Region 4
U.S. Environmental Protection Agency
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OPERATING PROCEDURE

Title: **Soil Gas Sampling**

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Revision History

The top row of this table shows the most recent changes to this controlled document. For previous revision history information, archived versions of this document are maintained by the SESD Document Control Coordinator on the SESD local area network (LAN).

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SESDPROC-307-R3, *Soil Gas Sampling*, replaces SESDPROC-307-R2 **General:** Corrected any typographical, grammatical, and/or editorial errors. Throughout the document mention of quality system or SESD quality system was replaced with Field Branches Quality System or FBQS. **Cover Page:** Changed the Author from Tim Slagle to TBD. Changed the Enforcement and Investigations Branch Chief from Archie Lee to Acting Chief John Deatrick. Changed the FQM from Liza Montalvo to Bobby Lewis. **Revision History:** Changes were made to reflect the current practice of only including the most recent changes in the revision history.	May 14, 2014
SESDPROC-307-R2, *Soil Gas Sampling*, replaces SESDPROC-307-R1	September 8, 2010
SESDPROC-307-R1, *Soil Gas Sampling*, replaces SESDPROC-307-R0	November 1, 2007
SESDPROC-307-R0, Soil Gas Sampling, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when collecting soil gas samples for field screening or laboratory analysis.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling soil gas samples in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another procedure must be used to obtain a soil gas sample, the variant procedure will be documented in the field log book, along with a description of the circumstances requiring its use. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD Local Area Network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

Geoprobe® Systems Tools and Equipment Catalog, Kejr Engineering, Inc., Salinas, Kansas, 1997.

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

SESD Operating Procedure for Control of Records, SESDPROC-002, Most Recent Version

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-104, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

SESD Operating Procedure for Packaging, Marking, Labeling and Shipping of Environmental and Waste Samples, SESDPROC-209, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management, SESDPROC-005, Most Recent Version

The Yellow Field Book©, Kejr Engineering, Inc., Salinas, Kansas, 2000.

US EPA. 1999. Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS); Center for Environmental Research Information, Office of Research and Development, Cincinnati, OH; EPA/625/R-96/010b

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version

US EPA. April 13, 1981. Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples. Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273)

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

Geoprobe Systems, Direct Push Installation of Devices for Active Soil Gas Sampling & Monitoring, Technical Bulletin No. MK3098, Prepared May, 2006.

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting soil gas samples. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines should be used to complement the judgment of an experienced professional.

Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting soil gas samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.
- Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) and/or International Air Transportation Association (IATA) hazardous materials shipping requirements.
- Documentation of field sampling is done in a bound logbook.
- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader and stored in a secure place.

2 Special Sampling Considerations

2.1 Special Considerations for Sampling

The tubing used as part of either of the described sampling systems should be Teflon® or stainless steel. As most soil gas sampling will be conducted to investigate the presence or extent of organic compounds, Teflon® tubing is required to ensure the integrity of the sample.

2.2 Special Precautions for Soil Gas Sampling

- A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should be changed any time during sample collection when their cleanliness is compromised.
- If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.
- Use O-rings on all tooling, adapters and probe rods to ensure that the entire sampling train is air-tight. This is necessary to prevent soil ingress during installation and to maintain sample integrity by ensuring that no ambient air is introduced into the sample during collection.
- When using the Post-Run Tubing (PRT) sampling system, excavate a small depression around the rods after driving the distance of the intended open interval. Fill the depression with bentonite crumbles (not pellets) and hydrate with tap water to ensure sealing at the ground surface. Special care should be taken to keep the rod string aligned with the push axis of the probe machine.

2.3 Sample Handling Requirements

1. Soil gas samples will typically be collected by directly filling evacuated, specially-prepared stainless steel canisters (SUMMA or SilcoSteel® canisters), after sample delivery line purging.

2. The canister will be labeled and identified according to SESD Operating Procedure for Packaging, Marking, Labeling and Shipping of Environmental and Waste Samples (SESDPROC-209).

2.4 Quality Control

Quality control sampling for soil gas sampling investigations will consist of collection of the following types of samples, as appropriate.

- Control Sample: If applicable to the study or investigation, a control sample should be collected from a location not affected by the possible contaminants of concern and submitted with the other samples.
- Field Blank: A canister field blank, prepared prior to the investigation by ASB personnel, should also be submitted with the sample set during the investigation.
- Equipment rinsate blank: Equipment rinsate blanks should be collected if equipment, such as PRT adapters, probe rod or other sampling equipment is field cleaned and re-used to document that low-level contaminants were not introduced into the sample by the decontaminated equipment.
- Field Split: Field split samples, at a minimum frequency of one for every twenty samples, should be collected. Split samples are collected by attaching the center leg of a Swagelok® "T" to the end of the sample tubing. The remaining legs of the "T" are connected to two sample containers which are opened and filled simultaneously.

2.5 Records

Information generated or obtained by SESD personnel will be organized and accounted for in accordance with SESD records management procedures found in the SESD Operating Procedure for Control of Records (SESDPROC-002). Field notes, recorded in a bound field logbook, will be generated, as well as chain-of-custody documentation according to the procedures found in SESD Operating Procedure Logbooks (SESDPROC-010) and SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005).

3 Geoprobe® PRT System Installation

3.1 General

Single event or grab sampling may be conducted using the Post-Run Tubing System (PRT). Using this system, soil gas samples can be collected quickly and with a high degree of assurance that the samples are representative of the targeted depth, i.e., using this method, there is no leakage at probe rod joints that will compromise the integrity of the sample.

The downhole components of the PRT system include:

- Sample delivery tubing
- Probe rods
- PRT Adapter
- Expendable point holder
- Expendable point

O-ring seals are used on the PRT Adapter, the expendable point holder and at all rod joints. The O-rings prevent soil ingress which can prevent air-tight docking of the PRT adapter.

3.2 PRT System Installation Procedures

The following procedures are used to collect soil gas samples using the Geoprobe® PRT system. The PRT system is available for 1.0-inch, 1.25-inch and 1.5-inch diameter probe rod. In SESD practice, 1.25-inch rods are used. All parts or accessories used in the PRT system must be selected with the appropriate diameter probe rod in mind to ensure compatibility of all components.

1. Place O-ring on PRT expendable point holder and attach to initial section of probe rod.

2. Place O-ring on expendable point and press into expendable point holder.

3. Add drive cap to probe rod and push PRT system into ground the distance of the intended open-interval. Take special care to assure that the rods are in line with the push axis of the probe machine. Dig a small depression around the rod string. Fill the depression with bentonite crumbles (not pellets) and hydrate with tap water.

4. At the desired sampling depth, attach a point popper to an extension rod and insert extension rod string into rods so that the point popper rests on the expendable

point. Using the rod puller, and taking special care to maintain probe alignment with the rods, begin pulling the rods while maintaining pressure on the extension rods. The extension rods should drop when the pull is started, indicating that the expendable point has been ejected. The rods can then be pulled to expose the desired open sampling interval.

5. Using a properly decontaminated water level sounder, check, if conditions warrant, to make sure groundwater is not present prior to proceeding with Step 6.

6. Secure the PRT adapter to a length of tubing sufficient to reach from the sampling interval to the surface, with several feet of excess tubing extending beyond the top of the probe rod to facilitate sampling. The adapter is secured tightly to the tubing using electrical tape. This will not compromise the integrity of the sample to be collected, as the sample is pulled directly through the adapter and is never exposed to the tape.

7. Run the tubing and adapter into the probe rod and, using steady downward pressure, turn the tubing counter-clockwise to dock the adapter into the top of the expendable point holder. Tug gently on the tubing to ensure that the adapter engaged with the expendable point holder. Continue rotating tubing until the adapter is firmly seated. Failure to dock could indicate that soil intruded during the push or that the expendable point was lost during the push.

8. At this point, the PRT system has been installed and is ready for sampling. If the sample can not be collected immediately, the end of the tubing should be capped with a stainless steel Swagelok® cap. Sampling is conducted using one of the procedures described in Section 5, Sampling PRT and Permanent Soil Gas Installations

3.3 Decommissioning PRT Sample Locations

Because it is impractical to pump grout through the PRT adapter on the lead probe rod, the entire string of rod must be removed before decommissioning can commence. The following methods are available, depending on conditions related to sample depth and post-removal probe hole wall stability:

1. **Direct Placement of Pellets or Grout** - If the sampling depth was fairly shallow, on the order of ten feet or less, grouting/sealing the open hole can be accomplished by directly placing bentonite pellets, hydrated in lifts or pouring a 30% solids bentonite grout mixture from the surface. The acceptable maximum depth for this option is somewhat dependent on the stability of the hole and these methods may be used at slightly greater depths if the holes do not collapse after removal of the rod.

2. **Re-entry Grouting** - For locations where sampling was conducted at somewhat greater depths or where the surficial formations tend to collapse, the only viable option for grout placement may be to re-probe the entire depth with an expendable point. After reaching the original sample depth, the expendable point is ejected and the hole is grouted by directly injecting grout through the inside of the rod string, as it is removed. Use of this option is dependent on the relative degree of hole stability.

4 Geoprobe® Permanent Soil Gas Implant Installation

4.1 General

Long-term soil gas sampling may be conducted using permanent soil gas sampling implants installed with the Geoprobe®. Stainless steel implants may be installed at any depth achievable by the Geoprobe® and may be installed using 1.0-inch, 1.25-inch or 1.5-inch diameter probe rod. In SESD practice, 1.25-inch probe rods are used. The implants may be installed in custom lengths, configured using a wide assortment of available implant lengths and connections. The implant screens are double-woven stainless steel mesh with 0.0057-inch (0.15 mm) pore openings.

Permanent soil gas sampling implants may also be installed using 2.125-inch diameter rods utilizing an advancing thin-walled corer to facilitate placement of the implant (see Geoprobe Systems, Direct Push Installation of Devices for Active Soil Gas Sampling & Monitoring, Technical Bulletin No. MK3098 for details of this application).

4.2 Installation of Permanent Soil Gas Sampling Implants (Typical)

The following procedures are used by to install a permanent soil gas sampling implant using the Geoprobe®. These are the general procedures which are used with 1.25-inch diameter probe rod.

1. Attach O-ring to implant point anchor.

2. Press implant point anchor into point holder and attach to first section of probe rod.

3. Push implant point anchor to the desired depth for implant installation. Using O-rings on all rod joints will prevent soil intrusion.

4. When the desired depth has been reached, attach the implant to the sample delivery tubing. This is accomplished by loosening or removing the Swagelok® fitting and pressing the tubing into the implant. When the end of the tubing is sufficiently engaged in the end of the implant, the Swagelok® fitting is tightened to secure the tubing in the implant. The Swagelok® tightening recommendation is 1 and ¼ turns after finger-tightening. It is critical that the tubing be securely attached to the implant so that it does not pull off during subsequent steps of the installation.

5. Feed the tubing into the probe rod until the implant reaches the implant point anchor. At this point, cut the tubing to allow enough tubing to remain for sampling, usually three to four feet.

6. Rotate the tubing and implant counter-clockwise, threading the implant into the anchor. If there was any soil intrusion during the push, the implant may not dock. If the implant does not dock, it is possible to salvage the installation by removing the implant and sealing the small hole on the bottom of the implant, if present, with foil or with a small sheet metal screw, then returning the implant to the hole.

7. After the implant has been docked, use a pull cap and pull the probe rod approximately one foot, exposing the implant. Observe the tubing to make sure that anchor remained in place and is not being pulled with the rod.

8. If the implant remained in place, slowly pour a measured amount of 60-100 mesh glass beads down the inside of the probe rod. The glass beads are used as a filter pack around the implant. The implant should be covered with beads to approximately six inches above the top of the implant. The volume of beads should be calculated based on the length of implant used. While pouring the beads, it is advisable to gently shake the tubing to prevent the beads from bridging inside the probe rod.

9. After placing the beads, the implant is sealed using a flowable mixture of the glass beads and fine-powdered bentonite. To accomplish this, two to three feet of rod is pulled and the mixture is slowly poured into the rod above the bead-packed implant. As with the bead placement, similar care should be taken to avoid bridging of this mixture. After placement of the bead/bentonite seal, hydrate by pouring one gallon of de-ionized water above the seal.

10. After placement and hydration of the seal, the rod string is removed and the resultant annular space is grouted using one of the following procedures, which are dependent on the depth and stability of the open hole.

    a. If the resultant open hole is shallow (ten feet or less) and the hole walls are stable, the hole may either be filled with bentonite pellets, hydrated in lifts or grouted using a 30% solids bentonite grout, poured from the surface.

    b. If the hole is deeper than ten to fifteen feet, better results may be obtained by using a tremie pipe to place a pumpable grout. ½-inch PVC tremie pipe or Geoprobe nylon grout tubing is threaded down the annulus to the top of the bead/bentonite seal. The tremie is pulled off the bottom to prevent jetting out the seal and grout is pumped until the annulus is filled. Procedures are similar to those for well annular seals described in SESDGUID-101, Section 2.3.5.

11. For permanent or long-term installations the tubing should be protected by an appropriate surface completion, such as a flush vault or well protective casing, similar to well protective casings, as described in SESDGUID-101. The finish

should be performed after 24 hours of grout curing.

12. After installation is complete the soil gas implant is sampled using one of the methods described in Section 5, Sampling PRT and Permanent Soil Gas Installations.

5 Sampling PRT and Permanent Soil Gas Installations

Soil gas samples may be collected from PRT and permanent soil gas implant installations using one of several methods, listed below. Canister sampling is the most common method utilized by SESD.

- Canister Sampling for Laboratory Analysis – After installation is complete and immediately prior to sampling, a flow-limiting device, consisting of a sintered stainless steel filter and a critical orifice, is attached at the sampling end of the tubing. After the device is connected to the Teflon® tubing, it is necessary to remove all stagnant or ambient air from the sample string. This volume, equal to approximately three times the volume of the sample string, should be estimated or calculated and attention must be given to not over-purging the estimated or calculated volume of the tubing and sample interval prior to sampling. Line purging can be accomplished using a low-flow pump, such as a personal air sampling pump, or a TVA1000.

  After all stagnant/ambient air has been removed, the purging pump is removed and an evacuated canister is attached using a Swagelok® or other suitable secure connection. After connection, the valve on the canister is opened, pulling soil gas from the implant into the canister. Typically the sample is collected over a one-hour period, at which time the canister valve is closed and the canister tagged with pertinent sampling information. Alternatively, in some situations a mass-flow controller will be required to collect a sample over a specified, longer period of time period. This type of sampler is typically out-fitted with a gauge that will display the canister vacuum during the sampling period. When using this type of device, it is advisable to check the canister vacuum throughout the sampling period to verify filling Gauge pressure/vacuum reading should be recorded in the project logbook.

- Real-time Field Analytical Methods – Real-time analytical measurements may be obtained from PRT or soil gas implant installations using appropriate instrumentation. The soil gas to be analyzed may be drawn directly into the instrument by the instrument pump or the instrument may be placed in line and the sample drawn into the instrument using a suitable pump connected to the discharge side of the instrument. Results may be qualitative, such as those obtained with flame ionization or photoionization detectors, or they may be quantitative, for instruments which can be calibrated to specific compounds.