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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Practices for Sampling Electrical Insulating Liquids[1]

This standard is issued under the fixed designation D 923; 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 Department of Defense.

1. Scope

1.1 These practices cover sampling of new electrical insulating liquids including oils, askarels, silicones, and synthetic liquids as well as such 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 (100°F).

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

1.3 Sampling procedures using syringe-type devices, tin plated steel cans with flexible sides and stainless steel cylinders are described in Test Methods D 3613. This method describes preferred techniques to use when sampling for dissolved gas analysis and water content in insulating fluid.

1.4 The procedures appear in the following order:

Procedure	Section/Paragraph
Dip-Type Device (drum thief)	6.2, 13, and A1.1
Pressure-Type Device	6.3, 14, and A1.2
Tank Car-Type Device	6.4, 15, and A1.3
Manifold-Type Device	6.5, 21, and A1.4
Electric Equipment Sampling Outlet or Valve	6.6 and 18

1.5 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. Proper use of personal protective equipment (PPE) is suggested.

1.6 Handle askarels as outlined in IEEE 799-1992 to avoid environmental contamination. For methods of testing askarels see Methods D 901.

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, state and federal regulations.

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 precautionary statements are given in 1.5, 1.7, 14.2, Section 17, 19.2, and 21.2.3.

2. Referenced Documents

2.1 *ASTM Standards:*

D901 Methods of Testing Askarels[2]

D 1933 Specification for Nitrogen Gas as an Electrical Insulating Material[2]

D 3613 Test Methods of Sampling Electrical Insulating Oils for Gas Analysis and Determination of Water Content[2]

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products[3]

2.2 *IEEE Standards:*

799-1992 Guide for Handling and Disposal of Transformer Grade Insulating Fluids Containing PCBs[4]

3. Terminology

3.1 *Definition:*

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 the bottom, whereas in the case of a liquid having a specific gravity greater than one, some of these impurities are most likely to be found on the surface.

4. Summary of Practice

4.1 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.

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[1] This test method is under the jurisdiction of ASTM Committee D-27 on Electrical Insulating Liquids and Gasesand is the direct responsibility of Subcommittee D27.07on Physical Tests.

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[2] *Annual Book of ASTM Standards*, Vol 10.03.

[3] *Annual Book of ASTM Standards*, Vol 05.02.

[4] Available from the IEEE, 345 E. 47th St., NY, NY 10017-2394.

5. Significance and Use

5.1 Accurate sampling, whether of the complete contents or only parts thereof, is extremely important from the standpoint of evaluating the quality of the product 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.

SAMPLING DEVICES

6. Application

6.1 Devices suitable for withdrawing samples of liquid from containers, electrical equipment, cable feeders, and cable joints are shown in Figs. 1-5.

6.2 *Dip Type or Drum Thief*—The device shown in Fig. 1 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 not recommended for use under the following conditions:

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

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

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

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

6.3 *Pressure Type*—The device shown in Fig. 2 and Fig. 3 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.

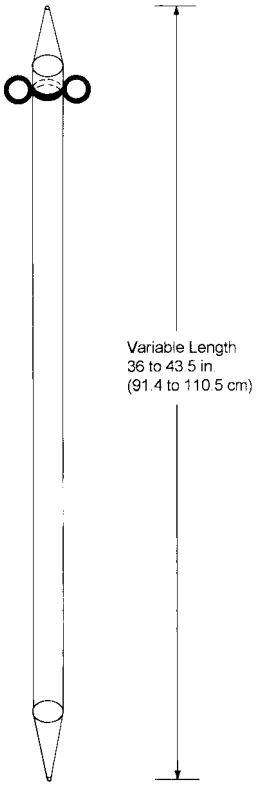
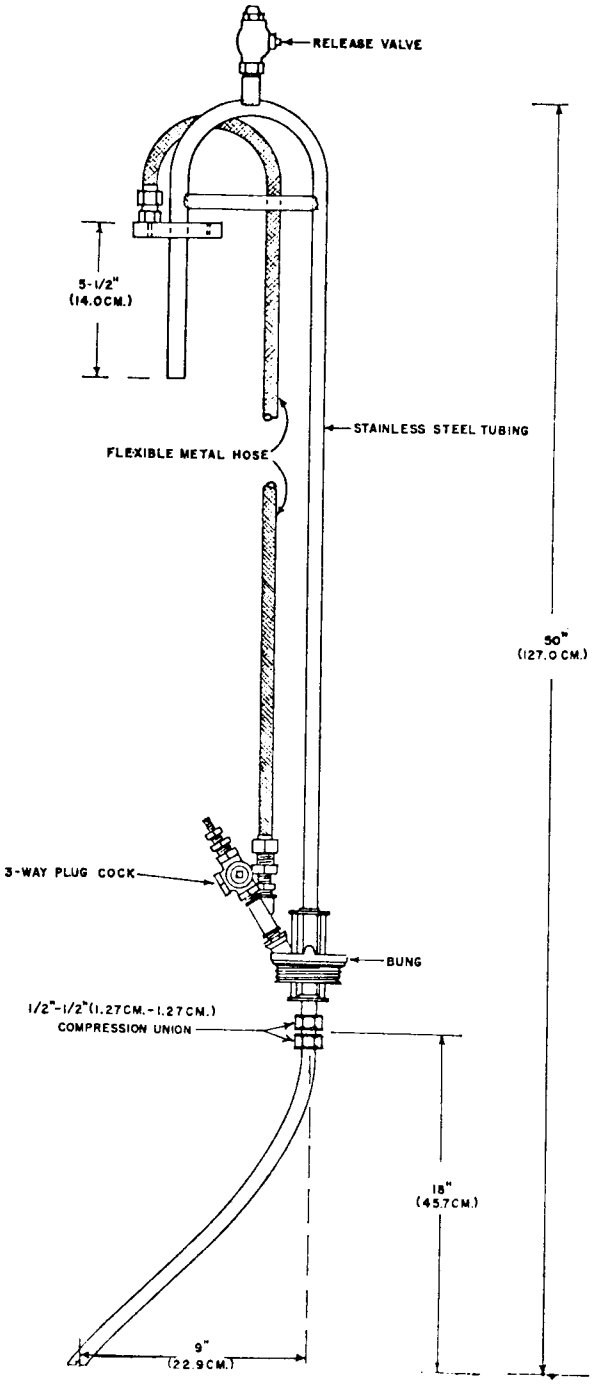


FIG. 1 Dip-Type Sampling Device



NOTE 1—The offset section of tubing at the bottom of the device shall be in the same vertical plane as the U-bend. This will permit easy alignment for obtaining a bottom sample from the center of the drum.

FIG. 2 Pressure-Type Sampling Device

6.4 *Tank Car Type*—The device shown in Fig. 4 is used for taking either top, middle, or bottom samples from containers of

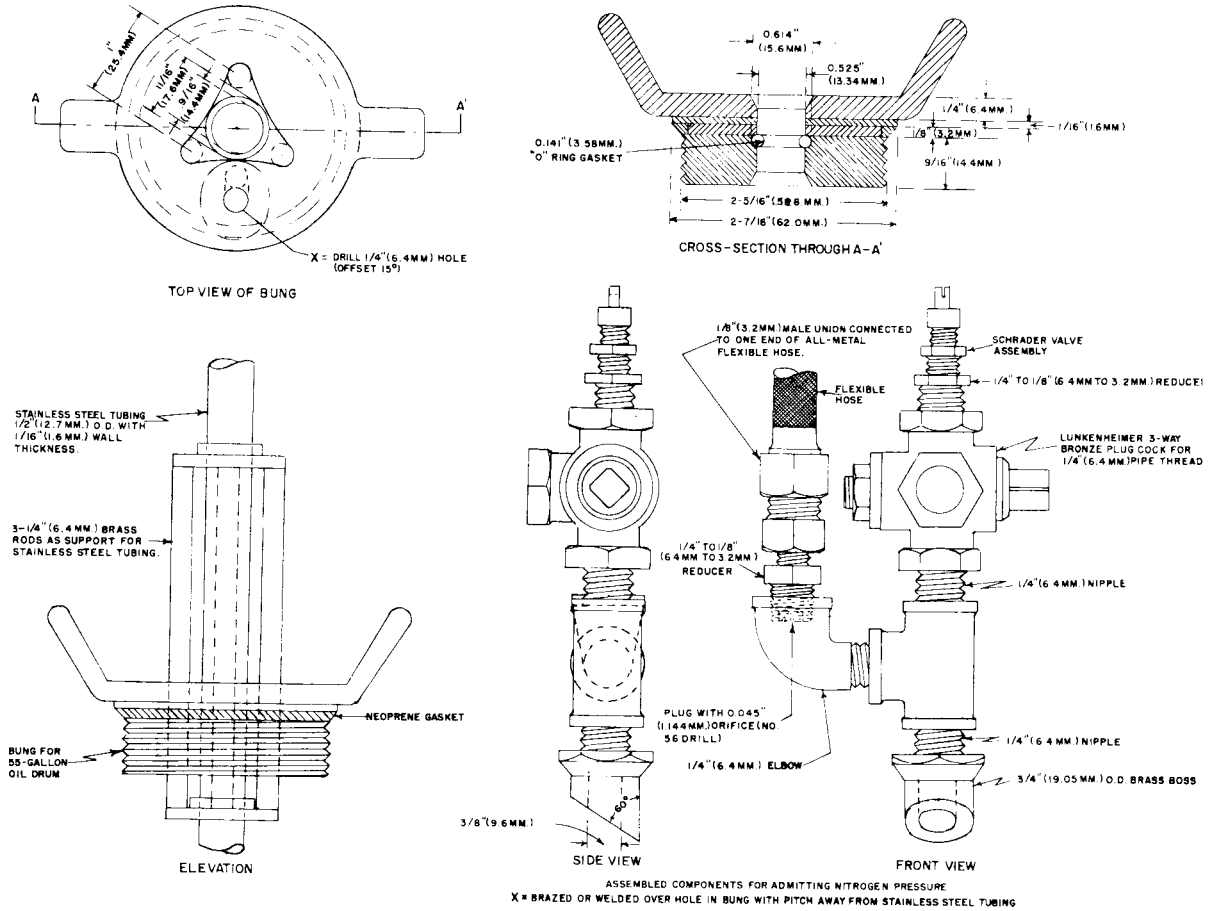


FIG. 3 Details of Bung and Fittings for Pressure-Type Sampling Device

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 6.2.1 through 6.2.4.

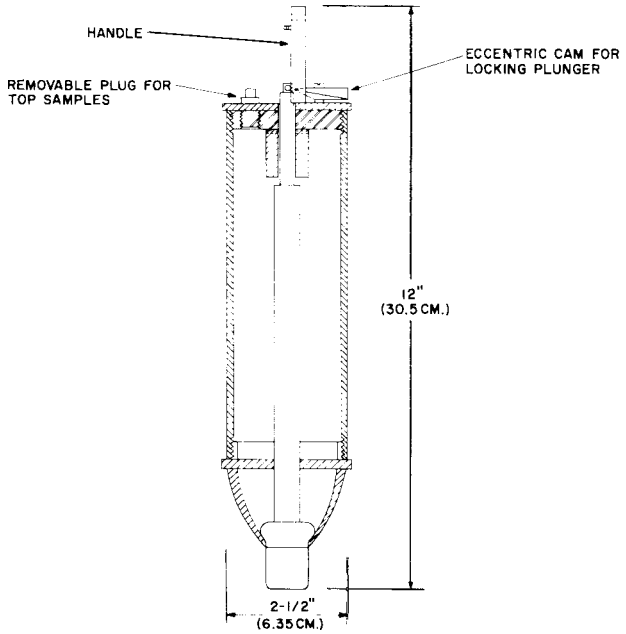


FIG. 4 Tank Car-Type Sampling Device

6.5 *Manifold*—The device shown in Fig. 5 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.

6.6 *Electrical Equipment Sampling Outlet or Valve*, 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 Section 9.

7. Construction

7.1 The construction of each of the devices shown in Figs. 1-5 is described in the Annex.

8. Storage

8.1 When not in use, clean sampling devices such as shown in Figs. 1-5 as described in 13.1, Sections 14 and 15, respectively, and keep at all times in a vertical position in a dry, dust-free cabinet or a clean sealed plastic bag. Provide the cabinet with a rack having a suitable drainage receptacle at the base.

8.2 When the sampling device shown in Fig. 5 is not in use, store in a room having low humidity.

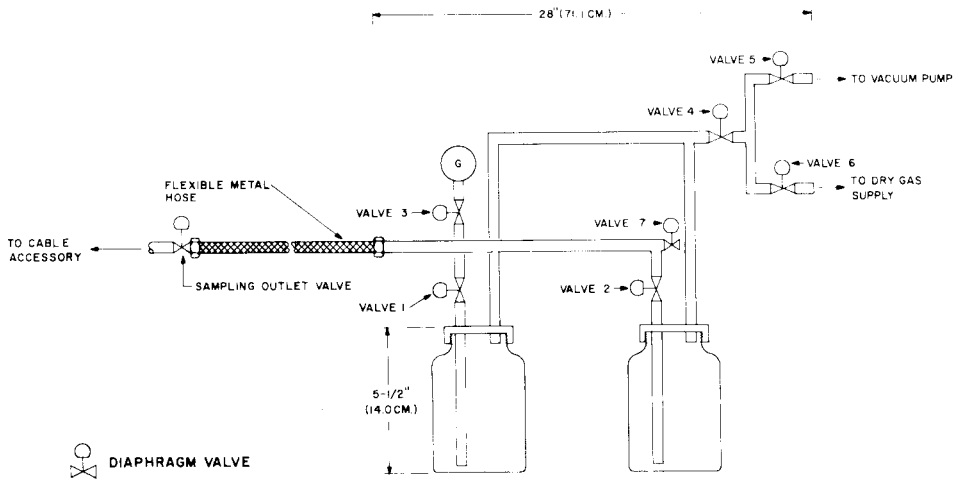


FIG. 5 Apparatus for Sampling Oil from Low-Pressure Filled Cable with Use of Vacuum and Dry Gas

SAMPLE CONTAINERS

9. Construction

9.1 Use amber colored glass (Note 1) or high-density polyethylene bottles (do not use for long term storage when water content is to be determined), aluminum or TFE-flurocarbon lined or welded seam metal cans as containers for the samples. The glass bottles 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 polyvinylidene chloride or polytetrafluoroethylene. Do not use any incompatible natural or synthetic rubber materials.

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 10.2. Refer to Test Method D 3613 for the proper techniques and materials used to retrieve test specimens for dissolved gas analysis.

9.2 If glass-stoppered bottles are used, take precautions to ensure that the stoppers provide a perfect fit. If tin-plated steel cans are used, use only those having welded seams and provided with screw caps lined as described in 9.1. Cans with soldered seams should not be used because the sample may become contaminated.

10. Cleaning and Preparation

10.1 Because of the inherent susceptibility of most insulating liquids to contaminating influences of the most minute nature, the cleanliness of the sample container is of paramount importance for ensuring that the sample obtained is representative of the bulk from which it was taken. For these reasons, it is essential that the procedures outlined in the following paragraphs are strictly observed.

10.2 If containers have been previously used for sampling liquids that are to be subjected to referee tests, thoroughly rinse the container with Stoddard solvent, precipitation naphtha, or other suitable cleaning agent that completely dissolves the liquid residue, and then subject to a soap and water cleaning and water rinse. If a water-soluble cleaning agent such as trisodium phosphate is used, rinse thoroughly with tap water. Invert the containers and drain for 10 min; then immerse in a 10 % solution of non-chro-mate acid-based cleaner for not less than 1 h. At the end of this period rinse with tap water, then with distilled water, and dry in an upright position in a forced-draft oven at 110°C for not less than 1 h. In the case of containers that have not been previously used, the initial cleaning may be omitted and the containers placed immediately in the non-chromate solution followed by the rinsing and drying outlined above.

10.3 Clean and dry containers for samples or test specimens to be subjected to routine tests as described in 10.2 except that after the initial tap-water rinse, rinse with distilled water.

10.4 Clean and dry glass stoppers in a manner similar to that of the container in which they are to be used. Do not reuse covers having vinyl liners. Dry new covers with vinyl liners in an oven at 110°C for not less than 30 min immediately prior to being placed on the bottles.

10.5 When the drying periods for the bottles and covers or stoppers have expired, tightly stopper each bottle immediately as it is removed from the oven, taking care not to touch the lip of the container or that portion of the stopper or cover likely to come in contact with the sample.

11. Storage and Handling

11.1 Keep containers that are to be stored for future use in a warm, dry storage cabinet. Store all sample containers with or without samples or test specimens in them in such manner that the possibility of their being contaminated is eliminated. Keep containers sealed until immediately before sampling, and seal again as soon as the sample or test specimen is taken to prevent contamination by dirt or moisture. As soon as samples are taken, properly identify them. To prevent breakage, handle the sample container after filling with care during transportation and storage. Store samples in the dark when clear glass bottles are used. Amber-colored glass bottles provide good protection against degradation of the sample by sunlight.

GENERAL PRECAUTIONS

12. General Precautions

12.1 Take and handle samples or test specimens in such a manner that the tests made on them indicate the characteristics

of the liquid. 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.

12.2 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.

12.3 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.

12.4 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.

12.5 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.

12.6 Unless otherwise specified, take samples of insulating fluids 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.

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

12.8 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.

12.9 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.

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

13. Using the Dip-Type or Drum Thief Device (Fig. 1)

13.1 *Cleaning the Device*—Clean the device by rinsing the inside and outside surfaces with Stoddard solvent, or other suitable solvent. Place a small funnel in one end of the tube, place the forefinger of one hand over the other opening, and partially fill the device with solvent. Remove the funnel, cover the opening with the forefinger of the other hand and flush the tube by agitating the solvent back and forth. Empty the tube, flush the outside surface with solvent, and take care after rinsing not to touch any portion of the tube that will be immersed in the liquid when the sample is being taken.

13.2 *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 (**Caution:** see Note 2). 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.

NOTE 2—**Caution:** The standard 55 gal (208 L) oil drum is so designed that when full and standing on end the bottom will bulge, thereby becoming concave on the inside so that at the center it is about 10 mm below that portion which is directly below the bung opening. It is essential when sampling liquid in this type of container that the dip-type device be inserted at an angle so that the bottom sample is obtained from that portion of the liquid in the center. The use of disposable polyethylene gloves would be appropriate when using this device.

14. Using the Pressure-Type Device (Fig. 2 and Fig. 3)

14.1 *Apparatus*—The following apparatus is required for the functioning of the pressure-type device:

14.1.1 *Nitrogen Gas Cylinder*—A tank of dry nitrogen gas for supplying the necessary nitrogen pressure to the liquid in the drum to be sampled. The nitrogen gas must meet the requirements prescribed in Table 1 of Specification D 1933.

14.1.2 *Pressure Regulator*, to reduce the gas pressure to the desired value.

14.1.3 *Safety Valve*—A relief valve set to operate when the nitrogen pressure reaches 69 kPa (10 psi).

14.2 *Cleaning the Device*—Invert the device, hold it in a

perpendicular position, and place the U-bend in a pail or similar container. Insert a small funnel into the top end of the tubing, and thoroughly rinse the inside surface of the tubing by flushing it several times with Stoddard solvent or other suitable solvent. Drain the solvent from the tubing and pour more solvent over the outside surface of those parts of the tubing that will be immersed in the liquid while the sample is being taken. When this operation is completed, exercise care not to touch any part of the sampling tube that will be immersed in the liquid when obtaining a sample. **Precaution—**Before proceeding to use this method, inspect the area in which the drums to be sampled are located to be positive there is adequate ventilation, preventing a concentration of the nitrogen gas which is dissipated during the sampling operation. Comply with OSHA regulations concerning confined space.

14.3 *Sampling Procedure*—Screw a sample bottle into the brass cap and adjust the bung on the tube so that when the bung is screwed into the drum the sampling tube will extend into the liquid to a depth of about 300 mm. With the hose from the nitrogen tank clipped on the check valve, set the three-way plug cock to permit nitrogen to flow into the drum. Adjust the regulator so that the pressure is gradually increased to 34 kPa (5 psi). This will purge air from sample bottle and subsequently start the liquid to fill the bottle. When the bottle is approximately ⅞ full, shut off the nitrogen supply and at the same time, vent the drum to the atmosphere by means of the three-way plug cock. Immediately vent the release valve in the top of the tube by means of the push-button valve. Unscrew the bottle and collect the drainage liquid from the tube. Discard this sample. Screw a clean sample bottle into the brass cap, push the tubing to the bottom of the drum, and set the three-way plug cock to permit nitrogen to flow into the drum. Restore 34 kPa (5 psi) pressure to the drum by means of the pressure regulator. This will purge the air from the sample bottle and subsequently start the liquid to fill the bottle. When the bottle is full, shut off the nitrogen supply and vent the drum to the atmosphere. Vent the release valve by means of the push-button valve, remove the sample bottle, and immediately screw the cover on tightly. Attach an identifying tag to the bottle. Withdraw the tube from the liquid and allow to drain. In sampling a shipment of new liquid in drums, the device may be inserted into the next drum and the sample taken without further cleaning or rinsing of the device, provided the previous sample showed no evidence of moisture or foreign particles.

15. Using the Tank Car-Type Device (Fig. 4)

15.1 *Cleaning the Device*—Holding the device suspended by its handle, thoroughly rinse the inside surface and then the outside surface with Stoddard solvent or other suitable solvent. When the liquid to be sampled is askarel, the solvent used for rinsing the device must not be from a petroleum base.

15.2 *Procedure for Sampling Oil*—When sampling a tank car, tank truck, or a large storage tank of oil not provided with a sampling-test nipple, it is desirable that bottom samples as defined in Practice D 4057, be taken in the area around the drain pipe. Prior to obtaining any sample, rinse the device by lowering it into the tank of oil approximately 300 mm beneath the surface, and with a cord attached to the plunger raise it so that liquid will fill the reservoir. When filled, release the plunger, withdraw the device, and discard the contents; then lower the device gently until it rests on the bottom of the tank, taking care that it is held in an upright position. The plunger will have recessed, and filling of the device will be evidenced by bubbles of air rising to the surface of the oil. When the bubbles cease to rise, the device is filled. Withdraw the device. In emptying the device into the sample container, allow the oil to flow against the side of the container. Repeat the operation at points on an imaginary circle around the drain pipe until the desired number of samples have been obtained. When it is desired to obtain samples at some specified depth, raise the plunger by means of the attached cord and when filled, as indicated by the cessation of air bubbles rising to the surface, withdraw the device. Empty the device into the sample container, observing the precautions previously mentioned. It is suggested that twice the number of samples or test specimens to be subjected to the desired tests be taken and half the number held in abeyance pending the possibility of additional tests being necessary, in which case a revisit to the location for resampling would be avoided. Attach an identifying tag to each sample bottle as soon as it has been filled.

15.3 *Procedure for Sampling Askarel*—When sampling a tank car, tank truck, or large storage tank of askarel not provided with a sampling-test nipple, take the samples from the surface layer of the liquid unless otherwise specified. Remove the plug in the top of the device and lock the plunger in its lowest or closed position. Gradually lower the device into the liquid so that the hole in the top is just below the liquid level, thereby filling the reservoir; withdraw the device from the liquid and *discard* its contents in accordance with current applicable government regulations; then refill the device by repeating the operation. In emptying the device into the sample container, allow the askarel to flow down the side of the container; do not allow the askarel to flow in a stream that splashes to the bottom of the container. The number of samples to be taken depends on the number of tests required. Attach an identifying tag to each sample container as soon as it is filled.

16. General Considerations

16.1 When taking samples of liquid from large storage tanks, transformers, oil-circuit breakers, gravity-feed 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. 5 is recommended.

16.2 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.

17. Mandatory Conditions

17.1 When it is necessary to obtain a sample from a piece of

energized equipment not hermetically sealed, under no circumstances take the sample by any other means than from an external sampling valve.

17.2 All non-hermetically sealed equipment in this category, filled with insulating fluid 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.

17.3 All non-hermetically sealed equipment in this category, filled with insulating fluid 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.

17.4 *Hazards of Sampling Electrical Apparatus*:

17.4.1 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.

17.4.2 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 18.1.

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

17.4.4 Do not draw samples from energized instrument transformer (C.T.s and P.T.s).

18. Using Electrical Equipment Sampling Outlet

18.1 Check for positive pressure at a sampling outlet by placing a slug of insulating fluid in a piece of clear plastic tubing and attaching it to the sampling outlet. While observing the slug of insulating fluid, slowly crack the sampling outlet valve open. If the slug moves towards the electrical apparatus, a negative pressure exists, and sampling should be discontinued. If the slug moves away from the electrical apparatus, a positive pressure exists, and samples can be obtained safely. Take extreme care in performing this procedure.

18.2 Place a flush-oil container under the main drain valve and remove the security pipe plug from the drain valve. Wipe the inside of the valve and threads with a clean lint-free cloth. Drain at least 2 qt of fluid 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 sample outlet.

18.2.1 *Procedure A*—Install a sample adapter on the drain valve (suitable thread size bushing adapter IPS to ⅜ in. bayonet) with a piece of oil-resistant tubing attached. Flush the valve and installed sample adapter by flushing at least 1 qt of fluid into the flush-oil container before collecting sample.

18.2.2 *Procedure B*—Install the drain valve security plug. Attach oil resistant tubing to the sample port on the drain valve and flush at least 1 qt of fluid into the flush oil container before collecting the fluid in the sample container.

18.3 When collecting the sample in a glass jar, bottle or tin-plated steel can, hold the sample container so that the fluid will run down the sides and limit aeration of the fluid. Partially fill the sample container several times and slosh the fluid around to warm the container in order to prevent condensation. Discard the fluid after each rinse. The flow of fluid 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.

18.4 Obtain the sample for evaluation by allowing the fluid to flow down the sides of the container or from the bottom up, filling the container to overflowing. Once the container is full install the cap immediately.

18.4.1 If glass sample containers are used, adequate space should remain in the container to allow for expansion of the fluid during warming of the sample. This applies to samples that are collected at temperatures below the temperature of the sample storage area.

18.5 Close the drain valve, remove the sample adapter, if used, and install the drain valve security 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.

SAMPLING CABLE FEEDERS

19. Mandatory Conditions

19.1 Contaminated liquid may be present in any piece of sealed equipment, cable feeder, or cable joint. In order that contaminated liquid is not discarded, do not draw off any liquid prior to taking a sample nor rinse the sampling device with liquid drawn from the sample source. Exception to the conditions will apply where a connecting line exists between the sampling point and the liquid source to be sampled. In this case, withdraw and discard a quantity of liquid approximately equal to the volume in the connecting line.

19.2 **Precaution**—In the sampling of oil from a high-pressure pipe-type cable feeder, exercise extreme caution when opening the valve. First connect the sampling device with the bottle in place to the sampling outlet and gradually open the valve to permit a flow of oil into the sample bottle without undue force.

20. General Considerations

20.1 Specify the location at which sampling outlets are to be installed on liquid-filled cable feeders and joints whenever sampling is contemplated and indicate on the design drawings so that samples will always be obtained at the same locations whenever sampling is repeated. In this way the history of the oil as a function of time will be comparable, since samples will always be obtained at specific locations.

21. Using the Manifold-Type Device (Fig. 5)

21.1 *Cleaning the Device*—With valve 3 closed and all other valves open, rinse the inside surface of the manifold thoroughly with Stoddard solvent or other suitable solvent and also the outside surfaces of the tubing that extends into the sample bottles. Screw two sample bottles into the caps, close valves 5 and 7, and purge the manifold with dry gas for approximately 15 s. Remove the sample bottles and do not use them for obtaining samples.

21.2 *Sampling Procedure*:

21.2.1 If there is no reservoir at the cable end remote from the sampling location, connect a reservoir of adequate oil and pressure capacity at the remote end. Close the valve on the reservoir at the sampling end to assure minimum dilution of the sample with reservoir oil.

21.2.2 Connect the manifold with the flexible metal hose to the sampling outlet and connect the vacuum and gas lines.

21.2.3 Open the sampling outlet valve and flush the manifold by opening valves 1, 2, and 7. After flushing the manifold, close valves 2 and 7 and continue draining oil through valve 1 until a quantity corresponding to the volume of the tubing between valve 1 and the location of the oil to be sampled in the joint or termination, has been drawn off. Close valve 1. **Caution:** Regulate the flow of oil so that a positive pressure will be maintained in the oil system. For this purpose install a gauge between valve 1 and the sampling outlet valve (see Fig. 5). The pressure as indicated on the gauge, with valve 3 open, shall be not less than 14 kPa (2 psi) if the gauge is installed at the same elevation as the sampling outlet valve. If the gauge is installed at a lower elevation than the valve, the minimum allowable pressure shall be increased by 2.8 kPa (0.4 psi) per foot of difference in elevation.

21.2.4 Screw clean sample containers into the metal caps. Open valves 4 and 5 and apply to the sample containers a vacuum of not less than 133 Pa (1 mm Hg) for 10 min. Close valves 4 and 5.

21.2.5 Open valve 1 and fill container No. 1 to 13 mm from the top. Close valve 1. Open valve 2 and repeat the same procedure for container No. 2. Close valve 2.

21.2.6 Break the vacuum with gas by opening valves 4 and 6. Remove the containers from the manifold, close valves 4 and 6, and seal and identify the sample containers.

21.2.7 Disconnect the manifold from the sampling outlet and restore the cable oil system to normal.

22. Sample Information

22.1 Attach a tag, lable or otherwise mark each sample container so that it can be properly identified.

22.2 At a minimum, include the following information: serial or identification number, and date of sampling.

23. Keywords

23.1 electrical insulating fluid; sampling electrical apparatus; sampling procedures

ANNEX

(Mandatory Information)

A1. CONSTRUCTION OF DEVICES USED FOR SAMPLING OF ELECTRICAL INSULATING LIQUIDS

A1.1 Dip Type

A1.1.1 Make the device[5] shown in Fig. 1 of either metal, plastic or glass.

A1.2 Pressure Type

A1.2.1 Construct the device as shown in Fig. 2 and Fig. 3 of the following components:

A1.2.1.1 *Stainless Steel Tubing*, ½ in. in outside diameter with 1⁄16 in. wall thickness.

A1.2.1.2 *Brass Cap*, having threads machined to receive a standard 70/400 wide mouth bottle 2⅜ in. in inside diameter of about 475 cc (16 oz) or about 950 cc (32 oz) capacity.

A1.2.1.3 *BUNA-N Ring Gasket*, ⅛ in. thick and ⅜ in. wide, cut to fit snugly around the inside of the brass cap to provide a seal between the rim of the sample bottle and the inside surface of the cap. Viton may also be used.

A1.2.1.4 *Release Valve*,[6] normally closed, pushbutton, mounted at the apex of the inverted U-bend in the stainless steel tubing for venting the oil line and thereby preventing the oil from siphoning back into the drum when the nitrogen pressure is released. (The nozzle on the outlet end of valve has been shortened.)

A1.2.1.5 *Brass Bung*, machined to the dimensions and with threads to fit a 55 gal (208 L) drum used for packaging oil. Details of the construction of this bung as well as the fittings assembled on it to admit nitrogen gas into the drum and sample bottle are shown in Fig. 3.

A1.2.1.6 *All Metal Flexible Hose*, 1.5 m (5 ft) length, 3⁄16in. size, equipped on both ends with a male union.[7] Connect one end of this hose over a ⅛in. diameter hole in the brass bottle cap and the other end into the bushing in the elbow connected in the nitrogen supply line. Insert an orifice 0.045 in. in diameter (No. 56 drill) into the bushing to reduce the flow of gas into the bottle.

A1.2.1.7 *Bronze Plug Cock*, three-way[8] for threaded ¼ in. pipe, with cock levers.[9]

A1.2.1.8 Provide the end of the stainless steel tubing that is to be inserted into the drum with three notches 120° apart and each not less than 3 mm deep.

A1.3 Tank Car Type

A1.3.1 Construct the device as shown in Fig. 4, in both about 475 cc (1 pt) and about 950 cc (1 qt) capacities[10] with the following features:

A1.3.1.1 Design the plunger so that, when recessed, the distance it extends through the bottom of the reservoir is within 13 mm.

[5] Available from any laboratory supply house.

[6] A Schrader Valve, Catalog No. 7184C, has been found satisfactory for this purpose.

[7] Can be obtained from Biglow, 183 Mill Lane, Mountainside, NJ 07092.

[8] A Lunkenheimer 3-way plug cock, Fig. 573, has been found satisfactory for this purpose. Consult a plumbing supply house.

[9] A Lunkenheimer Cock Lever, Fig. 1181, has been found satisfactory for this purpose. Consult a plumbing supply house.

[10] This device, known commercially as the "Bacon Bomb,'' may be obtained from any laboratory supply house.

A1.3.1.2 Provide an eccentric cam for locking the plunger when desired.

A1.3.1.3 Provide a ⅜in. threaded hole in the flat top of the device with a threaded plug which can be removed when top samples are taken.

A1.3.1.4 Sufficently weigh the device so that it will sink readily when lowered into liquid having a specific gravity of 1.6.

A1.3.1.5 The surfaces of the device must be smooth and properly machined to facilitate easy cleaning.

A1.4 Manifold

A1.4.1 Construct the device as shown in Fig. 5 of the following components:

A1.4.1.1 *Brass Piping*, NPS1/4.

A1.4.1.2 *Brass Caps*, two, having threads machined to receive standard 70/4000 wide mouth bottles 2⅜ in. in inside diameter, of about 475 cc (16 oz) or 950 cc (32 oz) capacity.

A1.4.1.3 *BUNA-N Ring Gaskets*, two, ⅛ in. thick, ⅜ in. wide, cut to fit snugly around the inside of the brass cap to provide a seal between the rim of the sample bottle and the inside surface of the cap.

A1.4.1.4 *Diaphragm Valves,*[11] eight, ¼ in.

A1.4.1.5 *All Metal Flexible Hose*, ⅜ in. provided with suitable fittings at each end for connection to the manifold and sampling outlet on the cable accessory respectively.

A1.4.1.6 *Compound Gauge*, capable of measuring pressures between 7 and 21 KPa (1 and 3 psi).

[11] Kerotest Catalog No.R42 A02P (brass with nylon seat or R42E02P (brass WHN silver seat) Diaphragm Valves have been found satisfactory for this purpose.