Designation: D923 – 15

Standard Practices for Sampling Electrical Insulating Liquids[1]

This standard is issued under the fixed designation D923; 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 These practices cover sampling of new electrical insulating liquids including oils, askarels, silicones, synthetic liquids, and natural ester insulating liquids as well as those insulating liquids in service or subsequent to service in cables, transformers, circuit breakers, and other electrical apparatus. These practices apply to liquids having a viscosity of less than 6.476×10^{-4} m^2/s (540 cSt) at 40°C (104°F).

1.2 Representative samples of electrical insulating liquids are taken for test specimens so that the quality pertinent to their use may be determined. The quality in different portions of a given container, or the average quality of the whole bulk may be ascertained if desired.

1.3 The values stated in SI units are regarded as the standard where applicable. Inch pound units are used where there is no SI equivalent.

1.4 These practices also include special techniques and devices for sampling for dissolved gases-in-oil (DGA) (D3612), water (D1533) and particles (D6786).

1.5 For ease of use, this document has been indexed as follows:

Section Title	Section/ Paragraph
Mandatory Conditions and General Information	Section 5
Description of Sampling Devices and Containers	Section 6, Annex A1, Appendix X2
Most Frequently Used Sampling Techniques for Electrical Apparatus	
Collecting Samples from Electrical Equipment Using Bottles and Cans	Section 7, Appendix X1, Appendix X2
Collecting Samples from Electrical Equipment Using Glass Syringes (DGA and Water Analysis)	Section 8
Collecting Samples from Electrical Equipment Using Stainless Steel Cylinders (DGA and Water Analysis)	Section 9
Sampling of Cans, Drums, Tank Cars, Tank Trucks and Small Electrical Equipment	
Sampling Using the Dip-Type Device (drum thief)	Section 10
Sampling Using the Pressure-Type Device	Section 11, Annex A1.1
Sampling Using the Tank Car-Type Device	Section 12, Annex A1.2
Sampling Cable Feeders	
Mandatory Conditions	Section 13
General Considerations	Section 14
Sampling Using the Manifold-Type Device	Section 15, Annex A1.3
Cleaning, Preparation, Storage, and Handling of Sampling Containers	Section 16
Storage, Packaging and Shipping of Samples	Section 17
Cleaning and Storage of Sampling Devices	Section 18
Sample Information	Section 19
Mandatory Information—Construction of Sampling Devices	Annex A1
Determination of Electrical Apparatus Temperature	Appendix X1
Sample Container Types	Appendix X2

1.6 Handle askarels containing polychlorinated biphenyls (PCBs) according to federal and local regulations existing for that country. For example, the federal regulations concerning PCBs in the United States can be found in 40 CFR Part 761.

1.7 Properly contain, package and dispose of any liquid or material resulting from the use of these practices in a manner that is in accordance with local and state regulations specific to the country in which the samples are taken.

1.8 *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.* Specific warning statements are given in 1.6, 1.7, Section 5, 10.1, 13.2, 15.2.3, Section 16, and 18.2. These practices involve close contact with the electrical insulating liquids being sampled as well as liquids and other materials used to clean the sampling tools and devices. When required, or as a matter of diligence to personal safety, use personal protective equipment (PPE).

[1] These practices are under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gases and are the direct responsibility of Subcommittee D27.07 on Physical Test.

Current edition approved Oct. 1, 2015. Published October 2015. Originally approved in 1947. Last previous edition approved in 2007 as D923 – 07. DOI: 10.1520/D0923-15.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1533 Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration

D1933 Specification for Nitrogen Gas as an Electrical Insulating Material

D3612 Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D6786 Test Method for Particle Count in Mineral Insulating Oil Using Automatic Optical Particle Counters

3. Terminology

3.1 *Definitions:*

3.1.1 *sampling*—the obtaining of that amount of a material which is adequate for making the required tests and which is representative of that portion of the material from which it is taken.

3.1.1.1 *Discussion*—In most cases the detection of contaminants that are not ordinarily dispersed uniformly through the liquid being sampled, such as water or solid particles, necessitates taking samples at specific locations where the contaminants are likely to be found. For a liquid having a relative density (specific gravity) less than one, water and some other impurities are most likely to be found on or near the bottom. In the case of a liquid having a specific gravity greater than one, some of these impurities are most likely to be found on or near the surface.

4. Significance and Use

4.1 Accurate sampling, whether of the complete contents or only parts thereof, is extremely important from the standpoint of evaluating the quality of the liquid insulant sampled. Obviously, examination of a test specimen that, because of careless sampling procedure or contamination in sampling equipment, is not directly representative, leads to erroneous conclusions concerning quality and in addition results in a loss of time, effort, and expense in securing, transporting, and testing the sample.

4.2 A study of gases and moisture contained in insulating oils from transformers and other electrical power apparatus can frequently give an early indication of abnormal behavior of the apparatus, and may indicate appropriate action be taken on the equipment before it suffers greater damage. Specific gas and moisture content can be determined from oil sampled for this purpose.

5. Mandatory Conditions and General Information

5.1 *Mandatory Conditions when Sampling Electrical Apparatus:*

5.1.1 Energized electrical apparatus being sampled must have a positive pressure at the sampling outlet, so as not to introduce an air bubble into the apparatus during the sampling process. Refer to 7.2.

5.1.2 Do not draw samples from any energized electrical equipment with a small volume of oil, especially those that require the addition of oil to maintain the electric strength of the insulation system. If the proper level or existing level can not be accurately determined do not proceed.

5.1.3 Maintain the insulating fluid within the electrical apparatus being sampled at a level that will not reduce the electric strength of the insulation system.

5.1.4 Do not sample electrical apparatus if only a drain plug is provided, as it would be difficult to control the flow.

5.1.5 Do not draw samples from energized instrument transformers such as CTs and PTs.

5.1.6 Do not draw samples from an energized switch or the cable termination compartment of network transformers.

5.2 *General Information:*

5.2.1 Take and handle samples or test specimens in such a manner as to avoid the loss or gain of properties for which they are being tested. Some tests are greatly affected by minute traces of impurities, and it is imperative that utmost precautions be taken to prevent contamination when obtaining samples. Due to the hygroscopic tendency of insulating liquids, it is important to minimize exposure to the atmosphere of the sample being taken.

5.2.2 Take a sufficient quantity of liquid as a sample to cover the requirements of the respective tests to be made. Make reference to the procedures governing these tests to ascertain the quantity of liquid for each test specimen and the number of test specimens required.

5.2.3 When samples are to be taken the temperature of the liquid should be equal to or greater than the temperature of the surrounding air in order to minimize the possibility of condensed moisture from the air being absorbed by the liquid during the sampling process, particularly in a humid atmosphere.

5.2.4 When taking samples of liquid from large storage tanks, transformers, oil-circuit breakers, gravity-fed reservoirs on oil-filled cable feeders, and other electrical equipment, the electrical equipment drain valve is usually adequate. However, when high relative humidity conditions exist and it is desired to obtain samples through a closed system, the manifold in Fig. 10 is recommended.

5.3 *General Information when Sampling Electrical Apparatus:*

5.3.1 All non-hermetically sealed equipment, filled with insulating liquid having a relative density (specific gravity) less than 1, should be provided with the sampling outlet located at the bottom of the tank so that bottom samples of the oil may be obtained.

5.3.2 All non-hermetically sealed equipment, filled with insulating liquid having a relative density (specific gravity) greater than 1, should be provided with the sampling outlet located at the top of the tank at the 25°C (77°F) liquid level so that a top sample of the liquid may be obtained.

[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.

5.3.3 When make-up liquid is added to any piece of electrical equipment or the liquid is filtered, allow sufficient time to lapse to allow for complete mixing before sampling in order that a representative sample is obtained.

5.3.4 If samples or test specimens must be taken when the liquid temperature is below 0°C (32°F), high water content may not be detected because of the formation of ice. Ice is a concern in both energized and de-energized electrical apparatus where insulating oil-filled compartments operate at temperatures below freezing, such as some tap changer compartments and circuit breaker tanks.

5.3.5 When retrieving samples from electrical apparatus, record the apparatus temperature (°C) along with the identification information as required by Section 19. Knowledge of the apparatus temperature (°C) at the time of sampling aids in the interpretation of results from certain tests (Refer to Appendix X1).

5.4 *General Information when Sampling Liquid-Filled Tanks, Drums, Tank Trucks, Tank Cars and other Similar Containers :*

5.4.1 When sampling large outdoor tanks, tank trucks, tank cars, and de-energized electrical equipment the temperature of the liquid to be sampled may be colder than the surrounding air. On such an occasion, determine and report the temperature of the liquid and air as well as the relative humidity with the results of tests. It is undesirable to collect samples that are exposed to the atmosphere when the relative humidity exceeds 50 % or under conditions of rain or snow.

5.4.2 Allow containers of new liquid to remain undisturbed for at least 8 h before samples or test specimens are taken. In some instances, such as in the case of tank cars, it is not practical to wait this prescribed length of time, and samples for routine tests may be taken after the liquid has remained undisturbed for as long a period as practicable. For referee tests, allow the full 8-h waiting period to elapse before taking samples or test specimens. Repeat samples or test specimens from tank cars may be taken without waiting an additional 8 h.

5.4.3 Unless otherwise specified, take samples of insulating liquids having a relative density (specific gravity) of less than 1 from the bottom of the liquid container. For drums, cans, small tanks, etc., design the sampling device so that the sample is obtained a distance of 3 mm from the bottom of the container, while for large tanks, tank trucks and tank cars, the distance is within 13 mm of the bottom.

5.4.4 Unless otherwise specified, take samples of insulating liquids having a relative density (specific gravity) of greater than 1 from the surface layer of the liquid.

6. Description of Sampling Devices and Containers

6.1 Devices suitable for withdrawing samples of liquid from containers, electrical equipment, cable feeders, and cable joints are described below, shown in Figs. 1–10 and the Annex, and discussed in Appendix X1.

6.2 *Electrical Equipment Sampling Drain Valve or Port*—Used for taking top or bottom samples from energized or de-energized electrical apparatus. This device is especially suitable when collecting samples in a glass jar, metal can, or other suitable containers as described in this section.

6.3 *Glass Bottle*—Used for securing and storing the sample. Amber or clear (see Notes 1 and 2) and may be either glass-stoppered or fitted with screw caps having a pulp-board liner faced with tin or aluminum foil, or with a suitable oil-resistant plastic such as polyethylene, polytetrafluoroethylene (PTFE) or fluoro-elastomers. Do not use any incompatible natural or synthetic rubber materials. Must meet the requirements of Section 16. (See Appendix X2.)

NOTE 1—While amber-colored glass bottles are used for storing samples as protection against light, clear glass bottles afford better visual inspection of the samples or test specimens for impurities such as water and foreign particles. Take samples that are to be subjected to referee tests in new amber-colored containers that have been cleaned as described in Section 16.

6.4 *Other Bottle or Can Containers (Note 2)*—Used for securing and storing the sample. May be constructed from a suitable oil-resistant plastic such as high-density polyethylene (HDPE) (do not use for long term storage when water content is to be determined), or metal cans such as those made from aluminum, stainless steel, other appropriate metal, or PTFE lined. Metals cans are to be constructed as fully extruded, pressed seams or welded seams. Solder seams may leave a residue that will contaminate the sample. Screw caps and closures must meet the requirements of 6.3. (See Appendix X2.)

NOTE 2—It is recommended to retrieve samples for DGA and water analysis using only syringes or stainless steel cylinders. If bottles and cans are used, gases that are to be measured in the DGA analysis can easily escape from these types of containers. Alternatively, environmental gases can become entrained into the sample. Both situations can alter the results significantly.

6.5 *Glass Syringe*—The device shown in Fig. 1 must be of a suitable size terminated with a Luer lock fitting to which is attached a three-way stopcock. It is used for taking samples usually from a valve located on an insulating liquid-filled electrical apparatus. Syringes having precision ground barrels and pistons are preferred. This sampling device is the preferred mechanism for taking samples for dissolved gases-in-oil and water content. Refer to Figs. 1–4 for step by step instruction on how the device is to be used. (See Appendix X2.)

6.5.1 Stopcocks used on syringes must be compatible with the insulating liquid being sampled. Polycarbonate and polystyrene for example stopcocks are not appropriate.

6.6 *Stainless Steel Sampling Cylinders*— The device shown in Fig. 5 is equipped with valves on each end may be used for sampling from a valve located on an insulating liquid-filled electrical apparatus. This is an alternative sampling device for taking samples for dissolved gases-in-oil, water content, and areas of excessive environmental contamination.

6.6.1 The materials of construction of the valves used on stainless steel cylinders must be compatible with the liquid being sampled. Valve packing materials such as Nitrile rubber, fluoro-elastomers and PTFE have been found suitable.

6.7 *Dip Type or Drum Thief*—The device shown in Fig. 6 is used for taking bottom samples from drums, storage tanks, and small de-energized electrical equipment, that are to be subjected to routine tests. It is fabricated of metal, glass or a

compatible plastic and available from most laboratory supply houses. It is not recommended for use under the following conditions:

6.7.1 When the samples are to be subjected to referee tests,

6.7.2 When the relative humidity of the atmosphere exceeds 50 %,

6.7.3 When the samples are to be tested for dissipation factor, resistivity, or moisture content, and

6.7.4 When the viscosity of the liquid to be sampled exceeds 2.28×10^{-5} $m^2/5$ (21 cSt) at 40°C.

6.8 *Pressure Type*—The device shown in Figs. 7 and 8 is intended primarily for sampling drums of high-viscosity liquids. However, it is particularly suitable for obtaining samples of all electrical insulating liquids in drums where it is desired that all contact of the sample with the atmosphere is eliminated. When possible, this device should be used for obtaining samples from drums when these samples are to be subjected to referee tests.

6.9 *Tank Car Type*—The device shown in Fig. 9 is used for taking either top, middle, or bottom samples from containers of large capacity such as tank cars, tank trucks, and large storage tanks not provided with a sampling-test nipple. This device is not recommended for use under the conditions described in 6.7.1 through 6.7.4.

6.10 *Manifold*—The device shown in Fig. 10 is used for taking samples from low-pressure oil-filled cable feeders with the use of vacuum and either dry carbon dioxide gas or dry nitrogen gas. Its use is recommended when high relative humidity conditions exist and it is desired to take the samples through a closed system.

MOST FREQUENTLY USED SAMPLING TECHNIQUES FOR ELECTRICAL APPARATUS

7. Collecting Samples from Electrical Apparatus Using Bottles and Cans

7.1 Unrepresentative samples are often obtained when sampling electrical apparatus using the sampling ports mounted on drain valves without appropriate preparation. The flow allowed by these ports is not adequate to properly flush the drain valve and drain valve extension of the electrical apparatus. Since the fluid in the drain valve and extension remain quite dormant during the normal operation of the electrical apparatus, contamination with stem packing and moisture must be thoroughly flushed prior to the collection of a sample.

7.2 Check for positive pressure at a sampling outlet by placing a slug of insulating liquid in a piece of clear oil-resistant plastic tubing and attaching it to the sampling port (also known as sampling cock) located on the side of the drain valve. With the valve closed, remove the drain valve pipe plug, making sure to catch any waste and debris, and then reinstall the pipe plug to equalize the pressure. While observing the slug of insulating liquid, open the sampling port and then slowly open the drain valve. If the slug moves towards the electrical apparatus, a negative pressure exists, and sampling is to be discontinued. If the slug moves away from the electrical apparatus, a positive pressure exists, and samples can be obtained safely. Close the drain valve and then close the drain valve port. Take extreme care in performing this procedure.

7.3 Place a flush-oil container under the main drain valve and remove the drain valve pipe plug. Wipe the inside of the valve and threads with a clean lint-free cloth making sure to remove all debris, water and plug sealing materials. Drain at least 2 L and preferably 4 L of liquid into the flush-oil container to flush the drain valve and drain valve extension. One of two procedures may then be used to prepare the drain valve for sampling.

7.3.1 *Procedure A*—Install a sample adapter on the drain valve (suitable thread size bushing adapter NPT to ⅜ or ¼ in. bayonet) with a piece of oil-resistant tubing attached (see Note 3). Stainless steel adapters and tubing have also been found to be practical for this purpose. Flush the valve and installed sample adapter by flushing at least 1 L of liquid into the flush-oil container before collecting sample.

7.3.2 *Procedure B*—This is an alternate procedure for purging the valve when it is not practical to flush oil through the drain valve or a flush container or catch pan cannot be placed below the valve. Install the drain valve pipe plug. Attach oil resistant tubing (see Note 3) to the sample port on the side of the drain valve and flush at least 2 L of liquid into the flush oil container before collecting the liquid in the sample container.

NOTE 3—A new piece of oil-resistant tubing is to be used every time a sample is taken. Be aware that plastic tubing can retain water that can be imparted to the sample during sampling. For this reason, flushing the tubing along with the sample container is necessary to remove that moisture.

7.4 Adequately protect the area from which the sample is being drawn from spillage by the use of such countermeasures as plastic, oil absorbent pads and catch pans.

7.5 When collecting the sample in a glass jar, bottle or metal can, hold the sample container so that the liquid will run down the sides and limit aeration of the liquid. Partially fill the sample container 2 to 3 times and gently swirl the liquid around to warm the container in order to prevent condensation. Discard the liquid after each rinse. The flow of liquid should be gentle but not interrupted from the start of the flushing of the valve and container to the completion of the final filling of the sample container.

7.6 Obtain the sample for evaluation by allowing the liquid to flow down the sides of the container or from the bottom up, filling the container.

7.6.1 If glass sample containers are used, adequate space should remain in the container to allow for expansion of the liquid. This applies to samples that are collected at temperatures below the temperature of the sample storage area. If metal cans, bottles or cylinders are used fill the container to overflowing. Once the container has been filled to the appropriate level install the cap immediately.

7.7 Close the drain valve, remove the sample adapter, if used, and install the drain valve pipe plug with a non-hardening thread sealant. Do not reuse the tubing. Clean the sample adapter before reusing on other oil-filled compartments or apparatus. Properly label and identify the sample(s) before

leaving the site or going to the next apparatus. Dispose of any waste materials in the proper manner.

8. Collecting Samples from Electrical Apparatus Using Glass Syringes

8.1 Perform the same steps as described in 7.1 – 7.4. Attach the oil-resistant tubing to the syringe as shown in Fig. 1

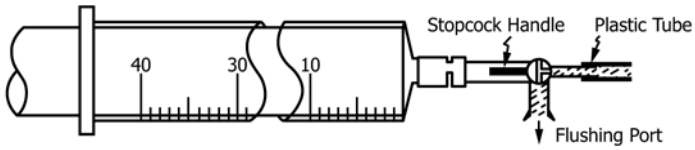

FIG. 1 Stopcock with Two Open Ports and Flushing of Stopcock

8.2 Before using a syringe make sure that the stopcock is on securely and there is no debris or obstruction in the syringe that would prevent its proper use.

8.3 The handle of the plastic stopcock always points to the closed port leaving the other two ports in open communication (Fig. 1).

8.4 Adjust the equipment drain valve or the sample port valve for a gentle flow of liquid through the tubing with the syringe stopcock open (Fig. 1) to permit flushing of the stopcock. Position the handle toward the syringe (see Note 3).

8.5 Turn the stopcock slowly to communicate with the syringe (Fig. 2, handle in line with the flushing port). Allow the

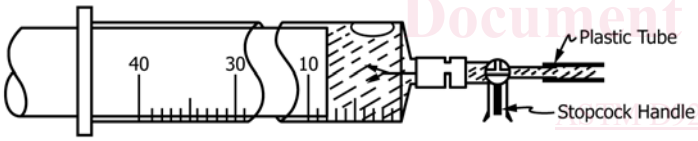

FIG. 2 Conditioning of Syringe, Stopcock Handle in Line with Flushing Port

liquid to fill the syringe to maximum full mark (shown as 40 in Fig. 2). Immediately close the port to the tubing (Fig. 3 handle

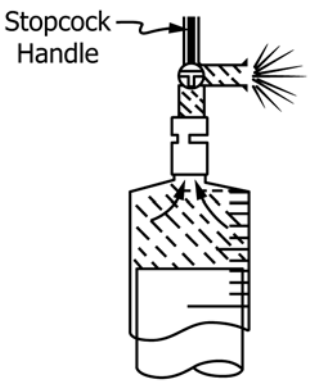

FIG. 3 Ejecting Oil from Syringe, Stopcock Handling Towards Tubing

toward tubing). Slowly depress the syringe piston (also known as plunger) until all the liquid is evacuated from the syringe to the flush container or catch pan completing the first conditioning. Perform this conditioning procedure at least one and preferably two more times.

8.5.1 If conditions warrant, the sample collection tubing may be removed from the syringe during the time the piston is depressed. In this case the flow of liquid shall continue and should be directed into the flush container. Care shall be taken not to contaminate the syringe inlet port.

8.6 Turn the stopcock slowly to open the port to the syringe (Fig. 2 handle in line with the flushing port). Allow 10 mL of liquid to enter the syringe. Immediately close the port to the syringe (Fig. 3 handle toward the tubing).

8.7 With the syringe vertical (Fig. 3), the stopcock handle up towards the tubing, eject any air bubbles by carefully depressing the syringe piston far enough to leave 1 to 2 mL of liquid in the syringe. If all of the liquid is evacuated from the syringe, there is a greater chance of an air leak. Close the stopcock by moving the stopcock handle toward the syringe.

8.8 To eliminate any possibility that air may be entrapped in the valve, let the liquid flow through the flushing port before the valve is turned to allow the syringe to be filled.

8.9 Open the stopcock (Fig. 2), with the handle in line with flushing port. Allow the liquid pressure to push the piston back until the syringe is filled to approximately 80 % full. Do not pull the piston manually since this can result in bubble formation.

8.10 Close the stopcock (Fig. 4), with the stopcock handle

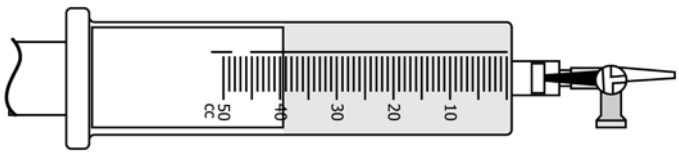

FIG. 4 Oil-Filled Syringe with Handle Towards Syringe

toward syringe. Separate the syringe from the tubing and inspect for gas bubbles. If gas is present, discharge oil with the syringe vertical (stopcock up) and obtain another sample.

8.11 Protect the syringe from sunlight after the sample is taken.

8.12 If, after a syringe has set for a period of time after the sample has been collected, and a gas bubble forms in the syringe, do not release this bubble as it contains gases from the liquid that have come out of solution but are still considered part of the sample.

8.13 Close the valve and secure the area as described in 7.7.

9. Collecting Samples from Electrical Apparatus Using Stainless Steel Cylinder

9.1 Perform the same steps as described in 7.1 – 7.4.

9.2 Hold the steel cylinder in a vertical position. Connect the oil-resistant tubing to the lower valve port on the stainless steel cylinder and connect a short piece approximately 60 cm (24 in.) of clear oil-resistant tubing to the upper valve on the steel cylinder as shown in Fig. 5 (see Note 3).

9.3 While keeping the cylinder in the vertical position, open the electrical apparatus sampling drain valve or the sample port valve. Open the lower valve on the stainless steel cylinder. Direct the short piece of plastic tubing towards the flush oil container and open the upper valve on the stainless steel cylinder. With all three valves open and the cylinder held in a vertical position (see Fig. 5), flush the cylinder. Two (2) litres of liquid should pass through the cylinder into the flush oil container.

9.4 If air bubbles are seen in the plastic tubing, the stainless steel cylinder may be tapped lightly or shaken to dislodge any bubbles inside the cylinder. Flushing with the insulating liquid should be continued until the flow out of the cylinder is free of any bubbles.

9.5 Tightly close the three valves in the following sequence: first close the upper cylinder valve; then the bottom cylinder valve; followed by the electrical apparatus drain valve or sample port valve. Remove the sample adapter if used, and reinstall the security plug with a non-hardening thread sealant.

9.6 As a final check to determine that the cylinder has been properly filled, shake the cylinder and listen for the motion of the bubbles and the splashing of liquid. If any sound is heard, the cylinder should be drained and the sampling repeated.

9.7 Close the valve and secure the area as described in 7.7.

SAMPLING OF CANS, DRUMS, TANK CARS, TANK TRUCKS, AND SMALL ELECTRICAL EQUIPMENT

10. Sampling Using the Dip-Type or Drum Thief Device (Fig. 6)

10.1 *Sampling Procedure*—Close the top hole of the device with the thumb and introduce the lower end into the liquid to be sampled to a depth of approximately 300 mm. Remove the thumb, allowing the liquid to flow into the device. Again, close the upper end with the thumb and withdraw the device, holding it in a nearly horizontal position. Shift the position of the device so that the liquid will flow back and forth in the tube, rinsing the inside surface. During this operation, take care to avoid handling any portion of the device that will be immersed in the liquid to be sampled. Discard the liquid used for rinsing. With the thumb again covering the top hole of the device, insert the lower end into the liquid at an angle so that it will come to rest on the bottom of the container at the center. Raise the device approximately 3 mm off the bottom and then release the thumb (**Warning:** see end of paragraph). When the device is filled, replace the thumb quickly, withdraw the device, and, placing the tip inside the neck close to the side of the sample container, release the thumb and allow the contents to fill the container. The free hand may be placed at a point above the liquid level to guide the tip of the device to its position on the sample container. When the container is filled, stop the flow of liquid by returning the thumb to the top hole. Do not close the bottom hole with the use of the other hand. Quickly close the sample container and attach an identifying tag. Where provided, replace the stopper in the container that was sampled. **Warning**—The standard 55 gal (208 L) oil drum is so designed

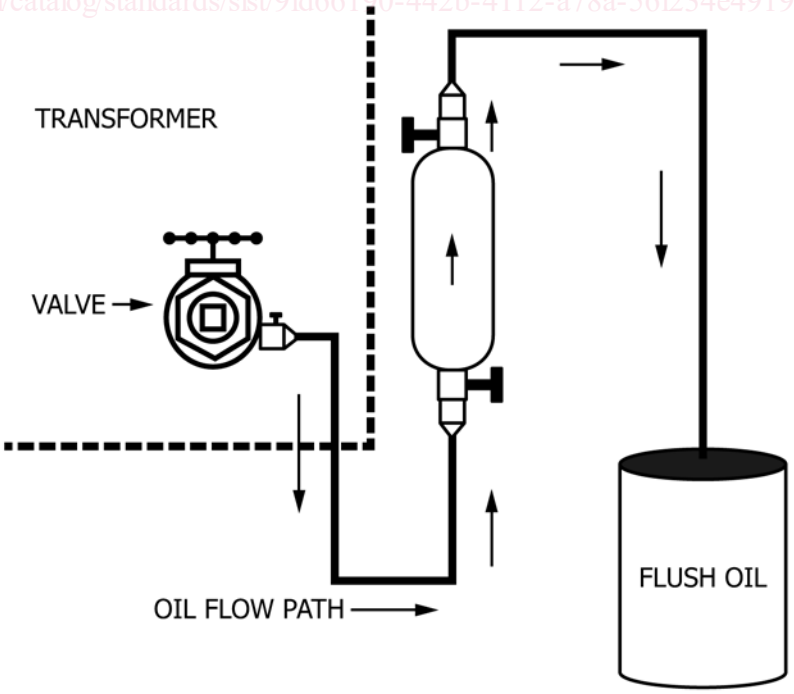

FIG. 5 Sampling with Stainless Steel Sampling Cylinder