



Designation: D4898 – 23

Standard Test Method for Insoluble Contamination of Hydraulic Fluids by Gravimetric Analysis¹

This standard is issued under the fixed designation D4898; 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 the determination of insoluble contamination in hydraulic fluids by gravimetric analysis. The contamination determined includes both particulate and gel-like matter, organic and inorganic, which is retained on a membrane filter disk of pore diameter as required by applicable specifications (usually 0.45 μm or 0.80 μm).

1.2 To indicate the nature and distribution of the particulate contamination, the gravimetric method should be supplemented by occasional particle counts of typical samples in accordance with Test Method F312.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For a specific warning statement, see 7.1.

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

A555/A555M Specification for General Requirements for

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.N0 on Hydraulic Fluids.

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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.

Stainless Steel Wire and Wire Rods

D1836 Specification for Commercial Hexanes

D2021 Specification for Neutral Detergent, 40 Percent Alkylbenzene Sulfonate Type (Withdrawn 2000)³

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

E319 Practice for the Evaluation of Single-Pan Mechanical Balances (Withdrawn 2021)³

F302 Practice for Field Sampling of Aerospace Fluids in Containers

F303 Practices for Sampling for Particles in Aerospace Fluids and Components

F312 Test Methods for Microscopical Sizing and Counting Particles from Aerospace Fluids on Membrane Filters

F314 Methods of Test for Identification of Metallic and Fibrous Contaminants in Aerospace Fluids (Withdrawn 1990)³

2.2 Military Standard:

MIL-C-81302C Cleaning Compound Solvent Trichlorotrifluoroethane⁴

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, refer to Terminology D4175.

4. Summary of Test Method

4.1 The insoluble contamination is determined by passing a given quantity of a fluid sample through a membrane filter disk and measuring the resultant increase in the mass of the filter. The fluid sample is drawn through the filter by a vacuum and the insoluble contamination is collected on the surface of the filter. In addition, the filter disk is microscopically scanned for excessively large particles, fibers, or other unusual conditions.

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

⁴ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098

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

5. Significance and Use

5.1 This test method indicates and measures the amount of insoluble contamination of hydraulic fluids. Minimizing the levels of insoluble contamination of hydraulic fluids is essential for the satisfactory performance and long life of the equipment. Insoluble contamination can not only plug filters but can damage functional system components resulting in wear and eventual system failure.

6. Apparatus

6.1 *Microbalance*, accurate to 0.005 mg, and the zero shall not drift more than 0.005 mg during the test period. The rated accuracy shall be obtainable by personnel actually making the weighings, under actual conditions of use and shall be verified in accordance with Practice E319.

6.2 *Membrane Filter Support*, fritted glass, sintered metal, or stainless steel screen, to support 25 mm or 47 mm to 51 mm membrane filters. The support shall be designed to enable attachment of a vacuum flask.

6.3 *Filtration Funnel*, glass or stainless steel, minimum capacity 15 mL, designed to enable attachment to the membrane filter support by means of a suitable clamping device. The filter funnel is calibrated to indicate volume.

6.4 *Vacuum Flask*, with rubber stopper.

6.5 *Filtered Liquid Dispensers* (2)—Washing bottles or other dispensers capable of delivering liquid through a 0.45 µm in-line membrane filter.

6.6 *Air Ionizer*, alpha emitter, 18.5 MBq, of polonium-210, with a useful life of 1.5 years to a final value of 1.1 MBq.⁵

6.7 *Membrane Filters* (2), 25 mm or 47 mm to 51 mm in diameter, with pore diameter as required.

6.8 *Microscope*, capable of 35× magnification.

6.9 *Vacuum Source*, capable of pulling 550 mm Hg. An electrically driven vacuum pump must be explosion-proof.

6.10 *Drying Oven*, capable of maintaining a temperature of 80 °C.

6.11 *Sample Bottles*, with contamination-proof caps. Aluminum-foil wrapped stoppers or polyethylene liners between cap and bottle have proved satisfactory.

6.12 *Graduated Cylinder*, 100 mL (May be replaced by volume-calibrated filter funnel.)

6.13 *Petri Dishes*, covered glass, 150 mm in diameter.

6.14 *Forceps*, with unserrated tips.

6.15 *Calibration Weights*, for microbalance, 10 mg and 20 mg, accurate to 0.005 mg and made from nonmagnetic material conforming to Type 310 in Specification A555/A555M. The accuracy is traceable to the National Bureau of Standards as discussed in their Technical Note 288.

⁵ May be obtained from any source approved by U.S. Nuclear Regulatory Commission.

7. Reagents

7.1 *Commercial Hexane*, conforming to Specifications D1836. (**Warning**—Flammable. Harmful if inhaled. Skin irritant on repeated contact. Eye irritant. Aspiration hazard.)

7.2 *Detergent*, free-rinsing. Material conforming to Specification D2021.

7.3 *Isopropyl Alcohol*, acetone-free. (**Warning**—Flammable. Harmful if inhaled. Skin irritant on repeated contact. Eye irritant. Aspiration hazard.)

7.4 *Refrigerant-113* (trichlorotrifluoroethane) conforming to U.S. Military Specification MIL-C-81302C. (**Warning**—Environmentally hazardous substance. Harmful if inhaled. Skin irritant on repeated contact. Eye irritant. Aspiration hazard. Acute and chronic aquatic hazard.)

8. Sample

8.1 A 100 mL ± 1 mL fluid sample should be used for this method. Larger or smaller samples may be used, however, to meet problems of unusually high or low contamination levels.

NOTE 1—Methods for obtaining the fluid samples are not specified in this method. These methods should be established by the individual agencies or laboratories in accordance with their requirements. However, extreme care should be taken to ensure that the samples are representative and free of external contamination.

8.2 The following ASTM sampling test methods should be used when applicable: Practices F302 and F303.

9. Preparation of Apparatus

9.1 The filtration funnel, petri dishes, graduated cylinders, and sample bottles shall be cleaned before each use by the following method:

9.1.1 Thoroughly wash in a solution of detergent and hot water.

9.1.2 Rinse with hot tap water and finally with distilled or deionized water.

9.1.3 Rinse twice with filtered isopropyl alcohol (delivered through a filtered liquid dispenser).

9.1.4 Rinse twice with filtered commercial hexane (delivered through filtered liquid dispenser).

9.1.5 Leave approximately 1 mL of commercial hexane in the bottom of each sample bottle. Replace sample bottle cap. (**Warning**—Flammable. Harmful if inhaled. Skin irritant on repeated contact. Eye irritant. Aspiration hazard.)

10. Procedure

10.1 Select two membrane filters of the pore diameter required. Allow the filters to stabilize to equilibrium with ambient room conditions. Record room temperature and relative humidity.

10.2 Take precautions to minimize apparatus contamination from airborne dust. Use a protective hood or cover.

NOTE 2—One of the filters mentioned in 10.1 is for a blank determination, which is necessary to provide a correction factor for adsorption of hydraulic fluid by the filter, desorption of filter constituents by the solvent, and variations of moisture content of the filter. This blank should be determined for each sample of a given composition and history. In a series of samples of similar fluids with similar history, the blank need