Appendix D
Hazardous Waste Sampling Instructions

D.1 Bulk Material Sampling

D.1.1 Scope and application. Instructions presented in this section are for collecting representative solid or liquid samples from various containment vessels. These include tanks, drums, waste piles, fiber drums, sacks, bags, and similar small containers. Sampling containerized materials can present unique obstacles to field personnel. Buried or underground containers, container staging, identification, opening, and sampling are all issues to be considered. Instructions for sampling containerized materials by the following techniques are included in this section: scoop or trowel, waste pile sampler, Veihmeyer sampler/corer, sampling trier, grain sampler, composite liquid waste sampler (COLIWASA), and an open tube sampler. The Bacon bomb sampler described in Instruction C-3 (Appendix C), can be used for sampling liquids from large storage tanks.

D.1.2 Sampling strategies. Sampling strategies must be geared toward the type of wastes anticipated to be encountered, whether they are above ground or buried, with an important emphasis placed on safety. Safety considerations include the safety of personnel conducting the work, the surrounding community, and the environment. Occupational Safety and Health Administration standards and regulations should be followed, and appropriate monitoring equipment should be used during sampling operations. Sampling strategies are also determined by the stage of the investigation. For instance, during a preliminary assessment of an inventory of containers, it is more appropriate to identify the number of containers present, and take a random sampling of the inventory to identify gross categorization of the waste inventory. The amount of sampling will depend upon the number of total containers and whether there are similar markings on the containers. This information may be used to estimate the cost of cleanup, including the costs involved with transportation, treatment, storage, and/or disposal of the wastes. Later stages of the investigation may require sampling and analysis of all the containers individually to identify the waste category and compatibility of the wastes if bulking operations are planned. Biased sampling techniques are typically used to sample containers.

D.1.2.1 Sampling locations. If buried containers (drums, tanks) are investigated, the location of the containers must be determined. Information should be obtained from historical records. Past areal photography of the area may also be helpful in identifying areas that have been filled in over time, show evidence of stressed vegetation, etc. Geophysical techniques may also be used to locate potential caches of containers. Actual test pit excavations may be made to verify other less conclusive evidence. For drums and other containers that may be staged, locations should be identified for sampling purposes. Typically these areas are temporarily bermed, with sufficient safety and spill cleanup equipment easily accessible. If few containers are encountered and the conditions are secure from a safety standpoint, sampling may be conducted in place. In any kind of container sampling, however, remote operations for handling, staging, and opening are recommended.

D.1.2.2 Types of samples. All waste samples must be grab samples. Until waste characterization and compatibility testing are completed and confirm that the wastes are compatible, containerized samples should never be composited. Composites are collected only just prior to or during bulking operations. Normally, a composite sample is acquired from the bulked waste in the same proportions of the original waste stream to verify the applicability of disposal options. It should be noted, however, that composite samples can mask the presence of contaminants by diluting isolated concentrations of analytes that may be present in the environmental matrix. Therefore, initial waste characterization screening must be thorough enough to avoid this problem.

D.1.2.3 Suggested samplers and handling equipment. Each sampling technique presents various dis advantages and advantages for its application. For example, sample disturbance, sample volume, chemical/ physical reactivity between potential contaminants and sampling tool materials, and ease of use and decontami-

nation vary from technique to techniques. The advantages and disadvantages of each sampling technique are presented in the discussion of the technique. Specialized equipment is available for handling drums and other bulk containers. Backhoes equipped with nonsparking bucket teeth and plexiglass safety cab shields are available for excavating and handling drums and bulk containers. Other excavating and handling equipment include backhoes with a drum grappler, industrial vacuum loaders, drum lifting yokes, and metal hoists. Special tools used to manually open drums for sampling include bung wrenches, drum deheaders, hand picks, pickaxes, and hand spikes. Remote devices for opening containers include backhoe spikes, hydraulic drum openers, and pneumatic devices. It is emphasized that remote handling and opening techniques are recommended, especially if the contaminants are not known or when container integrity is poor.

D.1.3 Sample preservation and handling. Bulk samples are considered medium- to high-concentration samples and may not need to be preserved, except for cooling and/or protection from light in some cases. Special procedures and techniques for transporting the samples to the offsite laboratory may be necessary, i.e., secondary containment within a paint can or similar container, as discussed in Instruction F-2, "Packaging and Shipping Procedures," Appendix F.

D.1.3.1 Sample containers. As noted, bulk samples are considered medium- to high-concentration samples. Generally, the sample volumes needed for analyses are smaller than those needed for samples in an environmental media. Also, if similar chemical parameters (i.e., extractable organics) with the same preservation requirements are required by the project, these chemical parameters may be combined into one sample container to minimize the amount of concentrated waste sampled and shipped. When samples are collected from concentrated waste samples for analysis of metals, a 125-ml wide-mouth glass container with PTFE-lined polypropylene caps may be used (PTFE is commonly referred to using the registered name of Teflon). When organics are the analytes of interest, 125-ml wide-mouth glass jars for extractables and as prescribed within the analytical method for purgeable organics should be used. All containers must have PTFE-lined caps. Containers should be cleaned based on the analyte of interest. Instruction E-6, "Decontamination Procedures," contains additional information on appropriate glassware cleaning protocols. If precleaned bottles are used, the cleanliness of each lot of precleaned bottles should be verified by the container supplier or in the laboratory and appropriate paperwork (i.e., certificates) retained with other field documentation. Analytical protocols for bulk samples typically focus on simple tests to characterize the waste, or encompass analytical parameters that define the disposal requirements or disposal options available. Chemical parameters may differ from routine environmental samples and the individual tests may be combined into fewer actual sample containers, but the collection order should still be performed in the order of the volatilization sensitivity of the parameters. A general collection order for some common parameters follows:

- Volatile organics (VOA) - total or toxicity characteristic leaching procedure (TCLP).
- Purgeable organic carbon (POC).
- Purgeable organic halogens (POX).
- Total organic halogens (TOX).
- Total organic carbon (TOC)
- Extractable organics - total or TCLP.
- Total metals - total or TCLP.
- Phenols.
- Cyanide - total or reactive.

- Sulfide - total or reactive.
- British thermal units (BTU) contents.
- Radionuclides.
- Ignitability.
- Corrosivity.
- Oxidizer test.
- Peroxide test.
- Density.

D.1.3.2 Sample preservation. Methods of sample preservation are relatively limited and are generally intended to retard biological action and hydrolysis and to reduce sorption effects. Preservation methods for samples from bulk containers are limited to cooling and protection from light.

D.1.3.3 Special precautions for bulk and container sampling. Bulk sampling typically involves sampling medium- to high-level contaminants. Consequently, special precautions are warranted. Prior to collecting samples, a sampling plan should be developed that includes the following: research about the waste; identification of the drums to be sampled; selection of appropriate drum opening and sampling device(s); determination of the number and volume of samples to be taken; the analytical protocols; and development of procedures for opening drums, sampling, sample packaging, and transportation. A phased approach is recommended when evaluating bulk containers. The investigation may include all or only parts of the phased approach: reconnaissance, staging, opening, sampling, and packaging.

D.1.3.3.1 A preliminary assessment of each drum shall be performed prior to opening or sampling activities. During this reconnaissance phase, visual observations are recorded of container conditions (integrity), any markings, composition of the container, and whether it is an open-top container or a closed-top (bung type) container. Any special problems, i.e., evidence of pressure buildup (bulging) or access problems, should be recorded. Also note any recommendations with respect to opening/sampling these unique situations. Ambient air monitoring (for explosive and organic vapors) and radiation monitoring should be performed concurrently with these activities. Special precautions should be implemented and segregation of any stainless steel or nickel containers and gas cylinders should be noted, due to the potential for highly reactive, toxic, pressurized, and/or shock-sensitive contents. Containers whose integrity is breached should be overpacked immediately, or as soon as possible, to prevent further contaminant migration. Any markings noted on the containers should be considered suspect and noted for informational purposes only.

D.1.3.3.2 All bulk container contents should be approached as if they are unknown. Drum staging may be required at sites that have a large number of drums. The purpose of drum staging is to respond to obvious problems that might impair worker safety; unstack and orient drums in a prepared area that minimizes the spread of contamination during opening and sampling; and if necessary, organize drums into different areas to facilitate characterization and remedial action. Handling may or may not be necessary, depending on how the drums are positioned at the site. Prior to handling the drums, all personnel should be warned about the hazards and instructed to minimize handling the drums as much as possible. In all phases of handling, personnel should be alert for new information about potential hazards and should respond to new hazards before continuing with routine handling operations. Sampling areas should be adequately prepared (i.e., lined with plastic sheeting) to minimize the spread of contamination. However, it may not be practical to line the entire area with plastic sheeting due to the use of heavy machinery in the movement of drums. Empty overpack drums. An adequate

volume of absorbent should be kept near areas where minor spills may occur. Where there is a potential for large spills, a containment berm should also be constructed around the area where opening and sampling of drums will occur. If drum contents spill, personnel trained in spill response should isolate and contain the spill. Unique drum sample identification numbers should be assigned and written on drums. For large sites, it is recommended that a grid be applied to the site, and information from the original drum area be incorporated into the drum sample identification number. This allows the drum sample identification number and associated results to include aspects of the drum origin and location.

D.1.3.3.3 Remedial and emergency operations may require a separate drum opening area. Procedures for opening drums are the same, regardless of where the drums are opened. Drum opening tools should be nonsparking in nature, and include both manual and remote types. Manual drum opening tools include a universal bung wrench, drum deheader, manual drum punch (pickaxe, hand pick, or hand spike) (Figures D-1, D-2, and D-3). Remote drum opening tools include a backhoe spike and a variety of hydraulic or pneumatic drum openers (Figures D-4 and D-5). Many drum openers damage the drum integrity, making final bulking of contents or overpacking necessary. The method of opening selected should be based on drum condition, accessibility, knowledge of drum contents, whether direct contact is allowed or remote contact is necessary, and if the integrity of the drum should be maintained. Immediately after the drum is opened, recommend continued air monitoring of the area around the drums for explosive and organic vapors.

D.1.3.3.4 Drum sampling can involve direct contact with unidentified wastes. A trained health and safety professional should determine the appropriate personal protection to be used during sampling, decontamination, and packaging of the sample. Worker safety should be maximized during drum opening and sampling activities. Initially, drums should be inspected to verify contents are deeper than 25.4 mm (1 in.). If contents are less than 25.4 mm (1 in.) deep, the drums should be considered empty and disposed of accordingly. Drums verified as containing $\geq$25.4 mm (1 in.) should be sampled for waste characterization testing (compatibility) and compatibility testing as detailed in Section D.1.8 for segregation, bulking, and disposal determinations. Section D.1.4 introduces several techniques that may be used to sample drum contents. Samples should be taken from each drum in sufficient volume and labeled with the assigned drum sample number, and information recorded in the field logbook or drum log sheets. Hazardous characterization (HAZCAT) and compatibility testing may be performed onsite or offsite at a laboratory.

D.1.3.3.5 Based on hazardous characterization and compatibility testing results, the waste drums should be removed from the staged sampling area, segregated into compatible waste drum groupings, and a composite sample of the compatible materials prepared for disposal analyses defined by the treatment, storage, and disposal (TSD) facility. All incompatible wastes should be overpacked if integrity is breached, and segregated for offsite disposal. Compatible drum contents may then be physically bulked, or the individual drums prepared for offsite shipment to a TSD facility.

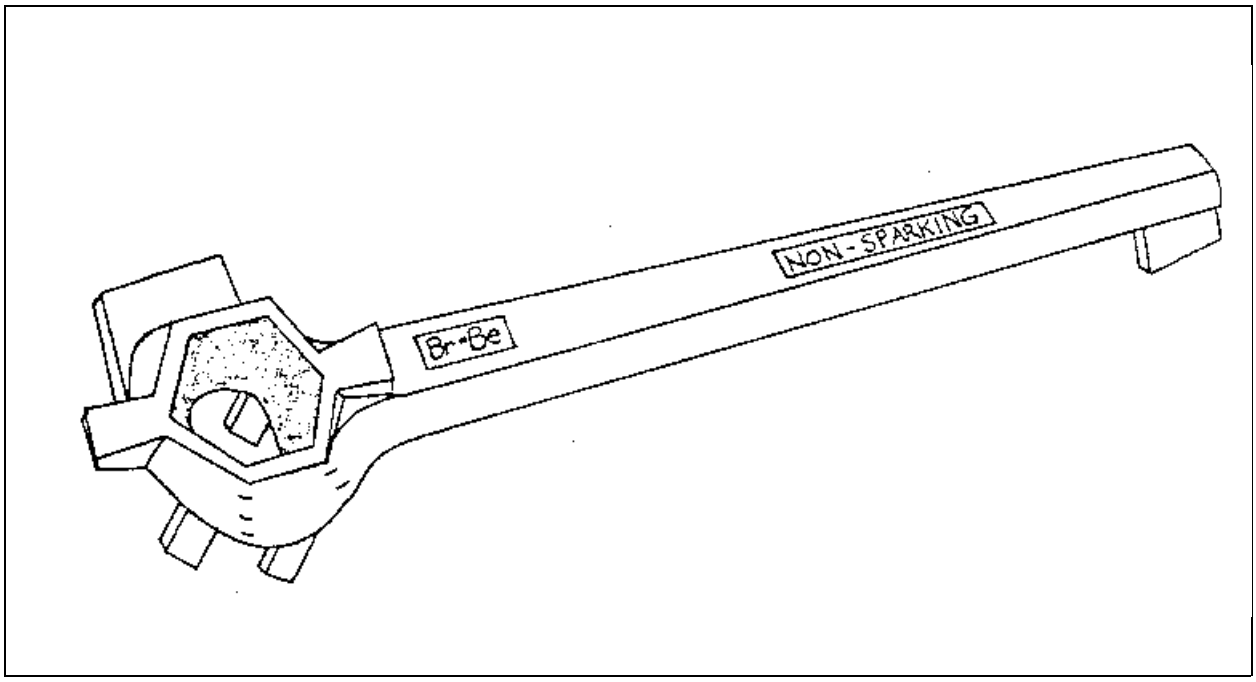

Figure D-1. Universal bung wrench

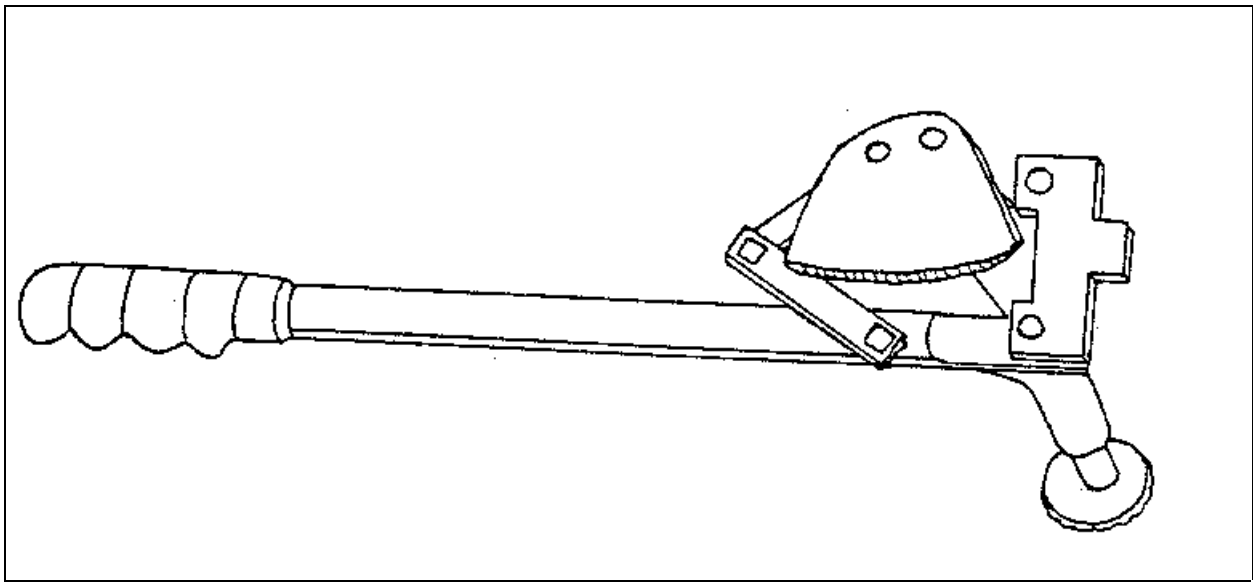

Figure D-2. Drum deheader

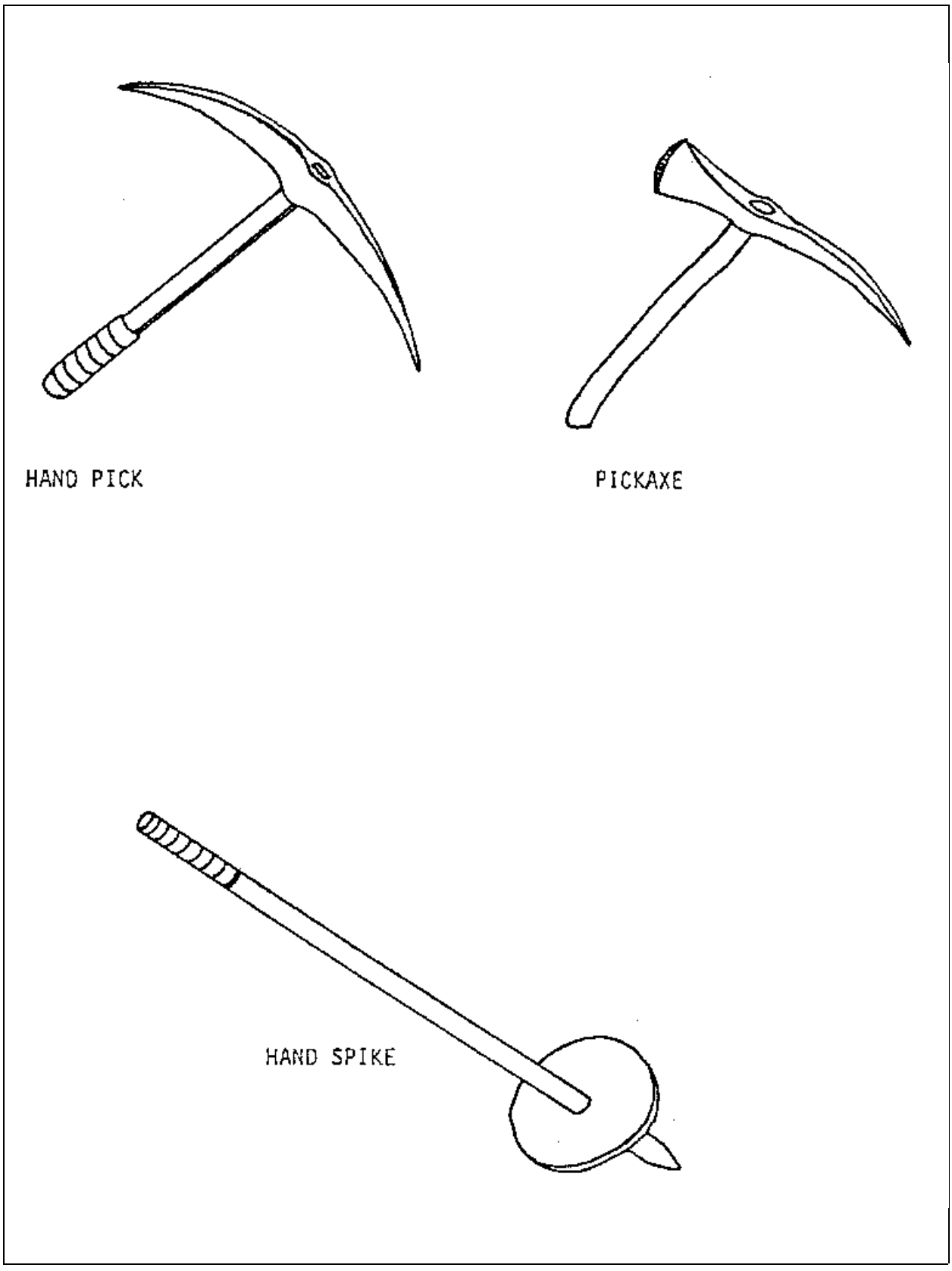

Figure D-3. Manual drum opening tools

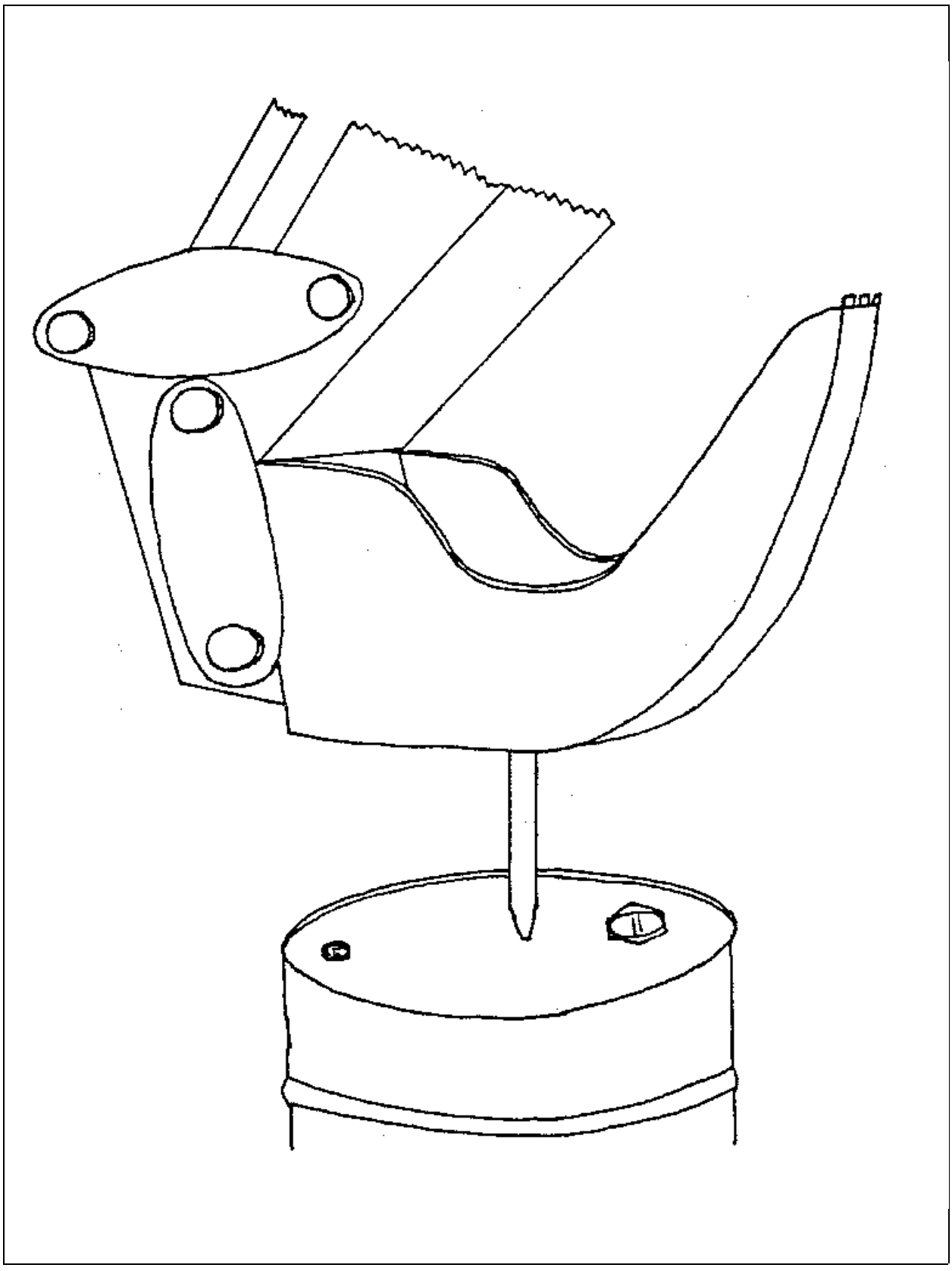

Figure D-4. Backhoe spike

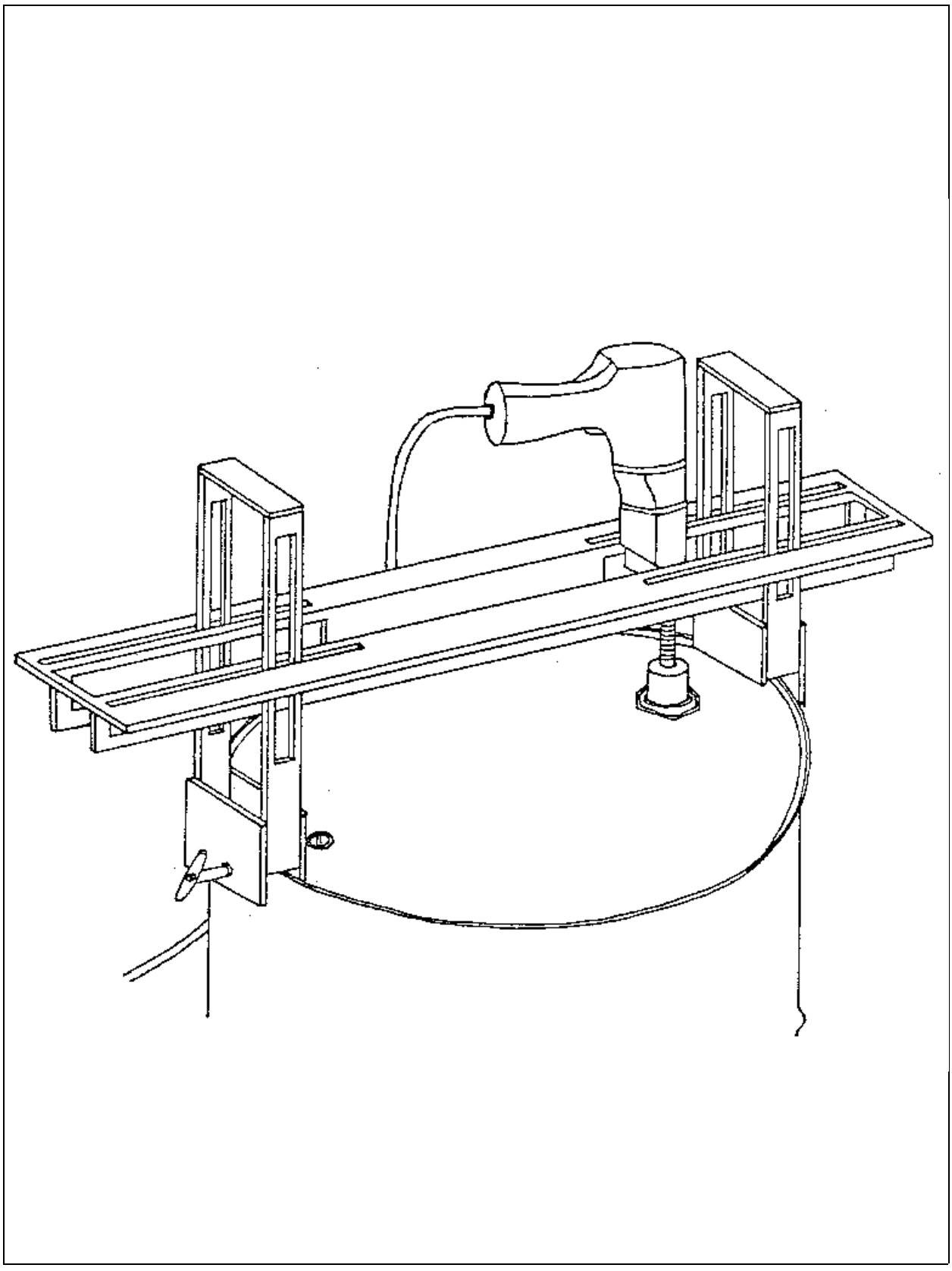

Figure D-5. Pneumatic drum opener

D.1.4 Sampling methods. Sampling instructions for the most common techniques of collecting liquid and solids samples from containers are as follows.

D.1.4.1 Open-ended tube. Method References: American Society for Testing and Materials (ASTM) D 5743 and EPA/540/P-91/008 (Standard Operating Procedure (SOP) #2009).

D.1.4.1.1 Applicability. The method provides a quick, relatively inexpensive means of collecting concentrated wastes. After sampling, the tubing can be discarded, thus eliminating the need for decontamination and the potential for cross-contamination.

D.1.4.1.2 Method summary and equipment. Liquid samples from open containers can be readily collected by merely submerging lengths of tubing into the containers (Figure D-6).

D.1.4.1.3 Sampling procedure.

- Insert tubing slowly almost to the bottom of the container. Approximately 0.3 m (1 ft) of tubing should extend above the drum. Use the tube to measure any sludge in the bottom of the drum.

- Be sure that the liquid in the container maintains a constant level in the tube during the descent of the tube.

- Cap the top of the sampling tube with a tapered stopper or gloved thumb, ensuring that the liquid does not come in contact with the stopper or thumb.

- Carefully remove the capped tube from the container and insert the uncapped end into the sample container, being careful not to spill any liquid outside the container. Removal of the tube from the container may require a step or platform aid.

- Release the stopper or thumb and allow the liquid to drain into the sample container until the appropriate sample containers are filled. Repeat as necessary.

- Remove the tube from the sample container and dispose of properly.

- Secure the cap tightly.

- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.

- Complete all chain-of-custody documents, drum log sheets, and/or record in field logbook (see Instruction F-1, "Documentation," Appendix F). Prepare samples for shipment (see Instruction F-2, "Packaging and Shipping Procedures," Appendix F).

D.1.4.2 Composite Liquid Waste Sampler (COLIWASA). Method References: ASTMs D 5495, D 5743, and EPA/540/P-91/008 (SOP #2009).

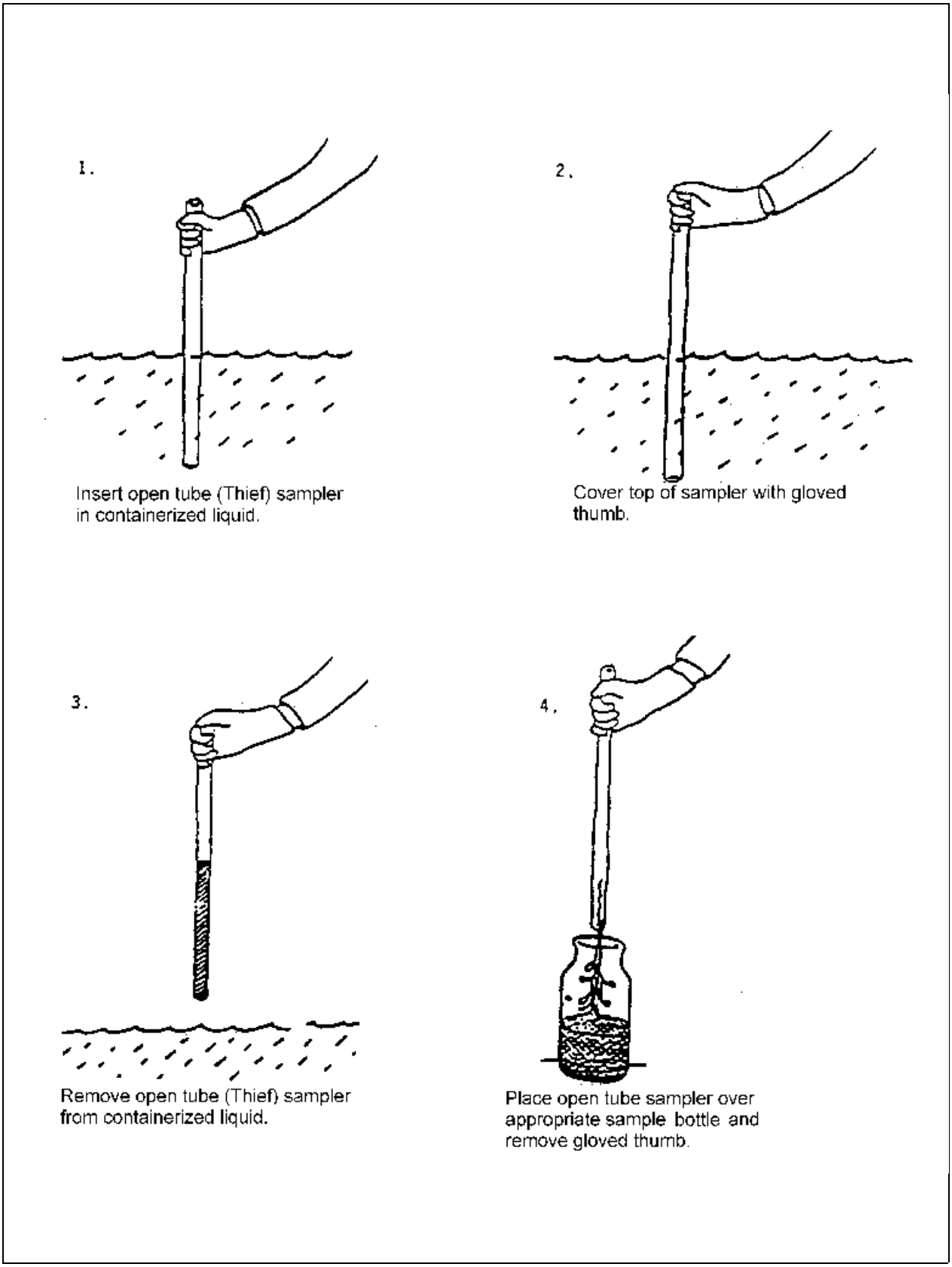

Figure D-6. Open-ended tube sampling procedure

D.1.4.2.1 Applicability. The COLIWASA permits the representative sampling of wastes having a wide range of viscosity, corrosivity, volatility, and solids content. Its simple design makes it easy to use and enables the rapid collection of samples, thus minimizing the exposure of the sample collector to potential hazards from the wastes.

D.1.4.2.2 Method summary and equipment. A properly constructed COLIWASA can be used to sample very hazardous materials safely and quickly.

D.1.4.2.3 Sampling procedure.

- Choose the plastic (Figure D-7) or glass ball type stopper (Figure D-8) COLIWASA for the liquid waste to be sampled and assemble the sampler.

- Ensure that the sampler is functioning properly. Adjust the locking mechanism if necessary to make sure the stopper provides a tight closure.

- Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the locking block of the sampler. The open position for the glass ball type is achieved by pulling up on the inner rod, thereby pulling the glass ball away from the tapered end of the outer tube.

- Slowly lower the sampler into the liquid waste. (Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sampler tube is lower than the level outside the sampler, the sampling rate is too fast and will result in a sample biased to bottom contents.)

- When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block. The closed position for the glass ball type is achieved by pushing the glass ball end of the inner rod against the tapered end of the outer tube.

- Slowly withdraw the sampler from the waste container with one hand while wiping the sampler tube with a disposable cloth or rag with the other hand.

- Carefully discharge the sample into a suitable sample container by slowly opening the sampler. This is done by slowly pulling the lower end of the T-handle away from the locking block and pulling up on the inner rod to release the contents while the lower end of the sampler is positioned in a sample container. Repeat as necessary.

- Secure the cap tightly.

- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.

- Complete all chain-of-custody documents, drum log sheets, and/or record in field logbook (see Instruction F-1, "Documentation," Appendix F). Prepare samples for shipment (see Instruction F-2, "Packaging and Shipping Procedures," Appendix F).

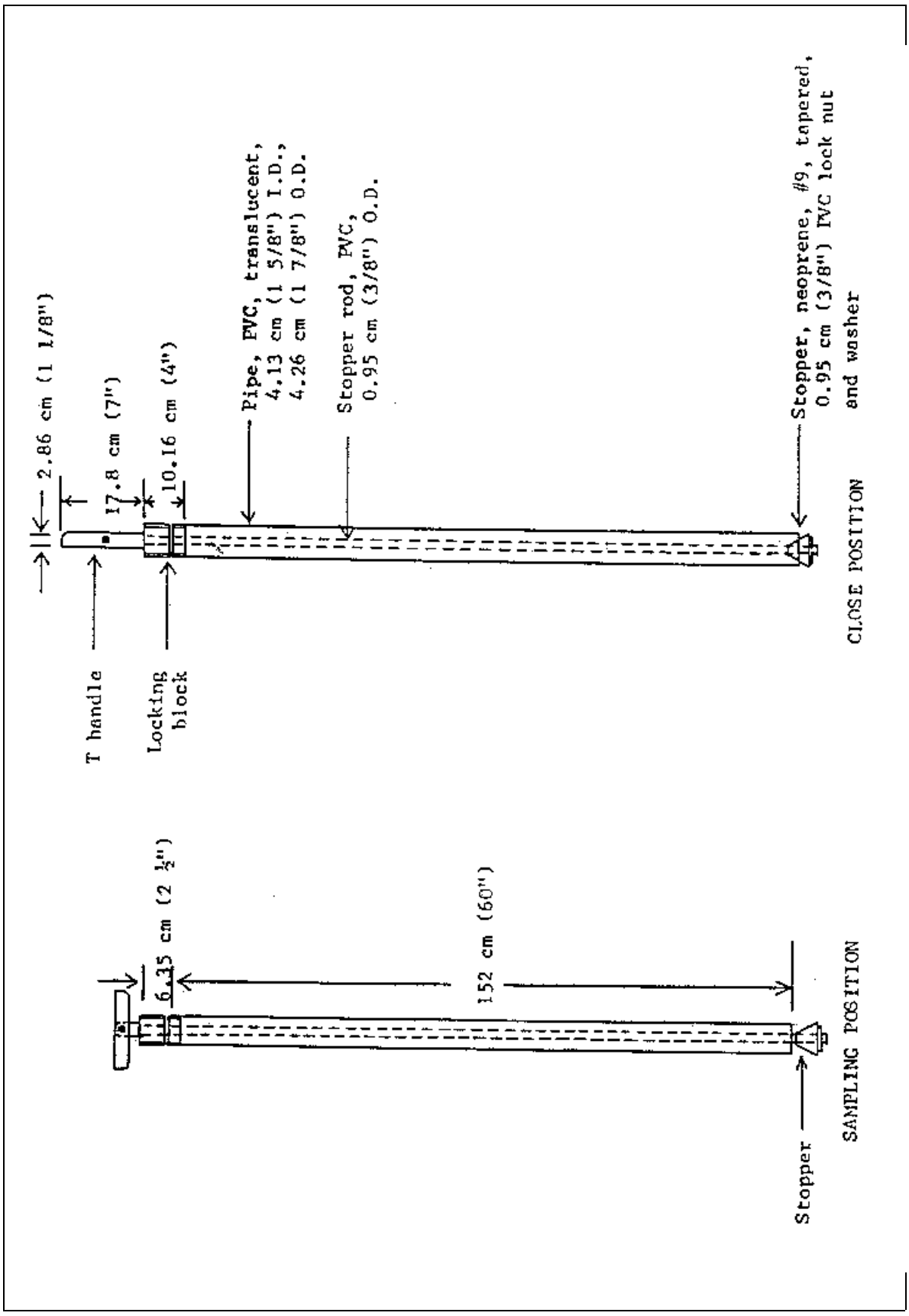

Figure D-7. Composite Liquid Waste Sampler (COLIWASA)

- Decontaminate the sampling equipment after use and between sampling locations. Since the tube is small and difficult to decontaminate, it may be cost-effective to dispose of the sampler and use new ones for additional sampling.

D.1.4.3 Emerging and innovative sampling procedures. Due to the difficulties with the use of a glass thief and COLIWASA sampler, recent modifications have been marketed to minimize spillage and sampling bias. The apparatus consists of a sample tube, an outer wiper for the sample tube, a head section that connects the sample tube directly to the sample container, and a plunger on a plastic line/rod or stainless steel rod that aids in the transfers of the waste to the sample container. The unique design minimizes spillage from several aspects, including the plunger assembly, which pulls the waste up the sampling tube into the head section and allows drainage into the sample container; the head section, which effectively connects the sample tube to the sample container, thereby completely enclosing the waste during this transfer; and the outer wiper, which cleans the outside of the sampler tube upon retrieval of the sampler. The features that isolate the waste will also minimize the potential for sampler exposure to the waste or cross-contamination of the samples. All components may be reused with decontamination protocols or disposed of after one use.

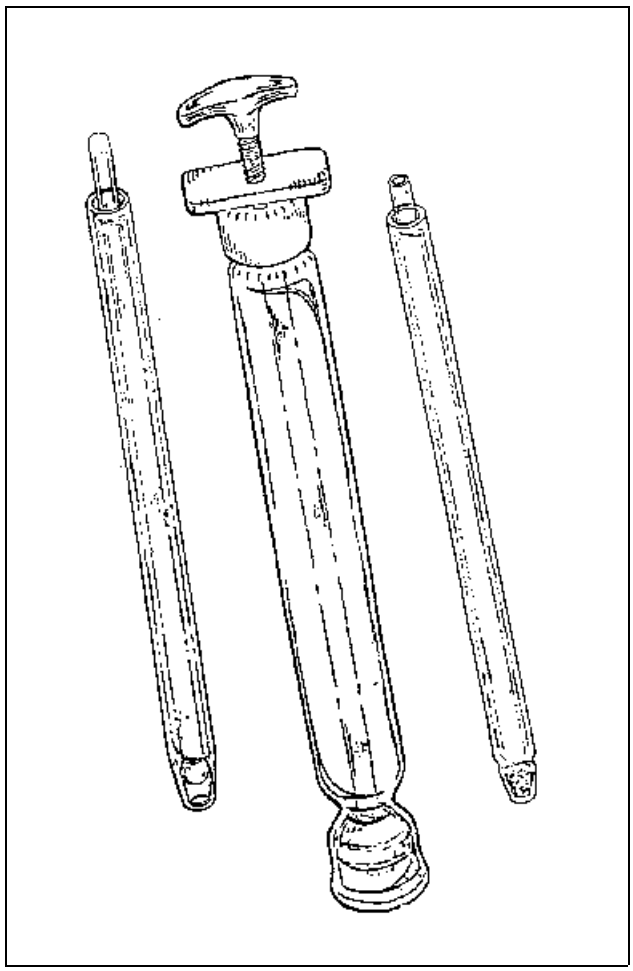

Figure D-8. Glass type Composite Liquid Waste Sampler (COLIWASA)

D.1.4.4 Scoop or trowel. Method Reference: ASTM D 5633.

D.1.4.4.1 Applicability. Stainless steel trowels can be used for sampling soil/solids drum materials and granular or powdered materials in bins or other shallow containers. The laboratory scoop, however, is a superior choice because it is usually made of materials resistant to corrosion or chemical reactions, thus lessening the probability of sample contamination.

D.1.4.4.2 Method summary and equipment. The trowel or scoop can be used to collect shallow samples in a variety of containers (see Figure C-10).

D.1.4.4.3 Sampling procedure.

- Insert scoop or trowel into material and remove sample.

- Begin sampling with the acquisition of any grab volatile organic compound (VOC) samples, conducting the sampling with as little disturbance as possible to the media. Refer to Instruction E-4, “Collection, Handling, and Storage of Solid Samples for VOC Analysis.”
- If homogenization of the sample location is appropriate for the remaining analytical parameters, transfer to a stainless steel bowl for mixing. Refer to Instruction E-2 for homogenizing procedures.

- Transfer sample into an appropriate sample bottle with a stainless steel spoon or equivalent.
- Check that a PTFE liner is present in the cap. Secure the cap tightly.
- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.
- Complete all chain-of-custody documents, drum log sheets, and/or records in field logbooks (see Instruction F-1, "Documentation," Appendix F). Prepare samples for shipment (see Instruction F-2, "Packaging and Shipping Procedures," Appendix F).
- Decontaminate sampling equipment after use and between sampling locations.

D.1.4.5 Sampling trier. Method References: ASTM D 5451 and EPA/540/P-91/008 (SOP #2017).

D.1.4.5.1 Applicability. The sampling trier is used to obtain a core sample and is preferred when the sampling medium is moist or sticky. It can be used for powdered, granular, or soil samples in relatively shallow containers; however, powdered or granular materials may provide low yield.

D.1.4.5.2 Method summary and equipment. Solid samples from open containers can be readily collected by pushing the trier into the medium and cutting the desired core sample (Figure D-9).

D.1.4.5.3 Sampling procedure.

- Insert the trier into the waste material at a 0- to 45-deg angle from horizontal. This orientation minimizes the spillage of sample from the sampler. Extraction of samples may require tilting of the containers.
- Rotate the trier once or twice to cut a core of material.
- Slowly withdraw the trier, making sure that the slot is facing upward.

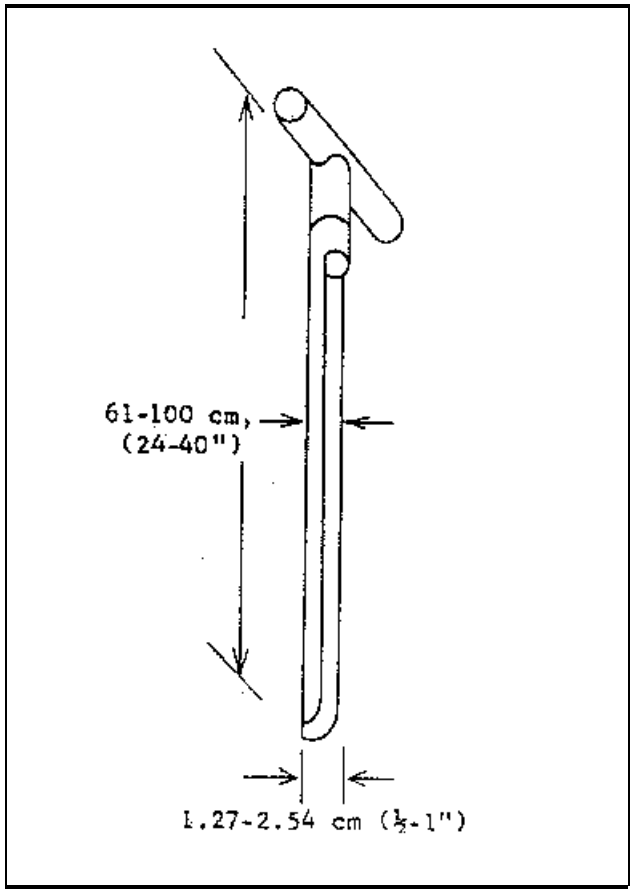

Figure D-9. Sampling trier

- Begin sampling with the acquisition of any grab VOC samples, conducting the sampling with as little disturbance as possible to the media. Refer to Instruction E-4, "Collection, Handling, and Storage of Solid Samples for VOC Analysis."

- Repeat the sampling at different points two or more times and combine the samples in the same sample container.

- If homogenization of the sample location is appropriate for the remaining analytical parameters, transfer to the stainless steel bowl for mixing. Refer to Instruction E-2 for homogenizing procedures.

- Transfer sample into an appropriate sample bottle with a stainless steel spoon or equivalent.

- Check that a PTFE liner is present in the cap. Secure the cap tightly.

- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.

- Complete all chain-of-custody documents, drum log sheets, and/or record in field logbook (see Instruction F-1, "Documentation," Appendix F). Prepare samples for shipment (see Instruction F-2, "Packaging and Shipping Procedures," Appendix F).

- Decontaminate sampling equipment after use and between sampling locations.

D.1.4.6 Grain sampler. Method Reference: EPA/540/P-91/008 (SOP #2017).

D.1.4.6.1 Applicability. The grain sampler is used to sample powdered or granular wastes or materials in bags, fiber drums, sacks, or similar containers. This sampler is most useful when the solids are no greater than 0.6 cm (0.24 in.) in diameter. It is generally used for noncohesive materials.

D.1.4.6.2 Method summary and equipment. Samples from granular and powdered materials can be easily obtained with a grain sampler (Figure D-10).

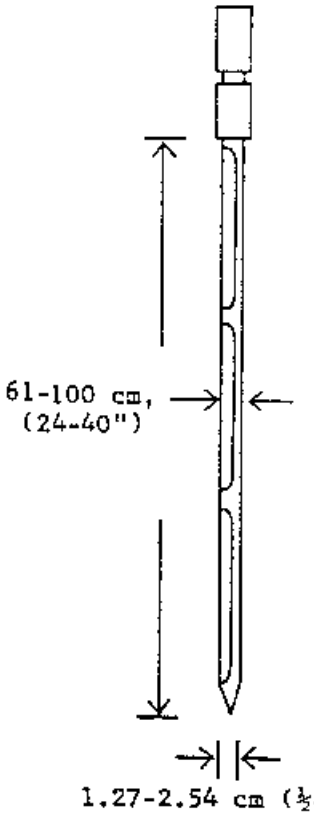

Figure D-10. Grain sampler

D.1.4.6.3 Sampling procedure.

- While the sampler is in the closed position, insert it into the granular or powdered material or waste being sampled from a point near a top edge or comet, through the center, and to a point diagonally opposite the point of entry.
- Rotate the inner tube of the sampler into the open position.
- Wiggle the sampler a few times to allow materials to enter the open slots.
- Place the sampler in the closed position and withdraw the sampler from the material being sampled.
- Place the sampler in a horizontal position with the slots facing upward.
- Rotate and slide the outer tube from the inner tube.
- Begin sampling with the acquisition of any grab VOC samples, conducting the sampling with as little disturbance as possible to the media. Refer to Instruction E-4, "Collection, Handling, and Storage of Solid Samples for VOC Analysis."
- Collect two or more core samples at different points and combine the samples in the same container.
- If homogenization of the sample location is appropriate for the remaining analytical parameters or if compositing of different locations is desired, transfer the sample to the stainless steel bowl for mixing. Refer to Instruction E-2 for homogenizing procedures.
- Transfer sample into an appropriate sample bottle with a stainless steel spoon or equivalent.
- Check that a PTFE liner is present in the cap. Secure the cap tightly.
- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.
- Complete all chain-of-custody documents, drum log sheets, and/or record in field logbooks (see Instruction F-1, "Documentation," Appendix F). Prepare samples for shipment (see Instruction F-2, "Packaging and Shipping Procedures," Appendix F).
- Decontaminate sampling equipment after use and between sampling locations.

D.1.4.7 Waste pile sampler. Method Reference: ASTM D 5451.

D.1.4.7.1 Applicability. The waste pile sampler is essentially a large sampling trier and is used primarily for sampling wastes in large heaps with cross-sectional diameters greater than 1 m (3 ft).

D.1.4.7.2 Method summary and equipment. Solid samples from large containers or heaps can be collected by pushing the sampler down into the medium and then retracting the device to obtain a core sample (Figure D-11).

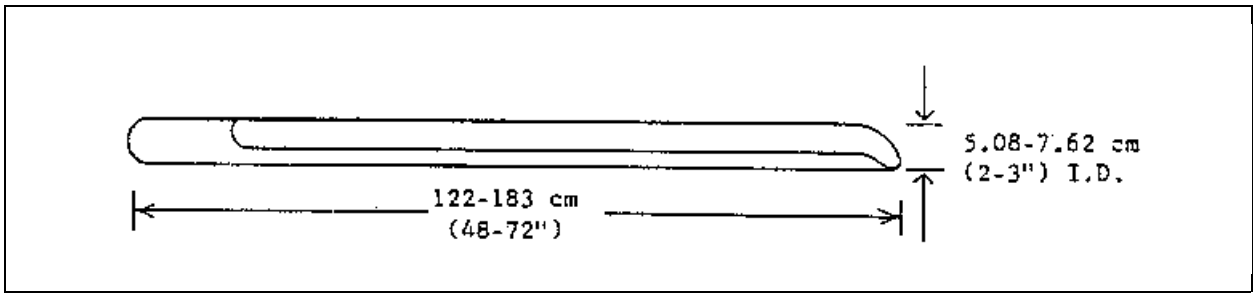

Figure D-11. Waste pile sampler

D.1.4.7.3 Sampling procedure.

- Insert the sampler into the waste material being sampled at 0 to 45 deg from horizontal.
- Rotate the sampler two or three times in order to cut a core of the material.
- Slowly withdraw the sampler, making sure that the slot is facing upward.
- Begin sampling with the acquisition of any grab VOC samples, conducting the sampling with as little disturbance as possible to the media. Refer to Instruction E-4, "Collection, Handling, and Storage of Solid Samples for VOC Analysis."
- Repeat the sampling at different sampling points two or more times and combine the samples in the same sample container.
- If homogenization of the sample location is appropriate for the remaining analytical parameters, transfer to the stainless steel bowl for mixing. Refer to Instruction E-2 for homogenizing procedures.
- Transfer the sample into an appropriate sample bottle with a stainless steel spoon or equivalent.
- Check that a PTFE liner is present in the cap. Secure the cap tightly.
- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.
- Complete all chain-of-custody documents and record in field logbook (see Instruction F-1, "Documentation," Appendix F). Prepare samples for shipment (see Instruction F-2, "Packaging and Shipping Procedures," Appendix F).
- Decontaminate sampling equipment after use and between sampling locations.

D.1.4.8 Veihmeyer sampler. Method Reference: ASTM D 4700.

D.1.4.8.1 Applicability. The Veihmeyer sampler is used to sample deeper soils, large heaps, and containers that contain hard substances. It is designed to penetrate specific types of media without pushing the medium ahead of it, thus preventing the core from compacting in the tube.

D.1.4.8.2 Method summary and equipment. Core samples from large heaps or hard, crusty materials can be obtained with a Veihmeyer sampler (Figure D-12).

D.1.4.8.3 Sampling procedure.

C Assemble the sampler by screwing in the tip and the drive head on the sampling tube.

C Insert the tapered handle (drive guide) of the drive hammer through the drive head.

C Place the sampler in a perpendicular position on the material to be sampled.

C With one hand holding the tube, drive the sampler into the material to the desired sampling depth by pounding the drive head with the drive hammer. Do not drive the tube further than the tip of the drive guide of the hammer.

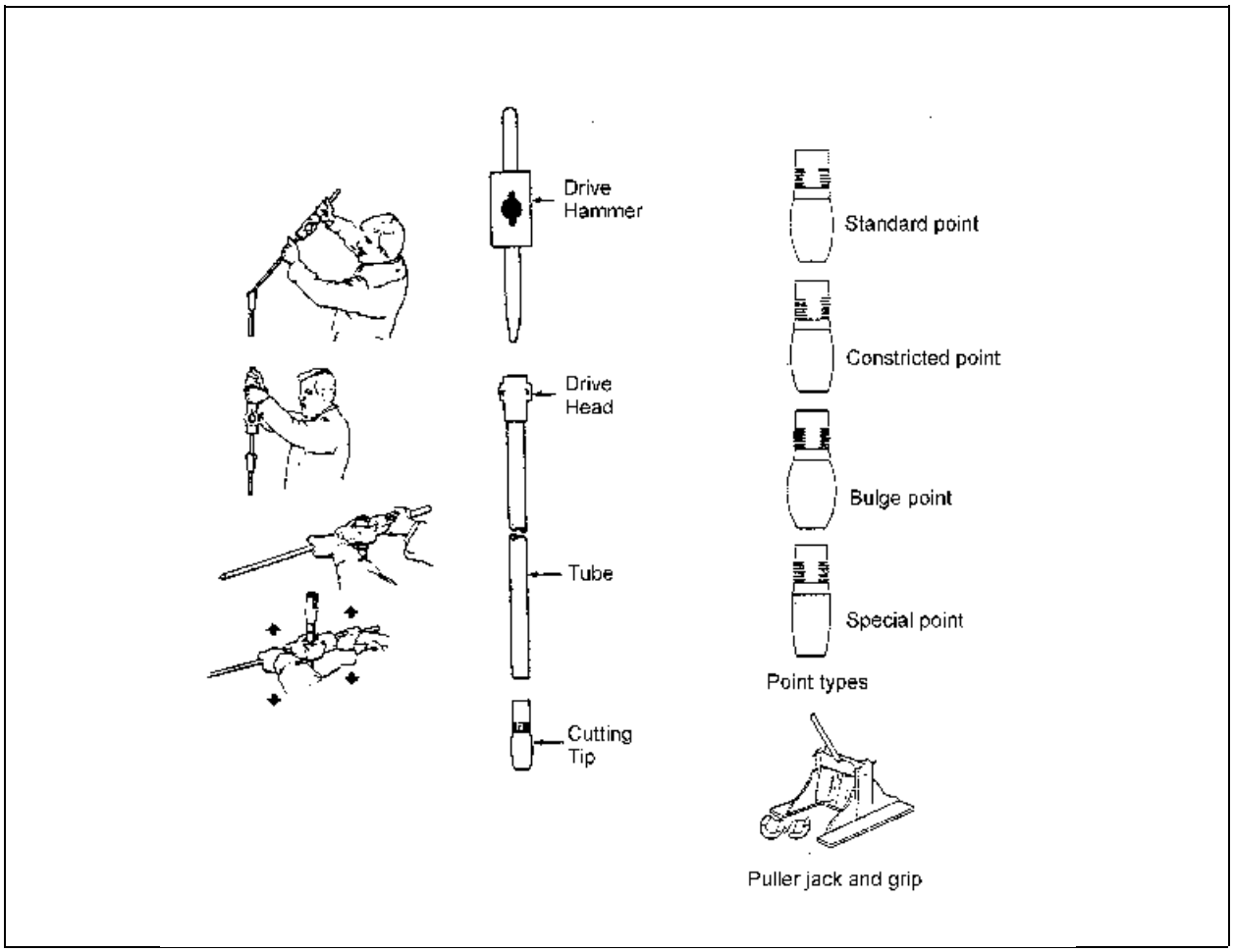

Figure D-12. Veihmeyer sampler

C Record the length of the tube that penetrated into the media.

C Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto the drive head. In this position, the hammer serves as a handle for the sampler.

C Rotate the sampler at least two revolutions to shear off the sample at the bottom.

C Lower the sampler handle (hammer) until it just clears the two earlike protrusions on the drive head and rotate about 90 deg.

- Withdraw the sampler from the material by pulling the handle (hammer) upward. When the sampler cannot be withdrawn by hand, as in deep sampling, use the puller jack and grip.

- Dislodge the hammer from the sampler, turn the sampler tube upside down; tap the head gently against the hammer; and carefully recover the sample from the tube. The sample should slip out easily.

- Store the core sample, preferably in a rigid, transparent, or translucent plastic tube when observation of soil layers is to be made. The use of the tube will keep the sample relatively undisturbed. In other cases, use a 1,000- or 2,000-ml (1-qt or 1/2-gal) sample container to store the sample.

- Collect additional core samples at different points.

- Secure the cap tightly.

- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.

- Complete all chain-of-custody documents and record in field logbooks (see Instruction F-1, "Documentation," Appendix F). Prepare samples for shipment (see Instruction F-2, "Packaging and Shipping Procedures," Appendix F).

- Decontaminate sampling equipment after use and between sampling locations.

D.1.5 Decontamination procedures. All sampling equipment must be decontaminated before its use. Much of the sampling equipment used for bulk sampling may be disposable. When applicable, sampling equipment should be cleaned as described in Instruction E-6 (Appendix E). Sampling equipment should be placed in plastic bags until immediately before use. Additional sampling devices may be needed onsite to ensure an adequate drying time.

D.1.6 Field control sample requirements. Field control samples are not routinely collected when sampling bulk materials. If appropriate, the sampling team should determine whether the data users require the acquisition of field control samples (i.e., blanks and replicate samples). A detailed discussion of field control samples is contained in Instruction G-2 (Appendix G).

D.1.7 Documentation requirements. Bound field logbooks should be used for the maintenance of field records. Record all aspects of the site set-up, sample collection, and handling as outlined previously and in Instruction F-1 of Appendix F.

D.1.8 Drum contents/waste testing. Physical and chemical HAZCAT testing should be performed on all unknown materials in order to properly characterize and segregate the contents of each drum into various waste-stream types or groups. In addition, wastes included within a hazardous waste group or within compatible groups should undergo compatibility testing before physical bulking operations. The following guidelines are provided to aid technical teams in developing site-specific physical, HAZCAT, and compatibility testing protocols.

D.1.8.1 Initial inspection record. Record any information gathered from the drum, such as the following:

- Drum size (5, 10, 18, 30, 42, 55, 85-gallon).

- Drum type (fiber, steel, stainless steel, nickel, polyurethane, polyurethane-lined, closed top, ring top, overpacked, etc.).

- Drum markings (manufacturer or chemical names, hazard symbols, or other labels).

- Drum condition (note any signs of deterioration such as corrosion, leaking, swelling/bulging).

- Field monitoring instruments readings.

D.1.8.2 Preliminary waste characterization testing. After opening, an initial sample should be withdrawn to inspect the contents. Record the sample identification number and description on the drum contents within the field logbook or drum log sheets. Recommend documenting the following waste physical descriptions:

- Number of phases: provide number and description of phases present. This determination may sometimes be difficult for very viscous liquids or resins. Lateral illumination, density, or conductivity measurement may be required to establish the actual interface in the mixture.

- Physical state: describe whether each phase is an aqueous liquid, gel, grease, oil, sludge, solid, etc. Also provide a general consistency of waste, if appropriate.

- Color: the color of each layer should be provided within the description.

- Clarity: the clarity of each layer should be described, such as clear, cloudy, translucent, or opaque.

- Homogeneity: the homogeneity of each layer should be provided within the description.

- Thickness of layer(s): the thickness of layers should be estimated from the general profile within the sampling device.

- General observations: note any additional items with respect to the appearance of each layer (i.e., dust, grains, metallic filings, fibers or friable material, pellets, crystals, fuming, etc.)

D.1.8.3 Hazardous waste characterization testing. Upon retrieving a sample, the sampler should conduct the following procedure for hazardous characterization testing as appropriate. Figure D-13 shows an example of a Hazardous Waste Characterization Testing Scheme. Each phase of a multiphase waste should be tested and classified. HAZCAT testing procedures may be purchased as commercial field kits, necessary reagents brought to a field/mobile laboratory, or samples sent to an offsite laboratory to conduct the testing.

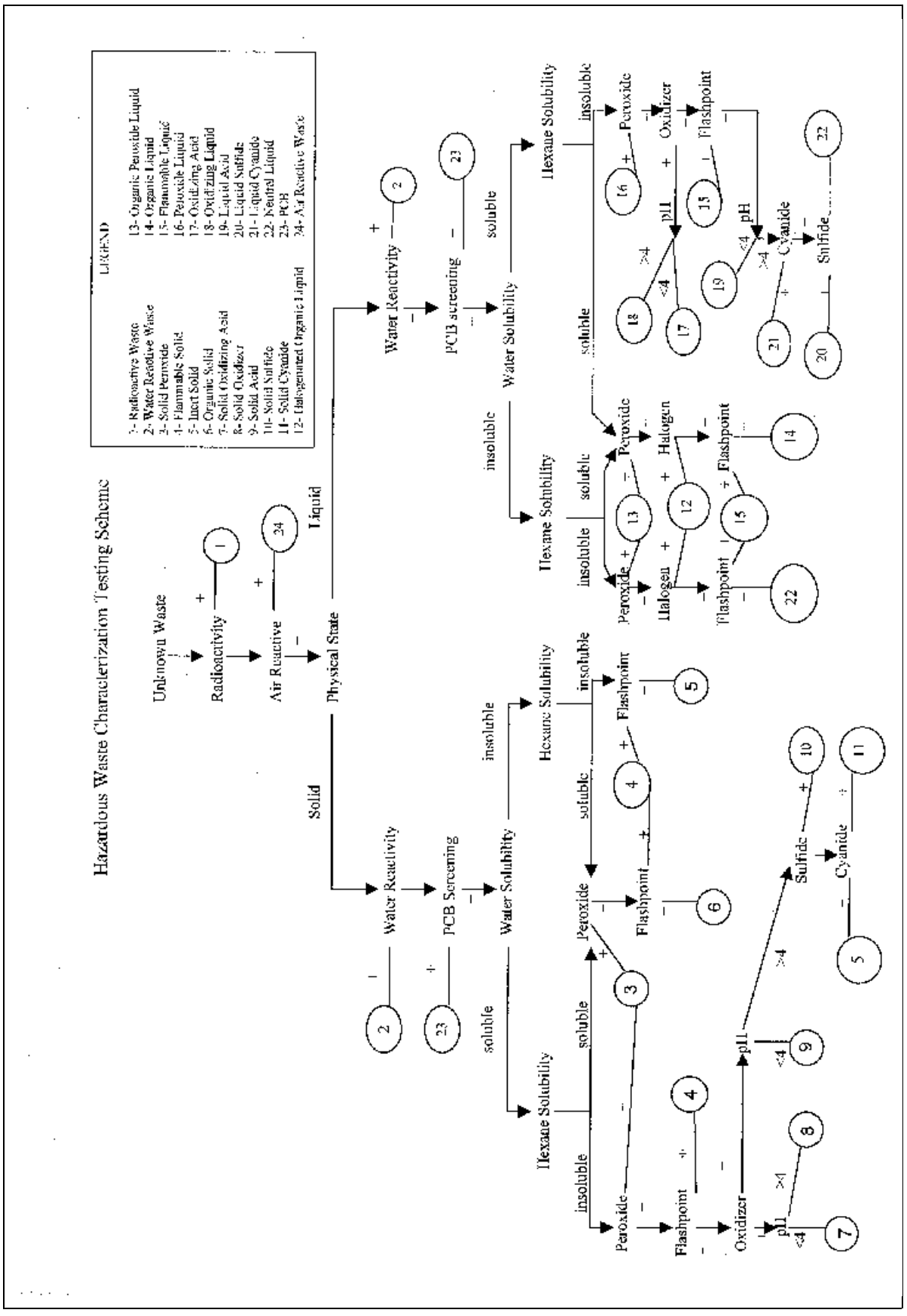

Figure D-13. Hazardous waste characterization testing scheme example

- Air reactivity
- Water reactivity
- Physical state (solid/liquid)
- Water solubility testing
- Hexane solubility testing
- pH testing
- Volatile organics headspace test with flame ionization detector/photoionization detector
- Peroxide test
- Oxidizer test
- Halogen test (Beilstein)
- Ignitability test (flashpoint)
- Cyanide test
- Sulfide test
- Polychlorinated biphenyls (PCB) screening (commercially available kits or gas chromatograph)

D.1.8.4 Waste compatibility testing. Following the physical/chemical testing, aliquots from containers with the same characteristics should be combined in a documented sequence. Visual observations (i.e., color, precipitation, gas evolution, or phase separation) and temperature measurements (to test for chemical reactions) should be made. If a reaction occurs, the compatibility sequence should be started again, omitting the sample that caused the reaction. This should be continued until the volume of waste deemed compatible is sufficient to constitute a bulk load for disposal.

D.2 Transformer Sampling

D.2.1 Scope and application. Instructions presented in this section are for collecting representative samples from transformers. Transformers can be classified into two primary types: pole-mounted and ground-mounted. Ground-mounted transformers are usually rectangular and are mounted on the ground surface or, in some cases, below ground. Pole-mounted transformers are usually round or oval and are typically mounted above ground. Instructions for sampling transformers by the following techniques are included in this section: outlet sampling method, glass thieving tube, and COLIWASA.

D.2.2 Sampling strategies. Successful investigations of hazardous waste sites are highly dependent on an effective sampling scheme. Development of a sampling scheme to characterize hazardous waste transformer contents should follow the fundamentals of scientific approach. A successful sampling scheme requires a logical design to allow an evaluation of potential contaminants.

D.2.2.1 Sampling locations. Sampling transformers is somewhat different from sampling other bulk objects. Transformers are often in secured, out-of-the-way locations, and access may present problems. Transformers may be located in underground cells.

D.2.2.2 Types of samples. Samples collected from transformers are typically discrete samples. A discrete (grab) sample is defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected immediately and at a particular point in the sample matrix. Representativeness of such samples is defined by the nature of the materials being sampled. Composites are nondiscrete samples composed of two or more specific aliquots collected at various sampling locations and/or different points in time. Analysis of this type of sample produces an average value and can, in certain instances, be used as an alternative to analyzing a number of individual grab samples and calculating an average value. The objective of sampling transformers is to identify the potential regulatory status of the equipment and the potential presence of PCBs in the dielectric fluid contained within the transformer. Therefore, the only appropriate sample type is the discrete sample. Compositing could mask the presence of contaminants by diluting isolated concentrations of the contaminant.

D.2.2.3 Suggested samplers. Each sampling technique presents various disadvantages and advantages for its application. For example, sample disturbance, sample volume, chemical/physical reactivity between potential contaminants and sampling tool materials, and ease of use and decontamination vary from technique to technique. Discussions of the advantages and disadvantages of each sampling technique are presented in the following sections.

D.2.2.4 Sample frequency. Transformer sampling requires one sample per transformer to assess the potential hazardous nature (PCB content) of the transformer fluid.

D.2.3 Sample preservation and handling. Preservation methods and sample containers should be as prescribed in the analytical method or as identified by the analytical laboratory. Since transformer fluids are typically an oil matrix, the preservation method would be cooling. Procedures and techniques for transporting the samples to the offsite laboratory are discussed in Instruction F-2, "Packaging and Shipping Procedures," Appendix F. Improper sample handling may alter the analytical results of the sample. Samples should be transferred in the field from the sampling equipment directly into the container that has been specifically prepared for that analysis or set of compatible parameters.

D.2.3.1 Sample containers. When sampling transformers, use 125-mℓ wide-mouth glass jars with PTFE caps. Containers should be cleaned prior to sampling. Instruction E-6, "Decontamination Procedures," contains additional information on appropriate glassware-cleaning protocols. If precleaned bottles are used, the

cleanliness of each lot of precleaned bottles should be verified by the container supplier or in the laboratory and appropriate paperwork (i.e., certificates) be retained with other field documentation.

D.2.3.2 Sample preservation. Methods of sample preservation are relatively limited and are generally intended to retard biological action and hydrolysis and to reduce sorption effects. Preservation methods are limited to cooling.

D.2.3.3 Special precautions. Transformer sampling typically involves sampling medium- to high-level contaminants. Consequently, the following special precautions are warranted and should be taken when preparing for and performing transformer sampling:

- The transformer must be certified as "off-line" and de-energized by an electrician or other responsible person. Do not pursue any sampling activities until the transformer is disconnected.

- A clean pair of new, disposable gloves should be worn each time a different location is sampled, and gloves should be donned immediately prior to sampling.

- Sample containers for source samples or samples suspected of containing high concentrations of contaminants should be placed in separate plastic bags immediately after collecting, preserving, tagging, etc. Also segregate the samples of waste or highly contaminated samples from the ice chest used to ship environmental samples. It is also good practice to enclose waste or highly contaminated samples in a plastic bag before placing them in ice chests. Ice chests or shipping containers for source samples or samples suspected to contain high concentrations of contaminants should be lined with new, clean plastic bags.

- If possible, one member of the field team should take all the notes and fill out sample tags, field sheets, etc., while the other members collect all of the samples.

- Sample collection activities should proceed progressively from the suspected least contaminated area to the suspected most contaminated area.

- Field personnel should use sampling equipment constructed of PTFE, stainless steel, or glass that has been properly precleaned.

D.2.4 Sampling methods. Presented in the following sections are sampling instructions for the most common techniques for collecting transformer samples. Prior to sample collection, the transformer location and any specific markings or information should be recorded in the field logbook. Selection of sampling equipment is usually based on access to the transformers. If possible, obtain access to the contents of the transformer by removing the cover. A COLIWASA or glass thieving tube should be used for sampling. The outlet sampling method should be used only if other sampling methods are not possible. The toxic nature of PCBs and degree of hazard posed by their potential presence in a transformer dictate that a high level of caution should be used. As noted in Section D.2.3.3, once the power source to the transformer is disconnected, spill control measures are put in place, and the cover of the transformer, if accessible, removed with hand tools. Spill prevention control should be accomplished by using plastic sheeting on the ground and/or the floor surface of the lift, and sorbent pads.

D.2.4.1 Outlet sampling method.

D.2.4.1.1 Applicability. Sampling from the transformer outlet valve is probably the easiest method of transformer sampling. However, because the outlet valve is typically located at the base of the transformer,

sample stratification may be a problem. PCBs are generally heavier than other insulating oils and may sink to the bottom, preventing the collection of representative samples utilizing the transformer outlet.

D.2.4.1.2 Method summary and equipment. A clear, plastic (Tygon) tube is placed over the transformer outlet, and the outlet is opened allowing the oil to flow from the tube into a sample jar. It is usually advisable to have a catch bucket below the outlet to capture any spilled oil.

D.2.4.1.3 Sampling procedure.

- Install bucket or pan under the electric equipment sampling outlet to catch overflow oil.
- Obtain clear, plastic tubing (Tygon). Attach one end of the tube to the electrical equipment sampling outlet valve and place the other end of the tube in the sample container. The tubing between the transformer and the container should be as short as possible to avoid leakage potential. The tube should be of a smaller diameter than the valve ends to ensure that there is no leakage.
- Drain some oil through the sample valve cock and tubing into the overflow bucket or pan to ensure that no contaminants are present in the sampling line. Then close the sample valve cock.
- After draining some oil through the sampling line, place the tubing in the sample container.
- Open the sample valve cock on the transformer.
- Fill the sample container.
- When the sample container is completely full of oil, close the transformer valve.
- Secure the cap tightly.
- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.
- Complete all chain-of-custody documents and record them in the field logbook (see Instruction F-1, "Documentation," Appendix F). Prepare sample for shipment (see Instruction F-2, Packaging and Shipping Procedures," Appendix F).
- Decontaminate sampling equipment after use and between sampling locations.

D.2.4.2 Glass thieving tube. Method Reference: ASTM D 5743.

D.2.4.2.1 Applicability. The glass thieving tube is relatively inexpensive and easy to use, but it requires removing the transformer cover.

D.2.4.2.2 Method summary and equipment. The glass thieving tube typically consists of a 6- to 16-mm inside diameter (ID) (1/4- to 5/8-in. ID) 1.2-m- (48-in.-) long glass tube. To sample, the cover of the transformer is removed, and the glass thieving tube is lowered into the oil.

D.2.4.2.3 Sampling procedure.

- Remove the cover from the transformer.
- Insert glass tubing almost to the bottom of the transformer. Approximately 0.3 m (1 ft) of tubing should extend above the drum.
- Allow the oil in the transformer to reach a constant level in the tube during the descent of the tube.
- Cap the top of the sampling tube with a tapered stopper or gloved thumb, ensuring that the liquid does not come in contact with the stopper or thumb.
- Carefully remove the capped tube from the transformer and insert the uncapped end into the sample container, being careful not to spill any oil outside the container.
- Release the stopper or thumb and allow the oil to drain into the sample container until it is approximately two-thirds full.
- Remove the tube from the sample container and dispose of the tube properly.
- Secure the cap tightly.
- Label the sample bottle with the appropriate sample tag. Be sure to label the tag carefully and clearly, addressing all the categories or parameters.
- Complete all chain-of-custody documents and record them in field logbooks (see Instruction F-1, "Documentation," Appendix F). Prepare samples for shipment (see Instruction F-2, "Packaging and Shipping Procedures," Appendix F).

D.2.4.3 Composite liquid waste sampler (COLIWASA). Method References: ASTM D 5495 and EPA/540/P-91/008 (SOP #2009).

D.2.4.3.1 Applicability. The COLIWASA is capable of obtaining a representative sample of multiphase containerized liquids. In comparison with the other transformer sampling methods, it is more expensive and decontamination is more difficult.

D.2.4.3.2 Method summary and equipment. The COLIWASA is designed to permit collection of representative samples from multiphase containerized liquids. COLIWASAs are commercially available and typically consist of a 1.5-m (5-ft) by 40-mm (1-1/2-in.) section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper.

D.2.4.3.3 Sampling procedure.

- Choose the plastic (Figure D-7) or glass ball type stopper (Figure D-8) COLIWASA for the liquid waste to be sampled and assemble the sampler.
- Ensure that the sampler is functioning properly. Adjust the locking mechanism if necessary to make sure the stopper provides a tight closure.
- Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the locking block of the sampler. The open position for the

glass ball type is achieved by pulling up on the inner rod, thereby pulling the glass ball away from the tapered end of the outer tube.

- Remove the cover from the transformer.

- Slowly lower the sampler into the liquid waste. (Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sampler tube is lower than the level outside the sampler, the sampling rate is too fast and will result in a nonrepresentative sample.)

- When the sampler stopper hits the bottom of the transformer, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block. The closed position for the glass ball type is achieved by pushing the glass ball end of the inner rod against the tapered end of the outer tube.

- Slowly withdraw the sampler from the transformer with one hand while wiping the sampler tube with a disposable cloth or rag with the other hand.

- Carefully discharge the sample into a suitable sample container until it is approximately two-thirds full by slowly opening the sampler. This is done by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container. Repeat as necessary.

- Secure the cap tightly.

- Label the sample bottle with the appropriate sample label. Be sure to complete the label carefully and clearly, addressing all the categories or parameters.

- Complete all chain-of-custody documents and record them in the field logbook (see Instruction F-1, "Documentation," Appendix F).

- Prepare samples for shipment (see Instruction F-2, "Packaging and Shipping Procedures," Appendix F).

- Decontaminate the sampling equipment after use and between sampling locations. Since the tube is small and difficult to decontaminate, it may be cost-effective to dispose of the sampler and to use new ones for additional sampling.

D.2.5 Decontamination procedures. All equipment must be decontaminated before its use. The inside surface of tubing apparatus may be considered disposable, or must be decontaminated by drawing the decontamination solution through the equipment. Other sampling equipment presented may also be considered disposable. When applicable, sampling equipment should be cleaned as described in Instruction E-6 (Appendix E). Sampling equipment should be placed in plastic bags until immediately before use. Additional sampling devices may be needed onsite to ensure an adequate drying time.

D.2.6 Field control sample requirements. Field control samples are not routinely collected when sampling transformers. If appropriate, the sampling team should determine whether the data uses require the acquisition of field control samples (i.e., blanks and replicate samples). A detailed discussion of field control samples is contained in Instruction G-2 (Appendix G).

D.2.7 Documentation requirements. Bound field logbooks should be used for the maintenance of field records. Record all aspects of the site set-up and sample collection and handling as outlined previously and in Instruction F-1 of Appendix F.