

Direct Push Technology (DPT) Sampling

SSFL SOP 4

Revision: 1

Date: November 2012

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Signature/Date**1.0 Objective**

The objective of this technical standard operating procedure (SOP) is to define the requirements for collecting subsurface soil using direct push technology (DPT) sampling techniques at the Santa Susana Field Laboratory (SSFL) site.

2.0 Background**2.1 Definitions**

DPT rig- A hydraulically-operated hammer device installed on the back of a van, pickup truck, or skid used to advance a hollow-stem rod and sampler into the subsurface soil (up to bedrock refusal) to collect subsurface soil samples.

Probe-Driven Sampler - A sampling device used to collect soil samples with a DPT rig. The sampler is 5-foot steel core barrel with an acetate liner to contain the sample.

Extension Rod - Stainless steel rod used to remove stop-pin and drive-point assembly.

Drive Point - Solid steel retractable point used to advance sample collection device to the required sample depth.

Probe Rod - Hollow, flush-threaded, steel rod similar to a drill rod.

Stop-Pin - Steel plug that threads into the top of the drive cap to hold the drive point in place during advancement of the probe rods.

Drive Cap - Threaded, hardened-steel top cap that attaches to the top of the probe rod; used when advancing the probe rods with the hydraulic hammer.

Pull Cap - Threaded, hardened-steel top cap that attaches to the top of the probe rod; used when retracting the probe rods.

2.2 Associated Procedures

- SSFL SOP 1, *Procedures for Locating and Clearing Phase 3 Samples*
- SSFL SOP 6, *Field Measurement of Total Organic Vapors*
- SSFL SOP 7, *Field Measurement of Residual Radiation*
- SSFL SOP 8, *Field Data Collection Documents, Content, and Control*
- SSFL SOP 9, *Lithologic Logging*
- SSFL SOP 10, *Sample Custody*
- SSFL SOP 11, *Packaging and Shipping Environmental Samples*
- SSFL SOP 12, *Field Equipment Decontamination*
- SSFL SOP 13, *Guide to Handling Investigation Derived Waste*
- SSFL SOP 15, *Photographic Documentation of Field Activities*
- SSFL SOP 16, *Control of Measurement and Test Equipment*

2.3 Discussion

The DPT rig consists of a hydraulically-operated hammer device mounted on the back of a van, a pickup truck or a skid. The DPT system hydraulically advances small-diameter hollow rods and sampler to the desired sampling depth. The specific type of DPT sampling equipment for soil sample collection is then deployed. This work will be performed by a subcontractor with CDM Smith oversight.

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The use of DPT technology is a cost-effective alternative to using conventional drilling techniques for collecting subsurface soil samples given the site-specific geologic and hydrogeologic conditions and sample requirements.

Advantages of using the DPT system include:

- Areas usually considered inaccessible by drill rigs because of terrain and vegetation, overhead wires, size constraints, etc., may be accessed with a van or pickup truck-mounted DPT rig.
- Investigation-derived wastes such as soil cuttings and purge water are minimized due to its small diameter rods and its displacement of soil horizontally, not vertically.
- Areas where traditional surface sampling equipment (e.g., Slide Hammer or Hand Auger) cannot penetrate the hard surface, a DPT rig may be used to obtain the sample(s).

In addition, all SOPs will be on hand with the field sampling team.

3.0 General Responsibilities

DPT Subcontractor—Subcontractor retained to perform all DPT drilling activities.

Field Team Leader (FTL)—The FTL is responsible for ensuring that sampling efforts are conducted in accordance with this procedure and the Field Sampling Plan (FSP) Addendum and this SOP.

Site Health and Safety Technician—The person who will use field screening instruments to monitor all field activities for VOCs and radiological contaminants and pre-shipment sample coolers. This person is a trained radiological technician who works under the guidance of Science Application International Corporation's (SAIC's) Certified Health Physicist (CHP).

Site Geologist—The person responsible for overseeing sample collecting, recording sampling information and for logging the soil sample.

4.0 Required Equipment at the Sampling Location

General

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| <ul style="list-style-type: none"> ▪ Site-specific plans (e.g., FSP Addendum, health and safety plan, and all SSFL SOPs) ▪ Field logbook ▪ Appropriate sample containers ▪ Insulated coolers ▪ Bags of ice ▪ Indelible black or blue ink pens and markers ▪ Plastic zip-top bags ▪ Nitrile or appropriate gloves ▪ Personal protective equipment ▪ Global Positioning System (GPS) ▪ 2-way radios | <ul style="list-style-type: none"> ▪ Monitoring/screening instruments required by the health and safety plan ▪ Plastic sheeting ▪ Decontamination supplies ▪ Trash bags ▪ Sample labels ▪ Kimwipes or paper towels ▪ Stainless steel trowel ▪ EnCore samplers and T-handle ▪ Plastic spoons or knives |
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DPT Soil Sampling Equipment

- DPT rig (tracked vehicle, van or truck-mounted) with the following:
 - Probe rods 5-foot [ft] lengths
 - Extension rods (5-ft) lengths, couplers, and handle
 - Piston stop-pins (two each per rig, minimum)
 - Drive caps and pull caps (two each per rig, minimum)
 - Carbide-tipped drill bit for working in concrete- or asphalt-covered areas

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- O-rings

- Assembled soil samplers (5-foot long continuous split-barrel with acetate sleeve)

5.0 Procedures

Subsurface and surface soil sampling procedures are discussed below. CDM Smith will oversee DPT operations and handle the samples. It is the DPT subcontractor's responsibility to operate the DPT equipment.

1. Review site-specific health and safety plan and FSP Addendum before initiating sampling activity.
2. Don the appropriate personal protective clothing as indicated in the site-specific health and safety plan.
3. Locate sampling location(s) in accordance with FSP Addendum and document pertinent information in the appropriate field logbook (SSFL SOP 8). Confirm GPS coordinates of each location (SSFL SOP 1).
4. Use clean (decontaminated) sampling tools to obtain sample material from each specified sample location.
5. Carefully remove stones, vegetation, debris, etc. from the ground surface in the sampling location area. Clear the sample location using a new and/or appropriately decontaminated tool as described to expose a fresh sampling surface.
6. The Site Health and Safety Technician will perform contaminant screening using hand-held instruments at each sample location before sampling and for each sample collected (SSFL SOPs 6 and 7). The most recent spoils materials will be segregated to minimize cross-contamination. The breathing zone and excavated materials will be monitored continuously. If levels are detected above health and safety plan action levels (HASP page 8), work will be temporarily discontinued, the Department of Energy (DOE), The Boeing Company (Boeing), and the California Department of Toxic Substances Control (DTSC) will be contacted. Site work will not resume at that location until further guidance is provided by DOE or Boeing. Contact information is in the health and safety plan.
7. If the sampling site is in an asphalt-covered area, drill a hole using the rotary function and a specially designed (1.5-inch or 2.0-inch diameter) carbide-tipped drill bit. Otherwise, the area needs to be cleared of heavy underbrush and immediate overhead obstructions.

5.1 Subsurface Soil Sampling

Assembly

1. Assemble the sampling device as follows:
 - Screw the cutting shoe to the bottom end of the sample tube, unless using standard probe drive sampler which has a built-in cutting edge.
 - Screw the piston tip onto the piston rod.
 - Screw the drive head onto the top end of the sample tube.
 - Insert the acetate liner into sample tube.
 - Slide the piston rod into the sample tube, leaving the piston tip sticking out of the bottom end of the sample tube.
 - Screw the piston stop-pin onto the top end of the piston rod in a counter-clockwise direction.
2. Attach the assembled sampler onto the leading probe rod.

Probing

3. Thread the drive cap onto the top of the probe rod and advance the sampler.
4. Advance the sampler using the hydraulic hammer. Add additional probe rods as necessary to reach the specified sampling depth (see Table 1 in FSP Addendum).

Stop-Pin Removal

5. Move the probe unit back from the top of the probe rods and remove the drive cap.

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6. Lower the extension rods into the inside diameter of the probe rods using extension rod couplers to join the extension rods.
7. Attach the extension rod handle to the top extension rod and rotate the handle clockwise until the leading extension rod is screwed into the piston stop-pin. Continue to rotate the handle clockwise until the stop-pin disengages from the drive head.
8. Remove the extension rods and attached piston stop-pin from the probe rods.

Continuous Sampling

Direct push sampling will be performed with a dual-tube sampling method using a specialty continuous coring sampler (4-ft with inner acetate sleeve). The sampler is driven in 4-ft intervals slightly ahead of stainless steel casing, and retrieved after each interval push as described above.

9. Replace the drive cap.
10. Advance the probe rods using the hydraulic hammer the length of the sample tube (4 ft).
11. Replace the drive cap with the pull cap and retract the probe rod(s). Secure the rod(s) with a clamp or by hand during removal so they do not fall back down the resulting borehole.
12. Detach the sampler from the lead probe rod, verifying that sufficient sample volume was recovered (Note: The length of sample contained within the tube is approximately equal to the length of exposed piston rod).
13. Disassemble the sampler. Remove the acetate liner. Use cutting tool to cut length of liner (2 times) to remove an approximate 1-inch strip to access the sample material.
14. The Site Health and Safety Technician will perform contaminant screening along the length of the acetate liner using hand-held instruments (SSFL SOPs 6 and 7). The most recent spoils materials will be segregated to minimize cross-contamination. The breathing zone and excavated materials will be monitored continuously. If levels are detected above health and safety plan action levels (HASP page 8), work will be temporarily discontinued and DOE, Boeing, and DTSC will be contacted. Site work will not resume at that location until further guidance is provided by DOE or Boeing. Contact information is in the health and safety plan.
15. If the PID indicates elevated VOCs or there is staining or discoloration evident, immediately collect VOC/1,4-dioxane and total petroleum hydrocarbons-gasoline range organics (TPH-GRO) samples using EnCore samplers per Section 5.2.
16. If there is no indication of contamination, collect the required number of Encore samplers for TPH-GRO analysis (if required by Table 1 of the FSP Addendum), then collect soil from the target interval as stated in the FSP Addendum Table 1, and place into glass jars using disposable plastic spoons or knives.
17. Wipe sealed jars with a clean Kimwipe or paper towel.
18. Fill out the sample label with the appropriate sample information (e.g., sample identification, date/time of sample collection, requested analyses per Table 1 of FSP Addendum) and attach to sample container.
19. Place sample containers in zip-top plastic bags and seal the bags. Place samples in a cooler with ice to maintain a temperature of 4°C ($\pm 2^\circ\text{C}$).
20. Proceed with additional sample depth collection as required by the FSP Addendum.

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21. When sampling is complete, place cuttings back into the borehole and top off with bentonite pellets, as necessary, to bring former borehole to ground surface. Place plastic sheeting and gloves in garbage bag and transfer decontamination water to storage container as specified in SSFL SOP 13.
22. Decontaminate the sampling equipment according to SSFL SOP 12.
23. Complete the field logbook entry (SSFL SOP 8), field sample data sheet for each sample, and lithologic log (SSFL SOP 9), being sure to record all relevant information before leaving the sample location.
24. Demobilize from sample location.

5.2 Method for Collecting Soil Samples for Volatile Organic Compound Analysis

The following text contains the recommended SW-846 Test Method 5035 procedure for sampling of soil samples for volatile organic compound (VOC) analysis, which includes the EnCore™ Sampler Method for low-level VOC analyses.

1. When collecting grab samples for VOC analysis, it is necessary to minimize sample disturbance and minimize analyte loss.
2. Wear new, clean gloves while handling sample containers and sampling devices. Change out gloves at each sampling location, or each time a new sample is to be collected to avoid cross-contamination.
3. The VOC samples shall be collected first as grab samples. EnCore samplers will be used to collect subsamples for the required analytical protocol (e.g., VOCs/1,4-dioxane and/or TPH-GRO). The VOC samples will be collected directly from the appropriate interval within the acetate sleeve – in a section of staining, odor, and/or PID response, or at the target depth per the FSP Addendum Table 1. Additional DPT cores may be necessary for all analyses.
4. Once the sleeve is retrieved, quickly screen the open end of the sleeve and the sample borehole for VOCs and radioactivity (SSFL SOPs 6 and 7).
5. Remove EnCore sampler and cap from package and attach T-handle to sampler body. Ensure the sampler is locked into the T-handle before sampling.
6. Push the sampler into the freshly-exposed sample in the acetate liner until the O-ring is visible within the hole on the side of the T-handle. If the O-ring is not visible within this window, then the sampler is not full.
7. Extract the sampler and wipe the sampler sides with a clean paper towel or Kimwipe so that the sampler cap can be tightly attached.
8. While locked into the T-handle, push the sampler cap on the head of the sampler with a twisting motion to secure it to the sampler body.
9. Remove the sampler from the T-handle and rotate the sampler stem counterclockwise until the stem locks in place to retain the sample within the sampler body.
- 10. Repeat** procedure for each of the remaining samplers.
11. When collecting soil samples using the EnCore Sampler Method, collection of soil for moisture content analysis is required. Results of the moisture analysis are used to adjust “wet” concentration results to “dry” concentrations to meet analytical method requirements. The moisture sample will be collected in a separate 4 ounce (oz.) glass jar. If only VOCs/1,4-dioxane are to be sampled at a location, following EnCore sample collection, fill one 4 oz. jar with soil from the liner in close proximity to the VOC samples for moisture analysis using a disposable plastic spoon or knife.
12. Complete the sample labels by filling in the appropriate information (i.e., sample identification, date and time of sample

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collection, requested analyses [per Table 1 of FSP Addendum]) and securing the label to the container.

13. Store samples at 4°C ($\pm 2^\circ\text{C}$) until samples are delivered to the FTL or sample coordinator (per SSFL SOP 10) for sample packing and shipment (per SSFL SOP 11) to the designated analytical laboratory. Encore samplers must be shipped and delivered to the analytical laboratory for extraction within 48 hours.
14. Decontaminate all non-disposable sampling equipment in accordance with SSFL SOP 12.

Note: A water trip blank will be included with sample coolers containing VOC samples.

5.3 Method for Collecting Samples for Nonvolatile Organic or Inorganic Compound Analyses

The requirements for collecting samples of subsurface soil for nonvolatile organic or inorganic analyses are as follows:

1. Wear new, clean gloves while handling sample containers and sampling devices. Change out gloves at each sampling location, or each time a new sample is to be collected to avoid cross-contamination.
2. The non-VOC samples will be collected after VOCs; a separate sampler with acetate liner will likely be needed. Collect the sample from a 6-inch section from the appropriate interval within the acetate sleeve – in a section of staining, odor, or PID response, or at the target depth per the FSP Addendum. Before sampling, quickly screen the length of the acetate liner for VOCs and radioactivity (SSFL SOPs 6 and 7).
3. Using a decontaminated stainless steel or plastic spoon or trowel, scoop soil from the acetate liner (from the 6-inch target interval) into the required glass sample jars.
4. Wipe the sample containers with a clean paper towel or Kimwipe to remove any residual soil from the sample container surface.
5. Fill out the sample label with the appropriate sample information (e.g., sample identification, date/time of sample collection, requested analyses per FSP Addendum Table 1, and attach to sample jar(s).
6. Place sample containers in individual zip-top plastic bags and seal the bags. Place baggies onto ice in an insulated cooler to maintain at 4°C ($\pm 2^\circ\text{C}$) until samples are delivered to the FTL or sample coordinator (per SSFL SOP10) for sample packing and shipment (per SSFL SOP 11) to the designated analytical laboratory.
7. Decontaminate all non-disposable sampling equipment in accordance with SSFL SOP 12.

5.4 Method for Surface Soil Collection by Direct Push Technology

Collection of surface soil samples with the Direct Push Technology (DPT) is allowed when hard soil conditions prevent collection via slide hammer. The following text contains the recommended procedure for sampling

Follow steps 1 thru 7 under SOP 4 paragraph 5.0 (Procedures) prior to sampling.

Assembly

1. Assemble the sampling device (sampler) as follows:
 - Screw the cutting shoe to the bottom end of the sampler, unless using standard probe drive sampler which has a built-in cutting edge.
 - Screw the piston tip onto the piston rod.
 - Screw the drive head onto the top end of the sampler.
 - Insert a stainless steel sleeve (5 $\frac{3}{4}$ inches x 1 $\frac{3}{4}$ inches each) into the sampler.
 - Slide the piston rod into the sample tube, leaving the piston tip sticking out of the bottom end of the sampler.
 - Screw the piston stop-pin onto the top end of the piston rod in a counter-clockwise direction.

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Probing

3. Thread the drive cap onto the top of the probe rod and advance the sampler.
4. Advance the sampler using the hydraulic hammer 6-inches into the surface to collect the sample and retrieve the sampler (step 5).

Stop-Pin Removal

5. Move the probe unit back from the top of the probe rods and remove the drive cap.
6. Lower the extension rods into the inside diameter of the probe rods using extension rod couplers to join the extension rods.
7. Attach the extension rod handle to the top extension rod and rotate the handle clockwise until the leading extension rod is screwed into the piston stop-pin. Continue to rotate the handle clockwise until the stop-pin disengages from the drive head.
8. Remove the extension rods and attached piston stop-pin from the probe rods.
9. Disassemble the sampler. Remove the stainless steel sleeve representing the surface sample.
10. The Site Health and Safety Technician will perform contaminant screening at the top and bottom of the stainless steel sleeve using hand-held instruments (SSFL SOPs 6 and 7). The breathing zone and extracted materials will be monitored continuously. If levels are detected above health and safety plan action levels (HASP page 8), work will be temporarily discontinued, the DOE, Boeing, and DTSC will be contacted. Site work will not resume at that location until further guidance is provided by DOE or Boeing. Contact information is in the health and safety plan.
11. If the PID indicates elevated VOCs or there is staining or discoloration evident, immediately collect VOC/1,4-dioxane and total petroleum hydrocarbons-gasoline range organics (TPH-GRO) samples from the bottom of the stainless steel sleeve using EnCore samplers per SOP 2, Section 5.2.2
12. If there is no indication of contamination, collect the required number of Encore samplers for TPH-GRO analysis (if required by Table 1 of the FSP Addendum), immediately cap both ends of the stainless steel ring with Teflon and caps. Label the top and bottom of the sample.
13. Wipe the capped sleeve with a clean Kimwipe or paper towel.
14. Fill out the sample label with the appropriate sample information (e.g., sample identification, date/time of sample collection, requested analyses per Table 1 of FSP Addendum) and attach to sample container.
15. Place sample containers in zip-top plastic bags and seal the bags. Place samples in a cooler with ice to maintain a temperature of 4°C ($\pm 2^\circ\text{C}$). Store samples at 4°C ($\pm 2^\circ\text{C}$) until samples are delivered to the FTL or sample coordinator (per SSFL SOP 10) for sample packing and shipment (per SSFL SOP 11) to the designated analytical laboratory
16. Repeat surface sampling process with steps 1 through 4 if additional volume is needed at the location to address the analytical requirement per Table 1 of the FSP Addendum. Move the sample tool entry point 6 inches away from initial sample point and collect the next sample. Repeat steps 5 through 15 to retrieve and process the sample.

Proceed with additional subsurface sample depth collection per Paragraph 5.1 above as required by the FSP Addendum.

17. When sampling is complete, place cuttings back into the borehole and top off with bentonite pellets, as necessary, to bring former borehole to ground surface. Place plastic sheeting and gloves in garbage bag and transfer decontamination water to storage container as specified in SSFL SOP 13.

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18. Decontaminate the sampling equipment according to SSFL SOP 12.
19. Complete the field logbook entry (SSFL SOP 8), field sample data sheet for each sample, and lithologic log (SSFL SOP 9), being sure to record all relevant information before leaving the sample location.
20. Demobilize from sample location.

6.0 Restrictions/Limitations

Before conducting the DPT sampling event, underground utilities and structures must be demarcated on the ground surface. In addition, archeological and cultural resources as well as Native American cultural concerns must be cleared. A subcontractor will be used to locate and mark the utility lines. The selected sampling location shall be a safe distance from the demarcated utility. In some cases, records regarding utility locations may not exist. In any event, a good practice is to slowly push the probe rods the first few feet (rather than hammering) to ensure that no utilities, underground storage tanks, or other subsurface structures are present.

Also, when grab sampling for VOC analysis or for analysis of any other compound(s) that may be degraded by aeration, it is necessary to minimize sample disturbance and analyte loss. The representativeness of a VOC grab sample is difficult to determine because the collected sample represents a single point, is not homogenized, and has been disturbed.

7.0 References

Geoprobe® Systems. 1991. *The Probe-Drive Soil Sampling System*. September.