Manual of Petroleum Measurement Standards Chapter 8—Sampling

Section 3—Standard Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products

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Measurement Coordination

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Chapter 8—Sampling

SECTION 3—STANDARD PRACTICE FOR MIXING AND HANDLING OF LIQUID SAMPLES OF PETROLEUM AND PETROLEUM PRODUCTS

0 Introduction

This standard describes methods and equipment for handling, mixing, and preserving, the integrity of petroleum and petroleum product samples from the time of collection until introduction into the analytical test apparatus.

1 Scope

This standard covers the handling, mixing, and conditioning procedures 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. For sampling procedures, refer to MPMS Chapters 8.1 and 8.2. MPMS Chapter 8.4 should be referred to for the mixing and handling of light fuels for volatility measurement.

Throughout this standard, the term "petroleum" will be used to denote petroleum and petroleum products normally associated with the petroleum industry.

2 References

The most recent editions of the following standards, codes, and specifications are cited in this section.

ACGIH[1]

Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment

API

Manual of Petroleum Measurement Standards
Chapter 8, "Sampling" (all sections)
Chapter 10, "Sediment and Water" (all sections)

Publ 2026 *Guide for Safe Descent onto Floating Roofs of Tanks in Petroleum Service*

Publ 2217 *Guidelines for Confined Space Work in the Petroleum Industry*

Publ 2003 *Protection Against Ignition Arising out of Static, Lightning, and Stray Currents*

ASTM[2]

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

DOT[3]

49 *Code of Federal Regulations* Section 173 and others

OSHA[4]

29 *Code of Federal Regulations* Section 1910.1000, Subchapter 2

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 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.

3.2 primary container/receiver: The vessel in which a sample is initially collected. (Examples of primary sample containers include glass and plastic bottles, cans, core-type thief, and fixed and portable sample receivers.)

3.3 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.

3.4 test specimen: A representative sub-sample taken from the primary or intermediate sample container for analysis.

4 Significance and Use

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.

[1]American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Building D-7, Cincinnati, OH 45211-4438

[2]ASTM, 100 Bar Harbor Drive, West Conshohocken, Pennsylvania 19428

[3]Department of Transportation. *The Code of Federal Regulations* is available from the U.S. Government Printing Office, Washington, D.C. 20402

[4]Occupational Safety and Health Administration, U.S. Department of Labor. The *Code of Federal Regulations* is available from the U.S. Government Printing Office, Washington, D.C. 20402

5 Safety Health Precautions

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

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. See Appendix C.

6 Sample Containers

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

6.1 CONTAINER CONFIGURATION

The following describes container configuration considerations:

a. Containers should drain continuously toward the outlet to ensure complete liquid withdrawal.
b. Cylindrical containers are better suited for samples that are to be tested for free water or sediment and water (S&W).
c. Containers should not have internal pockets or dead spots.
d. Internal surfaces of containers should minimize corrosion, incrustation, water, and sediment clingage.
e. Container configuration should allow for the transfer of samples from one container to another or the analytical apparatus while maintaining the integrity of the sample's composition.
f. 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.
g. Containers should allow for the preparation of a homogeneous mixture of the sample while preventing the loss of any constituents that affect the representativeness of the sample and the accuracy of the analytical tests.
h. Containers should be made so as to avoid contamination from external water or other foreign material.
i. Containers used with closed loop mixers may be equipped with a discharge line inside the container that 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.
j. 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 gauge should also be provided.
k. Containers used with closed loop mixers may have multiple suction ports. As a minimum there should be one suction port at the lowest point of the container.

6.2 CONTAINER SIZE

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

The size of primary containers is determined from the sampling operation as outlined in Chapters 8.1 and 8.2 of API's *Manual of Petroleum Measurements Standards.*

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.

6.3 CONTAINER MATERIAL

Sample containers are normally made of glass, metal, or plastic. Care must be exercised in 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 samples.

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.

Cans made of 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. Care must also be taken 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.

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.

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.

When sampling aviation fuels, ASTM D4306 should be consulted for guidance on container selection. This standard 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.

Appendix A is a guide for selecting material to make sample containers. It is impossible to cover all petroleum sampling container requirements; therefore, when questions arise about a container's suitability for a given application, experience and testing should be relied on.

6.4 CONTAINER CLOSURES

For glass bottles, stoppers or screw caps must be made of material that will not deteriorate or contaminate the sample. Cork stoppers should not be used with liquids when loss of light ends may affect test results and when liquids are hydroscopic or have a low water content specification. Rubber stoppers should never be used.

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.

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.

6.5 FEDERAL CONTAINER REQUIREMENTS

In addition to 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 Department of Transportation (DOT) regulations in the *Code of Federal Regulations* Title 49 Section 173.

6.6 SAMPLE CONTAINER CLEANLINESS

Sample containers must be clean and free from all substances that 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 solvents to remove 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.

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.

When sampling aviation fuel, ASTM 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.

7 Sample Container Labels

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

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

8 Sample Container Shipping Enclosures

Many sample containers require special shipping enclosures before they can be transported from the point of col-

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	

Figure 1—Typical Sample Label

lection. Regulations such as DOT's in the *Code of Federal Regulations* Title 49 Section 173 covering the transport of samples should be consulted.

9 Sample Storage and Disposal

Except when being transferred, samples should be maintained in a closed container 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.

There are many governmental agencies and jurisdictions that have regulations governing the storage and disposal of petroleum samples and containers that can be classified as hazardous materials or hazardous wastes. Those who handle petroleum samples must be familiar with these regulations in addition to their own company policies and procedures.

10 Handling and Compositing Samples

10.1 GENERAL CONSIDERATIONS

It is preferable that analytical tests be conducted using test specimens that have been drawn directly from the primary container. However, it is recognized that all sampling methods do not permit this nor do requirements to transport and store samples. The number of transfers using intermediate containers between the initial sampling operation and the analytical test should be minimized. Each use of intermediate containers increases the potential for loss of light hydrocarbons, loss of water due to clingage or inefficient mixing, and contamination of the sample from external sources including weather.

Before the sample is transferred from one container to another, a homogeneous mix must be created and maintained until the transfer is complete.

If the sampling procedure requires that multiple samples be taken from a single tank, or in the case of marine vessels, multiple or single samples from multiple tanks, analytical tests may be performed on each sample or on a composite of the various samples. When analytical tests are performed on individual samples, which is the recommended procedure, the test results are generally averaged. Depending on the particular application, the results may be averaged arithmetically or on a volumetrically proportional basis according to the proportion of the total petroleum that the sample represents.

10.2 COMPOSITE SAMPLES

A composite sample may be prepared from individual samples taken from the same tank or, in the case of marine vessels, all tanks that contain the same material. When a composite is required, it must consist of proportional parts from each zone if for a single tank. If the composite is for multiple tanks, it must consist of proportional parts from each tank sampled.

Composites can normally be made best in the laboratory. Therefore, samples to be composited should be submitted to the laboratory along with a list of each tank and the volume represented by each sample. The method of compositing should be documented and care taken to preserve the integrity and representativeness of the composite sample.

Making composite samples that will be tested for both density and water or sediment content is especially difficult. The mixing necessary prior to compositing for the water or sediment tests can result in the loss of light ends, which could affect results of the density test. Normally, cooling the sample will minimize loss of light ends.

It is recommended that a portion of each individual sample used in a composite be retained separately (not composited) for retesting if necessary.

10.3 OTHER MIXING PROTOCOL

The guidelines herein are intended to cover most sample handling and mixing requirements and should be used for analytical tests unless determined to be unacceptable for a specific application. This standard is intended to supersede mixing procedures presently found in various sections of the API MPMS Chapter 10.

11 Sample Mixing Methods

Sample mixing methods can be divided into three general categories: power mixers, shaking and none. These categories vary greatly in severity depending on the type of analytical test to be conducted and the characteristics of the sample. Following is a brief discussion of each category.

11.1 POWER MIXERS

Power mixers fall into two general groups: insertion and closed loop. Appendix B is a procedure for testing the effectiveness of power mixers prior to use. Sample container/mixer systems do not have to be tested individually if they are of the same design and operate within the demonstrated service range (that is, water concentration, viscosity of product, and sample volume).

Over-mixing with power mixers may create an oil and water emulsion that will affect the accuracy of certain analytical tests. Power mixers may entrain air into the sample, which could affect certain analytical tests. Loss of vapor normally associated with rise in temperature may also occur, which could affect test results for water, reid vapor pressure (RVP), and density.

11.1.1 Insertion Mixers

These mixers are stand-alone devices that are not an integral part of a given sampling or mixing system. These

mixers can be used on a variety of different types and sizes of sample containers. Non-aerating or high-speed shear mixers are examples of insertion mixers. Insertion mixers may also be of a circulating loop design where a suction port is inserted into the sample container and the sample is circulated externally with a pump through a static mixer and discharged back into the sample container through a dispersal system. Appendix B.4 details the acceptance test for insertion mixers.

11.1.2 Closed Loop Mixers

These mixers are typically used in conjunction with an automatic pipeline sampling system. The mixer may be an integral part of a stationary sample receiver or a stand-alone unit used for portable sample receivers. Appendix B.5 outlines the acceptance test for closed loop mixers.

11.2 SHAKING

Shaking involves manually or mechanically shaking the sample container to eliminate stratification.

11.3 NONE (NO MIXING)

If a sample is known to be homogeneous, no mixing is required. Samples should not be mixed when the analytical tests to be conducted may be affected by air, which could be induced by power mixing or shaking.

12 Selection of Sample Mixing Method

Table 1 lists the recommended mixing procedure to be used before a sample is transferred from a container. The degree of mixing depends on the type of transfer being made, the analytical test to be conducted and characteristics of the sample. In general, the following mixing procedures apply:

Table 1—Summary of Recommended Mixing Procedures

Test Purpose	Recommended Mixing Procedure		
	Power	Shaking	None
Sample transferred from container			
Density for crude and heavy fuels	X		
Sediment and water	X		
Density for other hydrocarbons		X	
Vapor pressure			X
Cloud point			X
Other tests	[a]	[a]	[a]
Sample transferred from extracting device to analytical device			
All tests [b]			X

[a] See specific analytical test procedure.

[b] Example: Static sample removed from a storage tank, e.g., thief to analytical glassware, at time of sampling.

1. Power mixing is required for all crude oil samples to be tested for S&W or density. Power mixing is also required when the sample has been transported or stored in either a primary or intermediate container.
2. No mixing is required if a crude oil sample is transferred from the extracting device to the analytical test device (e.g., core thief) at the time of extraction. However, when a sample is stored or transported in the extracting device, mixing is required.
3. Unless the specific procedure prohibits shaking, all other samples should be shaken with the exception of those to be tested for vapor pressure and cloud point.

APPENDIX A—GUIDE FOR SELECTING SAMPLE CONTAINERS

The following tables are intended to serve as a general guideline in selecting the material from which sample containers may be constructed. It is impossible to cover all petroleum sampling requirements and materials from which sample containers can be made. When multiple tests on the same sample are required, the most restrictive test shall be used as a guide for container selection. In case of conflicting requirements, multiple sampling in different containers should be considered. When questions arise as to a container's suitability for a given application, experience and testing should be relied on.

Table A-1—Summary of Container Materials for Crude Oils

	Type of Analysis:										
	Density	Hydrocarbon Chloride	Neutralization Distillation	Pour Number	Point	Salt	S&W	Trace Sulfur	Vapor Metals	Pressure	Viscosity
Hard borosilicate glass											
Immediate use	S	P	NP	P	S	S	S	P	P	S	S
Storage—6 months	S	P	NP	P	S	S	S	P	P	S	S
Reuse	S	P	NP	P	S	S	S	P	S	S	S
Stainless steel											
Immediate use	S	S	S	S	S	S	S	S	S	S	S
Storage—6 months	S	S	S	S	S	S	S	S	S	S	S
Reuse	S	S	S	S	S	S	S	S	S	S	S
Epoxy-lined steel											
Immediate use	P	S	S	S	S	S	P	S	S	S	S
Storage—6 months	P	S	S	S	S	S	P	S	S	S	S
Reuse	S	S	S	S	S	S	S	S	S	S	S
Tin-plated soldered steel (superclean only)											
Immediate use	S	S	S	S	S	S	S	S	NR	S	S
Storage—6 months	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Reuse	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Polyetrafluoroethylene, perfluoroalkoxy or fluorinated ethylene propylene											
Immediate use	S	S	NP	S	S	S	S	S	P	S	S
Storage—6 months	NR	NR	NP	NR	NR	NR	NR	NR	NR	NR	NR
Reuse	S	S	NP	S	S	S	S	S	S	S	S
High-density linear polyethylene											
Immediate use	S	S	NP	S	S	S	S	S	P	S	S
Storage—6 months	NR	NR	NP	NR	NR	NR	NR	NR	NR	NR	NR
Reuse	NR	NR	NP	NR	NR	NR	NR	NR	NR	NR	NR

Notes:

1. The containers listed in this summary should not be used without consulting the appropriate paragraphs of this practice for detailed advice.
2. Where reuse is indicated, containers should be cleaned in accordance with 6.6 prior to reuse.
3. NR = not recommended; NP = not practical; P = preferred; S = suitable.

Table A-2—Summary of Container Materials for Gasolines

	Type of Analysis:						
	Corrosion	Density	Distillation	Lead	Octane	Vapor Oxygenates	Pressure
Hard borosilicate glass							
Immediate use	S	S	S	S	S	S	S
Storage—6 months	S	S	S	S	S	S	S
Reuse	S	S	S	S	S	S	S
Stainless steel							
Immediate use	S	S	S	S	S	S	S
Storage—6 months	S	S	S	S	S	S	S
Reuse	S	S	S	S	S	S	S
Epoxy-lined steel							
Immediate use	S	S	S	S	S	S	S
Storage—6 months	S	S	S	S	S	S	S
Reuse	S	S	S	S	S	S	S
Tin-plated soldered steel (superclean only)							
Immediate use	NR	S	S	NR	S	S	S
Storage—6 months	NR	S	S	NR	S	S	S
Reuse	NR	S	S	NR	S	S	S
Polyetrafluoroethylene, perfluoroalkoxy or fluorinated ethylene propylene							
Immediate use	NR	NR	NR	NR	NR	NR	NR
Storage—6 months	NR	NR	NR	NR	NR	NR	NR
Reuse	NR	NR	NR	NR	NR	NR	NR
High-density linear polyethylene							
Immediate use	NR	NR	NR	NR	NR	NR	NR
Storage—6 months	NR	NR	NR	NR	NR	NR	NR
Reuse	NR	NR	NR	NR	NR	NR	NR

Notes:

1. The containers listed in this summary should not be used without consulting the appropriate paragraphs of this practice for detailed advice.
2. Where reuse is indicated, containers should be cleaned in accordance with 6.6 prior to reuse.
3. NR = not recommended; NP = not practical; P = preferred; S = suitable.

Table A-3—Summary of Container Materials for Kerosene

	Type of Analysis:								
	Color	Density	Flash Distillation	Freezing Point	Point	Haze	Water Particulate	Water Content	Separation
Hard borosilicate glass									
Immediate use	P	S	S	S	S	P	S	S	S
Storage—6 months	P	S	S	S	S	P	S	S	S
Reuse	P	S	S	S	S	P	S	S	S
Stainless steel									
Immediate use	S	S	S	S	S	NP	S	S	S
Storage—6 months	S	S	S	S	S	NP	S	S	S
Reuse	S	S	S	S	S	NP	S	S	S
Epoxy-lined steel									
Immediate use	S	P	S	S	S	NP	S	P	P
Storage—6 months	S	P	S	S	S	NP	S	P	P
Reuse	S	P	S	S	S	NP	S	S	S
Tin-plated soldered steel (superclean only)									
Immediate use	NR	S	S	S	S	NP	NR	NR	NR
Storage—6 months	NR	S	NR	S	S	NP	NR	NR	NR
Reuse	NR	S	NR	S	S	NP	NR	NR	NR
Polyetrafluoroethylene, perfluoroalkoxy or fluorinated ethylene propylene									
Immediate use	NR	S	S	S	S	NP	S	S	S
Storage—6 months	NR	NR	NR	NR	NR	NP	NR	NR	NR
Reuse	NR	NR	NR	NR	NR	NP	NR	NR	NR
High-density linear polyethylene									
Immediate use	NR	S	S	S	S	NP	S	S	S
Storage—6 months	NR	NR	NR	NR	NR	NP	NR	NR	NR
Reuse	NR	NR	NR	NR	NR	NP	NR	NR	NR

Notes:

1. The containers listed in this summary should not be used without consulting the appropriate paragraphs of this practice for detailed advice.
2. Where reuse is indicated, containers should be cleaned in accordance with 6.6 prior to reuse.
3. NR = not recommended; NP = not practical; P = preferred; S = suitable.

Table A-4—Summary of Container Materials for Fuel Oils (#2, #4, #5, #6)

	Type of Analysis:										
	Cetane	Cloud Point	Color	Density	Distillation	Flash Point	Haze	Pour Point	Sulfur Content	Water Content	Viscosity
Hard borosilicate glass											
Immediate use	S	S	P	S	S	S	P	S	S	S	S
Storage—6 months	S	S	P	S	S	S	P	S	S	S	S
Reuse	S	S	P	S	S	S	P	S	S	S	S
Stainless steel											
Immediate use	S	S	NP	S	S	S	NP	S	S	S	S
Storage—6 months	S	S	NP	S	S	S	NP	S	S	S	S
Reuse	S	S	NP	S	S	S	NP	S	S	S	S
Epoxy-lined steel											
Immediate use	S	S	NP	P	S	S	NP	S	S	P	P
Storage—6 months	S	S	NP	P	S	S	NP	S	S	P	P
Reuse	S	S	NP	S	S	S	NP	S	S	S	S
Tin-plated soldered steel (superclean only)											
Immediate use	S	S	NP	S	S	S	NP	S	NR	S	NR
Storage—6 months	NR	S	NP	NR	NR	NR	NP	NR	NR	NR	NR
Reuse	NR	S	NP	NR	NR	NR	NP	NR	NR	NR	NR
Polyetrafluoroethylene											
Immediate use	S	NR	NP	S	S	S	NP	S	P	S	S
Storage—6 months	NR	NR	NP	NR	NR	NR	NP	NR	P	NR	NR
Reuse	NR	NR	NP	NR	NR	NR	NP	NR	P	NR	NR
Perfluoroalkoxy or fluorinated ethylene propylene											
Immediate use	S	S	NP	S	S	S	NP	S	P	S	S
Storage—6 months	S	S	NP	S	S	S	NP	S	P	S	S
Reuse	NR	NR	NP	NR	NR	NR	NP	NR	P	NR	NR
High-density linear polyethylene											
Immediate use	S	NR	NP	S	S	S	NP	S	P	S	S
Storage—6 months	NR	NR	NP	NR	NR	NR	NP	NR	P	NR	NR
Reuse	NR	NR	NP	NR	NR	NR	NP	NR	P	NR	NR

Notes:

1. The containers listed in this summary should not be used without consulting the appropriate paragraphs of this practice for detailed advice.
2. Where reuse is indicated, containers should be cleaned in accordance with 6.6 prior to reuse.
3. NR = not recommended; NP = not practical; P = preferred; S = suitable.

APPENDIX B—ACCEPTANCE TEST FOR POWER MIXER AND SAMPLE CONTAINER COMBINATIONS

B.1 Introduction

Before a sample is transferred from one container to another, a homogeneous mixture must be created and maintained until the transfer is completed. Various designs of power mixers can be used for this purpose as outlined in Section 11. Before use, each power mixer design and sample container combination must be tested and proven to be effective. This appendix presents criteria for determining adequacy of sample mixers, together with an example calculation. Also included are detailed testing procedures and forms for recording results.

B.2 Outline of Test

The test for proving the effectiveness of a power mixer and sample container combination begins with placing known amounts of water and oil in a container. Tests are then conducted to see if analytical water test results agree with the known baseline water plus the known water added without affecting density of the total mixture by loss of light ends.

The acceptance test requires that each mixer/container combination be tested under the following conditions in which the system will be operated:

a. The normal low and high water content.
b. Liquids that represent the normal or extremes in viscosity. For multi-fluid applications, two fluids should be tested that represent extremes in viscosities.
c. The normal minimum and maximum expected sample volume.

The overall testing process is illustrated in a flowchart, Figure B-1.

B.3 Repeatability and Bias Calculations

During each test run, three test specimens are to be drawn for each time interval being tested. Acceptance criteria for each test run is two-fold. First, there must be repeatability between the three test specimens. Second, the system must be shown to be free of bias. Table B-1 lists the maximum permissible difference between test specimens as well as the maximum permissible difference between the average of all test specimens and total water concentration (bias). The equations on which Table B-1 is based follow.

B.3.1 The equation for maximum permissible variation between test specimens (repeatability check) follows:

$$W_r \leq \text{the larger of } 0.05 \text{ or } k\,\sigma\text{sys } (\%) \quad (1)$$

Where:

W_r = W_t max − W_t min (%)
W_t = individual test specimens
k = 2.92 (valid only for three test specimens)
σsys = $0.064\,(W_k)^{0.5}$
W_k = total water content, baseline + added water (%)

Another expression of Equation 1 is:

$$W_t \max - W_t \min \leq \max 0.05 \text{ or } 2.92 \times 0.064\,(W_k)^{0.5} \quad (2)$$

B.3.2 To establish that the average of three test specimens is acceptable or the bias is suitably small, use equations (3) and (4).

$$W_{avg} \geq W_k - \frac{1.96\,\sigma\text{sys}}{\sqrt{n}} \quad (3)$$

$$W_{avg} \leq W_k + \frac{1.96\,\sigma\text{sys}}{\sqrt{n}} \quad (4)$$

Where:

$$W_{avg} = \frac{\sum_{1}^{n} W_t}{n}$$

n = 3 (number of test specimens)

B.3.3 A sample calculation for acceptance test of a power mixer and sample container combination follows:

Given:

Baseline water concentration = 0.10%

Total water concentration, W_k = 1.00%
(0.10% baseline water plus 0.90% added water)

Test results of W_t:

W_1 = 0.98%
W_2 = 1.05%
W_3 = 1.07%

Step 1: Determine if repeatability is acceptable for the total water concentration as given in Table B-1, Column A.

(W_t max − W_t min) ≤ Table B-1, Column A

(1.07 − 0.98) ≤ 0.19 (at 1.00% Table B-1, Column A)

0.09 ≤ 0.19 (∴ Repeatability is acceptable.)

Step 2: Determine if system bias is acceptable as given in Table B-1, Column B.

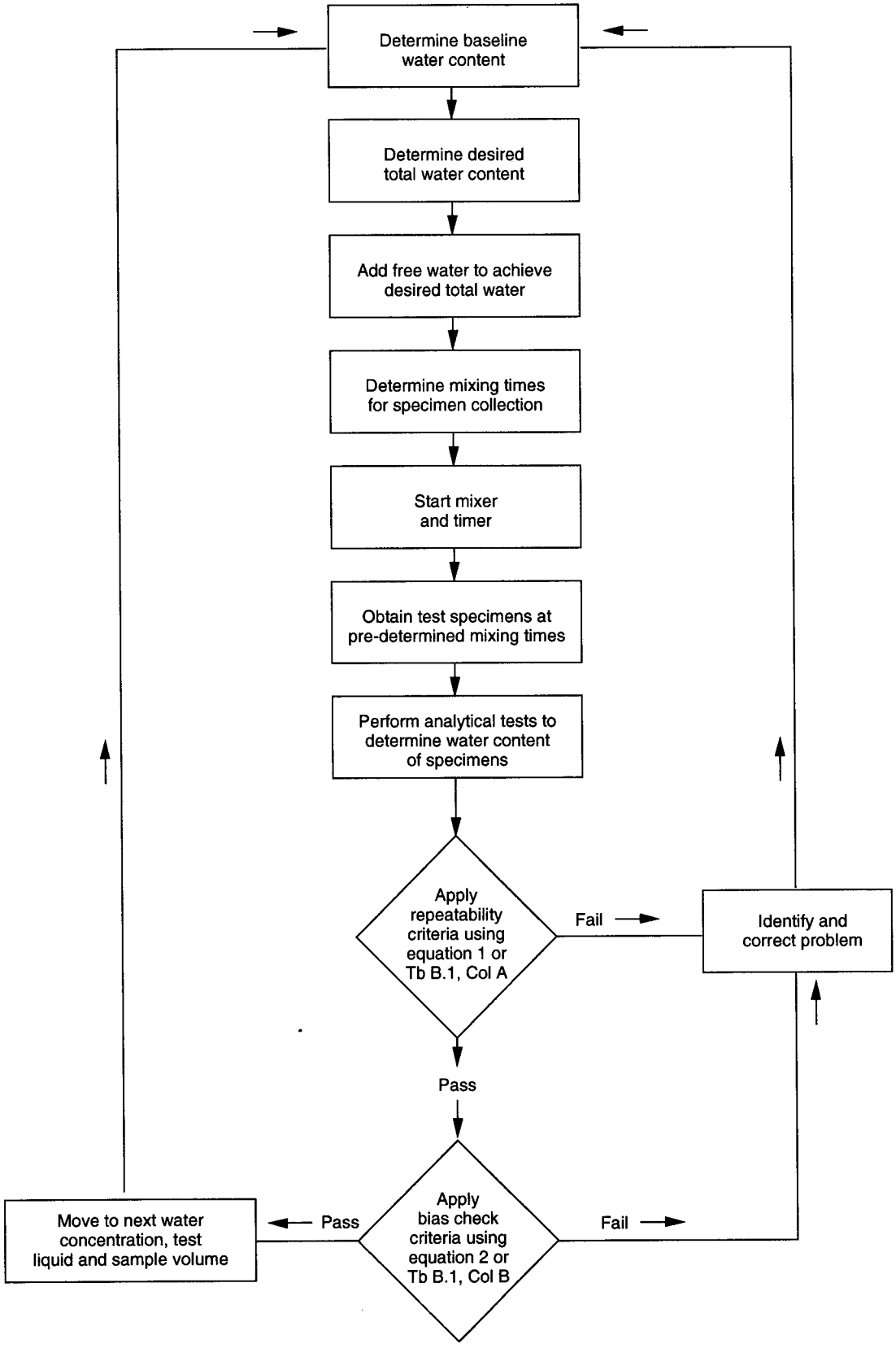

Figure B-1—Flowchart of Power Mixer and Sample Container Acceptance Test

Table B-1—Maximum Permissible Difference Between Test Specimens and Maximum Permissible Difference Between the Average of All Test Specimens and Total Water Concentration (Based on Three Test Specimens)

	Column A Repeatability Check	Column B Bias Check
Total Water Concentration (W_k) (%)	Maximum Permissible Difference Between Test Specimens (%)	Maximum Permissible Difference Between Average of all Test Specimens and Total Water Concentration (%)
0.10	0.06	0.05
0.15	0.07	0.05
0.20	0.08	0.05
0.25	0.09	0.05
0.50	0.13	0.05
1.00	0.19	0.07
1.50	0.23	0.09
2.00	0.27	0.10
2.50	0.29	0.11
3.00	0.32	0.13
3.50	0.35	0.14
4.00	0.37	0.14
4.50	0.40	0.15
5.00	0.42	0.16

Notes:

1. Values in Column A are calculated from the larger of 0.05% or $2.92 \times 0.064\ (W_k)^{0.5}$
2. Values in Column B are calculated from the larger of 0.05% or $1.96 \times 0.064\ (W_k)^{0.5}/\sqrt{3}$.
3. Values of W_k not shown in the table may be obtained by interpolation.
4. In developing this standard, the Working Group found that data available to make reasonable estimates of the expected variability between multiple test specimens during a single test run and the overall efficiency of the system are limited. Equations 1 through 4 have been derived from the available data. It is felt that the data is sufficient to provide a reasonable guideline for the industry at this time. It is hoped that by the publication of this standard and industry's use of test report sheets as shown in Attachments A and B that the database can be expanded for possible refinement of these equations in future revisions.

From Table B-1, Column B, at W_k of 1.00% the value of

$$\frac{1.96\ \sigma sys}{\sqrt{3}} = 0.07\%$$

Then:

$$W_k - \frac{1.96\ \sigma sys}{\sqrt{3}} \leq W_{avg} \leq W_k + \frac{1.96\ \sigma sys}{\sqrt{3}}$$

$$(1.00 - 0.07) \leq \frac{(0.98 + 1.05 + 1.07)}{3} \leq (1.00 + 0.07)$$

$$0.93 \leq 1.03 \leq 1.07\ (\therefore \text{Bias is acceptable.})$$

Step 3: If repeatability and system bias are acceptable, test the next water concentration, another liquid or sample volume. If repeatability or system bias is not acceptable, identify and correct the problem then proceed with retesting.

B.4 Acceptance Test for Insertion Mixers

The ability of each mixer to create a homogeneous mixture in a given sample container must be evaluated before it is used. In the case of insertion mixers, each mixer must be reevaluated for any change in type of petroleum liquid, volume in the sample container, type of sample container, change in mixing conditions such as mixing speed or mixing time, and increase in free water level.

The following test procedure is based on the Karl Fischer Coulometric mass method found in API MPMS Chapter 10.9 for determining water content. Other water test methods are acceptable. The volume of test specimen will therefore need to be adjusted accordingly if the centrifuge or distillation methods are used. Regardless of the test method used for water in the acceptance test, it is recommended that

the acceptance test results be validated using the water test method normally used to determine water content.

It is recommended that a form such as Attachment A be completed and maintained on file for each test conducted.

Note: This procedure and Attachment A.1 are applicable for volumes up to one liter (quart). When testing larger volumes, make adjustments in sample and water volumes to achieve the level of accuracy indicated.

B.4.1 BASELINE WATER DETERMINATION

B.4.1.1 Weigh an empty sample container to the nearest 0.01 gram. Fill the container to the selected level with petroleum liquid. The petroleum liquid used in the acceptance tests should contain no free water.

B.4.1.2 Immerse the mixer head or suction port into the petroleum liquid to a point about 1 to 2 millimeter ($^1/_{16}$ inches) above the bottom of the container and mix the petroleum liquid at the speed and for the duration expected to be used in normal operation. Suggested mixing time for variable speed mixers is one to five minutes at manufacturer's suggested speed. Suggested mixing time for constant speed circulation mixers is five minutes. (For analytical tests using volumetrics, non-aerating shear mixers should be used.)

B.4.1.3 Immediately after mixing, determine the water content based on three test specimens. Calculate the average water content to the nearest 0.01 percent.

B.4.2 TEST FOR KNOWN WATER LEVEL

B.4.2.1 Weigh the petroleum liquid and container.

B.4.2.2 Knowing the weight and baseline water content of the petroleum liquid, add enough water to increase the water content of the dry petroleum liquid to the preselected concentration. To add water to sample volumes less than one liter (quart), use a syringe. It is preferable to use a needle that will reach to the bottom of the container. The needle should be wiped free of water or petroleum liquid before each weighing. A beaker may be used to add water to sample containers larger than one liter (quart).

B.4.2.3 Calculate the percent mass of water in the sample container giving consideration to:

a. Baseline water found in B.4.1 and
b. Weight of water added in B.4.2.2.

B.4.2.4 Let the sample container sit undisturbed for 15 minutes after adding the water, then immerse the mixer at the same point and level as in Step B.4.1.2. Mix sample at the same speed and duration used in Step B.4.1.2. Care must be taken to prevent a rise in temperature that would cause liquid or foam to boil from the sample container. To prevent a boilover, it may be necessary to place the sample container in an ice bath.

B.4.2.5 If in actual practice test specimens will be drawn from the container before the mixer is turned off or slowed down (often done for quick settling phases), then test specimens should be drawn in this manner during the proving test.

If in actual practice test specimens will be drawn from the container after the mixer is turned off and the mixer is removed from the container, test specimens should then be drawn using the same elapsed time as it takes to draw test specimens or transfer sample from the container during the proving test.

B.4.3 ANALYSIS OF RESULTS

B.4.3.1 The mixer, position of the mixer head or suction/discharge ports, and mixing time are adequate when performance has been demonstrated per Equations 1 through 4. (See B.3.)

B.4.3.2 If acceptable results have not been obtained, the acceptance test must be repeated on fresh portions of petroleum liquid and water in a clean sample container while changing the power, mixing time, height of the mixer head or suction/discharge ports, or a combination thereof until the chosen conditions result in a mixture that yields repeatable results within an acceptable time. These conditions of power, mixing time, and depth of mixer head or suction/discharge ports should then be used for all subsequent mixing operations for that sample container and petroleum liquid. Experience has shown that if agreement has not been obtained after 20 minutes of continuous mixing (for most hydrocarbons) with the mixer running, additional mixing time is normally of no value. A change in one of the other conditions is necessary.

B.5 Acceptance Test for Closed Loop Mixing Systems

Closed loop mixers are normally designed for only one type and configuration of sample receiver and operate at a constant flow rate. These systems need to be evaluated at installation and reevaluated with changes in petroleum liquid, increase in free water concentration, or minimum and maximum sample volume. However, if more than one type and configuration of sample receiver is used with a given mixer, evaluations will need to be made for each configuration.

The following test procedure is based on the Karl Fischer Coulometric mass method found in API MPMS Chapter 10.9 for determining water content; however, other water test methods are acceptable. The size of test specimen specified will therefore need to be adjusted accordingly if the centrifuge or distillation methods are used. Regardless of the test method used for water in the acceptance test, it is recommended that the acceptance test results be validated with the water test method normally used to determine water content.

It is recommended that a form such as Attachment B be completed and maintained on file for each test conducted.

B.5.1 BASELINE WATER DETERMINATION

B.5.1.1 Place the predetermined volume of test liquid in the sample container. The test liquid should contain no free water.

B.5.1.2 Align valves on the sample receiver with the circulation pump and begin mixing. After five minutes and while the mixer is running, draw three test specimens. Calculate the average baseline water content to the nearest 0.01 percent.

B.5.2 TEST FOR KNOWN WATER CONTENT

B.5.2.1 Using a beaker and balance, weigh in the appropriate quantities of oil and water to produce the desired volume and water content in the sample receiver. A composite weigh-in tally is shown in Attachment B. If formation water is used, the sediment and salt content must be determined.

If the predetermined quantity of oil has been utilized in Step B.5.1, and baseline water determination and the test specimen extraction weights have been accounted for, then only the water portion needs be added for this test.

B.5.2.2 Calculate the mass percent of water in the sample receiver using the composite testing worksheet shown as Attachment B. Log the data from Steps B.5.2.2 and B.5.3.1 then calculate the mass percent of water.

B.5.2.3 After adding water to the sample receiver, let settle for 15 minutes before mixing. After five minutes of mixing, and while mixing, draw three test specimens and test for mass percent of water. At intervals of five minutes, continue to draw sets of three test specimens for a total of 15 minutes mixing time.

Note: Most closed loop mixing systems either do not have septums through which test specimens can be drawn or operate at a high enough pressure that use of septums may be unsafe. In these cases, it is recommended that the test specimen draw-off valve be equipped with a short piece of 1/4 inches (about 6 millimeters) stainless steel tubing with a short piece of plastic tubing slipped over the open end. The open end of the plastic tubing is placed in a clean container. Once flow is established and the tubing displaced, the syringes can be filled through a hole punched in the plastic tubing with the syringe needle. The sample in the draw-off container must then be returned to the sample container.

B.5.3 ANALYSIS OF RESULTS

B.5.3.1 The system and mixing time are adequate when repeatability and accuracy have been demonstrated per Equations 1 through 4. (See B.3.)

B.5.3.2 Experience has shown that mixing times of 5 to 20 minutes are effective. Normally, additional mixing is of no value and often produces diminishing results due to a reduction in viscosity from an increase in temperature. In these situations, consideration has to be given to changing the flow rate, in-line static mixer, configuration of sample receiver suction or discharge, or a combination thereof until the chosen conditions result in a mixture that yields the required agreement within an acceptable time.

B.6 Acceptance Test for Sediments

The procedures outlined in B.4 and B.5, while intended to show the effectiveness of mixers in the presence of water, are equally effective for sediments.

ATTACHMENT A.1
ACCEPTANCE TEST DATA SHEET FOR INSERTION MIXERS
(Gravimetrically using Coulometric Karl Fischer)

Date_____ Location _____ Technician _____ Test No._____

Mixer _____ Product _____ Sample Container_____

Speed_____ Mixing Time_____ Ice Bath Required_____

Position of Mixer Head, Suction/Discharge Ports _____

Test Conditions: ❒ Low Water Level ❒ Low Viscosity Liquid ❒ Low Sample Volume
❒ High Water Level ❒ High Viscosity Liquid ❒ High Sample Volume

I. Baseline Water Content of Petroleum Liquid

Test Specimen	Weight of Test Specimen (g)	μg Water	(μg/g) × 10000
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
		Average Baseline Water, % Mass (a)	_____

II. Calculated % Water in Sample

Wt. of Sample Container & Petroleum Liquid	(1)	_____ g
Wt. of Empty Container	(2)	_____ g
Wt. of Petroleum Liquid (1) − (2)	(3)	_____ g
Wt. of Water Added	(4)	_____ g
Total Wt. of Sample (3) + (4)	(5)	_____ g
Wt. of Baseline Water [(3) × (a)]/100	(6)	_____ g
Wt. of Water Added (4)	(7)	_____ g
Total Wt. of Water Present (6) + (7)	(8)	_____ g
Calculated % Water 5}((85))} 3 100		_____ % Mass (Wk)

III. Test Runs

Test Specimen (W_t)	Weight of Test Specimen (g)	μg Water	(μg/g) × 10000
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
		Average Baseline plus Known Water, % Mass (W_{avg})	

IV. Analysis

$(W_t \max - W_t \min) \leq k\ \sigma sys$; _____ ($W_t$ max) − _____ (W_t min) ≤ _____ (Tb B-1, Col A @ W_k)

Yes No (Circle one) _____ ≤ _____

$$\left(W_k - \frac{1.96\ \sigma sys}{\sqrt{3}}\right) \leq W_{avg} \leq \left(W_k + \frac{1.96\ \sigma sys}{\sqrt{3}}\right);$$

(___ (W_k) − _____ (Tb B-1, Col B @ W_k)) ≤ ___ + ___ + ___ / 3 ≤ (___ (W_k) + _____ (Tb B-1, Col B @ W_k))

Yes No (Circle one) _____ ≤ _____ ≤ _____

For a system to pass the acceptance test, the answer to both questions must be YES.

Remarks: _____

ATTACHMENT A.2
ACCEPTANCE TEST DATA SHEET FOR INSERTION MIXERS
(Volumetrically using Coulometric Karl Fischer, Distillation or Centrifuge)

Date_____ Location _____ Technician _____ Test No._____

Mixer _____ Product _____ Sample Container_____

Speed_____ Mixing Time_____ Ice Bath Required_____

Position of Mixer Head, Suction/Discharge Ports _____

Water Analysis ❒ Karl Fischer ❒ Distillation ❒ Centrifuge

Test Conditions: ❒ Low Water Level ❒ Low Viscosity Liquid ❒ Low Sample Volume

❒ High Water Level ❒ High Viscosity Liquid ❒ High Sample Volume

I. Baseline Water Content of Petroleum Liquid

Test Specimen	Test Results
1	_____
2	_____
3	_____
Average Baseline Water, % Vol (a)	_____

II. Calculated % Water in Sample

Vol. of Petroleum Liquid	(1)	_____
Vol. of Water Added	(2)	_____
Total Vol. of Sample (1) + (2)	(3)	_____
Vol. of Baseline Water [(1) × (a)]/100	(4)	_____
Vol. of Water Added (2)	(5)	_____
Total Vol. of Water Present (4) + (5)	(6)	_____

Calculated % Water $= \frac{(6)}{(3)} \times 100$ _____ % Vol (W_k)

III. Test Runs

Test Specimen (W_t)	Test Results
1	_____
2	_____
3	_____
Average Baseline plus Known Water, % Mass (W_{avg})	_____

(see back for Analysis)

IV. Analysis

$(W_t \max - W_t \min) \leq k\,\sigma\text{sys}$; _____ ($W_t$ max) − _____ (W_t min) ≤ _____ (Tb B-1, Col A @W_k)

Yes No (Circle one) _____ ≤ _____

$$\left(W_k - \frac{1.96\,\sigma\text{sys}}{\sqrt{3}}\right) \leq W_{avg} \leq \left(W_k + \frac{1.96\,\sigma\text{sys}}{\sqrt{3}}\right);$$

(___ (W_k) − _____ (Tb B-1, Col B @W_k)) ≤ ___ + ___ + ___ (3) ≤ (___ (W_k) + _____ (Tb B-1, Col B @W_k))

Yes No (Circle one) _____ ≤ _____ ≤ _____

For a system to pass the acceptance test, the answer to both questions must be YES.

Remarks: _____

ATTACHMENT B.1
ACCEPTANCE TEST DATA SHEET FOR CLOSED LOOP MIXING SYSTEMS
(Gravimetrically using Coulometric Karl Fischer)

Date_____ Location _____ Technician _____ Test No._____

Manufacturer_____ Mixer Model _____ Sample Receiver Model_____

GPM _____ Running Press _____ In-Line Static Mixer_____

Test Conditions: ❒ Low Water Level ❒ Low Viscosity Liquid ❒ Low Sample Volume
❒ High Water Level ❒ High Viscosity Liquid ❒ High Sample Volume

I. % Sediment in Test Water

Wt. of Beaker and Sediment after Test	(a)	_____ g
Wt. of Empty Beaker	(b)	_____ g
Wt. of Sediment (a) − (b)	(c)	_____ g
Wt. of Test Water Used	(d)	_____ g
% Mass Sediment [(c)/(d)] × 100	(e)	_____ %

II. Weight of Petroleum Liquid Placed in Sample Receiver

Pour	Beaker Full Wt. (g)	Beaker Empty Wt. (g)	Net (g)
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____
5	_____	_____	_____
6	_____	_____	_____
		Total Weight (f)	_____ g

III. Baseline Water Content of Petroleum Liquid

Test Specimen	Weight of Test Specimen (g)	μg Water	% Mass (μg/g) × 10000
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
		Average Baseline Water, % Mass (h)	_____

IV. Calculated % Water in Sample

Wt. of Petroleum Liquid (f)	(1)	_____ g
Wt. of Water and Sediment Added	(2)	_____ g
Wt. of Sediment Added [(2) × (e)]/100	(3)	_____ g
Wt. of Water Added (2) − (3)	(4)	_____ g
Total Wt. of Sample (1) + (3) + (4)	(5)	_____ g
Wt. of Baseline Water [(1) × (h)]/100	(6)	_____ g
Wt. of Water Added (4)	(7)	_____ g
Total Wt. of Water Present (6) + (7)	(8)	_____ g
Calculated % Water = $\frac{(8)}{(5)} \times 100$		_____ % Mass (W_k)

V. Test Runs

Test Specimen (W_t)	Weight of Test Specimen (g)	μg Water	% Mass (μg/g) × 10000
1			
2			
3			
4			
		Average Baseline plus Known Water, % Mass (W_{avg})	

VI. Analysis

$(W_t \max - W_t \min) \leq k\,\sigma sys$; $\underset{W_t - \max}{\_\_\_} + \underset{W_t - \min}{\_\_\_} - \_\_\_ \leq \underset{\text{Tb B-1, Col A @}W_k}{\_\_\_}$

Yes No (Circle one) $\_\_\_ \leq \_\_\_$

$$\left(W_k - \frac{1.96\,\sigma sys}{\sqrt{3}}\right) \leq W_{avg} \leq \left(W_k + \frac{1.96\,\sigma sys}{\sqrt{3}}\right);$$

$\underset{W_k}{(\_\_\_} - \underset{\text{Tb B.1, Col B @}W_k}{\_\_\_}) \leq \underset{3}{\_\_\_} \leq \underset{W_k}{(\_\_\_} + \underset{\text{Tb B-1, Col B @}W_k}{\_\_\_})$

Yes No (Circle one) $\_\_\_ \leq \_\_\_ \leq \_\_\_$

For a system to pass the acceptance test, the answer to both questions must be YES.

Remarks: _____

ATTACHMENT B.2
ACCEPTANCE TEST DATA SHEET FOR CLOSED LOOP MIXING SYSTEMS
(Volumetrically using Coulometric Karl Fischer, Distillation, or Centrifuge)

Date_____ Location _____ Technician _____ Test No._____

Manufacturer_____ Mixer Model _____ Sample Receiver Model_____

GPM_____ Running Pressure _____ In-Line Static Mixer_____

Water Analysis: ❒ Karl Fisher ❒ Distillation ❒ Centrifuse

Test Conditions: ❒ Low Water Level ❒ Low Viscosity Liquid ❒ Low Sample Volume

❒ High Water Level ❒ High Viscosity Liquid ❒ High Sample Volume

I. % Sediment in Test Water

Wt. of Beaker and Sediment after Test	(a)	_____ g
Wt. of Empty Beaker	(b)	_____ g
Wt. of Sediment (a) − (b)	(c)	_____ g
Wt. of Test Water Used	(d)	_____ g
% Mass Sediment [(c)/(d)] × 100	(e)	_____ % Mass
% Vol. Sediment [((e) × Sp. Gty. Test Liquid)/2]	(f)	_____ % Vol.

II. Volume of Petroleum Liquid Placed in Sample Receiver

Pour	Beaker Volume
1	_____
2	_____
3	_____
4	_____
5	_____
6	_____
Total Vol. (g)	_____

III. Baseline Water Content of Petroleum Liquid

Test Specimen	Test Results
1	_____
2	_____
3	_____
Average Baseline Water, % Vol. (h)	_____

IV. Calculated % Water in Sample

Vol. of Petroleum Liquid (g)	(1)	_____
Vol. of Water & Sediment Added	(2)	_____
Vol. of Sediment Added [(2) × (f)]/100	(3)	_____
Vol. of Water Added (2) − (3)	(4)	_____
Total Vol. of Sample (1) + (3) + (4)	(5)	_____
Vol. of Baseline Water [(1) × (h)]/100	(6)	_____
Vol. of Water Added (4)	(7)	_____
Total Vol. of Water Present (6) + (7)	(8)	_____
Calculated % Water = $\frac{(8)}{(5)} \times 100$		_____ % Vol. (W_k)

V. Test Runs

Test Specimen	Test Results
1	_____
2	_____
3	_____
4	_____

Average Baseline plus Known Water, % Vol. (W_{avg}) _____

VI. Analysis

(W_t max − W_t min) ≤ k σsys; $\underset{W_t \text{ max}}{+\quad +} - \underset{W_t \text{ min}}{\_\_\_\_\_} \leq \underset{\text{Tb B-1, Col A @}W_k}{\_\_\_\_\_}$

Yes No _____ ≤ _____
(Circle one)

$$\left(W_k - \frac{1.96\ \sigma\text{sys}}{\sqrt{3}}\right) \leq W_{avg} \leq \left(W_k + \frac{1.96\ \sigma\text{sys}}{\sqrt{3}}\right);$$

$\underset{W_k}{(\_\_\_} - \underset{\text{Tb B-1, Col B @}W_k}{\_\_\_\_\_}) \leq \underset{3}{\_\_\_\_\_} \leq \underset{W_k}{(\_\_\_} + \underset{\text{Tb B-1, Col B @ }W_k}{\_\_\_\_\_})$

Yes No _____ ≤ _____ ≤ _____
(Circle one)

For a system to pass the acceptance test, the answer to both questions must be YES.

Remarks: _____

APPENDIX C—SAFETY AND HEALTH PRECAUTIONS

C.1 Physical Characteristics and Fire Considerations

C.1.1 Personnel involved with the handling of petroleum-related substances (and other chemical materials) should be familiar with their physical and chemical characteristics, including potential for fire, explosion, and reactivity, and appropriate emergency procedures. They should comply with individual company safe operating practices and local, state, and federal regulations, including use of proper protective clothing and equipment. Personnel should be alert to avoid potential sources of ignition and should keep containers of materials closed when not in use.

C.1.2 API Publications 2217, 2026, 2003, and any applicable regulations should be consulted when handling and mixing petroleum samples.

C.1.3 Information regarding particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, and the material safety data sheet.

C.2 Safety and Health Conditions

C.2.1 Potential health effects can result from exposure to any chemical and are dependent on the toxicity of the chemical, concentration, and length of the exposure. Everyone should minimize his or her exposure to workplace chemicals. The following general precautions are suggested:

a. Minimize skin and eye contact and breathing of vapors.

b. Keep chemicals away from the mouth; they can be harmful or fatal if swallowed or aspirated.

c. Keep containers closed when not in use.

d. Keep work areas as clean as possible and well ventilated.

e. Clean up spills promptly and in accordance with pertinent safety, health, and environmental regulations.

f. Observe established limits and use proper protective clothing and equipment.

Information on exposure limits can be found by consulting the most recent editions of the Occupational Safety and Health Standards, 29 *Code of Federal Regulations* Sections 1910, 1000 and the ACGIH publication, *Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment.*

C.2.2 Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer, and the material safety data sheet.

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