



Designation: D8194 – 18<sup>ε1</sup>

# Standard Practice for Evaluation of Suitability of 37 mm Filter Monitors and 47 mm Filters Used to Determine Particulate Contaminant in Aviation Turbine Fuels<sup>1</sup>

This standard is issued under the fixed designation D8194; 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.

<sup>ε1</sup> NOTE—Subsection 9.1.2 was corrected editorially in August 2020.

## 1. Scope

1.1 This practice determines suitability of products used for measuring particulate contamination in aviation turbine fuel when using Test Methods D5452 and D2276.

1.2 There are two major parts of this practice. The first is for evaluation of the cellulose acetate butyrate field monitors that are used in combination with the filters and the filter support pads. The second part is for evaluation of the filter when used with an appropriate cellulose acetate butyrate field monitor.

1.3 *Units*—The values stated in SI units are to be regarded as the 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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>

D362 Specification for Industrial Grade Toluene (Withdrawn 1989)<sup>3</sup>

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.J0.05 on Fuel Cleanliness.

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<sup>2</sup> 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.

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

D1193 Specification for Reagent Water

D1319 Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption

D1655 Specification for Aviation Turbine Fuels

D2276 Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling

D2624 Test Methods for Electrical Conductivity of Aviation and Distillate Fuels

D3948 Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separator

D4171 Specification for Fuel System Icing Inhibitors

D5452 Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration

F316 Test Methods for Pore Size Characteristics of Membrane Filters by Bubble Point and Mean Flow Pore Test

### 2.2 Federal Standard:

MIL-DTL-85470 Inhibitor, Icing, Fuel System, High Flash NATO Code Number S-1745<sup>4</sup>

## 3. Terminology

### 3.1 Definitions:

3.1.1 *cellulose acetate butyrate, n*—thermoplastic that is known to be adequate for manufacture of field monitors and chemically compatible for use with aviation fuel.

3.1.2 *field monitor, n*—two-part device (inlet plus outlet) used to hold a filter securely.

3.1.2.1 *Discussion*—In this practice, all field monitors are manufactured from cellulose acetate butyrate polymer.

3.1.3 *filter, n*—thin, porous membrane used to separate particulate contamination from a liquid.

3.1.4 *plugs, n*—small plastic parts designed to block inlets and outlets of field monitors.

<sup>4</sup> Available from DLA Document Services, Bldg. 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, http://quicksearch.dla.mil.

#### 4. Summary of Practice

4.1 Water with blue dye dispersion is passed through a membrane filter in a field monitor to evaluate the field monitor for leaks bypassing the filter.

4.2 Membrane filters are evaluated for color per Appendix X1 of Test Method **D2276**.

4.3 Maximum and mean flow rate pore sizes of membrane filters are determined, as well as distribution of pore sizes on the filter.

4.4 Reagent water Type III of Specification **D1193** is filtered through a pre-weighed membrane filter in a field monitor and the change in membrane filter mass is determined after drying.

4.5 Fuel, (Test Fluid 2) filtered through a 0.45 μm pore size membrane filter and prepared as per **10.3.2** is filtered through a pre-weighed membrane filter in a field monitor and the change in membrane filter mass is determined after drying.

4.6 Membrane filters are evaluated for compatibility and wettability with aviation fuel.

4.7 Membrane filters are evaluated for strength.

#### 5. Significance and Use

5.1 This practice provides criteria for products used to measure particulate matter present in a sample of aviation turbine fuel. The objective is to verify that filters, support pads, and field monitors fall within the acceptable ranges that are established by this practice.

#### 6. Membrane Filter and Field Monitor Evaluation Procedures

6.1 The test procedures will be run on three representative membranes or field monitors that have been selected at random from a standard production batch. Passing criteria are summarized in **Table 1** and at the end of each section. All three samples shall pass criteria. To ensure impartiality, all testing shall be conducted by an independent laboratory.

6.2 *Specification Limits*—See **Table 1** for specification limits.

6.3 *Evaluation of Filter Membrane, Field Monitor, or Both*—Companies wishing to evaluate a membrane or field monitor separately need only undertake testing related to that particular item.

#### 7. Sealability

7.1 For consistent and representative filtration performance, membranes shall seal completely when installed in filtration and field monitor equipment. The test setup outlined in **Fig. 1** is adequate for carrying out this test.

##### 7.2 Apparatus:

7.2.1 A pressure source for dry, high-purity, compressed nitrogen.

7.2.2 A pressure vessel of 5 L or greater capacity.

**TABLE 1 Specification Limits<sup>A</sup>**

Test	Description	Summary of Passing Criteria
1	Sealability	The filter shall show no sign of leaking through the seal area under the field monitor's inlet contact with the filter (bypassing the filter).
2	Color	Appendix X1 of Test Method <b>D2276</b> . Color standard rating shall match rating of 0 N96.
3	Pore size/distribution: – Maximum pore size – Nominal pore size – Pore size distribution within 0.2 gm of nominal	– 2.5 μm – Between 0.7 μm and 1.1 μm – 20 % (or greater)
4	Flow rate/weight change: Time to collect 5 L of water through casing.  – Flow time specification – Weight change specification	110 s ± 5 s  Fluid 1:    Fluid 2:    Fluid 3: ≤8 min    ≤8 min    ≤8 min +0.15 mg   +0.70 mg   +0.70 mg
5	Filter compatibility: – Flow time change specification – Weight change specification – General requirement	Fluid 1:    Fluid 2:    Fluid 3: N/A        ± 30 s        ± 45 s N/A        ± 3.5 mg     ± 2.5 mg Following the compatibility test, filter membrane shall show no evidence of physical change to surface or diameter.
6	Wettability	Membrane shall be completely wetted by fuel within 15 min.
7	Mechanical strength	Shall show no sign of structural damage. Evidence of brittleness is unacceptable.

<sup>A</sup> For an explanation of Fluid Types 1, 2, and 3, see **10.3**.

7.2.3 An in-line pressure gauge capable of measuring from 0 kPa to at least 518 kPa in 7 kPa increments.

7.2.4 A field monitor, complete with protective plugs, to contain the 37 mm, 0.8 μm membrane filter backed by a 34 mm support pad.

7.2.5 A field monitor casing so constructed that a perfect seal is made between its upper part and the top of the field monitor and also between its lower part and the bottom of the field monitor.

7.2.6 A graduated metal receptacle of 5 L or greater capacity.

7.2.7 *Conductive Tubing*—Precautions to assure that tubing is conductive can be found in Test Method **D2276**, Section 6, if testing field monitors and in Test Method **D5452**, Section 7, if testing filters.

7.2.8 A vacuum source, for example, as per Test Method **D2276**, Section 11.

7.2.9 A digital camera to record results.

##### 7.3 Reagents:

7.3.1 *Purity of Reagents*—Reagent-grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on



FIG. 1 Test Apparatus for Seal Assessment: All Components to be Electrically Bonded Together and Grounded

Analytical Reagents of the American Chemical Society where such specifications are available.<sup>5</sup> Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.3.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Type III of Specification D1193.

7.3.3 A high molecular weight (300 g/mol to 500 g/mol) blue pigment powder, such as toluidine or phthalo blue.

7.3.4 Laboratory grade detergent 10 % solution of 4-(1,1,3,3-tetramethylbutyl) phenyl-polyethylene glycol, t-octylphenoxy polyethoxyethanol, and polyethylene glycol tert-octylphenyl ether.

#### 7.4 Procedure:

7.4.1 Prepare a dispersion of 0.5 g blue pigment in 3.785 L of distilled water and add 1 mL of the detergent. Mix thoroughly for 1 min. This dispersion has a maximum shelf life of two months; however, it should be mixed for 1 min before each test.

7.4.1.1 Add the blue dispersion to the pressure vessel.

7.4.1.2 Install the field monitor casing to the vessel's outlet. The field monitor casing contains the field monitor, which contains the membrane filter.

7.4.1.3 Apply 345 kPa pressure to the vessel with the field monitor casing's three-way valve in the OFF position.

7.4.1.4 Turn the three-way valve to BYPASS to vent off any air, then to ON.

7.4.1.5 Allow 50 mL of the blue dispersion to pass through the field monitor casing.

7.4.1.6 Remove the field monitor from the vessel and place on the vacuum source.

7.4.1.7 Draw off remaining liquid from the field monitor through the monitor's outlet and remove the monitor's inlet with the vacuum still applied.

7.4.1.8 Inspect the area of the test membrane outside of the filtration area for trace amounts of blue color.

7.4.1.9 Photograph results in color so that any blue coloration outside the seal area may be clearly seen.

7.4.2 The area outside the filtration area should show no trace of blue coloration. If blue coloration shows a leak path that bypasses the seal (through the field monitor's sealing surface), the seal is not acceptable and the test is rated as a fail.

## 8. Color

8.1 Membranes are used for the visual rating of aviation fuel cleanliness by color change. The initial color is, therefore, important. The surface of dry, unused membranes shall correspond to a rating 0 N96 on the ASTM Color Standards per Appendix X1 of Test Method D2276.

## 9. Pore Size and Distribution

9.1 Membrane pore size and distribution is important to ensure consistent results in relation to legacy filter membranes.

9.1.1 *Maximum Pore Size*—Maximum pore size shall be determined by Method A of Test Methods F316 for three membranes/monitors. Water, as per Section 7 of Test Methods F316, is to be used for this determination. The maximum pore size permitted is 2.5 μm.

9.1.2 *Pore Size Distribution*—Pore size distribution is to be determined by Method B of Test Methods F316. The nominal (mean flow rate) pore size shall be between 0.7 μm and 1.1 μm

<sup>5</sup> *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the United States *Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.