Designation: D3948 – 22

Standard Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer[1]

This standard is issued under the fixed designation D3948; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method covers a rapid portable means for field and laboratory use to rate the ability of aviation turbine fuels to release entrained or emulsified water when passed through fiberglass coalescing material.

1.2 The procedure section of this test method contains two different modes of test equipment operation. The primary difference between the modes of operation is the rate of fuel flow through the fiberglass coalescing material. Test method selection is dependent on the particular fuel to be tested.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered 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:*[2]

D1655 Specification for Aviation Turbine Fuels

D2550 Method of Test for Water Separation Characteristics of Aviation Turbine Fuels (Withdrawn 1989)[3]

D3602 Test Method for Water Separation Characteristics of Aviation Turbine Fuels (Withdrawn 1994)[3]

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

D4306 Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination

D6615 Specification for Jet B Wide-Cut Aviation Turbine Fuel

D7224 Test Method for Determining Water Separation Characteristics of Kerosine-Type Aviation Turbine Fuels Containing Additives by Portable Separometer

D7261 Test Method for Determining Water Separation Characteristics of Diesel Fuels by Portable Separometer

D8073 Test Method for Determination of Water Separation Characteristics of Aviation Turbine Fuel by Small Scale Water Separation Instrument

2.2 *Military Standards:*[4]

MIL-DTL-5624 Turbine Fuel, Aviation Grades JP-4 and JP-5

MIL-DTL-38219 Turbine Fuel, Low Volatility, JP-7

MIL-DTL-83133 Turbine Fuel, Aviation, Kerosene Types, JP-8 NATO F-34, NATO F-35, and JP-8+100 NATO F-37

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method that are not shown below, refer to Test Methods D7224, D7261, and Terminology D4175.

3.1.2 *Micro-Separometer*[5] rating (MSEP[5] rating), *n—in the aviation fuel industry*, a numerical value indicating the ease of separating emulsified water from aviation (jet) fuel by coalescence as affected by the presence of surface active materials (also known as surface active agents or surfactants).

3.1.2.1 *Discussion*—MSEP ratings obtained using Test A and Test B are termed MSEP-A and MSEP-B, respectively.

[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.J0.05 on Fuel Cleanliness.

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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.

[4] Available online at ASSIST Quick Search, http:/quicksearch.dla.mil.

[5] 'MSEP', 'DSEP', and 'Micro-Separometer' are trademarks of EMCEE Electronics, Inc., 520 Cypress Ave., Venice, FL 34285.

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

3.1.2.2 *Discussion*—MSEP ratings are only valid within the range of 50 to 100, with ratings at the upper end of the range indicating a clean fuel with little or no contamination by surfactants, which is expected to show good water-separating properties when passed through a filter-separator (coalescing-type filter) in actual service.

3.1.3 *reference fluid, n—in MSEP and DSEP*[5] *[diesel separability] water separability tests*, a reference fluid base to which a prescribed quantity of a known surface active agent has been added.

3.1.3.1 *Discussion*—The known surface active agent is typically bis-2-ethylhexyl sodium sulfosuccinate, commonly referred to as AOT, dissolved in toluene.

3.1.4 *reference fluid base, n—in aviation MSEP water separability tests*, jet fuel that has been cleaned in a prescribed manner to remove all surface-active contaminants (agents).

3.1.5 *surfactant, n—in petroleum fuels*, surface active material (or surface active agent) that could disarm (deactivate) filter separator (coalescing) elements so that free water is not removed from the fuel in actual service.

3.1.5.1 *Discussion*—Technically, surfactants affect the interfacial tension between water and fuel which affects the tendency of water to coalesce into droplets.

4. Summary of Test Method

4.1 A water/fuel sample emulsion is created in a syringe using a high-speed mixer. The emulsion is then expelled from the syringe at a programmed rate through a standard fiberglass coalescer and the effluent is analyzed for uncoalesced water by a light transmission measurement. The results are reported on a 0-to-100 scale to the nearest whole number. High ratings indicate the water is easily coalesced, implying that the fuel is relatively free of surfactant materials. A test can be performed in 5 min to 10 min.

5. Significance and Use

5.1 This test method provides a measure of the presence of surfactants in aviation turbine fuels. Like previous obsolete Test Methods D2550 and D3602, and current Test Methods D7224 and D8073, this test method can detect carryover traces of refinery treating residues in fuel as produced. They can also detect surface active substances added to or picked up by the fuel during handling from point of production to point of use. Certain additives can also have an adverse effect on the rating. Some of these substances affect the ability of filter separators to separate free water from the fuel.

5.2 The Micro-Separometer has a measurement range from 50 to 100. Values obtained outside of those limits are undefined and invalid. In the event a value greater than 100 is obtained, there is a good probability that light transmittance was reduced by material contained in the fuel used to set the 100 reference level. The material was subsequently removed during the coalescing portion of the test, thus, the processed fuel had a higher light transmittance than the fuel sample used to obtain the 100 reference level resulting in the final rating measuring in excess of 100.

TABLE 1 Applicable Test Mode for Various Fuels

Available Test Mode(s)	
Fuel	Applicable Test Mode
Jet A	A
Jet A-1	A
Jet B	A
MIL JP-5	A
MIL JP-7	A
MIL JP-8	A
MIL JP-4	B

5.3 Test Mode A function of the separometer will give approximately the same rating for Jet A, Jet A-1, MIL JP-5, MIL JP-7, and MIL JP-8 fuels as Test Methods D2550 and D3602. Using Mode A water separation characteristic ratings of Jet B and MIL JP-4 fuels will not necessarily be equivalent to Test Method D2550 but will give approximately the same rating as Test Method D3602. All Micro-Separometers have Test Mode A capability.

5.4 The Test Mode B option is used to determine water separation ratings for MIL JP-4 fuels containing fuel system corrosion and icing inhibitors. These ratings are approximately the same as those obtained using Test Method D2550.

5.5 Selection of Mode A or Mode B depends on the specific fuel and specification requirement. Table 1 identifies the recommended test method for various fuels.

5.6 The basic difference between Modes A and B is the flow rate at which the water/fuel emulsion is forced through the standard fiberglass coalescer cell. The lapsed time required to force the emulsion through the coalescer cell in Mode A is 45 s ± 2 s, whereas, Mode B requires 25 s ± 1 s.

6. Apparatus

6.1 A Micro-Separometer[6,7] is used to perform the test. The unit is completely portable and self-contained, capable of operating on an internal rechargeable battery pack or being connected to an ac power source using power cords which are available for various voltages. Connection to an ac power source will provide power to the unit and affect battery recharge. The accessories as well as the expendable materials for six tests can be packed in the cover of the lockable case.

NOTE 1—An extensive study was performed to verify that the Mark X Micro-Separometer gives equivalent results to the Mark V Deluxe Micro-Separometer. See Research Report RR:D02-1647.[8]

NOTE 2—The Mark X has a universal power supply and requires only one power cord as compared to the Mark V Deluxe that requires individual power cords for different voltages.

[6] The sole source of supply of the apparatus, the Model 1140 Micro-Separometer Mark V Deluxe and Mark X, known to the committee at this time is Emcee Electronics, Inc., 520 Cypress Ave., Venice, FL 34285, www.emcee-electronics.com. 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,[1] which you may attend.

[7] The Model 1140 Micro-Separometers Mark III and Mark V Standard versions may also be used, but they are no longer supported by the manufacturer. For operating procedures using these instruments, the user is referred to D3948–87.

[8] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-1647. Contact ASTM Customer Service at service@astm.org.

FIG. 1 Micro-Separometer Mark V Deluxe and Associated Control Panel

6.2 The Micro-Separometer Mark V Deluxe and Mark X and associated control panel are shown in Fig. 1 and Fig. 2, respectively. The emulsifier is on the right side of the raised panel and the syringe drive mechanism is on the left side. The control panel containing the operating controls is mounted on the fixed panel in the left side of the case. Table 2 lists the manual and audio operating characteristics of the instruments.

6.2.1 All of the controls are located in a pushbutton array on the control panel. The pushbuttons illuminate when depressed thus indicating operational status. A circuit breaker located on the control panel provides protection for the ac power circuit.

6.2.2 The Mark X has an LCD display on the control panel that provides information to the operator during the test. The information includes test status and an error code that defines a malfunction in the Micro-Separometer.

6.2.3 The turbidimeter is located under the main control panel and consists of a well in which the sample vial is placed, a light source, and a photocell.

6.2.4 By depressing the ON pushbutton, the electronic circuits are energized. The ON pushbutton pulses on and off when the instruments are being operated by an ac source and constantly remains on when the battery (dc) pack is used. The lettered pushbuttons will sequentially illuminate on and off indicating READY operational status.

NOTE 3—Of the lettered (A-G) pushbuttons on the control panel of the Mark V Deluxe, only the A and B pushbuttons are applicable to this test method. Of the lettered (Jet A – Diesel) pushbuttons on the control panel of the Mark X, only the Jet A and Jet B pushbuttons are applicable to this test method.

6.2.5 The RESET pushbutton can be depressed at any time to cancel the test in progress and restore the program to the initial start mode. The lettered pushbuttons commence to sequentially illuminate, thus indicating a READY operational status enabling test mode selection.

6.2.6 *Mark V Operation:*

6.2.6.1 Selection of Test Mode A or Test Mode B programs is accomplished by depressing either the A or B lettered pushbutton. The depressed pushbutton illuminates and the sequential illumination of the other lettered pushbuttons ceases. The START pushbutton also illuminates.

6.2.6.2 The START pushbutton, when depressed initially, initiates the CLEAN cycle causing the syringe drive mechanism to travel to the UP position and the emulsifier motor to operate for the cleaning operation.

6.2.6.3 The START pushbutton, when depressed after the CLEAN cycle, initiates the automatic program sequence causing the read indicator and the two ARROWED pushbuttons to illuminate, indicating that a full-scale adjustment period is in effect. A numerical value also appears on the meter.

6.2.6.4 By depressing the appropriate ARROWED pushbutton, the displayed value on the meter can be increased or decreased, as required, to attain the 100 reference level for the vial of fuel sample in the turbidimeter.

6.2.7 *Mark X Operation:*

6.2.7.1 Selection of Test Mode A or Test Mode B program is accomplished by depressing either the Jet A or Jet B lettered pushbutton. The depressed pushbutton illuminates and the sequential illumination of the other lettered pushbuttons ceases. The CLEAN 1 pushbutton also illuminates.

6.2.7.2 The first and second clean cycles are initiated by depressing the CLEAN 1 and CLEAN 2 pushbuttons. The RUN pushbutton will illuminate at the end of the second clean cycle.

6.2.7.3 The automatic portion of the test sequence is initiated by depressing the RUN pushbutton.

6.2.7.4 The 100 reference level for the vial of fuel in the turbidimeter is set automatically and does not require any adjustment. If the turbidimeter could not auto adjust to 100, the error alert indicator illuminates and an ERR-04 is displayed.

6.3 Accessory equipment and expendable materials needed to perform the test are shown in Fig. 3 and consist of the following:

6.3.1 *Syringe Plug, (A)*—A plastic plug used to stopper the syringe during the CLEAN and EMULSION cycles.

6.3.2 *Syringe, (Barrel (B) and Plunger (C))*—A disposable plastic syringe.

6.3.2.1 Use of syringes other than those demonstrated to be free of surfactant contamination in a precision program such as described in Section 12 will render test results invalid.

6.3.3 *Vials, (D)*, 25 mm outside diameter vial premarked for proper alignment in the turbidimeter well.