



Designation: D4007 – 22



Manual of Petroleum Measurement Standards (MPMS), Chapter 10.3

Standard Test Method for Water and Sediment in Crude Oil by the Centrifuge Method (Laboratory Procedure)¹

This standard is issued under the fixed designation D4007; 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 describes the laboratory determination of water and sediment in crude oils by means of the centrifuge procedure. This centrifuge method for determining water and sediment in crude oils is not entirely satisfactory. The amount of water detected is almost always lower than the actual water content. When a highly accurate value is required, the revised procedures for water by distillation, Test Method D4006 (API MPMS Chapter 10.2) (Note 1), and sediment by extraction, Test Method D473 (API MPMS Chapter 10.1), shall be used.

NOTE 1—Test Method D4006 (API MPMS Chapter 10.2) has been determined to be the preferred and most accurate method for the determination of water.

1.2 The values stated in SI units are to be regarded as standard.

1.2.1 *Exception*—The values given in parentheses are for information only.

1.3 *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.* Specific warning statements appear in 7.1, 9.3, and A1.5.4.

1.4 *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.*

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and the API Committee on Petroleum Measurement and is the direct responsibility of Subcommittee D02.02/COMQ the joint ASTM-API Committee on Hydrocarbon Measurement for Custody Transfer (Joint ASTM-API). This test method has been approved by the sponsoring committees and accepted by the Cooperating Societies in accordance with established procedures.

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2. Referenced Documents

2.1 ASTM Standards:²

D95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation (API MPMS Chapter 10.5)

D473 Test Method for Sediment in Crude Oils and Fuel Oils by the Extraction Method (API MPMS Chapter 10.1)

D665 Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water

D1796 Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure) (API MPMS Chapter 10.6)

D4006 Test Method for Water in Crude Oil by Distillation (API MPMS Chapter 10.2)

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products (API MPMS Chapter 8.1)

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

D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products (API MPMS Chapter 8.2)

D4928 Test Method for Water in Crude Oils by Coulometric Karl Fischer Titration (API MPMS Chapter 10.9)

D5854 Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products (API MPMS Chapter 8.3)

E969 Specification for Glass Volumetric (Transfer) Pipets

2.2 API Standards:³

MPMS Chapter 1 Terms and Definitions Database

MPMS Chapter 8.1 Manual Sampling of Petroleum and Petroleum Products (ASTM Practice D4057)

MPMS Chapter 8.2 Automatic Sampling of Petroleum and Petroleum Products (ASTM Practice D4177)

MPMS Chapter 8.3 Mixing and Handling of Liquid Samples

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 Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, www.api.org.

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

of Petroleum and Petroleum Products (ASTM Practice D5854)

MPMS Chapter 10.1 Determination of Sediment in Crude Oils and Fuel Oils by the Extraction Method (ASTM Test Method D473)

MPMS Chapter 10.2 Determination of Water in Crude Oil by Distillation (ASTM Test Method D4006)

MPMS Chapter 10.4 Determination of Sediment and Water in Crude Oil by the Centrifuge Method (Field Procedure)

MPMS Chapter 10.5 Determination of Water in Petroleum Products and Bituminous Materials by Distillation (ASTM Test Method D95)

MPMS Chapter 10.6 Determination of Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedures) (ASTM Test Method D1796)

MPMS Chapter 10.9 Test Method for Water in Crude Oils by Coulometric Karl Fischer Titration (ASTM Test Method D4928)

2.3 *IP Standard*:⁴

Methods Book, Appendix B Specification for Methylbenzenes (Toluenes)

2.4 *ISO Standard*:⁵

ISO 5272:1979 Toluene for Industrial Use—Specifications

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, refer to Terminology D4175 and the API *MPMS Chapter 1 Terms and Definitions Database*.

4. Summary of Test Method

4.1 Equal volumes of crude oil and water-saturated toluene are placed into a cone-shaped centrifuge tube. After centrifugation, the volume of the higher density water and sediment layer at the bottom of the tube is read.

5. Significance and Use

5.1 The water and sediment content of crude oil is significant because it can cause corrosion of equipment and problems in processing. A determination of water and sediment content is required to measure accurately net volumes of actual oil in sales, taxation, exchanges, and custody transfers. It is not anticipated that this test method, which is written with a dedicated laboratory facility in mind, is likely to be used in field test rooms or sample rooms due to safety concerns for proper ventilation and handling.

5.2 This test method may not be suitable for crude oils that contain alcohols that are soluble in water. In cases where the impact on the results may be significant, the user is advised to consider using another test method, such as Test Method D4928 (API *MPMS Chapter 10.9*).

6. Apparatus

6.1 Centrifuge:

6.1.1 A centrifuge capable of spinning two or more filled cone-shaped, 203 mm (8 in.) centrifuge tubes at a speed that can be controlled to give a relative centrifugal force (rcf) of a minimum of 600 at the tip of the tubes shall be used (see 6.1.6).

6.1.2 The revolving head, trunnion rings, and trunnion cups, including the cushions, shall be soundly constructed to withstand the maximum centrifugal force capable of being delivered by the power source. The trunnion cups and cushions shall firmly support the tubes when the centrifuge is in motion. The centrifuge shall be enclosed by a metal shield or case strong enough to eliminate danger if any breakage occurs.

6.1.3 The centrifuge shall be heated and controlled thermostatically to avoid unsafe conditions. It shall be capable of maintaining the sample temperature during the entire run at 60 °C ± 3 °C (140 °F ± 5 °F). The thermostatic control shall be capable of maintaining the temperature within these limits and operate safely if there is a flammable atmosphere.

6.1.4 Electric powered and heated centrifuges must meet all safety requirements for use in hazardous areas.

6.1.5 Calculate the necessary minimum speed of the rotating head in revolutions per minute (r/min) as follows:

$$r/\text{min} = 1335 \sqrt{\text{rcf}/d} \quad (1)$$

where:

rcf = relative centrifugal force and

d = diameter of swing measured between tips of opposite tubes when in rotating position, mm, or

$$r/\text{min} = 265 \sqrt{\text{rcf}/d} \quad (2)$$

where:

rcf = relative centrifugal force and

d = diameter of swing measured between tips of opposite tubes when in rotating position, in.

6.1.6 Calculate the relative centrifugal force from a measured speed (r/min) as follows:

$$\text{rcf} = d \left(\frac{r/\text{min}}{1335} \right)^2 \quad (3)$$

where:

d = diameter of swing measured between tips of opposite tubes when in rotating position, mm, or

$$\text{rcf} = d \left(\frac{r/\text{min}}{265} \right)^2 \quad (4)$$

where:

d = diameter of swing measured between tips of opposite tubes when in rotating position, in.

6.2 *Centrifuge Tubes*—Each centrifuge tube shall be a 203 mm (8 in.) cone-shaped tube, conforming to dimensions given in Fig. 1 and made of thoroughly annealed glass. The graduations, numbered as shown in Fig. 1, shall be clear and distinct, and the mouth shall be constricted in shape for closure with a cork. Scale error tolerances and the smallest graduations between various calibration marks are given in Table 1 and apply to calibrations made with air-free water at 20 °C (68 °F),

⁴ Available from Energy Institute, 61 New Cavendish St., London, WIG 7AR, U.K., <http://www.energyinst.org.uk>.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.