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Standard Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products[1]

This standard is issued under the fixed designation D5854; 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 practice covers the handling, mixing, and conditioning procedures that are required to ensure that a representative sample of the liquid petroleum or petroleum product is delivered from the primary sample container/receiver into the analytical test apparatus or into intermediate containers.

1.2 Annex A2 covers acceptance test criteria for power mixer and sample container combinations, while Annex A3 and Annex A4 detail acceptance tests for mixing systems. Appendix X1 is a guide for selecting sample containers.

1.3 For sampling procedures, refer to Practices D4057 (API *MPMS* Chapter 8.1) and D4177 (API *MPMS* Chapter 8.2). Practice D5842 (API *MPMS* Chapter 8.4) covers sampling and handling of light fuels for volatility measurement.

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:*[2]

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products

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

D4928 Test Methods for Water in Crude Oils by Coulometric Karl Fischer Titration

D5842 Practice for Sampling and Handling of Fuels for Volatility Measurement

2.2 *API Documents:*[3]

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

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

MPMS Chapter 8.4 Practice for Sampling and Handling of Fuels for Volatility Measurement (ASTM Practice D5842)

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

Recommended Practice 2003, Protection Against Ignitions Arising Out of Static, Lighting, and Stray Currents

Publication 2026, Safe Access/Egress Involving Floating Roofs of Storage Tanks in Petroleum Service

Publication 2217, Guideline for Confined Space Work in the Petroleum Industry

2.3 *Department of Transportation:*[4]

Code of Federal Regulations, Title 49, Section 173

2.4 *Occupational Safety and Health Standards:*[4]

29 Code of Federal Regulations, Subpart Z, "Toxic and Hazardous Substances," Part 1910.1000 and following

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *intermediate container*—the vessel into which all or part of the sample from a primary container/receiver is transferred for transport, storage, or ease of handling.

3.1.2 *petroleum*—denotes petroleum crudes, as well as petroleum products, normally associated with the petroleum industry.

[1] This practice is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and the API Committee on Petroleum Measurement, and is the direct responsibility of Subcommittee D02.02.0B the joint ASTM-API committee on Sampling, Sediment, Water.

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

[4] Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

3.1.3 *primary container/receiver*—the vessel in which a sample is initially collected.

3.1.3.1 *Discussion*—Examples of primary sample containers include glass and plastic bottles, cans, and fixed and portable sample receivers.

3.1.4 *sampling*—all the steps required to obtain a sample that is representative of the contents of any pipe, tank, or other vessel, and to place that sample in a container from which a representative test specimen can be taken for analysis.

3.1.5 *test specimen*—the representative sample taken from the primary or intermediate sample container for analysis.

4. Significance and Use

4.1 Representative samples of petroleum and petroleum products are required for the determination of chemical and physical properties used to establish standard volumes, prices, and compliance with commercial and regulatory specifications. The treatment of samples from the time of collection until they are analyzed requires care and effort to maintain their compositional integrity.

5. Safety and Health Precautions

5.1 In view of the potential health and safety hazards associated with the handling and mixing of petroleum samples, only qualified personnel should be involved.

5.2 All sample handling and mixing equipment should be approved by the parties involved. All equipment should be installed, operated, and maintained in a manner to minimize potential health and safety hazards.

6. Sample Containers

6.1 No single container type will meet requirements of all petroleum sampling operations. The following are general design and construction considerations for sample containers.

6.2 *Container Configuration*:

6.2.1 Containers should drain continuously toward the outlet to ensure complete liquid withdrawal.

6.2.2 Cylindrical containers are better suited for samples that are to be tested for free water or sediment and water.

6.2.3 Containers should not have internal pockets or dead spots.

6.2.4 Internal surfaces of containers should minimize corrosion, incrustation, water, and sediment clingage.

6.2.5 Container configuration should allow for the transfer of samples from one container to another or to the analytical apparatus while maintaining the integrity of the sample's composition.

6.2.6 Containers should have an inspection cover/closure/cap of sufficient size to facilitate filling, inspection, and cleaning. A means of installing security seals should be provided.

6.2.7 Containers should allow for the preparation of a homogeneous mixture of the sample while preventing the loss of any constituents which affect the representativeness of the sample and the accuracy of the analytical tests.

6.2.8 Containers should be made so as to avoid contamination from external water or other foreign material.

6.2.9 Containers used with closed loop mixers may be equipped with a discharge line inside the container which has multiple outlet ports. Another method of achieving the effect of multiple discharge ports is to split the discharge stream coming from the mixing pump into two or more separate streams with each having its own inlet into the sample container.

6.2.10 Containers used with closed loop mixers should be equipped with a pressure/vacuum relief valve set so as not to exceed the design pressure of the container. A pressure gage should also be provided.

6.2.11 Containers used with closed loop mixers may have multiple suction ports. As a minimum there should be one suction port at the lowest point in the container.

6.3 *Container Size*:

6.3.1 A general rule is that both primary and intermediate containers should be large enough to hold the required sample size within 80 % of the total capacity to facilitate mixing and to provide for thermal expansion.

6.3.2 The size of primary containers is determined from the sampling operation as described in Practices D4057 (API *MPMS* Chapter 8.1) and D4177 (API *MPMS* Chapter 8.2).

6.3.3 The size of intermediate containers should be as large as practical to minimize surface tension effects with due consideration given to storage space requirements, shipping rules and regulations, costs, availability, and other practical considerations.

6.4 *Container Material*:

6.4.1 Sample containers are normally made of glass, metal, or plastic. Exercise care in the selection of container material as it could affect the test results obtained from the sample. Containers acceptable for samples to be tested immediately may not be acceptable for storage of sample.

6.4.2 Glass containers are suitable for many sample test and storage requirements. Clear glass bottles may be examined visually for cleanliness and allow for visual inspection of the sample for free water or solid impurities. Some petroleum samples are affected by exposure to sunlight if clear glass is used. In these cases, brown glass bottles may afford the necessary protection.

6.4.3 Cans coated with tin must have seams that have been soldered on the exterior surfaces with a flux of rosin cleaned in a suitable solvent. Such a flux is easily removed with gasoline, whereas many others are very difficult to remove. Minute traces of flux may contaminate the sample so that results obtained on tests such as dielectric strength, oxidation resistance, and sludge formation may be erroneous. Exercise care also to ensure that samples containing free or entrained water are not corrosive to the metal. Internally epoxy-lined tin cans may have residual contamination and precaution should be taken to ensure its removal.

6.4.4 Cans made of stainless steel with welded seams are suitable for many sampling operations. Other than ensuring the cleanliness, use of these containers presents no unusual concerns.

6.4.5 Plastic bottles must be of a material that is impervious to attack from the sample. This is especially a consideration when using plastic for long term storage of certain petroleum products. Clear plastic bottles are unsuitable for samples sensitive to light.

6.4.6 When sampling aviation fuels, Practice D4306 should be consulted for guidance on container selection. This practice gives information on the types of containers that have been found satisfactory for tests to determine water separation, copper corrosion, electrical conductivity, thermal stability, lubricity, and trace metal content.

6.4.7 Appendix X1 is a guide for selecting the material of which sample containers may be made. It is impossible to cover all petroleum sampling container requirements; therefore, when questions arise as to a container's suitability for a given application, experience and testing should be relied upon.

6.5 *Container Closures*:

6.5.1 For glass bottles, stoppers or screw caps made of a material that will not deteriorate or contaminate the sample may be used. Care must be used when using cork stoppers. Situations where corks should not be used include liquids where loss of light ends may affect the test's results and liquids which are hydroscopic or which have a low water content specification. Rubber stoppers should never be used.

6.5.2 Cans and plastic bottles should be closed with screw caps made of the same material as the container. Caps should provide a vapor tight seal.

6.5.3 Screw caps for cans used to store or transport samples must be protected by a disk faced with a material that will not deteriorate or contaminate the sample. Consideration of closure type is important for samples where vapor loss will affect the test results.

6.6 *Federal Container Requirements*—In addition to the requirements listed above, any sample container that contains hazardous materials or the residue of hazardous material offered for shipment or transportation by air, public roadway, rail, or water, or any combination thereof, must meet the requirements set forth in applicable regulations such as DOT regulations in the Code of Federal Regulations, Title 49, Section 173.

6.7 *Container Cleanliness*:

6.7.1 Sample containers must be clean and free from all substances which might contaminate the material being sampled (such as water, dirt, lint, washing compounds, naphtha and other solvents, soldering fluxes, acids, rust, and oil). Prior to further use, reusable containers such as cans and bottles should be rinsed with a suitable solvent. Use of sludge solvents to remove all traces of sediments and sludge may be necessary. Following the solvent wash, the container should be washed with a strong soap solution, rinsed thoroughly with tap water, and given a final rinse using distilled water. Dry the container either by passing a current of clean warm air through the container or by placing it in a hot dust-free cabinet at 40°C (104°F) or higher. When dry, stopper or cap the container immediately. Normally, it is not necessary to wash new containers.

6.7.2 Depending on service, receivers used in conjunction with automatic samplers may need to be washed with solvent between uses. In most applications, it is not desirable or practical to wash these receivers using soap and water as outlined above for cans and bottles. The cleanliness and integrity of all sample containers/receivers must be verified prior to use.

6.7.3 When sampling aviation fuel, Practice D4306 should be consulted for recommended cleaning procedures for containers that are to be used in tests for determination of water separation, copper corrosion, electrical conductivity, thermal stability, lubricity, and trace metal content.

6.8 *Labels*:

6.8.1 Each sample container is to have a label attached to it which meets the requirements of the parties involved.

6.8.2 Fig. 1 is an example of a label which shows the typical information needed to properly identify the sample. In addition to this basic information, certain governmental agencies such as DOT and OSHA have additional labeling requirements with which personnel involved in the handling and shipping of samples must be familiar.

6.9 *Shipping Enclosures*—Many sample containers require special shipping enclosures before they can be transported from the point of collection. Regulations covering the transport of samples should be consulted (see the Code of Federal Regulations, Title 49, Section 173).

6.10 *Storage and Disposal*:

6.10.1 Except when being transferred, samples should be maintained in a closed container in order to prevent loss of light components. Samples should be protected during storage to prevent weathering or degradation from light, heat, or other potential detrimental conditions.

Sample Identification No.	
Product Name / Grade	
Terminal, Station or Lease	
Sampling Date and Time	
Gauger	

Type of Sample:

☐ All-Level	☐ Running
☐ Bottom	☐ RVP
☐ Clearance	☐ Top
☐ Composite	☐ UML
☐ Line	☐ 1–Foot
☐ Outlet	☐ Other:

Type of Sample:

- ☐ Barge Name
- ☐ Pipeline Batch No.
- ☐ Railcar No.
- ☐ Ship Name
- ☐ Tank No.
- ☐ Truck No.
- ☐ Other

Lab / Job Reference	
Date & Time in Lab	
Technician	

FIG. 1 Typical Sample Label