# FIELD PROCEDURE FP 5-7

# MONITORING WELL AND BOREHOLE ABANDONMENT

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## 1.0 PURPOSE

The purpose of this procedure is to describe, in general terms, the principles and methods of securing a borehole from external contaminants after testing is completed.

## 2.0 SCOPE

This procedure applies specifically to abandonment of test holes and wells generally with the understanding that federal or local regulations may modify these requirements. A specific plan for abandonment should be presented as an integral part of the monitoring well or borehole approval process.

## 3.0 REQUIREMENTS

The potential for entrance of contaminants into groundwater through monitoring wells or boreholes that are not properly maintained after testing is complete or simply abandoned, is enormous. For this reason, an effective method for preventing the entrance of contaminants into groundwater must be developed and utilized.

## 4.0 REFERENCES

4.1 Ohio Administrative Code (OAC) 3745-9-10, February 1975. *Abandonment of Test Holes and Wells*.

4.2 USATHAMA, March 1987. *Geotechnical Requirements for Drilling, Monitoring Wells, Data Acquisition, and Reports*.

## 5.0 DEFINITIONS

**Borehole** - For purposes of this procedure only, any hole drilled into the subsurface for the purpose of identifying lithology or installing monitoring wells.

**Contaminant** - Any substance, which if introduced, would degrade the quality of groundwater.

**Grout** - A slurry of cement, clay, or other material impervious to and capable of preventing movement of water. Typically a neat cement grout containing three to five percent bentonite powder by weight.

## 6.0 RESPONSIBILITIES

### 6.1 Project Manager

The Project Manager is responsible, with input from the Field Operations Leader, for notifying the client of boreholes that are damaged or no longer necessary for field investigations.

### 6.2 Field Operations Leader

The Field Operations Leader is responsible for assuring that monitoring wells and boreholes are abandoned in accordance with this procedure.

## 7.0 EQUIPMENT

1. Drilling Rig Equipped with Appropriate Drilling Tools and Crews
2. Cement, Sand, Bentonite Powder, Bentonite Pellets, or Commercial Hole-Sealing Products.

## 8.0 PROCEDURE

### 8.1 Determining Boreholes for Abandonment

- Boreholes that have been damaged to such an extent that they are no longer functional shall be identified to the client.
- Boreholes that have served their intended purpose and are no longer required shall be identified to the client for abandonment.
- The client shall, with regulatory input, provide written notification to the contractor that a borehole shall be abandoned. The notification shall include a specific location or unique identification number. If any confusion exists, the borehole shall be physically marked for abandonment in the field.

### 8.2 Methodology

- The borehole shall be examined to determine if any damaged casing exists that would allow infiltration of contaminants.

- If damage exists, the borehole shall be redrilled to remove the damaged casing. Damaged casings shall be drummed with borehole cuttings in accordance with the project-specific work plan.
- Undamaged casings, damaged casings that have been removed, and open boreholes shall be grouted to land surface with a side-discharge, rigid tremie pipe. The grout shall consist of a neat cement of sand, cement and water with a three to five percent bentonite powder, by weight, additive.
- The grout shall be placed in such a fashion as to prevent any voids or air pockets from forming. Side-discharge, rigid tremie pipe should be placed in the bottom of the borehole and slowly pulled up as the grout reaches the bottom of the tremie pipe. Grouting shall continue until undiluted grout flows from the borehole at the ground surface. Shallow holes may be sealed without a tremie pipe, by slowly pouring in the grout mixture and "rodding" the mixture to prevent voids or air pockets from forming.
- Test holes dug with a backhoe to a relatively shallow depth and having a length/width to depth ration less than 1:10 may be backfilled with the material that was removed from the test hole and compacted in layers to the approximate density of the undisturbed soil. A soil/bentonite mixture or neat cement/bentonite grout may also be used. In areas where an impermeable layer (cap) has been installed a neat cement/bentonite mixture shall be used to replace the cap.
- Hand-augered boreholes shall be filled with dry flaked bentonite from the bottom of the auger hole to land surface and allowed to hydrate.
- The abandoned site shall be checked every 24 hours for grout settlement. Any depressions shall be filled with grout. This process shall continue until firm grout remains at ground surface.
- A Brass Surveyor's monument, noting the borehole location or unique identification number shall be placed at the land surface to permanently identify the borehole location.
- A boring/well abandonment record shall be submitted to AEC within three working days after the abandonment is complete.
- Replacement borings/wells, if applicable, shall be at least 20 feet from the abandoned site in a up- or cross-gradient groundwater direction.

## 9.0 ATTACHMENTS

None.

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**FIELD PROCEDURE FP 6-2**

**SURFACE WATER AND SEDIMENT SAMPLING**

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## 1.0 PURPOSE

The purpose of this procedure is to define the requirements necessary for surface water and sediment sampling. This procedure describes the methods and equipment commonly used for collecting environmental samples of surface water and sediment samples for either on-site examination and testing, or for laboratory analysis.

## 2.0 SCOPE

Surface water and sediment sampling is applicable to almost any site that has surface drainages on it or located hydraulically downgradient from it. The collection of concentrated sludges or hazardous waste samples from disposal or process lagoons often requires methods, precautions, and equipment different from those described herein. Consequently, specific sampling problems may require the adaptation of existing equipment or design of new equipment or the integration of new and existing methodologies. Any adaptations to these operating procedures and collection of internal quality control checks during sampling is specified in the project-specific work plan.

## 3.0 REQUIREMENTS

Many factors must be considered in developing a sampling program for surface water or sediments, including study objectives; accessibility; site topography, flow, mixing, and other physical characteristics of the water body; point and diffuse sources of contamination; and personnel and equipment available to conduct the study. For waterborne constituents, dispersion depends on the vertical and lateral mixing within the body of water. For sediments, dispersion depends on bottom current or flow characteristics, sediment characteristics (density, size) and geochemical properties (which affect an adsorption/desorption). The hydrologist developing the sampling plan must know not only the mixing characteristics of streams and lakes, but also must understand the role of fluvial-sediment transport, deposition, and chemical sorption.

## 4.0 REFERENCES

**4.1** Feltz, H.R., 1980. *Significance of Bottom Material Data in Evaluating Water Quality in Contaminants and Sediments*. Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., Volume 1, p. 271-287.

**4.2** Kittrell, R.W., 1969. *A Practical Guide to Water Quality Studies of Streams*. U.S. Federal Water Surveillance Control Administration, Washington, DC, pp. 135.

**4.3** United States Environmental Protection Agency, 1980. *Standard Operating Procedures and Quality Assurance Manual*. Water Surveillance Branch, USEPA Surveillance and Analytical Division, Athens, Georgia.

**4.4** U.S. Geological Survey, 1977. *National Handbook of Recommended Methods for Water-Data Acquisition*. Office of Water Data Coordination, USGS, Reston, Virginia.

## 5.0 DEFINITIONS

**Environmental Sample** - Low concentration sample typically collected offsite and not requiring DOT hazardous waste labelling as a high hazard sample.

**Hazardous Waste Sample** - Medium to high concentration sample (e.g., source material, sludge leachate) requiring DOT labelling and Contract Lab handling as a high hazard sample.

## 6.0 RESPONSIBILITIES

### 6.1 Field Operations Leader

The Field Operations Leader has overall responsibility for the correct implementation of surface water and sediment sampling activities, including review of the sampling plan and any necessary training of the sampling technician(s). The actual collection, packaging documentation (sample label and log sheet, chain-of-custody recorded, Contract Lab reports, etc.) and initial custody of samples will be the responsibility of the sampling technician(s).

## 7.0 EQUIPMENT

1. Sampling Bottles Treated with Preservatives, if necessary
2. Specific Conductivity Meter
3. pH Meter
4. Thermometer
5. Stainless Steel Bowl and Spoon
6. Stainless Steel Hand Auger, Shovel, or Spoon
7. Filtering Equipment (if analyzing for metals in water)
8. Open Tube
9. Dip Sampler
10. Kemmerer or Van Dorn Sampler
11. Teflon® or Stainless Steel Bailer
12. Hand-Driven Tube Sampler with Liners (Brass or Stainless Steel)
13. Decontamination Equipment and Supplies
14. Pump.

## 8.0 PROCEDURE

### 8.1 General Procedures

The following section outlines commonly used procedures for collecting surface water and sediment samples. Criteria for choosing the correct piece of sampling equipment is also covered in this section. All sampling equipment should be cleaned and decontaminated prior to use in accordance with FP 3-1.

- In general, whenever sampling surface water and sediments from the same location, the surface water samples should be collected first and sediments second to minimize collection of sediment with the water samples.
- The sampling sequence shall begin at downstream locations and progress upstream to prevent cross-contamination from one location to another.
- When collecting water samples, samples for volatile organics analysis should be collected first followed by non-volatile organics and inorganics. All water sample containers except for volatile organic sample containers shall be triple rinsed downstream of the sampling point. Split samples and duplicate samples should be taken according to

analysis type. All samples for volatile organics analysis should be taken as near simultaneously as possible, followed by all non-volatile organics and inorganics.

- Prior to sampling sediments in a stream, the sampling devise shall be rinsed with stream water at a point downstream from the sampling location. Twigs, leaves, pebbles, and debris that are not integral components of the matrix of interest must be removed by the sampling team. Prior to sampling sediments in a pond or lagoon, the sampling devise shall be triple rinsed with water near the sampling point. However, caution must be exercised to avoid disturbing the sediments at the sampling point by the rinsing activities.
- When collecting sediment samples for analysis, samples for volatile organics analysis shall be taken directly from the sampler and immediately placed in the sample container and sealed to minimize volatilization. The remaining sample should be composited in a stainless-steel bowl. Samples for other analyses shall be taken from the composite sample. Duplicates and split samples shall be collected at the same time as the original sample and in the same analytical sequence.
- Water samples for volatile organics analysis should be collected ensuring that no bubbles are trapped in the sample container. Sediment samples for volatile organics analysis should be packed into the sample container until all voids are filled, if possible, and no headspace remains between the sample container lid and the sample. As much liquid as possible should be decanted from the sample container.
- After sampling each location, the equipment shall be rinsed with distilled water or AEC-approved water.
- If required, samples for dissolved inorganic parameters in surface waters will be filtered in accordance with FP 6-8 before preservation. Water samples collected for total inorganic analysis will not be filtered.

## 8.2 Water/Sediment Sampling Techniques

### 8.2.1 Dip Sampling

Water is often sampled by filling a container, either attached to a pole or held directly, from just beneath the surface of the water (i.e., a dip or grab sample). Constituents measured in grab samples are only indicative of conditions near the surface of the water column and in the cross section. Therefore, whenever possible, one should augment dip samples with samples that represent both dissolved and suspended constituents and both vertical and horizontal distributions.

### 8.2.2 Weighted Bottle Sampling

A grab sample can also be taken using a weighted holder that allows a sample to be lowered to any desired depth, opened for filling, closed, and returned to the surface. This allows discrete sampling with depth. Several of these samples can be combined to provide a vertical composite. Alternatively, an open bottle can be lowered to the bottom and raised to the surface at a uniform rate so that the bottle collects sample throughout the total depth and is just filled on reaching the surface. The resulting sample using either method will roughly approach a depth-integrated sample.

A closed weighted bottle sampler consists of a stoppered glass or plastic bottle, weight and/or holding device, and lines to open the stopper and to lower or raise the bottle. The procedure for sampling is:

1. Gently lower the sampler to the desired depth so as not to remove the stopper prematurely (watch for bubbles).
2. Pull out the stopper with a sharp jerk of the sampler line.
3. Allow the bottle to fill completely, as evidenced by the cessation of air bubbles.
4. Raise the sampler and cap the bottle.
5. Preserve sample, if required, with appropriate preservatives.
6. Decontaminate the outside of the bottle. The bottle can be used as the sample container as long as the original bottle is an approved container.

**8.2.3 Pumps**

Pumps may be operated by peristaltic, bellows, diaphragm, or siphon action. Pumps which operate by a bellows, diaphragm, or siphon action should not be used to collect samples which will be analyzed for volatile organics because the slight vacuum applied may cause loss of these contaminants. To avoid contamination of the pump, a liquid trap consisting of a vacuum flask or other vessel to collect the sample should be inserted between the sample inlet hose and the pump.

Tubing used for the inlet hose shall be nonreactive (preferably Teflon®). The tubing and liquid trap must be thoroughly decontaminated between uses or disposed of after one use.

When sampling, the tubing is weighted and lowered to the desired depth. The sample is then obtained by operation of the pump and subsequently transferred from the trap to the sample container.

**8.2.4 Kemmerer/Van Dorn Samplers**

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon® coated sampler, a Standard Kemmerer or Van Dorn sampler may be used. The Kemmerer sampler is a brass cylinder with rubber stoppers that leave the ends open while being lowered in a vertical position to allow free passage of water through the cylinder. The Van Dorn sampler is plastic and is lowered in a horizontal position. In either case, a "messenger" is sent down the line when the sampler is at the designated depth which causes the rubber stoppers to close, thereby allowing the sample to be contained and raised. The sample is removed through a valve to fill the sample containers.

## 8.3 Sediment Sampling Techniques

Sediment samples are usually collected at the same locations as the water samples. If only one sediment sample is to be collected, the site shall be approximately at the center of the water body. This is particularly true for reservoirs that are formed by the impoundment of rivers or streams. Generally, the coarser grained sediments are deposited near the headwaters of the reservoir. Bed sediments near the center will be composed of fine-grained materials which may, because of their lower porosity and greater surface area available for adsorption, contain greater concentrations of contaminants. The shape, flow pattern, depth distribution, and water circulation patterns must all be considered when selecting sediment sampling sites. In streams, areas likely to have sediment accumulation (i.e., bends, behind islands or boulders, quiet shallow areas or very deep, low-velocity areas) shall be sampled while areas likely to show net erosion (i.e., high-velocity, turbulent areas) and suspension of fine solid materials shall be avoided.

Chemical constituents associated with bottom material may reflect an integration of chemical and biological processes. Bottom samples reflect the historical input to streams, lakes, and estuaries with respect to time, application of chemicals, and land use. Bottom sediments, especially fine-grained material, may help act as a sink or reservoir for adsorbed heavy metals and organic contaminants, even if the water column concentrations are below detection limits. It is important to minimize the loss of low-density "fines" during any sampling process.

### 8.3.1 Scoop Sampler

A scoop sampler consists of a pole to which a jar or scoop is attached. The pole may be made of bamboo, wood, or aluminum, and be either telescoping or of fixed length. The stainless steel scoop or jar at the end of the pole is usually attached using a clamp.

If the water body can be sampled from the shore or if it can be waded, the easiest and "cleanest" way to collect a sediment sample is to use a scoop sampler. This reduces the potential for cross-contamination. This method is accomplished by reaching over or wading into the water body and, while facing upstream (i.e., into the current), scooping the sample along the bottom in the upstream direction. It is very difficult not to disturb fine-grained materials of the sediment-water interface when using this method.

**8.3.2 Core Samplers**

Core samplers are used to sample vertical columns of sediment. They are useful when a historical record of sediment deposition is desired, for they preserve the sequential layering of the deposit. Coring devices are particularly useful for sediments because the "shock wave" created by descent is minimal, thus the fines at the sediment-water interface are not disturbed. Also, the sample is withdrawn intact, permitting the removal of only those layers of interest. Core liners manufactured of glass, Teflon®, brass, or stainless steel, can be purchased, thus reducing possible sample contamination. In addition, samples are easily delivered to the lab for analysis in the tube in which they are collected. The disadvantage of coring devices is that a relatively small surface area and sample size is obtained necessitating repetitive sampling to obtain large amounts of sample needed for some analyses.

Many types of coring devices have been developed to address varying depths of water from which the sample is to be obtained, the nature of the bottom material, and the length of the core to be collected. In shallow wadeable waters, the direct use of a core liner is recommended. The liner material shall be chosen based upon the analytical parameters required.

Core sampler tubes or liners shall be approximately 12 inches long since only recently deposited sediments, eight inches or less, are to be sampled. Soft or semi-consolidated sediments such as mud and clays have a greater adherence to the inside of the tube and thus can be sampled with larger diameter tubes. However, because coarse or unconsolidated sediments such as sand and gravel will tend to fall out of the tube, a small diameter is required. A tube about 2 inches in diameter is usually sufficient. The wall thickness of the tube shall be about 1/3 inches for either Teflon® or glass. The end of the tube may be tapered by filing it down to facilitate entry of the liner into the substrate.

**8.3.3 Hand Operated Gravity Corers**

Hand corers are generally constructed of an outer rigid metal tube into which a 2 inch ID, core sleeve fits with minimal clearance. The cutting edge of the corer has a recessed lip on which the core sleeve rests and which accommodates a plastic core catcher. The core catcher is composed of intermeshing "fingers" that point upward into the core sleeve so that when the sampler is pressed into the sediment,the core is free to move past the catcher, but the core cannot fall through the catcher upon removal of the sampler from the sediment.

Use of hand corers or liners involves pushing the device into the substrate until only 4 inches or less is above the sediment-water interface. When sampling hard or coarse substrates, a gentle rotation of the corer while it is pushed will facilitate greater penetration and cut down on core compaction. The liner is then capped with a Teflon® plug or a sheet of Teflon® held in place by a plastic cap and Teflon® tape. After capping, the corer is slowly extracted, the negative pressure and core catcher (if used) keeping the sample in the liner. As the bottom part of the liner comes out of the water, it too is capped. If the top or bottom of the liner contains water or air, the caps should be removed, the water carefully decanted avoiding removal of surface sediments. The caps are then replaced and secured with friction tape. The orientation of the cores should be marked on the sleeve.

Gravity corers are used to obtain sediment samples in bodies of water deeper that three to five feet. These samplers can be used for collecting one to two foot cores, with a two inch I.D., of surface sediments at depths of up to several hundred feet beneath the water surface. Because of their small diameter, gravity corers are not suitable for obtaining coarse-grained samples, but are excellent for obtaining fine-grained materials.

The gravity core sampler operates in a manner similar to the hand operated core. A liner, two inch I.D., fits within a metal core housing fitted with a cutting edge. Core-catchers are used to retain the core within the liner. An opening exists above the liner to allow free flow of water through the corer as it moves vertically through the water and into the sediment. The sampler has a messenger-activated valve assembly which seals the opening above the line following sediment penetration, which creates a partial vacuum to assist in sample retention during retrieval.

Samples are obtained by allowing the sampler, which is attached to sufficient length of stainless steel cable, to drop to the bottom. The weight of the sampler drives the core into the sediment to various depths depending on the characteristics of the sediments. The messenger is then dropped and the sampler carefully retrieved. Upon retrieval, treatment is similar to that described for hand corers.

#### 8.3.4 Dredges

Dredges are generally used to sample sediments which cannot easily be obtained using coring devices (i.e., coarse-grained or partially-cemented materials) or when large quantities of materials are required. Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a messenger. Most dredges are heavy, up to several hundred pounds, and require use of a winch and crane assembly for sample retrieval. There are three major types of dredges: Peterson, Eckman, and Ponar dredges.

The Peterson dredge is used when the bottom is rocky, in very deep water, or when the flow velocity is high. The dredge should be lowered very slowly as it approaches bottom, because it can force out and miss lighter materials if allowed to drop freely.

The Eckman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high flow velocities.

The Ponar dredge is a Peterson dredge modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends, thus reducing the "shock wave" and permitting direct access to the secured sample without opening the closed jaws. The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates. Access to the secured sample through the covering screens permits subsampling of the secured material with coring tubes or Teflon® scoops, thus minimizing the chance of metal contamination from the frame of the device.

## 9.0 ATTACHMENTS

### 9.1 Surface Water/Sediment Sampling Form

SAIC®
An Employee-Owned Company

# Sampling Form
(Field Sheet)

Project Name and Number: ______________________

Sampling Crew: ______________________

Sampling Point Number: ______________________

Sampling Location: ______________________

Sample Type: ☐ GW ☐ SW ☐ Soil ☐ SED ☐ Other: ____________

Date and Time Sample Collected: ______________________

Weather Conditions: ______________________

***Purging Information*** (if applicable):

Method: ______________________

Quantity of Water Purged: ______________________

Disposition of Purge Water: ______________________

______________________

Date and Time of Purging: Start: ____________ End: ____________

Comments: ______________________

______________________

***Groundwater:***

Date and Time Collected: ______________________

Sampling Depth: ______________________

Water Level: ______________________

Sampling Method/Equipment: ______________________

Field Measurements: pH ________ Temp: ________ Cond: ________ Alkalinity: ________

Date and Time Filtered (if applicable): ______________________

Comments: ______________________

______________________

***Surface Water:***

Date and Time Collected: ______________________

Collection Method: ______________________

Date and Time Filtered (if applicable): ______________________

Field Measurements: pH ________ Temp: ________ Cond: ________ Turbidity: ________

Comments: ______________________

______________________

***Soils/Sediment Sampling:***

Date and Time Collected: ______________________

Sampling Depth: ______________________

Sampling Method: ______________________

Comments: ______________________

______________________

# FIELD PROCEDURE FP 6-3
# SOIL SAMPLING

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## 1.0 PURPOSE

The purpose of this procedure is to outline the requirements for soil sampling. Soil sampling aids in defining the hydrogeological character of the substrata, or grid and the nature and extent of soil contamination. Soil samples are collected over an areal distribution as well as at different depths to characterize the on-site features.

## 2.0 SCOPE

Soil sampling is potentially applicable to any hazardous waste site. A variety of sampling techniques are available for collection of soil samples. These include split-spoon sampling, collecting auger cuttings, Shelby tube sampling and continuous coring. Split-spoon sampling is the most commonly used technique. The collection of internal quality control checks during sampling is specified in the project-specific work plan.

## 3.0 REQUIREMENTS

The collection point should be within two feet horizontally of the identified location. The final location of the sampling point should be defined by surveying or measuring from previously surveyed points. The accuracy of the soil sampling point location will be determined by the following data quality objectives:

- Sample collection information should be recorded in the Field Logbook and on the Sampling Forms.
- Surface/air contact may be minimized by placing the sample in an airtight container immediately after collection.
- Sampling and sample preparation equipment will be decontaminated in accordance with FP 3-1 prior to and after each sample is collected unless disposable equipment is used.

- Soil sample locations shall be permanently identified using a brass surveyor's pin or equivalent permanent marker inscribed with the boring location identification set placed in a concrete marker, according to the project-specific work plan.
- Soil samples with possible volatile organic analytes should be collected and containerized undisturbed (e.g. "California tubes"), if possible.
- Depth-profile sampling must comply with the above requirements. Care must be taken to prevent cross-contamination and misidentification of samples.
- Vertical depth control tolerances are specified in the project-specific work plan.

## 4.0 REQUIREMENTS

4.1 HAZWRAP, July 1990. *Quality Control Requirements for Field Methods*, DOE/HWP-69/RI.

4.2 United States Environmental Protection Agency, 1987. *A Compendium of Superfund Field Operation Methods.*

4.3 American Society for Testing Materials, 1989. *Standard Method for Penetration Test and Split-Barrel Sampling of Soils*, Method D-1586-84.

## 5.0 DEFINITIONS

**Auger Cuttings** - Soil brought to the surface by the action of the augers as they are screwed into the ground.

**Hazardous Waste Sample** - Medium to high concentration sample (e.g., source material, sludge, leachate) requiring DOT labelling and Contract Lab handling as a high hazard sample.

**Shelby Tube Sampler** - A thin-walled metal tube is used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from two to five inches in outside diameter and 18 to 54 inches in length. A stationary piston device is included in the sampler to reduce sampling disturbance and increase sample recovery.

**Split-Spoon Sampler** - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. This device can be driven into resistant (consolidated) materials using a drive weight mounted on the drilling rig. A standard split-spoon sampler, used for performing standard penetration tests, is two inches in outside diameter and 1 3/8 inches in inside diameter. This standard spoon typically is available in two common lengths, providing either 20 inch or 26 inch internal longitudinal clearance for obtaining 18 inch or 24 inch long samples, respectively. A five-foot long split-spoon sampler is also available.

**Continuous Core Sampler** - A steel tube, which may be split in half and held together by threaded collars or may be one piece. The sampler is usually five or ten feet in length and three to five inches in diameter. This device may be driven ahead of hollow-stem augers or may be driven into the soil by vibrational and/or rotary action.

## 6.0 RESPONSIBILITIES

### 6.1 Field Operations Leader

The Field Operations Leader is responsible for overall management of field activities and ensuring that the appropriate sampling procedure is followed.

### 6.2 Site Geologist

The Site Geologist directly supervises the sampling procedures, classifies soil and rock samples, and directs the packing and sealing of soil and rock samples. Such duties may also be performed by geotechnical engineers, field technicians or other qualified field personnel.

## 7.0 EQUIPMENT

The following pieces of equipment may be needed to collect samples:

1. Drilling Equipment (capable of collecting depth-specific samples)
2. Stainless Steel Hand Auger, Shovel, or Post-Hole Digger
3. Teflon® Tape
4. Teflon® or Stainless Steel Spatula
5. Stainless Steel Bowl or Teflon® Mixing Board
6. Organic Vapor Monitoring Device (HNu or OVA)
7. Appropriate Sampling Containers
8. Shelby Tube Sampling Equipment
9. Decontamination Supplies, as specified in the project-specific work plan
10. Split-Spoon Sampling Equipment, either 1 3/8" or 2 1/2" I.D.
11. Field Logbook and Field Sampling Forms.

## 8.0 PROCEDURE

### 8.1 Split-Spoon Sampling

Split-spoon samples are usually obtained in conjunction with hollow stem auger or rotary drilling techniques using either a 140 or 340 pound drive hammer (depending on the size of the sampler) or automatic sampling hammers. The split-spoon is attached to a metal rod and driven into the undisturbed soil ahead of the lead auger. The drive weight is raised 30 inches and dropped to hammer the split-spoon into the ground. The hardness of the soil can be determined by extrapolating the number of blows of the hammer required to pound the split-spoon into the soil six inches. The first six inches of penetration is considered a sealing drive. The number of blows for the second and third six inches is recorded to determine the penetration resistance. If the penetration resistance exceeds 50 blow counts per inch, split-spoon sampling will be discontinued at that interval and drilling will resume. The sampler will be advanced at least 18 inches or until refusal. The split-spoon is retrieved from the borehole and opened with the air around the sample monitored with a HNu portable photoionization detector or other appropriate instrument.

Samples for chemical analyses are taken with a split-spoon sampler equipped with brass or stainless steel sleeves. For samples for volatile organics, the sleeve is sealed and labelled. Samples for analyses other than volatile organics are placed in a stainless steel bowl, homogenized and placed in the appropriate container. Large pebbles and cobbles should be excluded from samples taken for chemical analysis.

Samples for head space analysis and lithologic description are collected and placed in the appropriate sampling jar or container. Lithologic samples are described according to the requirements of FP 7-3.

Soil samples collected for lithologic analysis will be placed in a sampling jar, sealed with foil and allowed to stand for approximately 10 minutes. The head space will then be sampled using the organic vapor detector. Procedures for collecting split-spoon samples are as follows:

1. Decontaminate the split-spoon sampler, liners and other sampling equipment according to Field Procedure FP 3-1.
2. Insert liners into the split-spoon sampler as follows: two three-inch stainless steel liners, two three-inch brass or stainless steel, and one six-inch liner, either brass or stainless

steel. The two three-inch stainless steel sleeves shall be inserted into the spoon adjacent to the driving shoe (sand catcher end of split-spoon).

3. Attach the split-spoon sampler to the bottom end of the drill rod string which extends from the top of the auger or borehole to the bottom of the borehole.

4. Attach the specified weight hammer to the top of the drill rod string and drive the sampler into the soil at the bottom of the borehole. Record the hammer weight on the field log form.

5. To drive the sampler into the soil, alternately raise the hammer on a rope, which passes around a rotating cathead, and allow the hammer to free-fall 30 inches by suddenly releasing the tension on the rope. Record the blow count - penetration existence - on the field log form in accordance with FP 7-3.

6. Pull the sampler up from the bottom of the borehole by reversing direction of the rope on the cathead, and alternate applying and releasing pressure. Remove from the bottom of the drive rod string.

7. Remove the top assembly and the drive shoe from the sampler. Open the tube by removing one-half of the split-spoon.

8. Transfer soil selected for chemical analyses to pre-labelled containers as described below.

9. For samples to be analyzed for volatile organic compounds (VOCs), trim the ends of one of the three-inch brass liners, place a thin Teflon® disk over each end of the liner, slip a plastic end cap onto each end, and tape the end caps in place with Teflon® tape. The entire brass liner is then labeled and shipped to the laboratory for volatile organics analyses. Samples for VOCs shall be capped within 15 seconds from the time the sampler is opened.

10. Remove the soil from one of the three-inch long liners and place in the sampling jar for lithologic analysis. Immediately cover the jar opening with aluminum foil and let the jar stand for approximately ten minutes. Insert the organic vapor probe through the foil and record the organic vapor readings in the Field Logbook.

11. Remove the soil from one of the three-inch stainless steel liners and place in the sampling jar for metals analysis.

12. For inorganic and nonvolatile samples, push the soil from the remaining liners, mix the soil on a Teflon® board or in a stainless steel mixing bowl, and evenly subdivide it into the sample containers.

    **NOTE:** This mixing minimizes the heterogeneity of the soil samples and provides representative split and duplicate samples.

13. For soil sampling where split samples or field duplicates are to be taken, the following procedures and sequence will be followed:

For volatile organic analyses, adjacent three-inch long liners will be collected as soon as the split-spoon is opened. The liners will be handled as described in step 9 and labelled appropriately. Duplicate samples for non-volatile analyses or inorganic analyses will be collected from the same soil, and composited and handled as described in step 11 and labelled appropriately.

14. Describe the samples and record the description on the Field Logbook and Field Sampling Forms.
15. Verify that samples have been properly labeled and store on-site in a cooler at 4°C until they are packaged for shipping.
16. If sleeved samplers are not used, then the soil must be peeled and the ends of the sample are removed and discarded. Peeling is the process that removes the portion of sample which is in direct contact with the sampler. Samples for volatile organic compound analysis shall be peeled, bottled (usually a 40 mL VOA vial or 4 oz. glass jar), and capped within 15 seconds from the time the sampler is opened. Soil should be packed in the container to minimize void spaces. Container shall be placed in the cooler at 4°C as soon as possible.
15. To minimize off-gassing of the volatiles, the sampler should not be driven until the sampling team is ready to accept and process the volatile portion.
16. This sampling procedure is repeated at appropriate intervals in accordance with the project-specific work plan throughout the borehole.
17. Upon completion of soil sampling activities, collect all spilled and excess material and place into lined waste disposal drums. Dispose of material in accordance with applicable regulations and client as prescribed in the project-specific work plan.
18. All sampling equipment, including internal components, will be decontaminated prior to use, between sampling events, and prior to demobilization.

## 8.2 Undisturbed Soil Sampling

Undisturbed soil samples are collected using a thin-walled tube or Shelby tube sampler to recover relatively undisturbed soil samples suitable for laboratory tests. The thin-walled sampler is used to collect soil samples for physical tests such as porosity, permeability and grain-size.

A standard Shelby tube (ASTM D1587-83) is a hollow steel tube that is two to five inches in outside diameter and five to ten times the diameter in length. The sample tube is positioned at the bottom of the boring using drilling rods and is pushed vertically into the soil with continuous and rapid motion without impact or twisting to a depth of between two and two 1/2 feet. The sampling tube is retrieved and any disturbed material is removed from the top of the tube. One inch of soil is removed from the base of the tube. An impervious disk is placed at both ends of the tube and sealed with a wax plug prior to shipment to the laboratory. The tube is properly labelled and is stored and transported such that it is cushioned and remains undisturbed. The tube is packed with styrofoam plugs or other cushioning material and shipped to the testing laboratory. Sampling equipment shall be decontaminated following Field Procedure FP 3-1.

### 8.3 Hand Augered Sampling

Decontaminated equipment will be used to collect the soil sample. A hand auger consists of a sample bucket attached to the bottom of a length of pipe that has a crossbar at the top. A hole is drilled by turning this crossbar at the same time the operator presses the auger into the ground. The hand auger is driven to the desired depth which is usually within a few feet of the surface. A hand-drive sampler with a six-inch steel shoe utilizing brass or stainless steel liners will be used to collect soil samples. The liners will be two, four, or six inches in length. The liner for volatile organic analyses will be sealed with plastic end caps and Teflon® tape within AEC time guidelines, labelled and sent for analysis. If metals analysis is required, the sample shall be collected from the initial split-spoon liner driven into the ground (i.e., stainless steel liner).

Soil samples that are not to be analyzed for volatile organics or metals are placed in a stainless steel bowl and homogenized with a stainless steel spoon or Teflon® spatula. Large pebbles and cobbles should be removed from the sample. The composite samples for chemical analyses are placed in appropriate containers.

Place the samples on ice in a cooler maintained at 4°C or below.

Note the sample identification, sample location (provide sketch), sampling time, and sampling personnel in the Field Logbook.

After augering and sampling are completed, the borehole will be filled using bentonite. The ground surface will be restored to its original configuration.

Sampling equipment should be decontaminated by following Field Procedure FP 3-1.

### 8.4 Continuous Core Sampling

Continuous core samples may be obtained by using the rotosonic drilling method or other appropriate continuous coring methods.

Prior to sampling for lithologic description and chemical analyses, lightly scrape the outer surface of the core using a stainless steel scoop, to expose representative material for sampling. Core samples should be scanned with an OVA or HNu photoionization detector and the levels recorded in the Field Logbook. Core samples showing high organic vapor content and physical evidence of contamination, such as soil discoloration, are potential sampling intervals.

Samples for VOCs are collected first. The sample for VOC analyses should be collected from a relatively undisturbed portion of the core. Depending on the cohesiveness of the material, VOC samples shall be collected using a stainless steel scoop, tube-type soil sampler, or a brass sleeve approximately three to four inches long with a nominal inside diameter of two inches. If a brass sleeve is used, drive the sleeve into the center of the core, extract and seal the sleeve, first with Teflon® disk and then with tightly fitting plastic caps. Otherwise, carefully pack the VOC sample material into an approved glass container.

Soil samples for lithologic description and well-site head space analysis shall be collected at selected intervals and placed into the appropriate sample container. The container will be sealed with foil, allowed to stand for approximately 10 minutes, and the head space sampled using an organic vapor detector. Lithologic descriptions are recorded according to the requirements of Field Procedure FP 7-3.

The remainder of that portion of the core designated as the sample interval is then composited in a stainless steel bowl and sampled for the remaining parameters. The samples are placed into the approved containers. Samples are then placed on ice in an insulated cooler maintained at 4°C or below without freezing the samples.

The sampling information is recorded in the Field Logbook and Sampling Form. After a sample is collected, the sampling equipment is decontaminated according to Field Procedure FP 3-1.

## 9.0 ATTACHMENTS

### 9.1 Soil Sampling Form

SAIC
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# Sampling Form
(Field Sheet)

Project Name and Number: ______

Sampling Crew: ______

Sampling Point Number: ______

Sampling Location: ______

Sample Type: ☐ GW ☐ SW ☐ Soil ☐ SED ☐ Other: ______

Date and Time Sample Collected: ______

Weather Conditions: ______

***Purging Information*** (if applicable):

Method: ______

Quantity of Water Purged: ______

Disposition of Purge Water: ______

Date and Time of Purging: Start: ______ End: ______

Comments: ______

***Groundwater:***

Date and Time Collected: ______

Sampling Depth: ______

Water Level: ______

Sampling Method/Equipment: ______

Field Measurements: pH ______ Temp: ______ Cond: ______ Alkalinity: ______

Date and Time Filtered (if applicable): ______

Comments: ______

***Surface Water:***

Date and Time Collected: ______

Collection Method: ______

Date and Time Filtered (if applicable): ______

Field Measurements: pH ______ Temp: ______ Cond: ______ Turbidity: ______

Comments: ______

***Soils/Sediment Sampling:***

Date and Time Collected: ______

Sampling Depth: ______

Sampling Method: ______

Comments: ______

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# FIELD PROCEDURE FP 6-4

# DRUM HANDLING AND SAMPLING

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| Subject | Procedure No. | Rev. | |
|---|---|---|---|
| | FP 6-4 | 1 | Page 1 of 20 |
| DRUM HANDLING AND SAMPLING | Issue Date | Effective Date | |
| | 10/04/93 | 10/04/93 | |
| | Supersedes Procedure Number | Rev. | Date |
| | 630 FP 8 | 0 | - |
| Acceptance - Program QA | Approval - Program Manager | | |

## 1.0 PURPOSE

The purpose of this procedure is to provide general reference information for use in planning for and implementing sampling programs involving the moving and/or opening of closed containers on uncontrolled hazardous substance sites. Guidelines are provided for selecting containers to be opened and for moving and opening them. In addition, site organization, protective clothing, worker protection and other safety procedures are discussed.

## 2.0 SCOPE

This guideline is applicable to opening and sampling of closed containers (120 gallon or less) on uncontrolled hazardous substance sites. Bulk tanks such as railroad tank cars, large above-and below-ground tanks (with a capacity of more than 120 gallons), and tank trailers are not considered in this procedure. Bulk tank removal is best handled through the procurement of a subcontractor (See Attachment 9.1).

## 3.0 REQUIREMENTS

Strict adherence to safety precautions cannot be overemphasized when handling and sampling drums. Hazards encountered when sampling drums include detonations, fires, explosions, vapor generation and worker exposure to the waste. Scenarios involving drums encountered in the field may include drums that are unmarked, mislabeled, bulging, buried, deteriorated or leaking. Consequently, such drums may require handling to accommodate sampling. Because the condition of the drum and its contents dictate how drums are handled and sampled, no single procedure can be written to cover all possibilities. This procedure lists general guidelines that should be used when developing and on-site drum handling/sampling procedure. The procedure developed should be based on all available information and revised as more information becomes available. When implementing the procedure, common sense and good judgement are paramount.

Consult OSHA regulations (29 CFR Sections 1910 and 1926) for established general requirements and standards for storing, containing, and handling chemicals and containers, and for maintaining equipment used for handling materials.

Consult EPA regulations (49 CFR 265 ) for requirements pertaining to the types of containers, maintenance of containers and containment structure, and design and maintenance of storage areas.

## 4.0 REFERENCES

4.1 NUS Corporation, 1983. *Operating Guidelines Manual.*

4.2 Cassic, J.A., et al., 1985. *Guidance Document for Cleanup of Surface Tank and Drum Sites.* Prepared for Office of Emergency and Remedial Response, USEPA, Washington, DC under Contract No. 68-01-6930.

4.3 IT Corporation, December 1988. *Hazardous Waste Operations and Emergency Response*, IT Corporation, Knoxville, Tennessee.

4.4 Martin, F.M., Lippitt, J.M., Prothero, T.G., 1987. *Hazardous Waste Handbook for Health and Safety*, Butterworth Publishers, p. 167-177.

## 5.0 DEFINITIONS

**Air Reactive Wastes -** Some chemicals, such as white phosphorus or barium oxide, react with oxygen in the air, while others, such as sodium, cesium or various metal hydrides, react with the moisture or water vapor in the air. Many of these compounds are explosive when they come in contact with air or water.

**Container -** Defined as any drum, bottle, can, bag, etc., with a capacity of 120 gallons (450 liters) or less.

**Glass Thief -** A glass tube 4 feet long and 3/4 inches in diameter, used for taking samples from drums. The tube is usually broken and disposed of in the drum following sampling.

**Polyethylene or PVC-lined Drums -** Often contains strong acids or bases. If the lining is punctured, the substance usually corrodes the steel, resulting in a significant leak or spill.

**Exotic Metal Drums** (i.e., aluminum, nickel, stainless steel, or other unusual metals) - Very expensive drums that usually contain an extremely dangerous material.

**Single-Walled Drums Used as a Pressure Vessel -** These drums have fittings for both product filling and placement of an inert gas, such as nitrogen. Such drums may contain reactive, flammable, or explosive substances.

**Laboratory Packs -** Such drums are commonly used for disposal of expired chemicals and process samples from laboratories, hospitals and similar institutions. Bottles in the laboratory pack may contain incompatible materials and may not be packed in absorbent material. They may contain radioisotopes, shock sensitive, highly volatile, highly corrosive, or very toxic exotic chemicals. Laboratory packs are the primary ignition source for fires at most hazardous waste sites.

## 6.0 RESPONSIBILITIES

### 6.1 Program Manager

The Program Manager is responsible for determining that opening and sampling of containers is necessary for the field investigation program, and the approximate numbers and types of containers to be opened.

### 6.2 Field Operations Leader

The Field Operations Leader is responsible for the overall safe conduct of the container opening and sampling operations. This includes informing and obtaining help from local authorities if necessary; selection of containers to open/sample; testing, moving, and staging of containers; container opening and sampling; resealing; and halting operations, including ordering site evacuation or requesting public evacuation, with help from local authorities, if necessary. The drum opening and sampling program will be planned in detail in the project-specific work plan. If any unexpected results (e.g., explosions, atmospheric releases) occur, the Field Operations Leader must inform the Project Manager immediately. Together with the Health and Safety Officer and outside assistance, if necessary, (e.g., EPA's Emergency Response Team), he must determine the most prudent course of action.

### 6.3 Health and Safety Officer

The Health and Safety Officer is responsible for safety of all on-site operations, alerting the Field Operations Leader of any potentially unsafe conditions, and halting work if on-site personnel or off-site public health is threatened.

## 7.0 EQUIPMENT

1. Spill Control Kit
2. Drum Overpacks
3. Drum Grappler
4. Drum Opening Equipment (suitable for the respective type drums)
5. Explosion Meter
6. HNu Portable Organic Vapor Analyzer
7. Fire Extinguisher, Class A, B and C, 12 lb. capacity
8. Alpha and Beta Radiation Detector
9. Personal Protective Equipment as specified in the project-specific work plan. This may include: Robar or Tingley boots, Tyvek protective suit with acid jacket and pants, vinyl booties, vinyl sample gloves, nitrile outer gloves, hard hat with splash shield, and supplied air respirator.
10. Plexiglass Shield
11. Sheet Plastic
13. Sampling Equipment
14. Field Logbook.

## 8.0 PROCEDURE

### 8.1 General

The guidance presented is based on field experience in working with containers on uncontrolled hazardous substance sites. It will be evident that in many cases hard-and-fast rules cannot be given, and professional judgement is required because uncontrolled variables are involved. For example, no on can be absolutely certain of any assessment of the potential contents of a container. Labels cannot be absolutely trusted; only educated guesses can be made by a thorough review of all available background data, such as potential sources of the wastes.

Three basic risks are involved in moving and opening closed containers: (1) exposure of personnel to toxic materials, (2) fire, and (3) explosion. The first risk can be reasonably eliminated though the use of proper skin and respiratory protection equipment. The use of level A protection (i.e. totally encapsulated suit in conjunction with a self-contained breathing apparatus) acceptably reduces the risk of a worker being injured by toxic vapors, mists, or splashes. In the same way, standard fire prevention procedures can be used to reduce the fire hazard through the use of detector instruments and proper equipment. These include the use of non-sparking tools and intrinsically safe radios, pumps, and other equipment, as well as the staging of firefighting equipment and the elimination of any other possible ignition sources.

The explosive risk, however, is not as easily handled, and thus is the primary consideration in any container-opening operation. Even if no solid evidence of the presence of explosives is found during the preliminary data collection, one can never be certain that explosives have not been disposed of at the site. In order to provide the same reasonable level of protection against this risk as against toxic exposure and fire, a very cautious approach, such as the one recommended in this guideline, should be used.

## 8.2 Background Review

This section details the elements of a site background review necessary to prepare a Site Operations Plan for drum opening. The decision of whether or not to conduct the operation depends on the assessment of the site history. Therefore, it is important that the following tasks are completed thoroughly.

### 8.2.1 Preliminary Assessment

The preliminary assessment of existing data should be consulted in planning for a container-opening operation. Of special importance are items that can be used to characterize the types of hazardous material present at the site (e.g., generator records, manifests, inventories, personal interviews, monitoring data). The review of all such data should search for the possible presence of shock-sensitive explosives and/or reactive chemicals. The absence of waste inventory information could prevent drum opening on the site without prior review.

### 8.2.2 Explosive Product Survey

If the site is a waste disposal or storage operation, a survey of commercial producers or users of explosives within the area served by the facility must be conducted. The determination of the area covered in this survey is a judgement that should be based on locations of known waste generators that used the facility and geographic location of the site. Agencies that could assist in identifying explosive producers or users are local and state police units, state transportation departments, the U.S. Department of Transportation (DOT), and EPA state hazardous-waste permit offices. Standard Industrial Classification (SIC) codes can be used to locate producers of explosives from lists of manufacturers available from state commerce agencies, local chambers of commerce, planning agencies, etc.

### 8.2.3 Site Inspection

A site visit is required prior to planning a drum opening operation. This visit may be in addition to the Reconnaissance Survey. Information on the following should be gathered during the inspection:

1. Site boundaries - fences, roads, natural boundaries, etc.
2. Access points - travel routes on the site.
3. Topographic features.
4. Adjacent land uses - residential, agricultural, public use areas, commercial establishments, schools, natural areas, etc.
5. Power lines, railroads, and public roads close to the site.
6. Container storage areas - provide observational details; describe if drums are jumbled, stacked, piled, arranged in rows, etc. General condition of drums indicates if containers can be grouped according to visual features, contents or any other classification method.
7. Buildings and other site structures, as well as any other disposal areas such as lagoons, landfills, surface piles, etc.
8. Location of water sources.
9. Location of potential staging areas.

In general, the preliminary assessment and site inspection should have been completed prior to involvement in opening and sampling drums. Field characterization should help to establish ambient conditions and identify potential hot spots. This information is to be plotted on the site sketch. Observations from maps and aerial photographs can also be used in compiling the site sketch.

During the site inspection phase, local officials should be contacted to arrange for fire protection and police support during the operation. Interviews should also be conducted with site workers, local officials, and any other people familiar with the site's history.

The central purpose of the background review is to evaluate the risk presented to personnel engaged in drum-opening operations. An assessment of drum contents is most important because it identifies specific risks. However, other site features also affect the hazard potential. Leaking and corroded drums, crowded and poorly organized conditions, and drums of unknown and apparently diverse origins are conditions that require careful planning.

There are no accurate quantitative methods available to evaluate the total danger. Assessment of the danger is subjective and should be done by personnel experienced in field operations at hazardous sites. Good professional judgement is required, and project management must feel that adequate information is available to support a decision to conduct the drum-opening operations.

Any positive indication of shock-sensitive materials that might react or explode requires special consideration. Sites that are suspected or known to contain such materials are to be referred to the Project Manager for planning for drum opening. In addition, sites that are judged to be unduly hazardous for any other reason should be referred to the Project Manager.

### 8.3 Container Selection Considerations

The containers selected for opening and sampling will depend on the purpose of the operation and on considerations of safety (i.e., that is a container that may detonate is to be avoided). Even though many drums are found at uncontrolled disposal sites where the content are unknown, it is worthwhile to consider drum markings and types, as well as drum groupings.

When considering sampling for enforcement, the first choice of drums would be those marked with known hazardous materials (trade name, chemical name, empirical formula) or hazardous labeling. Next would be those isolated by themselves or material contained in an exotic metal container (e.g., aluminum, nickel, monel, stainless steel). Then consideration should be given to the unmarked drum piles or stacks. These should be sampled randomly among the various distinguishable drum lots.

When sampling for site characterization purposes, a concerted effort should be made to distinguish drum lots and to get a drum count among the lots. A drum that appears to be characteristic and in the center of all the major drum lots should be sampled first, followed by drums in as many of the smaller lots as practical. Also, if practical, duplicate samples should be taken on major drum lots at either end of a lot to see if the wastes appear to be characteristic all the way through.

On most abandoned waste sites, there is some organization or pattern to the way the material was placed on the site. The pattern is occasionally as detailed as finding the flammable solvents in one area, acids in another, cyanide in another, recoverable metals in a fourth, and so on. Some disposal facilities stencil control numbers on drums to indicate specific lots. Often, if the site was poorly run, the only indication that a group of drums is related will be their color, size, or type.

Typically, waste is shipped to sites in 55-gallon drums on trucks. About 60 to 80 drums are delivered from a given load, depending on the weight of the load. During the initial site inspection, one should look for distinguishing features in an attempt to define the different lots of drums on the site. Often the trade name, chemical name, or empirical formula will be written on the drum. Another distinguishing feature would be drums of exotic metal such as aluminum, nickel, monel, stainless steel, etc. A manufacturing facility will use a specified DOT coded drum, a strange drum size, or a drum with an unusual configuration or adaptation for a particular process line (i.e., center of drum head fill bung, double-sided fill/vent bungs, etc.).

At almost every site that has been receiving waste, there is an isolated group of containers. Approach these with care and try to determine why they were segregated.

In any lot of drums sometimes encountered is an unusual or out-of-place container. This oddball container will not fit the pattern, color, size, etc., of those around it (e.g., it may be the only distended drum among undistended drums or a lined drum among unlined drums).

An attempt should be made to avoid drums that are structurally damaged or if their movement or sampling would endanger a team member. Samples of drums in stacks or piles should not be taken if at all possible.

Before sampling any drums, an external radioactivity scan must be conducted with the results recorded in the Field Logbook. On a site where many different types of containers are present, based on what they can be expected to contain and in increasing order of hazard, the containers should be sampled in the following order:

1. Paper, plastic, cloth, and burlap bags.
2. Glass carboys and jugs (except chemical reagent or laboratory-packed bottles).

3. Fiberboard drums.
4. Plastic and polyethylene carboys and containers.
5. Plastic-lined steel drums.
6. Steel drums.
7. Exotic metal drums.
8. Odd containers (distended, isolated, etc.).

Attachment 9.2 contains information of the types, sizes, DOT designation, openings, and recommended opening techniques for the various kinds of containers. The DOT designation, which is usually found on the bottom of a drum, can be useful in determining the material of the drum.

**8.4 Container Handling and Staging**

Personnel involved in handling and transporting containerized waste shall work in teams containing no fewer than two people. Visual contact shall be maintained between members of the working team at all times. All team members shall be able to communicate between themselves and with the Site Health and Safety Officer by intrinsically safe two-way radio at all times on the work site.

Prior to physically handling a drum or other container, the following preliminary classifications checklist must be reviewed and each response noted in a Field Logbook:

1. Is the drum radioactive?
2. Does the drum exhibit leakage or deterioration, i.e., is it unsound?
3. Does the drum exhibit apparent internal pressure?
4. Is the drum empty?
5. Does the drum contain markings which would indicate that the contents are potentially explosive?

The results of the preliminary classification checklist dictate which specific procedures shall be followed in handling, opening, and sampling the drum.

The handling, movement, and transport of drums and other containers should be by use of mechanical equipment only; no drums should be handled manually. Remote drum handling equipment may consist of a grappler equipped backhoe or front-end loader. Drum transportation should be with front-end loaders or fork lifts with modified carrying platforms. Portions of equipment that contact drums or canisters should be constructed of non-ferrous metals or contact portions should be coated or lined to preclude spark generation. Handling and transport equipment must be equipped with full frontal and side splash and explosion shields. Class ABC fire extinguishers shall be fitted to the body of each piece of equipment.

When possible, drums or other containers to be sampled should be opened and sampled in place to minimize handling. However, when drums are stacked or are close together, they may have to be moved to prevent sympathetic detonation of, or chemical reaction with, other drums around the one being opened. The main criterion is distance to other drums. A reasonable distance should be maintained to keep the drum to be opened segregated from the others.

Drums or containers exhibiting the following characteristics require special treatment in handling and sampling:

- leaking or deteriorated drums
- bulging drums
- drums containing explosive or shock-sensitive waste
- drums containing radioactive waste
- laboratory packs
- gas cylinders.

When drums are moved, they should be taken to a staging and sampling area that is lined and diked or bermed to control any major spillage. Again, this area should be far enough away from other drums on the site to prevent a chain reaction. Only one container at a time should be placed in the staging area and opened. One crew can be moving and setting up the remote-opening equipment on the next container while another crew is sampling, labeling, and resealing the first container.

Containers that are inside warehouses, basements, or other buildings must be moved outside before they can be opened. Adequate ventilation is critical for container-opening operations.

Empty drums containing less than one inch of solid residual waste and those resulting from on-site bulking and repack operations shall be loaded by grappler into transport equipment and placed within the empty drum staging area. Residuals, where possible shall be transferred to repack containers prior to movement.

## 8.5 Remote Opening

Because of the possibility of encountering a drum containing a shock-sensitive material, any drum to be moved and/or sampled should be remotely shaken, One way of doing this is to carefully tie a rope around the drum and shake it from behind a barrier at a safe distance.

The required method of opening drums is by remote means, except as noted in Attachment 9.2. Three types of remote-opening equipment are available: the bung spinner, the remote-controlled drill, and the drum pierce. The bung spinner consists of:

1. Air impact wrench with non-sparking adapter
2. Drum-mounting bracket
3. Two-stage regulator
4. Compressed air cylinder with 100 feet of air hose and control valve.

The impact wrench is mounted over the bung on top of the drum by means of the steel-mounting bracket. The air tank, regulator, and control valve can be placed up to 100 feet away from the drum in a well-protected location.

A remote-controlled, air-operated, self-feeding, and self-retracting drill can also be used. This tool consists of:

1. Self-feeding and self-retracting drill
2. Drum-mounting bracket
3. 100 feet of air and control hoses
4. Two-stage high-pressure regulator
5. Compressed air cylinder
6. Filter/regulator/lubricator unit.

As with the bung spinner, the air tank, regulator, and control valves can be placed up to 100 feet away from the drum in a well-protected location. There are two controls on this piece of equipment, a start valve and an emergency retract valve. The drum non-sparking pierce consists of:

1. Hydraulic ram with hand pump
2. 100 feet of hydraulic hose
3. Drum-mounting bracket (top or side)
4. Piercing nail.

This unit uses the same bracket as the drum drill. The hydraulic ram slowly forces a non-sparking pierce through the drum surface as the hand pump is operated. When the 1/2-inch diameter hole is complete, opening a relief valve on the pump allows the spring to retract the piercer from the hole.

When any of these pieces of equipment is used, the control lines are to be extended to their maximum, and drum-opening personnel are to operate the controls from behind sandbags, concrete or brick structure, or other solid barriers. Remember, the opening surfaces of the drill or bung spinner should be decontaminated after each use.

The following guidelines are offered for other types of containers:

1. **Ring-closed, open-top drums** - Loosen the ring and then remove it remotely by means of a rope. If it is necessary to cut the ring, do so near the bolt or clamp/lever so that there will be a place to attach the rope.
2. **Glass carboys or jugs with lapped/ground-glass top or plastic cap** - Slowly release any retaining wire and vent any pressure. Remove the stopper or cap by hand only.
3. **Fiberpacks or corrugated cardboard containers** - Release the locking ring and remove the ring and lid by hand.
4. **Plastic or polyethylene carboys and plastic-lined drums, when necessary** - Use a non-sparking aluminum, brass, or beryllium bung wrench of the proper size. Do not use a bung wrench on any distended drums of this type; remote methods will be applied.
5. **Plastic Kraft paper, burlap, or cloth bags** - Use a trowel or sampling trier. The bags should be resealed or placed in an overpack.

## 8.6 Problem Containers

Special handling techniques are required for containers which may expose personnel to particularly hazardous conditions. These techniques are described in general below (information derived from Reference 4.2), although site-specific conditions may require the development of specialized methods.

### 8.6.1 Leaking or Deteriorated Drums

1. The contents of drums that exhibit leakage or apparent deterioration such that movement will cause rupture (determined by the Health and Safety Officer) must immediately be transferred to a repack drum. Equipment, including transfer pumps used in the repack operation, must be of explosion proof construction.

2. Leaking drums containing sludges or semi-solids, drums that are structurally sound but which are open and contain liquid or solid waste, and drums which are deteriorated but can be moved without rupture must be immediately placed in overpack containers.

**8.6.2 Bulging Drums**

1. Drums which potentially may be under internal pressure, as evidenced by bulging, must be sampled in place. Extreme care shall be exercised when working with and adjacent to potentially pressurized drums.

2. Should movement of a pressurized drum be unavoidable, handle only by a grappler unit constructed for explosive containment. The bulging drum should be moved only as far as necessary to allow seating on firm ground or it should be carefully overpacked.

3. Openings into pressurized drums shall be plugged and the bung holes fitted with pressure venting caps set at 5 psi release.

**8.6.3 Drums Containing Explosive or Shock Sensitive Waste**

1. If drums containing wastes that have been identified by sampling, or are suspected by visual examination to be explosive in nature are found, the Project Manager and the Health and Safety Officer must be notified immediately, before the drums are handled in any way.

2. If the Project Manager and the Health and Safety Officer approve handling of these drums, they shall be handled with extreme caution. Initial handling shall be by a grappler unit constructed for explosive containment. Drums shall be palletized prior to transport to a high hazard interim storage and disposal area.

3. If at any time during remedial activities, an explosive, pursuant to provisions of Title 18, U.S. Code, Chapter 40 (Importation, Manufacturer, Distribution, and Storage of Explosive Materials, 1975 Explosives List) is identified, it should be secured and the appropriate state and federal agencies notified.

4. Identification of an explosive substance during the course of a remedial action is usually based on the experience of the on-site personnel. Potentially explosive materials usually may be identified by their physical characteristics (i.e., texture, color, density, etc.), as well as the way they are packaged or labeled. Most explosives are solids. In some cases they are packaged in water-tight containers to exclude water, while in other cases they are packaged wet to preclude explosion.

5. Prior to handling or transporting drums containing explosive wastes, personnel working in the area shall be removed to a safe distance as determined by the Health and Safety Officer. Continuous contact with the communication base shall be maintained until handling or transporting operations are complete. An audible siren signal system, similar to that employed in conventional blasting operations, shall be used to signify the commencement and completion of explosive waste handling or transporting activities.

### 8.6.4 Drums Containing Radioactive Waste

1. Drums containing radioactive wastes shall not be handled until radiation levels have been determined by an initial field survey which is recorded in a Field Logbook. The survey shall include background levels, direct gamma readings and laboratory analysis of drum surface wipe samples.

2. Depending on the level of radiation encountered, handling and transport may require special shielding devices to protect personnel. Following handling and transport, equipment used shall be surveyed by the Health and Safety Officer and decontaminated to background levels prior to recommencing work. Surveys shall also be made of the ground surface in the vicinity of original drum storage to identify potential soil contamination by spilled or leaked radioactive waste. Prior to recommencing work in the area, radioactive soil areas shall be isolated to prevent tracking of radioactive contaminants about the site, and workers who entered the area should have their gloves and boots surveyed for radiation.

### 8.6.5 Packaged Laboratory Wastes (Laboratory Packs)

1. If drums known or suspected of containing discarded laboratory chemicals, reagents or other potentially dangerous materials in small volume, or individual containers are found, the Project Manager is to be notified immediately, before the drums or containers are moved or opened.

2. If the Project Manager and the Health and Safety Officer approve the handling of these containers, they shall be handled with extreme caution. Until otherwise categorized, they shall be considered explosive or shock-sensitive wastes. Initial handling shall be by a grappler unit constructed for explosive containment. Drums shall be palletized and overpacked if required prior to transport to the Laboratory Pack staging area for sorting, identification, repacking and/or stabilization.

3. Prior to handling or transporting Laboratory Packs from the existing drum area, personnel working in the immediate area shall be removed to a safe distance. Continuous contact with the communication base shall be maintained until handling or transporting operations are complete. An audible siren signal system, similar to that employed in conventional blasting operations will be used to signify the commencement and cessation of Laboratory Pack handling or transporting activities.

### 8.6.6 Air Reactive Wastes

1. If the presence of air reactive substance is verified or even suspected, the material should be immediately segregated and transported to a separate high hazard interim storage and disposal area.

2. Air reactive wastes may be discovered during opening or sampling operations. Air reactive substances normally require special packaging. They may be stored under water or some other liquid to minimize air contact. They may also be found in sealed ampoules, corrugated drums, stainless steel canisters, or specially lined drums.

### 8.6.7 Gas Cylinders

1. Gas cylinders, when encountered, should be stored and disposed of on a special case basis depending on the integrity of the cylinders and type of substance they are expected to contain.

## 8.7 Container Sampling

### 8.7.1 Equipment

1. Personal protection equipment.
2. 500 ml, wide-mouth amber glass bottle with Teflon® cap liner.
3. Uniquely numbered sample identification labels and tags, filled out and affixed to sample containers before sampling commences.
4. Four-foot long by 3/4 inch inside diameter glass sampling thief.
5. Remotely operated opening device (see Section 8.5).
6. One gallon covered cans half-filled with absorbent (for off-site shipment only).

### 8.7.2 Sampling Procedures

All drums and mechanical equipment should be grounded prior to the commencement of sampling. If the bung or container lid can be removed, sample contained liquids using a glass thief, which shall then be broken and discarded within the barrel. A barrel that has a badly rusted bung, or that cannot be sampled as above, shall be safely entered with a hydraulic penetrating device operated remotely (see Section 8.5). All openings shall be plugged except during sampling operation. The step to be followed in sampling are as follows:

1. Record any markings, special drum conditions, and type of opening in the Field Logbook, on the sample log sheet, and, later, on the Chain-of-Custody form. Locate the general area on a sketch of the site.
2. Stencil an identifying number on the drums and record in the logbook. Consult the project-specific work plan for identifications.
3. Make certain that the drum/container is set on a firm base, preferably in a fully upright position.
4. Open the drum/container as described in Section 8.5 and Attachment 9.2.
5. Insert glass tubing almost to the bottom of the drum or until a solid layer is encountered. About one foot of tubing should extend above the drum.

6. Allow the waste in the drum to reach its natural level in the tube. Cap the top of the sampling tube with a tapered stopper, ensuring liquid does not come into contact with stopper.
7. Carefully remove the capped tube from the drum and insert the uncapped end in the sample container. Release the stopper and allow the glass thief to drain completely into the sample container.
8. Deliver 100 to 250 ml of the sample to a clean, wide-mouth, 500-ml glass sample jar. If the sample is not free flowing and is taken through a bung opening, repeated sampling may be necessary.
9. Place the used sampling tube, along with paper towels or waste rags used to wipe up any spills, into an empty metal barrel for subsequent disposal. If glass tubing has been used, it may be broken and left inside the drum being sampled.
10. Clamp the sample container tightly and place prelabeled and tagged sample container in a carrier.
11. Replace the bung or lids or place plastic over the drum/container.
12. Measure the sample for radioactivity and record results in a Field Logbook. If the meter readings exceed 10 mRhr, notify the Field Operations Leader immediately.
13. Fill out Chain-of-Custody Record and carefully pack samples. The finished package will be padlocked or custody-sealed for shipment to the laboratory. The preferred procedure includes the use of a custody-seal across filament tape that is wrapped around the package at least twice. The custody-seal (paper, plastic, or metal) is folded over and stuck to itself so that the only access to the samples is by cutting the filament tape or breaking the seal to unwrap the tape. The seal is signed before the package is shipped.
14. Complete the appropriate traffic report. Drum samples are always considered to be high-hazard samples.

### 8.7.3 Sample Preservation and Packing Procedures for Drummed Waste Samples

1. No preservatives shall be used.
2. Place sample in a Ziplock plastic bag.
3. Place each bagged container in a 1-gallon covered can containing absorbent packing material. Place lid on can.
4. Mark the sample identification number on the outside of the can.
5. Arrange for the appropriate transportation mode consistent with the type of hazardous waste involved.

### 8.8 Resealing and Restage Containers

All containers opened for sampling need to be resealed to prevent the escape of vapors and possible reactions from rainwater, air and so on. The resealing methods will depend on the opening methods used and include the following:

1. Replacing the bung, screw cap, etc.
2. Replacing the lid and retaining ring.
3. Placing the drum ion an overpack (larger drum) when it cannot be resealed by any other method.
4. If a hole is drilled, use a special rubber plastic plug. A drum bonnet should be used to ensure that rainwater does not seep around the plug.

It is important to note that these resealing methods are for the purpose of preventing leakage from the container while it is in storage on the site. If the container is to be moved off the site, DOT regulations regarding transportation of drums must be complied with. These will generally require more rigorous sealing procedures.

Once the drum is sampled and resealed, it should be left where it cannot react with other containers on the site. For a small number of drums, the storage areas may be the staging and opening area. In any event, the sampled drums should be placed in an area away from other groups of containers on the site. The reason is that slowly progressing chemical reactions can start when a container is opened and the contents exposed to air or the disturbance caused by handling the drum. Such a reaction could take hours or even days to occur. Another reason for the segregation and identification of drums for recovery is for use as evidence.

### 8.9 Public Evacuation/Alert Consideration

#### 8.9.1 General

The potential need for evacuation of the site and surrounding area must be considered. Several site-specific factors influence the need for, and the extent of, the evacuation or alerting of the nearby off-site public. These factors include the following:

1. Proximity of residences, shopping or other commercial or business areas, factories, highways, railroads, and airfields or other transportation routes that may have to be evacuated. This information will be available from the background review and preliminary site inspections.

2. Proximity of other facilities that could be involved in, cause or propagate a fire, explosion, or toxic release on the site. This information will also be known from the background review and site inspection.

3. Presence of explosive, flammable, or volatile substances on the site. Some general indications of the types of hazards present may be provided by the background review and site inspection. The probability of encountering explosives (i.e., directly detonatable or shock-sensitive materials as opposed to explosive vapor-oxygen mixtures) will have been reduced by the screening procedures applied during earlier site evaluation. Preliminary assessment and site inspection may provide indications, or definite knowledge, that specific compounds presenting known flammability or toxicity hazards are in the containers. Of these known hazards, those having the greatest potential for atmospheric spread off the site should be used in estimating evacuation hazard distances as described below. For example, if several volatile toxic liquids, or toxic vapors, are present, those having the greatest toxic potential in air, as measured by a Threshold Limit Value (TLV) or classified as Immediately Dangerous to Life and Health (IDLH), should determine the hazard distance, since these have the potential for the greatest health impacts.

   Atmospheric drift of a toxic or flammable vapor cloud or plume can often extend to great distances from the site, and hence potentially threaten more people than even an explosive hazard. Similarly, thermal-radiation hazards generated by even a large fire on the site generally reach to distances which are small compared to possible atmospheric drift distances of a vapor cloud.

4. Potential for an accident on the site which could result in an atmospheric release of flammable or toxic liquid or vapor. This possibility should be remote if only one drum is opened at a time and if that drum is segregated from the other drums.

   The most important parameter that needs to be established for any accident is the rate of liberation of flammable or toxic vapor; unfortunately, this is often the most uncertain quantity.

5. Prevailing wind speed and direction and atmospheric stability strongly affect the pattern of atmospheric spread of a gas cloud. If these can be quantitatively estimated at the time an actual accidental release occurs, this information should be used in calculating and estimated evacuation corridor as detailed below.

   However, because wind direction is subject to rapid and unpredictable variations, and because atmospheric drift of a concentrated cloud or plume is greatest under stable atmospheric conditions and low winds speeds, it is usually preferable to take a conservative approach. Thus, one should base a public hazard evacuation distance, in any direction from the site, on an assumed worst-case atmospheric condition, that is, a stable atmosphere and nominal low wind speed, 5 mph.

### 8.9.2 Plausible Accident Scenario

A plausible but hypothetical scenario for an accident that may be expected to occur during closed-container opening operations would involve a release, from only the one 55-gallon drum being opened, of a volatile toxic liquid that rapidly vaporizes and forms and non-burning but continuous source of a toxic vapor plume. The rate of vapor generation and release can be calculated from the assumption that the upright drum is completely open at the top and a knowledge of the vapor pressure and some other readily available chemical properties of the chemical involved. For simplicity, the fact that a complex mixture of chemicals may actually be involved is neglected and the most toxic liquid or vapor is treated as if it were a pure component.

### 8.9.3 Estimating Hazard Evacuation Radius

Once the rate of atmospheric release of vapor is estimated for the accident scenario, outside assistance from any of several sources may be sought to estimate an atmospheric dispersion distance appropriate for the degree of flammability or toxicity hazard of the chemical involved. This estimate would then be used as a recommendation of an evacuation radius to be made to the responsible official in charge at the site, who will actually determine the necessity and extent of public evacuation.

Outside assistance in estimating the hazard radius in an emergency situation may be obtained from EPA's Emergency Response Team (ERT), the U.S. Coast Guard's Hazard Assessment Computer System (HACS), or from other hazard analysts.

Two different situations may require the evacuation of the off-site public:

1. The emergency resulting from an actual occurrence of an accident involving atmospheric release during drum-opening operations.
2. Precautionary planning before the start of drum-opening operations, in anticipation of an accident.

The above hypothetical scenario involving a single drum may be used in planning precautionary evacuations before the start of a dangerous drum-opening operation. On the other hand, in an actual accident, the release rate may be estimated if the number of drums releasing and the size of the opening in each such drum can be estimated by observation.

The decision to evacuate or alert the public off the site as a precautionary measure depends on the degree of hazard presented by the materials known to be present at the site. For the scenario described above, a table of numerical hazard distances for several of the commonly encountered chemicals and those expected to be found at the site should be prepared before drum-opening commences. These distances may then be used as numerical decision criteria for precautionary evacuation by comparing them to the known distances of populated areas from the site.

## 9.0 ATTACHMENTS

**9.1 Reference Information for Procuring Qualified Subcontractors for Drum Handling and Removal.**

**9.2 Techniques for Opening Containers**

# DRUM HANDLING AND REMOVAL

## 1.0 PURPOSE

The purpose of this attachment is to provide reference information for procuring a qualified subcontractor for drum handling and removal activities at hazardous waste sites.

## 2.0 SCOPE

It is assumed that the removal and/or special on-site handling of drums at a hazardous waste site will require the services of a subcontractor specialist and that the lead firms within AEC will not undertake this activity themselves. This attachment is limited to addressing the procurement of a qualified subcontractor for drum handling and removal activities.

## 3.0 REQUIREMENTS

Drum handling and removal is normally handled by specialty subcontractors. Specific contractual requirements are necessary to address this dangerous and sensitive activity.

## 4.0 REFERENCES

None.

## 5.0 DEFINITIONS

**Drum** - Any container used to store hazardous materials in a quantity less than 60 U.S. gallons.

**Hazardous Materials** - Any substance capable of producing deleterious health effects, upon any form of skin contact, inhalation or ingestion by animals or humans.

## 6.0 RESPONSIBILITIES

### 6.1 Project Manager

The Project Manager is responsible for identifying the need for procuring drum handling and removal services and for developing the bid package, technically reviewing bids and preparing the purchase requisition.

### 6.2 Field Operations Leader

The Field Operations Leader is responsible for monitoring the progress of the drum handling/removal subcontractor while the subcontractor is on-site, establishing that the subcontractor conforms to the requirements of the work scope.

## 7.0 EQUIPMENT

None specified.

## 8.0 PROCEDURES

### 8.1 Information to be Transmitted to the Subcontractor

In preparing the bid package, the Project Manager shall provide all available information as related to the drum handling activity in question. The request shall make it a contractual requirement that the same information be transmitted by the main subcontractor to any lower-tier subcontractors who may be needed in order to complete the task. The information shall include, but is not limited to, the following:

- General information and project/site background
- Scope of work and proposed date(s) of activity
- Waste characterization including:
  1. Drum contents
  2. Numbers of drums
  3. Physical condition of drums
  4. Physical description of drums.
- Known chemical and physical hazards associated with the site and drums
- Health, Safety and Training Requirements including, but not limited to the following:
  1. Health and Safety Plan (HASP) for the AEC Program which defines:
     a. medical surveillance requirements for all subcontractor personnel. Prior to subcontractor personnel performing on-site work, each person must successfully complete, at subcontractor expense, the medical monitoring defined in the HASP and must provide the specified Physical Statement signifying medical approval to perform site work.
     b. fundamental Health and Safety Training (1 day) which is to be completed by the subcontractor's on-site employees prior to site work and which will generally be provided by the Health and Safety Officer assigned to the site.
  2. Personal Protective Equipment requirements, which should be defined in the project specific HASP prepared by the Health and Safety Officer.
  3. Contract language requirements for the subcontractor to comply with all requirements of the Program HASP, the project-specific work plan, and all applicable Federal, State and Local Health and Safety regulations. Contract language should also specify that the

Health and Safety Officer may stop the subcontractor's work on his failure to comply with any of these requirements and that subsequent damages may be assessed.

### 8.2 Information Required to Evaluate the Subcontractor

The subcontractor and any lower-tier subcontractor to be used should be required to provide the following information as part of their bid:

- Complete case history regarding drum handling activities on hazardous waste sites and references regarding job performance
- Experience of specific subcontractor personnel who are to perform the drum handling activity in question
- Detailed description of equipment to be used for performing the scope of work.

The bid package should request sufficient information from the bidders to permit the following considerations to be addressed:

- Experience and Reference
  1. How long has the subcontractor been in business?
  2. How many similar drum handling jobs has the subcontractor performed?
  3. Are references favorable?
  4. What is the experience of personnel specifically assigned to this project?
  5. Are the personnel in a current medical monitoring program?
  6. Is the subcontractor familiar with Health and Safety training and Operational Procedures?
- Training
  1. Does the subcontractor have an employee training program?
  2. If so, how often is refresher training given?
  3. Are personnel certified or licensed by reputable agencies, associations?
  4. What does the training program encompass? Equipment operation? Health and Safety? Proper working procedures?
- Procedures
  1. Are the subcontractor's drum handling procedures consistent with EPA protocol, OSHA procedures, and other applicable standards?
  2. Do these procedures account for:
     a. environmental stress?

b. inclement weather?

c. upgrading in the level of protection?

3. How does the subcontractor plan to carry out these procedures?

   a. how many operators?

   b. how many helpers?

   c. what are the specific responsibilities for assigned personnel?

- Equipment

1. Is the subcontractor's equipment:

   a. in conformance to OSHA standards?

   b. regularly inspected?

   c. regularly serviced?

   d. easily serviceable?

   e. modern?

2. Does the subcontractor employ:

   a. drum grapplers attached to a hydraulic excavator?

   b. front-end loader, which can be loaded manually, equipped with a bucket sling, or used with a right terrain forklift?

3. Which of the aforementioned methods is better for the job?

4. Has the subcontractor proposed another acceptable method which is more feasible?

5. Has the subcontractor attempted to employ remote handling equipment that will lessen the potential for worker contact? Or is all work manual, presenting improper lifting and potential back injury concerns?

6. Does loading equipment contain:

   a. an air conditioned cab for operation safety and comfort?

   b. an overhead canopy and safety splash shield for operation safety?

   c. emergency escape packs if this is deemed necessary?

   d. provision for use of supplied air respirators?

- Costs

Are costs:

1. Clearly outlined for the scope of work?

2. Responsible and competitive for the procedures and equipment being used?

These criteria should be cited as part of the detailed bid package for technical evaluation and selection of a drum handling subcontractor.

## 9.0 ATTACHMENTS

None.

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## TECHNIQUES FOR OPENING CONTAINERS

| Types | Size | DOT Designation | Type of Opening | Recommended Opening Technique |
|---|---|---|---|---|
| Steel drum, open head, unlined and lined | 5-110G | DOT 5-<br>DOT6-<br>DOT17-<br>DOT37-<br>DOT42- | Detachable steel lid with a clamp or lever-locking ring, or a ring with forged lugs and secured by a bolt. | Remove bolt. If possible, relieve pressure on clamp or lever-locking ring remotely (i.e., lanyard); Remove ring with layard. Remove lid by hand. |
| Steel drum, closed head, lined | 5-110G | DOT5-<br>DOT6-<br>DOT17-<br>DOT37-<br>DOT42- | Plastic bung opening not larger than 2.3 in. | Preferred method is to remotely open bung. Manually open otherwise. |
| Steel drum, closed head, unlined (steel, monel, stainless, nickel, and aluminum) | 5-110G | DOT5-<br>DOT6-<br>DOT17-<br>DOT37-<br>DOT42- | Steel or other metal bung not over 2.3 in. | Remote method. |
| Burlap bag, double Kraft paper bag, cloth bag, plastic bag | Various | DOT36-<br>DOT44-<br>DOT45- | Various | Open with sharp implement; reseal bag or overpack in fiberpack. |
| Glass carboys and jugs | 6-20G | Usually DOT 1- branded into the wooden outer sheathing; often sheathing is no longer present. | Lapped or ground glass stopper; occasionally a plastic screw cap will be encountered. | Manually. |

## TECHNIQUES FOR OPENING CONTAINERS (Continued)

| Types | Size | DOT Designation | Type of Opening | Recommended Opening Technique |
|---|---|---|---|---|
| Laboratory reagent bottles (amber bottles), small reagent cans | Various | None | Screw top or press lid. | Usually encountered in lab packs. Not to be handled or sampled. Replace drum lid carefully. Contact Project Manager for action. |
| Polyethylene and other plastic drums or barrels | 5-11OG | DOT2- | Usually bung opening not over 2.7 in. in diameter. | Manually. |
| Gas Cylinders | Various | DOT3-<br>DOT4-<br>DOT8-<br>DOT39- | Valve, threaded fitting, quick-connect or puncture-type fittings. | Not to be handled or sampled. Contact Project Manager for action. |
| Fiberpack or corrugated | 5-11OG | DOT12-<br>DOT21-<br>DOT23- | Usually a detachable plastic lid with a clamp or lever-locking ring. | Manually. |

**FIELD PROCEDURE FP 6-5**

**GROUNDWATER SAMPLING**

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| Subject | Procedure No. 2 | Rev. | |
|---|---|---|---|
| | FP 6-5 | 1 | Page 1 of 10 |
| GROUNDWATER SAMPLING | Issue Date | Effective Date | |
| | 10/04/93 | 10/04/93 | |
| | Supersedes Procedure Number | Rev. | Date |
| | 630 FP | 0 | |
| Acceptance - Program QA | Approval - Program Manager | | |

## 1.0 PURPOSE

The purpose of this procedure is to obtain groundwater samples that are representative of the source from which they are taken and minimize sampler exposure to groundwater contaminants. The methods and equipment described are for the collection of water samples from the saturated zone of the substrata.

## 2.0 SCOPE

This procedure provides information on proper equipment and techniques for groundwater sampling. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described should be followed whenever applicable, noting that site-specific conditions, the project-specific work plan, FP 5-5, FP 5-6 and FP 6-8 may require adjustments in methodology. The collection of internal quality control checks during sampling is specified in the project-specific work plan.

## 3.0 REQUIREMENTS

Generally, wells should be sampled within three hours of purging. However, wells with poor recharge should be sampled within 24 hours of purging. Poor recharge wells are those that cannot recharge 90 percent of the original volume within six to eight hours.

Applicable preservatives must be added to the sample containers after the groundwater samples are added to the containers, except for the volatile organic compounds containers, which will be preserved before groundwater samples are collected. All sampling equipment must be decontaminated in accordance with Field Procedure FP 3-1, Decontamination of Sampling Equipment, before commencement of sampling.

## 4.0 REFERENCES

4.1 ASTM, 1986. *Annual Book of ASTM Standards*, Section 11. Volume 11.04, D4448-85A.

4.2 Barcelona, M.J., J.P. Gibb and R.A. Miller, 1983. *A Guide to the Selection of Materials for Monitoring Well Construction and Groundwater Sampling*, ISWS Contract Report 327, Illinois State Water Survey, Champaign, Illinois.

4.3 Johnson Division, UOP, Inc., 1975. *Ground Water and Wells, A Reference Book for the Water Well Industry*, Johnson Division, UOP, Inc., Saint Paul, Minnesota.

4.4 Nielson, D.M. and G.L. Yeates, 1985. *A Comparison of Sampling Mechanisms Available for Small-Diameter Ground Water Monitoring Wells*, Ground Water Monitoring Review 5:38-98.

4.5 Scalf, M.R., J.F. McNabb, W.J. Dunlapp, R.L. Crosby and J. Fryberger, 1981. *Manual of Ground Water Sampling Procedures*, R.S. Kerr Environmental Research Laboratory, Office of Research and Development, USEPA, Ada, Oklahoma.

4.6 HAZWRAP, July 1990. *Quality Control Requirements for Field Methods*, DOE/HWP-69/R1.

4.7 USAEC, May 1993. *U.S. Army Environmental Center Guidelines for Implementation of ER 1110-1-263 for USAEC Projects.*

4.8 United States Environmental Protection Agency (USEPA), 1980. *Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities*, Office of Solid Waste, USEPA, Washington, DC.

4.9 USEPA, 1987. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, EPA SW-846.

4.10 USEPA, 1987. *Ground Water Handbook*, EPA/625/6-87/016.

4.11 USEPA, 1987. *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.

4.12 USEPA, September 1986. *Resource Conservation and Recovery Act (RCRA) Ground Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1.

4.13 USATHAMA, January 1990. *U.S. Army Toxic and Hazardous Materials Agency Quality Assurance Program*, USATHAMA PAM 11-41.

## 5.0 DEFINITIONS

**Environmental Sample** - Low concentration sample typically collected offsite and not requiring DOT hazardous waste labeling as a high hazard sample.

**Hazardous Waste Sample** - Medium to high concentration sample (e.g., source material, sludge leachate) requiring DOT labeling and Contract Lab handling as a high hazard sample.

## 6.0 RESPONSIBILITIES

### 6.1 Project Manager

The Project manager is responsible for reviewing the sampling procedures used by the field crew and for performing in-field spot checks for proper sampling procedures.

### 6.2 Site Hydrogeologist or Geochemist

The Site Hydrogeologist or Geochemist is responsible for selecting and detailing the specific groundwater sampling techniques and equipment to be used, documenting these in the project-specific work plan, and properly briefing the site personnel.

### 6.3 Site Geologist

The Site Geologist is primarily responsible for the proper acquisition of the groundwater samples. When appropriate, such responsibilities may be performed by other qualified personnel (engineers, field technicians).

## 7.0 EQUIPMENT

Sample containers shall conform with EPA regulations for preservation of appropriate contaminants (see Field Procedure FP 6-7). Ideally, sample withdrawal equipment should be completely inert, economical, easily decontaminated, easily sterilized, reusable, able to operate at remote sites in the absence of power sources, and capable of delivering variable rates for well flushing and sample collection. The sample withdrawal equipment (evacuation devices) most commonly used are discussed in Field Procedure FP 5-5 and FP 5-6. The following pieces of equipment may be needed to collect groundwater samples:

1. Sample Containers
2. Coolers for Sample Shipping and Cooling
3. Chemical Preservatives
4. Appropriate Packing Cartons and Filler
5. Labels
6. Chain-of-Custody Documents
7. Thermometer
8. pH Meter/Paper
9. Dissolved Oxygen Meter
10. Portable HNu or OVA Photoionization Detector
11. Specific Conductivity Meter
12. Camera and Film
13. Appropriate Keys (for Locked Wells)
14. Tape Measure
15. Pipe Wrenches
16. Water-Level Indicator
17. Flow Meter
18. Appropriate Sampling Gloves
19. Field Sampling Logbooks
20. Knife
21. Sample Table and Plastic Cover
22. Plastic Trash Bags
23. Indelible Marking Pens
24. Black, Permanent Ink Pens
25. Shallow-Well Pumps (centrifugal, positive displacement or peristaltic pumps where applicable)
26. Deep-Well Pumps (submersible pump and electrical power generating unit or bladder pump with compressed air source, where applicable)

27. Sample Tubing Such as Teflon®, Polyethylene and Polypropylene (tubing type shall be selected based on specific site requirements and must be chemically inert to groundwater being sampled)
28. Teflon® Bailers
29. Teflon®-Coated Wire, Stainless Steel Single Strand Wire, Polypropylene Monofilament Line, or One-Quarter Inch Nylon Rope and Tripod-Pulley Assemble (if necessary)
30. Pails (plastic, graduated)
31. Decontamination Solutions (distilled water, deionized, analyte free water, Alconox or Liquinox, methanol, and hexane, where applicable)

## 8.0 PROCEDURE

### 8.1 General

To be useful and accurate, a groundwater sample must be representative of the particular saturated zone of the substrata being sampled. The physical, chemical, and bacteriological integrity of the sample must be maintained from the time of sampling to the time of testing in order to keep any changes in water quality parameters to a minimum.

Methods for purging wells prior to sampling include the use of pumps and bailers. These procedures are described in FP 5-5 and FP 5-6 and will be used for purging wells prior to sampling. Purging is not required when sampling private supply wells. Water produced during purging shall be collected, stored, or treated and discharged as indicated in the project-specific work plan.

Stratification of contaminants may exist in the aquifer formation, either in terms of concentration gradients as a result of mixing and dispersion processes in a homogeneous layer, or due to layers of variable permeability into which a greater or lesser amount of the contaminant plume has flowed. Excessive pumping can dilute or increase the contaminant concentrations in the recovered sample compared to what is representative of the integrated water column at that point. This can result in the collection of a non-representative sample.

### 8.2 Sampling Approach

The sampling approach consisting of the following, is developed in the project-specific work plan and includes:

1. Background and objectives of sampling.

2. Brief description of area and waste characterization.
3. Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).
4. Sampling equipment to be used.
5. Assigned number, sequence, volumes, and types of samples. If the relative degrees of contamination between wells is unknown or insignificant, a sampling sequence which facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these should be sampled last to reduce the risk of cross-contamination between wells as a result of the sampling procedures.
6. Sample preservation requirements.
7. Working Schedule.

**8.2.1 Sampling Methods**

The collection of a groundwater sample is made up of the following steps.

1. Set up the sample table adjacent to the well and cover the table top with clear sheet plastic to minimize contamination of the table. Tape the plastic onto the table and record the sample location, site, anticipated sample time, and field sample number onto the plastic using an indelible pen. Fill out sample labels for each of the required sample containers and place labels onto the appropriate sample containers. Labels must be waterproof to prevent water damage. The following information must be included on the sample label:

   - site name
   - field identification or sample station number
   - date and time of sample collection
   - designation of the sample as grab or composite
   - type of sample (matrix) and a brief description of the sampling location
   - printed initials of the sampler
   - sample preservative used
   - types of analyses to be performed.

   If a sample is split with another party, sample labels with identical information should be attached to each of the sample containers.

2. Position the labeled sample containers and required trip blanks, on the sample table so that the sampling information on the plastic is legible and take a photograph of the sampling setup.

3. Health and Safety Officer or designee will open the well cap and use volatile organic detection equipment (HNU or OVA) to monitor the escaping gases at the well head to determine the need for respiratory protection.

4. When proper respiratory protection has been selected and outfitted, sound the well for total depth and water level (using decontaminated equipment) and record these data in the field notebook. If the well volume is unknown, calculate the fluid volume in the well according to FP 5-5 or FP 5-6.

5. Wells will be checked for light and dense immiscible fluids before purging and sampling the well. The presence of light floating and dense sinking immiscible liquids will be determined using an interface probe by first checking the surface of the groundwater and the base of the well.

6. Calculate depth from the casing top to the midpoint of the screen or well section open to the aquifer. Any dry wells encountered must be noted.

7. An initial measurement of purge water for physical parameters including pH, conductivity, temperature, and turbidity (description by unaided eye) shall be recorded on the Groundwater Sampling Form and in the Field Logbook.

8. Lower purging equipment into the well to a short distance below the water level and begin water removal. If resistance is encountered when lowering the device into the well, withdraw the device from the well and inform the Field Operations Leader or use a smaller diameter device. Purge the well following the appropriate procedure (Field Procedures FP 5-5 Well Purging - Bailing Method, or FP 5-6 Well Purging - Pumping Method).

9. To ensure that groundwater samples are representative of actual conditions, samplers must work efficiently to minimize the loss of groundwater contaminants and the introduction of foreign contaminants. To prevent contamination of samples, the sample bottles should be opened only when receiving sample preservatives or groundwater samples and closed immediately afterwards. To prevent introduction of foreign contaminants into the well, sample bottles should be held away from the well opening when receiving samples and the bailing rope should not be allowed to touch the ground, or other potentially contaminating objects.

   The sampler should quickly add the sample into the sample containers, while minimizing aeration and loss of volatile contaminants. Samples collected for analysis of volatile constituents will be collected first, followed by samples collected for analysis of total organic carbon (TOC), total organic halogens (TOX), and those constituents which require field filtration or field determination after collection of volatile organics. Large volume samples for extractable organic compounds, total metals, etc., should be collected last.

10. When a sample bottle is filled, the bottle must be tightly capped as soon as possible.

11. Efficiency and care must be utilized to obtain representative samples for volatile organic analysis. Unnecessary delays or poor sampling technique will lead to loss of the volatile constituents from the sample. Prevent unnecessary stripping of volatile constituents from the sample by minimizing turbulence and aeration when filling the bailer and when filling the sample container. Quickly fill the sample container until a positive meniscus is achieved above the rim of the container and cap the container immediately. Gently tap the sample container to dislodge any air bubbles and verify that no bubbles are present. If bubbles are detected, immediately uncap the sample, add additional sample from the bailer until a positive meniscus is re-established, immediately recap the sample and check the sample for bubbles. After the sample container has been opened twice, the sampling process must start over with a new sampling container. Repeat this step until the volatile organics sample contains no bubbles and all required samples are obtained.

12. All sample bottles and caps, except bottles for volatile organic compounds analysis, shall be triple rinsed with the water being sampled before filling the bottle with the sample to be analyzed. Bottles for filtered samples shall be rinsed with filtered sample water, and bottles for unfiltered samples shall be rinsed with unfiltered sample water.

13. After collecting the sample add the required preservative to each sample container in accordance with the project-specific work plan. Do not preserve bottles for filtered analyses until after filtering is complete. Label all containers and stage the collection setup to minimize sampling time.

14. Follow Field Procedure 6-8 when field filtering of groundwater samples is required. The sample will be filtered immediately after it is collected, and then preserved as necessary in accordance with the project-specific work plan.

15. After obtaining chemical analysis samples, draw a second sample for temperature, conductivity, and pH measurement record results in the Field Logbook, replace the well cap.

16. As soon as all samples are collected, promptly prepare the samples for shipment in accordance with Field Procedure FP 6-7, Packaging and Shipment of Field Samples.

17. Record all sampling information in the Field Logbook.

18. Decontaminate all equipment.

When sampling private supply wells or taps, the sample shall be collected from a tap directly into the approved containers. The water shall be allowed to run from the tap for two to three minutes before sampling. Where possible, the tap should be located before the water is treated by any on-site treatment system. Steps 1,2,7, and 9 through 17 shall be followed for private well and tap sampling.

### 8.2.2 Collection of Split Samples or Field Duplicates

Whenever field duplicates are collected or samples are split with another organization the additional samples for identical analyses will be collected along with the original sample (i.e., containers for all volatile organic analyses will be filled first and together, all semi-volatiles together and in proper sequence, and so forth until all sample parameters are in the proper containers).

### 8.2.3 Sample Containers

For most samples and analytical parameters, either glass or plastic containers are satisfactory. Field Procedure FP 6-7, Packaging and Shipment of Field Samples, describes the required sampling containers for various analytes at various concentrations.

### 8.2.4 Preservation of Samples and Sample Volume Requirements

Sample preservation techniques and volume requirements depend on the type and concentration of the contaminant and on the type of analysis to be performed. The project-specific work plan describes the sample preservation and volume requirements for most of the chemicals that will be encountered during site investigations.

### 8.2.5 Field Filtration

In general, preparation and preservation of water samples include some form of filtration. All filtration must occur in the field immediately upon collection. The recommended method is through the use of a disposable in-line filtration module (2.0 micron filter for metals and 0.30 micron filter for gross alpha/gross beta) using the pressure provided by the pumping device for its operation. Filters must be prerinsed with organic-free water (see Field Procedure FP 6-8). Samples for organic analyses must never be filtered.

### 8.2.6 Handling and Transporting Samples

After collection, samples should be handled as little as possible. It is preferable to use self-contained "chemical" ice (e.g., "blue ice") to reduce the risk of contamination. If natural ice is used, it should be bagged and steps taken to ensure that the melted ice does not cause sample containers to be submerged and thus the possibility of cross-contaminated. All sample containers should be enclosed in plastic bags or cans to prevent cross-contamination.

Samples should be secured in the ice chest to prevent movement of sample containers and possible breakage. Sample packing and transportation requirements are described in Field Procedure FP 6-7 and requirements for chilling samples are described in the project-specific work plan.

#### 8.2.7 Sample Holding Times

Holding times, allowed time between sample collection and analysis for routine samples, are given in the project-specific work plan.

### 8.3 Records

Records will be maintained for each sample that is taken. The groundwater sampling form (Attachment 9.1) will be used to record the following information:

- Sample identification (site name, location, project number; sample name/number and location; sample type and matrix; time and date; sampler's identity).
- Sample source and source description.
- Field observations and measurements (appearance; volatile screening; field chemistry; sampling method).
- Sample disposition (analyses to be run; number and size of bottle; preservatives added).
- Additional remarks (e.g., sampled in conjunction with state, county, local regulatory authorities; samples for specific conductance value only; sampled for key indicator; etc.).

### 8.4 Chain-of-Custody

Proper chain-of-custody procedures play a crucial role in data gathering. Field Procedure FP 6-7 describes the requirements for a correct chain-of-custody.

## 9.0 ATTACHMENTS

### 9.1 Groundwater Sampling Form

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# Sampling Form
(Field Sheet)

Project Name and Number: ____________________
Sampling Crew: ____________________
Sampling Point Number: ____________________
Sampling Location: ____________________
Sample Type: ☐ GW ☐ SW ☐ Soil ☐ SED ☐ Other: ____________________
Date and Time Sample Collected: ____________________
Weather Conditions: ____________________

***Purging Information*** (if applicable):

Method: ____________________
Quantity of Water Purged: ____________________
Disposition of Purge Water: ____________________

Date and Time of Purging: Start: __________ End: __________
Comments: ____________________

***Groundwater:***

Date and Time Collected: ____________________
Sampling Depth: ____________________
Water Level: ____________________
Sampling Method/Equipment: ____________________
Field Measurements: pH ______ Temp: ______ Cond: ______ Alkalinity: ______
Date and Time Filtered (if applicable): ____________________
Comments: ____________________

***Surface Water:***

Date and Time Collected: ____________________
Collection Method: ____________________
Date and Time Filtered (if applicable): ____________________
Field Measurements: pH ______ Temp: ______ Cond: ______ Turbidity: ______
Comments: ____________________

***Soils/Sediment Sampling:***

Date and Time Collected: ____________________
Sampling Depth: ____________________
Sampling Method: ____________________
Comments: ____________________

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