Standard Operating Procedure

SOP #:	FM-9.6 Rev. 004
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Title: Soil Sampling in Test Pits and Trenches

1. Purpose/Scope

This guideline describes the method for logging and sampling of test pits and trenches to determine subsurface soil and rock conditions and recover small-volume or bulk samples. The methods apply only to data collection and not to the construction of excavations.

The guideline is applicable to the collection of bulk and small-volume samples of subsurface soils for laboratory testing at sites where exposure to hazardous substances may occur.

Nobody is permitted to enter an excavation greater than four feet in depth or an excavation that contains standing water without an approved work plan and required permitting.

2. References

GES SOP FM 9.1: Soil Sampling for Analysis

GES SOP FM 13.2: Sample Preservation

GES SOP FM 13.3: Sample Identification

GES SOP FM 13.4: Chain-of-Custody

GES SOP FM 13.5: Sample Packaging and Shipping

GES SOP HS 1.11: Excavation and Trenching

Occupational Safety and Health Administration (OSHA), 29 CFR 1926.650-653. 1979

3. Equipment/Materials

The following equipment is needed for taking samples for chemical or geotechnical analysis from test pits and trenches:

- A site-specific Health and Safety Plan (HASP) and excavation plan.
- Backhoe or other excavating machinery
- Shovels, picks and hand augers, stainless steel trowels
- Sample container (bucket with locking lid for large samples and glass bottles for chemical or geotechnical analysis samples.

- Polyethylene bags for enclosing sample; buckets
- Remote sampler consisting of 10-foot sections of steel conduit (1-inch diameter), hose clamps and right angle adapter for conduit (See Attachment B).
- Field notebook
- Photoionization detector (PID) or flame ionization detector (FID)
- Combustible gas meter
- Camera

4. Procedure

A private utility mark-out company should be contracted prior to performing subsurface activities so that the approximate location of any potential subsurface utility line is identified near the areas to be excavated. This is in addition to the state required one-call notice. Site features may warrant a site walk prior to identify potential subsurface hazards. For any utility line which is identified, a "soft-dig" (air knife) contractor should be utilized to verify the location and depth of the lines as well as the size and type of line.

Prior to excavation, the site-specific HASP must be reviewed. The plan should address known and/or potential excavation and trench hazards, air monitoring requirements, potential flash fire hazards (high concentrations of volatiles and sparking via equipment or rock ripping) and mitigating actions.

4.1 Data Collection and Sampling

4.1.1 General

Test pits and trenches are usually logged as they are excavated. Records of each test pit/trench will be made on prepared forms or in a field notebook. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records will also include sample screening information.

General test pit/trench log forms are shown in **Attachments A-1** and **A-2**. This suggested format is useful because it provides all necessary sampling, monitoring and subsurface records for each pit or trench in a concise and uniform manner. This format also provides a cross-check with chain-of-custody records and sample labels. In completing a record of the trench profile (**Attachment A-2**), sketch the profile of each wall on the same form (or use two forms) when there are significant differences in the two trench walls. Requirements for sampling should be determined by the scope of work and field work directive. Field personnel should have sufficient tools and equipment to sample each pit. The tools and equipment must be properly decontaminated prior to use.

Entry of test pits by personnel is extremely dangerous and should be avoided unless absolutely necessary. Pits more than four feet deep must be shored prior to entry, the "buddy" system must be used, and all applicable H&S and OSHA requirements should be followed (see **Section 5.1.3**).

The final depth and type of samples obtained from each test pit will be determined at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may be collected.

In some cases, samples of soil may be extracted from the test pit for reasons other than waste sampling and chemical analysis, such as to obtain geotechnical information.

4.2 Sampling Methods

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 5.1.3.

1. Excavate trench or pit in several depth increments. After each increment the operator will wait while the sampler inspects the test pit from grade level to decide if conditions are appropriate for sampling. Monitoring of background air with a PID may be necessary. Practical depth increments range from 2 to 4 feet.
2. The backhoe operator, who will have the best view of the test pit, will immediately cease digging if:

   - Any fluid phase or groundwater seepage is encountered in the test pit,
   - Any drums, other potential waste containers, obstructions or un-marked utility lines are encountered, or
   - Distinct changes of material are encountered.

   This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. Depending upon the conditions encountered, it may be necessary to excavate more slowly and carefully with the backhoe.
3. Remove loose material to the greatest extent possible with backhoe.
4. Secure walls of pit if necessary (refer to SOP HS-1.11). There is seldom any need to enter a pit or trench which would justify the expense of shoring the walls. All observations and samples can generally be taken from the ground surface.
5. Samples can be obtained from the backhoe bucket. The sampler or Field Operations Leader directs the backhoe operator to remove material from the selected depth or location within the test pit/trench. The bucket is brought to the surface and moved away from the pit. The sampler and/or HSO then approaches the bucket and monitors its contents with a PID or FID. If granular or loose soils and/or uniform materials are encountered, the sample can be obtained directly from the bucket. The sample is collected from the center of the bucket and placed in sample containers using a clean stainless steel trowel or spatula. If a composite sample is

desired, several depths or locations within the pit/trench are selected and a bucket is filled from each area. It is preferable to send individual sample bottles filled from each bucket to the laboratory for compositing under more controlled laboratory conditions. However, if compositing in the field is required, each sample bottle should be emptied into a mixing container (e.g., a stainless steel bucket) and thoroughly stirred prior to being placed into the sample containers. Composite sampling is not appropriate for samples which will undergo analysis for volatile organic compounds (VOCs).

6. Using the remote sampler shown in **Attachment B**, samples can be taken at the desired depth from the side wall or bottom of the pit. The face of the pit/trench should first be scraped (using a long-handled shovel or hoe) to remove the smeared zone that has contacted the backhoe bucket. The sample is then collected directly into the sample jar by scraping with the jar edge, eliminating the need to utilize samplers and minimizing the likelihood of cross-contamination. The sample jar can be capped, removed from the assembly, and packaged for shipment.
7. Prepare shipping papers, labels, and chain-of-custody records in accordance with SOPs FM-13.1, and FM-13.3–13.5. Preserve samples as described in SOP FM-13.2.

4.2.1 In-Pit Sampling

Samples can also be obtained by personnel entering the test pit/trench. This is necessary when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., excessive mixing of soils or wastes within the test pit/trench) or when samples from relatively small discrete zones within the test pit are required. This approach may also be necessary to sample any seepage occurring at discrete levels or zones in the test pit that are not accessible with remote samplers.

In general, personnel should sample and log pits and trenches from the ground surface, except as provided for by the following criteria:

- The project will benefit significantly from the improved quality of the logging and sampling data obtained if personnel enter a pit or trench rather than conduct such operations from the ground surface.
- There is no practical alternative means of obtaining such data.
- The Site Health & Safety Officer determines that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the pit/trench after it is dug (including, at a minimum, measurements of volatile organics, explosive gases and available oxygen).
- An experienced geotechnical professional determines that the pit/trench is stable or is made stable prior to entrance of any personnel (by grading the sidewalls or using shoring). OSHA requirements must be strictly implemented.

If these conditions are satisfied, one person will enter the pit/trench. On potentially hazardous waste sites, this individual will be dressed in safety gear as required by the conditions in the pit.

He will be affixed to a safety rope and continuously monitored while in the pit. Procedures described in SOPs HS-1.9 and HS-1.11 must be followed, as appropriate.

A second individual will be fully dressed in protective clothing, including a self-contained breathing device, and on standby during all pit entry operations. The individual entering the pit will remain therein for as brief a period as practical, commensurate with performance of his work. After removing the smeared zone, samples are obtained with a clean trowel or spoon.

As an added precaution, it is advisable to keep the backhoe bucket in the test pit when personnel are working below grade. Such personnel can either stand in or near the bucket while performing sampling operations. In the event of a cave-in, they can either be lifted clear in the bucket, or at least climb up on the backhoe arm to reach safety.

4.2.2 Geotechnical Sampling

In addition to the equipment described in **Section 4.0**, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled borings (i.e., open tube samplers), which can be pushed or driven into the floor of the test pit.
- Suitable driving (e.g., a sledge hammer) or pushing (e.g., the backhoe bucket) equipment which is used to advance the sampler into the soil.
- Knives, spatulas, and other suitable devices for trimming hand-carved samples.
- Suitable containers (e.g., bags, jars, tubes, boxes), labels, wax, etc. for holding and safely transporting collected soil samples.
- Geotechnical equipment (e.g., pocket penetrometer, torvane) for field testing collected soil samples for classification and strength properties.

Disturbed grab or bulk geotechnical soil samples may be collected for most soils in the same manner as comparable soil samples for chemical analysis (see **Sections 5.1.2** and **5.1.3**). These collected samples may be stored in containers or plastic-lined sacks (larger samples), which will preserve their moisture content. Smaller samples of this type are usually tested for their index properties, to aid in soil identification and classification, while larger bulk samples are usually required to perform compaction tests.

Relatively undisturbed samples are usually extracted in cohesive soils using open tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings (see SOP FM-9.1), except the sampler is advanced by hand or backhoe, rather than a drill rig. Also, the sampler may be extracted from the test pit by excavation around the sampler when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in **Section 5.1.3** must be

followed. The open tube sampler should be pushed or driven vertically at a steady rate into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate, because the sample will not have the correct orientation.

A backhoe may be used to drive or push the sampler or tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, to minimize disturbance to the sample. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hand excavation to remove the soil from around the sides of the sampler and slice off the sample at its bottom may be required. Again, if this requires entry of the test pit, the requirements in **Section 5.1.3** must be followed. Prepare, label, pack and transport the sample in the required manner, as described in SOP FM-13.5.

Hand-carved block samples are extracted in a similar manner to open tube samples, except that the sampling container (usually a large tube or box with no top or bottom) is not used to cut the sample. Instead, the surrounding sections of the test pit floor are carved away by hand to leave a sample slightly smaller in plan dimensions than the container, with the sample remaining connected to the test pit floor at its bottom. The container is slipped over the sample, and the annular space and top of the sample is covered with melted wax. The bottom of the sample is then sliced away from the test pit floor, the container is inverted, about 1/2 inch of soil removed, and the space filled with melted wax. Caps are then installed, taped, and dipped in hot wax for each end of the container, and the block sample is labeled and shipped in the same manner as a tube sample.

Because the above method requires entering the test pit, it will be necessary to adhere to all appropriate Health and Safety procedures for doing so.

5. Records

The following information is to be recorded on the test pit/trench log form and in the field notebook:

- Name, work assignment number and location of job
- Date of digging or trenching
- Surface elevation
- Depth, surface area and orientation of pit or trench
- Sample numbers
- Method of taking samples, type and size of samples

- Approximate water levels after stabilization (if below the water table), and location and depth of any seeps
- Description of soil
- Other pertinent information, such as PID readings, weather conditions, etc.
- List of photographs
- Name of contractor, backhoe (or other equipment) operator and sampler
- Date and type of backfill

Attachments

Attachment A-1 – Test Pit Record

Attachment A-2 – Test Pit/Trench Profile

Attachment B – Remote Sampling/Sample Holder for Test Pit/Trench

Attachment A-1 – Test Pit Record

Site _____

Test Pit _____ Date _____

Time Start _____ Time End _____

Coordinates _____ Grid Element _____

Sketch map of test pit site, showing surface monitoring results

N

Scale 1" = _____ feet

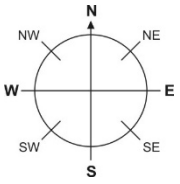
Crew Members

1
2
3
4
5
6

Monitor Equipment

- ☐ PID or FID
- ☐ Explosive Gas
- ☐ Available Oxygen
- ☐ Camera
- ☐ Other

Record winds



Notes

Attachment A-2 – Test Pit/Trench Profile

TEST PIT RECORD: PROFILE ALONG TEST PIT

Site

Depth (ft) _____ Scale 1" = _____ feet

Notes		*SAMPLES OBTAINED*			
		Sample ID	Depth (ft)	Init. Ser. No.	HD SP (ppm)

_____
Signature

Reference: Field Book, P.G. _____

Attachments _____

Attachment B – Remote Sampling/Sample Holder for Test Pit/Trench

Figure 1 – Remote Sample Holder for Test Pit/Trench Sampling