of fuel in the fuel receiver if required.

6.5 *Stopwatch*~~, manual or electronic, nominal accuracy 0.2s.~~ , capable of measuring to the nearest 0.2 s, required for verifying the flow rate and preparing the sample.

6.6 *Thermometer*, electronic or liquid in glass type thermometers with a range of at least 15 to 25°C and an accuracy of ± 0.5ºC or better are suitable.

6.7 *Forceps*, spade ended, for use with Filter A.

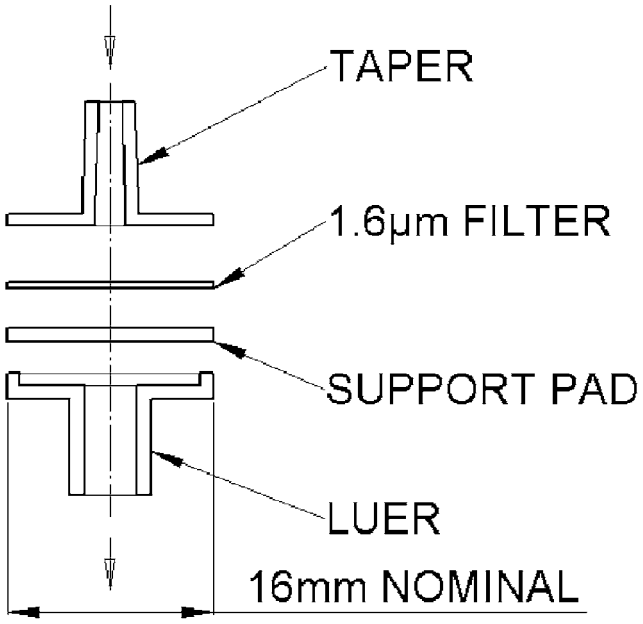

FIG. 2 Filter B

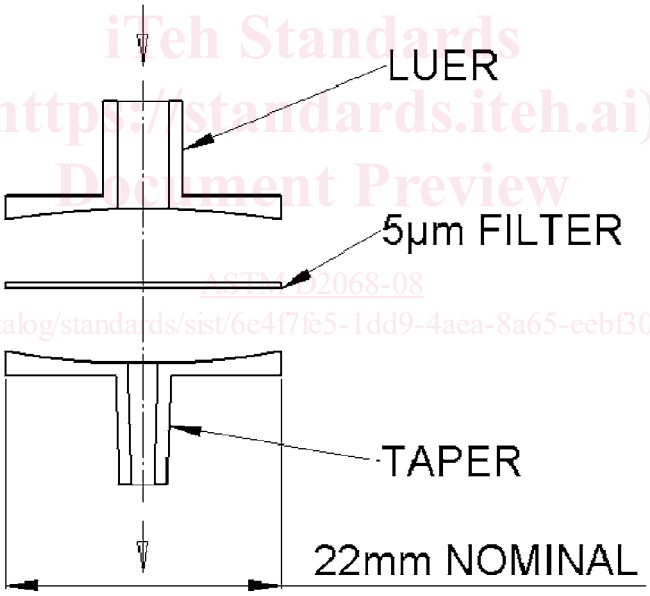

FIG. 3 Filter C

6.8 *Open-ended Spanner Wrenches* , plastic or metal, for use with Filter A.

6.9 *Adaptor*, only for use with Procedure B, to convert the Luer fitting on the apparatus to a fitting compatible with the tapered fitting on Filter B.

6.10 *Anti-splash Tubing*, nylon or silicone rubber, approximately 4 mm inner diameter for Filters A and C, and 6 mm inner diameter for Filter B, to reduce splashing of the sample in the fuel receiver beaker.

7. Sampling

~~7.1The laboratory fuel sample from which an aliquot is being drawn for the purposes of this test must be representative of the lot of fuel, whether the fuel is in a storage tank, a tank car, a pipeline, or other container. The laboratory sample should therefore have been obtained by following the practices of Practices D 4057, D 4177, or similar standard. The maximum sample size is dictated by the quantity that can be mixed thoroughly (see 9.2).~~

~~7.2Draw a representative 1 to 2 L aliquot from the thoroughly mixed laboratory sample into an epoxy-lined can or dark glass bottle that has been previously rinsed three times with the product to be sampled.~~

~~NOTE2—Because the situations under which samples are taken vary from laboratory to laboratory and from situation to situation, no firm recommendations for sampling can be given. It is the responsibility of the user of this test method to ensure the representativeness of the aliquot used in this test method.~~

7.1 Unless otherwise specified, samples shall be obtained in accordance with Practices D 4057, D 4177 or other comparable sampling practices.

7.1.1 Containers shall have been previously flushed three times with the product to be sampled.

7.2 Obtain at least 400 mL of a representative aliquot of the sample to be tested in an epoxy-lined can or dark glass bottle.

7.3 If any undissolved water is visually apparent (as determined by Test Methods D 4176 or D 4860), discard and replace with a fresh sample.

8. Preparation of Apparatus

8.1 ~~*Calibration*— Calibration is required when a new batch of filter media is used, when there is doubt concerning the validity of a test result, or when the apparatus has not been used for three months. A procedure for the preparation of standard solutions for the apparatus calibration is given in Annex A1 to this test method.~~ Verification:

8.1.1 *Pressure and Temperature*—Follow the manufacturer's instructions for verifying that the pressure and temperature readings are in accordance with the tolerances given in A1.1.3 and 6.6 respectively. Verify the pressure reading, at ambient atmospheric pressure (0 kPa) and at approximately 100 kPa, at least every 6 months or if the apparatus has not been used for the previous 3 months. Verify the temperature reading is correct, at ambient temperature, at least every 12 months. If the readings do not meet the specified tolerances in A1.1.3 and 6.6, calibrate the sensors (8.2.1).

8.1.2 *Flow Rate*—Follow the manufacturer's instructions for verifying that the flow rate is 20 ± 1 mL/min through a filter assembly. The flow rate is verified by measuring the volume pumped during a 15 minute period, at least once a month, using a suitable measuring cylinder (6.4). If the measured volume is between 285 and 315 mL the flow rate is correct. More frequent checks on the flow rate may be made by measuring the volume during a 1 minute period using a 25 mL measuring cylinder (6.3). If the measured volume is not between 19 and 21 mL, calibrate the pump (8.2.2).

8.2 *Calibration*:

8.2.1 *Pressure and Temperature*—Follow the manufacturer's instructions to calibrate the pressure at atmospheric pressure (0 kPa) and approximately 100 kPa, and temperature measuring device at ambient temperature.

8.2.2 *Flow Rate*—Follow the manufacturer's instructions to set and lock the mechanical flow adjustment control on the pump to give a flow rate of 20 ± 1 mL/min.

8.2.2.1 A filter assembly shall be fitted when the flow rate is calibrated.

8.3 *Apparatus Assembly*~~—Assemble the apparatus as shown in~~ —Assemble the apparatus as shown in Fig. A1.1, without the filter unit connected.

8.4 *Filter Assembly*— Assemble the filter appropriate to the test procedure specified.

8.4.1 *Filter A (for Procedure A)*—Assemble the filter as shown in Fig. 1 ~~without the filter unit connected. To ensure that the pump and pipework are clean and to calibrate the pump, fill the fuel reservoir with fuel that has been previously filtered through a glass fiber filter medium. Measure the delivery rate of the pump by timing the removal of 200 mL of fuel from the reservoir. If the time is not 600 ± 30 s, adjust and repeat.~~

8.3~~*Filter Unit Assembly*—Assemble the filter unit as shown in Fig. 2 using a new glass fiber filter medium handled with the forceps, taking care not to damage the filter medium. The medium is placed into the holder with the face marked with a grid pattern uppermost.~~ using a new filter medium handled with the forceps (6.7) taking care not to damage the filter medium. Place the medium into the holder with the face marked with a grid pattern uppermost. The open ended spanner wrenches (6.8) may be used to assist in assembling or disassembling the housing. Attach a suitable length (typically 80 to 90 mm) of anti-splash tubing (6.10) to the outlet of the filter assembly.

~~NOTE3—It is most important that the filter unit components are assembled as above, and in the exact configuration shown in Fig. 2, because any leakage would yield erroneous results.~~ 2—It is most important that the filter unit components are assembled in the exact configuration shown in Fig. 1.

NOTE 3—Over- or under-tightening of the Filter A assembly can lead to erroneous results.

8.4.2 *Filter B (for Procedure B)*—Attach a suitable length (typically 80 to 90 mm) of anti-splash tubing (6.10) to the outlet of the filter assembly.

8.4.2.1 Attach the adaptor (6.9) to the Luer fitting on the outlet of the apparatus.

8.4.3 *Filter C (for Procedure C)*—Attach a suitable length (typically 80 to 90 mm) of anti-splash tubing (6.10) to the outlet of the filter assembly.

8.5 Rinse the fuel reservoir beaker with some of the product to be tested, and discard.

8.6 Remove the adaptor if Procedures A or C are to be used.

9. ~~Procedure~~

~~9.1Measure the temperature of the fuel in the container and, if necessary, adjust to 15 to 25°C.~~

~~9.2Shake the fuel container vigorously for 120 ± 5 s, and then allow to stand on a vibration-free surface for 300 s.~~

~~9.3Place 320 ± 5 mL of the sample into the fuel reservoir container and check that the temperature is still within the range 15 to 25°C. Record the actual temperature. If any undissolved water is apparent in the fuel at this stage (as determined by Test Method~~