SOIL GAS SAMPLING

CONTENTS

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* These sections are affected by Revision 0.0

SOIL GAS SAMPLING

1.0 SCOPE AND APPLICATION

Soil gas monitoring provides a quick means of detecting volatile organic compounds (VOCs) in the soil subsurface. Using this method, underground VOC contamination can be identified, and the source, extent, and movement of pollutants can be traced.

This standard operating procedure (SOP) outlines the methods used for the installation of soil gas wells; the collection of soil gas using Tedlar bags, sorbent tubes, and/or Summa canisters; and measurement of organic vapor levels in the soil gas using a Photo Ionization Detector (PID), Flame Ionization Detector (FID) and/or other air monitoring devices.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute United States Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

A d-inch (")diameter hole is driven into the ground using manual (i.e., slam bar) or power driven mechanical (i.e., Geoprobe) methods. Soil gas can be sampled at specific depths by controlled penetration and/or the use of a longer bar or bar attachments. A ¼"outer diameter (O.D.) stainless steel probe is inserted into the hole. The hole is sealed around the top of the probe using clean modeling clay. The gas contained in the interstitial spaces of the soil is pulled through the probe using an air sampling pump. The sample may be stored in Tedlar bags, drawn through sorbent cartridges, or analyzed directly using a field portable instrument such as a PID. An air sampling pump is not used for Summa canister sampling of soil gas; sampling is achieved by soil gas equilibration with the evacuated Summa canister.

Power driven mechanical devices may be used to make holes when conditions make the use of manual devices unfeasible (i.e., frozen ground, very dense clays, pavement, etc.). Commercially available soil gas sampling probes (hollow, ½" O.D. steel probes) can be driven to the desired depth using a power hammer (e.g., demolition hammer or Geoprobe). Soil gas samples can be drawn through the probe itself, or through Teflon tubing inserted through the probe and attached to the probe point. Samples are collected and analyzed as described below.

Other field air monitoring devices, such as the Combustible Gas Indicator (CGI) and the Organic Vapor Analyzer (OVA), can also be used, depending on specific site conditions. Measurement of soil temperature using a temperature probe may also be desirable. Bagged samples may be analyzed in a field laboratory using portable gas chromatography (GC) instrumentation, or shipped to a laboratory using an overnight service.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Tedlar Bags

Soil gas samples are generally collected in 1.0-liter (L) Tedlar bags. Bagged samples should be stored in the dark (i.e., in opaque containers) and protected from mechanical damage during transit

to the laboratory. Further, bagged samples should be maintained at ambient temperature by placing them in coolers and out of direct sunlight. Samples should be analyzed as soon as possible, preferably within 24 to 48 hours following sample collection. Refer to ERT/SERAS SOP# 2102, *Tedlar Bag Sampling*, for additional information.

3.2 Sorbent Tubes

Soil gas can be drawn directly onto sorbent tubes (i.e., Tenax tubes) and analyzed by Gas Chromatography/Mass Spectrometer (GC/MS) methodologies. Bagged samples can also be drawn onto tubes. If sorbent tubes are to be used, special care must be taken to avoid contamination. Refer to ERT/SERAS SOP# 2104, *Tenax/CMS Tube Sampling*, for additional information. Samples should be refrigerated at 4 ^{o}C during storage and analyzed within 30 days of collection. Samples taken on multi-sorbent tubes should be analyzed as soon as possible after sampling.

3.3 Summa Canisters

The Summa canisters used for soil gas sampling have a 6-L sample capacity and are certified clean by GC/MS analysis before being used in the field. After sampling is completed, they are stored and shipped in travel cases. Most volatile organic compounds (VOCs) can be recovered from canisters with minimal loss up to thirty days. Refer to ERT/SERAS SOP# 1704, *Summa Canister Sampling*, for additional information.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 PID Measurements

A number of factors specific to soil gas can affect the response of a PID (e.g., HNu PI 101). High humidity can cause lamp fogging and decreased sensitivity. This can occur when soil moisture levels are high, or when a soil gas probe is in the saturated zone. High concentrations of methane can cause a downscale deflection of the meter. High and low temperature, electrical fields, FM radio transmission, and naturally occurring compounds, such as terpene hydrocarbons in wooded areas, will affect instrument response. Refer to ERT/SERAS SOP# 2114, *Photoionization Detector (PID) HNu* for additional information.

4.2 FID Measurements

A number of factors specific to soil gas can affect the response of an FID (e.g., OVA Model 128). High humidity can cause the FID to flame out or not ignite at all. This can be significant when soil moisture levels are high, or when a soil gas probe is in the saturated zone. The FID can only read organic based compounds (they must contain carbon in the molecular structure). The FID also responds poorly to hydrocarbons and halogenated hydrocarbons (such as gasoline, propane fuel). High and low temperature, electrical fields and FM radio transmission will also affect instrument response. Consult the instrument manual for additional information.

4.3 Factors Affecting the Concentrations of Organic Compounds in Soil Gas

Concentrations of organic compounds in soil gas can be affected by the physical and chemical characteristics of the soil and by soil moisture. Organic molecules can be tightly adsorbed to the

surface of chemically active soil particles, such as clays, thus reducing the concentration in the soil interstitial spaces. Similarly, some organic compounds can be dissolved in the soil water or associated with soil organic components (i.e., humic acids).

Soil porosity and permeability will affect the movement of soil gas and the recharge rate of the soil gas well. The movement of organic vapors through fine textured soil may be very slow, thus limiting the sample volume available and the use of this technique. Existing information and soil surveys prepared by the Soil Conservation Service should be consulted prior to planning and designing a soil gas survey.

The presence of a high, or perched water table, or of an impermeable underlying layer (such as a clay lens or layer of buried slag) may interfere with the movement and sampling of the soil gas. Knowledge of site geology is useful in such situations, and can prevent inaccurate sampling.

4.4 Soil Probe Clogging

A common problem with the soil gas sampling is clogging of the probe. A clogged probe can be identified by using an in-line vacuum gauge or by listening for the sound of the pump laboring. This problem can usually be eliminated by using a wire cable to clear the probe (see Section 7.1.3.).

4.5 Underground Utilities

Prior to selecting sample locations, an underground utility search must be completed. The local utility companies can be contacted and requested to mark the locations of their underground lines. Each sample location should also be screened with a metal detector or magnetometer to verify that no underground metallic or ferro-magnetic pipes or drums are present.

5.0 EQUIPMENT/APPARATUS

5.1 Slam Bar Method

- Slam bar
- Soil gas probes: stainless steel tubing, 1/4" O.D., 5-foot (ft) length
- Flexible wire or cable
- "Quick Connect" fittings
- Modeling clay.
- Vacuum box
- Pumps, capable of drawing approximately 3.0 L/min
- ¼" Teflon tubing, 2-ft to 3-ft lengths
- ¼" Tygon tubing
- Tedlar bags, 1.0-L
- Sample documentation (soil gas sample labels, field data sheets, logbook, etc.)
- PID/FID, or other field air monitoring devices
- Cooler(s)
- Metal detector or magnetometer
- Portable GC instrument
- Summa canisters (plus shipping cases)

- Large dark plastic bags

5.2 Power Hammer Method

- Power (Demolition) hammer
- ½" O.D. steel probes, extensions, and points
- Dedicated aluminum sampling points
- ¼" Teflon tubing, 2-ft to 3-ft lengths
- "Quick Connect" fittings
- Modeling clay.
- Vacuum box
- Pumps, capable of drawing approximately 3.0 L/min
- ¼" Tygon tubing
- Tedlar bags, 1.0-L
- Sample documentation (soil gas sample labels, field data sheets, logbook, etc.)
- PID/FID or other field air monitoring devices
- Cooler(s)
- Metal detector or magnetometer
- Portable GC instrument
- Summa canisters (plus shipping cases)
- Generator w/extension cords.
- High lift jack assembly
- Large dark plastic bags

5.3 Direct-Push (Geoprobe) Method

- Tubing; polyethylene, Teflon, or stainless steel
- Gas sampling cap
- robe rods
- Tubing adaptor(s)
- Expendable point holder, threaded
- Expendable drive point(s)
- O-rings for expendable point holder
- O-rings for adaptor
- O-rings for probe rods
- O-rings for gas sampling cap
- Vacuum pumps
- Tape
- Tedlar bags, 1.0-L
- Summa canisters (plus shipping cases)
- Sample documentation (soil gas labels, field data sheets, logbook, etc.)
- Metal detector or magnetometer
- Cooler(s)
- Large dark plastic bags
- Portable GC instrument

6.0 REAGENTS

- Calibration and spike gases
- Deionized, organic-free water
- Methanol, High Performance Liquid Chromatography (HPLC) grade
- Ultra-zero grade compressed air
- Propane torch

7.0 PROCEDURES

7.1 Soil Gas Probe Installation

7.1.1 Slam Bar Method

1. A hole slightly deeper than the desired sampling depth is made. For sampling up to 5 feet, a 5-ft single piston slam bar is used. For deeper depths, a piston slam bar with threaded 4-ft-long extensions is used.

2. The tip of the rod is placed on the ground and the piston of the slam bar is used to drive the rod to the desired depth. The number of blows required to reach the desired depth is recorded.

3. After the hole is made, the slam bar is carefully withdrawn to prevent the collapse of the walls.

4. The soil gas probe is carefully inserted into the hole. To prevent plugging of the probe, a decontaminated metal wire or cable, slightly longer than the probe and with an O.D. slightly less than the inner diameter (I.D.) of the rod, is inserted in the probe rod; 1- to 2-inches of wire should protrude from the end of the probe. The probe is inserted to full depth of the hole, then pulled up three to six inches. The probe is cleared by moving the cable up and down several times.

5. The top of the sample hole is sealed at the surface to prevent infiltration of ambient air. A golf-ball size lump of clean modeling clay is kneaded until it becomes soft. The clay is carefully molded around the probe at the soil surface to seal the space between the probe and the hole.

6. If semi-permanent soil gas installations are required, the probe remains in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.1.2 Power Hammer Method

1. A power hammer may be used to make holes when the soil is very hard, frozen or fine textured (clay), or when soil gas from beneath pavement or concrete is collected.

2. A power hammer is used to drive the probe to the desired depth (up to 12 feet may be attained with extensions). Threaded extensions are added until the desire depth is needed.

3. After the hole is made, the threaded rod is carefully withdrawn. This should be done

in such a manner to prevent collapse of the walls. If necessary, a jack assembly may be used to retrieve the rods.

4. The soil gas probe is installed in the hole as described in Section 7.1.1, Steps 4 and 5.

5. If semi-permanent soil gas installations are required, the probe remains in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.1.3 Direct-Push Method

1. Direct-push sampling technology refers to soil gas samplers that are inserted into the ground without the use of slam bars, demolition hammers, or drilling rigs. The U.S. EPA/ERT utilizes a Direct-Push unit mounted on an all-terrain track mounted vehicle, and direct push tools. These tools are able to collect samples at depths greater than 50 feet, depending on soil conditions.

2. Sampling probes, consisting of 3-foot sections of flush-threaded, 1¼-inch hardened steel alloy steel rod tipped by an expendable steel point, are driven into the ground to the target depth. The probe tools are withdrawn to release the expendable tip and allow soil gas to flow into the tool's tubing.

3. To ensure a representative soil gas sample, a discrete volume of gas is purged to rid the tubing of atmospheric air and allow the subsurface soil gas to enter the probe tubing. The volume of gas removed is determined by the volume of tubing employed in the probe. (Unlike groundwater sampling, purging of a soil gas probe is designed to remove only the ambient air within the tubing.)

4. After allowing the system to return to atmospheric pressure, an aliquot of soil gas is withdrawn from the probe. Duplicate samples are collected as necessary and required.

5. If semi-permanent soil gas installations are required, the probe remains in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.2 Screening with Field Instruments

1. It is recommended that any appropriate SOPs and the manufacturers' manuals be consulted for the correct use and calibration of all instrumentation. Pumps should be calibrated prior to use in the field.

2. An amount of air, equivalent to the volume of the soil gas well must be calculated prior to sampling. Connect a vacuum pump to the sample probe using a section of Teflon tubing. The pump is turned on and adjusted to a flow rate of 3.0 L/minute. The calculated volume of air is evacuated from the hole by pulling a vacuum through the probe for the specified length of time. Longer time is required for sample wells of greater depths.

3. After evacuation, a monitoring instrument (i.e. HNu or OVA) is connected to the probe using a Teflon connector. Upon stabilization, the reading is recorded on soil gas data sheets.

4. Readings may be above or below the range set on the field instruments. The range may be reset, or the response recorded as a greater than or less than figure. The recharge rate of the well with soil gas must be considered when resampling at a different range setting.

7.3 Tedlar Bag Sampling

1. Follow step 1 of section 7.2 to evacuate well volume. If air monitoring instrument screening was performed prior to sample collection, evacuation is not necessary.

2. Use the vacuum box and sampling train (Figure 1) to collect the sample. The sampling train is designed to minimize the introduction or loss of contaminants due to adsorption and other factors. All parts used are either Teflon or stainless steel, and a vacuum is drawn indirectly to avoid contamination from sample pumps.

3. Place the Tedlar bag inside the vacuum box, attach it to the sampling port and open the valve. The sample probe is attached to the sampling port via Teflon tubing and a "Quick Connect" fitting.

4. Draw a vacuum around the outside of the bag, using a pump connected to the vacuum box evacuation port, via Tygon tubing and a "Quick Connect" fitting. The negative pressure inside the box causes the bag to inflate, drawing the sample into the bag.

5. Break the vacuum by removing the Tygon line from the pump. Remove the bagged sample from the box and close the valve. Record the date, time, sample location ID, and the PID/FID instrument reading(s) on sample bag label and on data sheets or in logbooks.

6. Bags should not be labeled directly with a marker or pen (particularly those containing volatile solvents) nor should adhesive labels be affixed directly to the bags. Inks and adhesive may diffuse through the bag material and contaminate the sample. Labels should be tied to the metal eyelets provided on the bags.

Chain of custody sheets must accompany all samples.

7.4 Sorbent Tube Sampling

Samples collected in Tedlar bags may be adsorbed onto sorbent tubes for further analysis by GC/MS.

7.4.1 Additional Apparatus

- Syringe, with a Luer-lock tip, capable of drawing a soil gas or air sample from a Tedlar bag onto a sorbent tube. The syringe capacity is dependent upon the volume of sample being drawn onto the tube.

- Adapters, for fitting the sorbent tube between the Tedlar bag and the sampling syringe. The adapter attaching the Tedlar bag to the sorbent tube consists of a reducing union (¼" to 1/16" O.D. - Swagelok cat. # SS-400-6-ILV or equivalent) and a length of ¼" O.D. Teflon tubing, which replaces the nut on the 1/16" (Tedlar bag) side. A ¼" I.D. Teflon or silicone O-ring replaces the ferrules in the nut on the

¼" (sorbent tube) side of the union.

- The adapter, attaching the sampling syringe to the sorbent tube, consists of a reducing union (¼" to 1/16" O.D. - Swagelok Cat. # SS-400-6-ILV or equivalent) and a ¼" I.D. Teflon or silicone O-ring, which replaces the ferrules in the nut on the ¼" (sorbent tube) side and the needle of a Luer-lock syringe inserted into the 1/16" side (held in place with a 1/16" ferrule). The Luer-lock end of the needle can be attached to the sampling syringe. It is useful to have a Luer-lock on/off valve situated between the syringe and the needle.

- Two-stage glass sampling cartridge (¼" O.D. x c" I.D. x 5c") contained in a flame-sealed tube containing two sorbent sections retained by glass wool:

- Teflon-capped culture tubes or stainless steel tube containers for sorbent tube storage and shipping. These containers should be conditioned by baking at 120^{o} C for at least two hours. The culture tubes should contain a glass wool plug to prevent sorbent tube breakage during transport. Reconditioning of the containers should occur between uses or after extended periods of disuse (i.e., two weeks or more).

- Nylon gloves or lint-free cloth. (Hewlett Packard Part # 8650-0030 or equivalent.)

7.4.2 Sample Collection

- Handle sorbent tubes with care, using nylon gloves (or other lint-free material) to avoid contamination.

- Immediately before sampling, break one end of the sealed tube and remove the sorbent cartridge.

- Connect the valve on the Tedlar bag to the sorbent tube adapter. If using a Tenax/CMS sorbent tube, connect the sorbent tube to the sorbent tube adapter with the Tenax (white granular) side of the tube facing the Tedlar bag. Connect the sampling syringe assembly to the carbon molecular sieve [CMS (black)] side of the sorbent tube. Fittings on the adapters should be finger-tight. Open the valve on the Tedlar bag. Open the on/off valve of the sampling syringe. Depending on work plan stipulations, at least 10% of the soil gas samples analyzed by field screening methods must be submitted for confirmation GC/MS analysis (according to a modified TO-17method for sorbent tubes). Each soil gas sample must be absorbed on replicate sorbent tubes. The volume adsorbed on a sorbent tube is dependent on the total concentration of the compounds measured by field screening methods as follows:

Total Concentration (ppm)	Sample Volume (mL)
>10	Use Serial Dilution
10	10-50
5	20-100
1	100-250

- After sampling, remove the tube from the sampling train with gloves or a clean

cloth. DO NOT LABEL OR WRITE ON THE SORBENT TUBE.

- Place the sorbent tube in a conditioned stainless steel tube holder or culture tube. Culture tube caps should be sealed with Teflon tape.
- Each sample tube container (not tube) must be labeled with the site name, sample number, date sampled, and volume sampled. Verify that all sample containers are properly labeled.
- Chain of custody sheets must accompany all samples to the laboratory.

7.5 Summa Canister Sampling

1. Follow Section 7.2, step 1, to evacuate well volume. If PID/FID readings were taken prior to taking a sample, evacuation is not necessary.
2. Attach a certified clean, evacuated 6-L Summa canister via the ¼" Teflon tubing.
3. Open valve on Summa canister. The soil gas sample is drawn into the canister by pressure equilibration. The approximate sampling time for a 6-L canister is 20 minutes.
4. Sample number, sample location, date collected and work assignment number must be recorded on a chain of custody form and on a blank tag attached to the canister.
5. Chain of custody sheets must accompany all samples to the laboratory.

8.0 CALCULATIONS

8.1 Field Screening Instruments

Instrument readings are usually read directly from the meter. In some cases, the background level at the soil gas location may be subtracted:

Final Reading = Sample Reading - Background Reading

8.2 Field Portable GC Analysis

Calculations used to determine concentrations of individual components by field portable GC analysis are beyond the scope of this SOP and are covered ERT/SERAS SOP #2109, *Photovac GC Analysis for Soil, Water and Air/Soil Gas*.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

9.1 Sample Sorbent Tubes

Before field use, a quality assurance (QA) check must be performed on each batch of sorbent tubes by thermal desorption/cryogenic trapping GC/MS. These tubes are prepared and cleaned in accordance with EPA Method EMSL/RTP-SOP-EMD-013 by the vendor. Prior to purchasing a lot of tubes from a vendor, ten tubes from the lot are sent to the SERAS laboratory where the tubes

are tested for cleanliness, precision and reproducibility.

Sample tubes should be stored out of ultraviolet (UV) light (i.e., sunlight) and kept on ice until analysis. Samples should be collected in duplicate, whenever possible.

9.2 Sample Probe Contamination

Sample probe contamination is checked between each sample by drawing ambient air through the probe using a vacuum pump (e.g., Gilian pump) and checking the response of the FID/PID. If readings are higher than background, replacement or decontamination is necessary.

Sample probes may be decontaminated simply by drawing ambient air through the probe until the HNu reading is at background. Contamination can also be removed by decontaminating with methanol and deionized water, then air drying. For persistent contamination, use of a portable propane torch may be needed. Using a pair of pliers to hold the probe, run the torch up and down the length of the sample probe for approximately 1-2 minutes. Let the probe cool before handling. When using this method, make sure to wear gloves to prevent burns. Having more than one probe per sample team will reduce lag times between sample stations while probes are decontaminated.

9.3 Sample Train Contamination

The Teflon line forming the sample train from the probe to the Tedlar bag should be changed on a daily basis. If visible contamination (soil or water) is drawn into the sampling train, it must be changed immediately. When sampling in highly contaminated areas, the sampling train should be purged with ambient air, via a vacuum pump (e.g., Gilian pump), for approximately 30 seconds between each sample. After purging, the sampling train can be checked using an FID or PID, or other field monitoring device, to establish the cleanliness of the Teflon line.

9.4 FID/PID Calibration

The FID and PID must be calibrated at least once a day using the appropriate calibration gases.

9.5 Trip Blanks

A trip blank detects any sample contamination during shipping and storage. With the exception of Summa canisters, the trip blank is prepared and added to the site samples after sampling has been completed and prior to shipment.

9.5.1 Tedlar Bags

Each cooler containing Tedlar bag samples must contain one Tedlar bag of ultra-zero grade air, acting as a trip blank, when samples are shipped to an outside laboratory. A chain of custody record must accompany each cooler of samples and should include the blank that is dedicated to that group of samples.

9.5.2 Sorbent Tubes

At least one trip blank per cooler must be submitted with the sorbent tube samples. The ends of the sorbent tube are broken but no air is drawn through the tube.

9.5.3 Summa Canisters

Canister trip blanks are evacuated containers that are shipped to and from the site with the canisters used for air sampling.

9.6 Field Blanks

A field blank detects sample contamination during the handling and shipping process. The field blank must be associated with an actual sampling event.

9.6.1 Tedlar Bags

For each day of sampling, a Tedlar bag is filled with ultra-zero air at the beginning of the day. The field blank is handled in the same manner as the samples.

9.6.2 Sorbent Tubes

For each day of sampling, a field blank must be submitted for sorbent tubes. The ends of the sorbent tube are broken at the beginning of the day but no air is drawn through the tube.

9.7 Trip Standards

If Tedlar bags are used for sampling, each cooler containing samples should contain a Tedlar bag of standard gas to calibrate the analytical instruments (Photovac GC, etc.). This trip standard will be used to determine any changes in concentrations of the target compounds during the course of the sampling day (e.g., migration through the sample bag, degradation, or adsorption). A fresh trip standard must be provided and placed in each cooler pending additional sample collection. A chain of custody record must accompany each cooler of samples and should include the trip standard that is dedicated to that group of samples.

9.8 Lot Blanks

9.8.1 Tedlar Bags

Prior to use, one bag is removed from each lot of Tedlar bags to be used for sampling and checked for possible contamination as follows: Fill the test bag with ultra-zero grade air; withdraw a sample from the bag and analyze using a field portable GC or any other applicable field instrument used for sample analysis. This procedure will ensure sample container cleanliness prior to the start of the sampling effort.

9.8.2 Summa Canister Check

From each lot of four cleaned Summa canisters, one is used for a GC/MS certification check. If the canister passes certification, it is re-evacuated and all four canisters from that lot are available for sampling. If the chosen canister is contaminated, the entire lot of four Summa canisters must be re-cleaned, and a single canister is re-analyzed by GC/MS for certification.

9.8.3 Sorbent Tubes

Provide a minimum of one sorbent tube per sampling event. Do not break the ends of the tube.

9.9 Options

9.9.1 Duplicate Samples

A minimum of 5% of all samples should be collected in duplicate (i.e., if a total of 100 samples are to be collected, five samples should be collected in duplicate). In choosing which samples to duplicate, the following criteria applies: if, after filling the first Tedlar bag and evacuating the well for 15 seconds, the second HNu reading (or other field monitoring device being used) matches or is close to (within 20%) the first reading, a duplicate sample may be taken.

9.9.2 Spikes

A Tedlar bag spike and sorbent tube spike may be desirable in situations where high concentrations of contaminants other than the target compounds are found to exist (landfills, etc.). The additional level of QA/QC attained by this practice can be useful in determining the effects of interferences caused by these non-target compounds. Summa canisters containing samples are not spiked.

10.0 DATA VALIDATION

10.1 Blanks

For each target compound, the concentration found in the sample must be greater than three times the level (for that compound) found in the appropriate blank (lot, field, and trip) that accompanied that sample, to be considered valid.

11.0 HEALTH AND SAFETY

Because the sample is being drawn from underground, and no contamination is introduced into the breathing zone, soil gas sampling usually occurs in Level D. Nevertheless, ambient air should be constantly monitored using the HNu P101 to obtain background and breathing zone readings during the sampling procedure. As long as the levels in ambient air do not rise above background, no upgrade of the level of protection is needed.

When conducting soil gas sampling, appropriate personal protective equipment [PPE (leather gloves, steel-toed shoes, Tyvek safety suit)] should be worn, and proper slam bar techniques should be implemented Also, an underground utility search must be performed prior to sampling (See Section 4.5).

12.0 REFERENCES

Gilian Instrument Corp. 1983. *Instruction Manual for Hi Flow Sampler: HFS113, HFS 113 T, HFS 113U, HFS 113 UT.*

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New Jersey Department of Environmental Protection. 1992. *Field Sampling Procedures Manual*.

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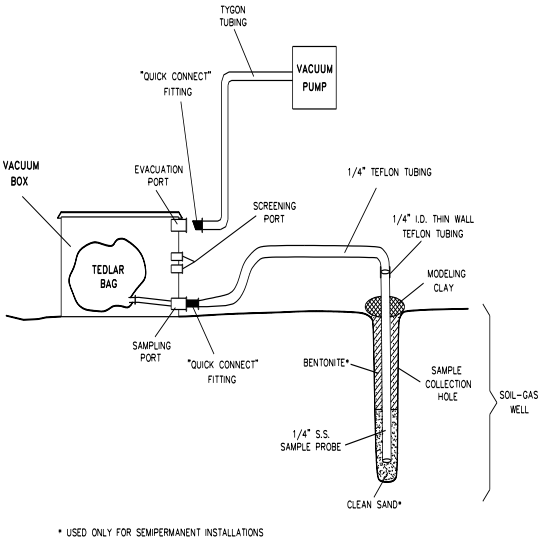
13.0 APPENDICES

A - Figures
B - HNu Field Procedure

APPENDIX A
Figure
SOP # 2042
April 2001

FIGURE 1. Sampling Train Schematic



APPENDIX B

HNu Field Procedure
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April 2001

HNu Field Procedure

The following sections detail the procedures that are to be followed when using the HNu in the field.

Startup Procedure

a. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug in; don't force the probe cord.

b. Turn the function switch to the battery check position. The needle on the meter should read within or above the green battery area on the scale. If not, recharge the battery. If the red indicator light comes on, the battery needs recharging.

c. Turn the function switch to any range setting. Look into the end of the probe for no more than two to three seconds to see if the lamp is on. If it is on, it will give a purple glow. Do not stare into the probe any longer than three seconds. Long term exposure to UV light can damage eyes. Also, listen for the hum of the fan motor.

d. To ZERO the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed for this instrument. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 to 20 seconds to ensure that the zero reading is stable. If necessary, readjust the instrument to zero.

Operational Check

a. Follow the start-up procedure.

b. With the instrument set on the 0-20 ppm range, hold a solvent-based magic marker near the probe tip. If the meter deflects upscale, the instrument is working.

Field Calibration Procedure

a. Follow the start-up procedure and the operational check.

b. Set the function switch to the range setting for the concentration of the calibration gas.

c. Attach a regulator to a disposable cylinder of isobutylene gas. Connect the regulator to the probe of the HNu with a piece of clean Tygon tubing. Turn on the regulator valve.

d. After fifteen seconds, adjust the span dial until the meter reading equals the concentration of the calibration gas used. Be careful to unlock the span dial before adjusting it. If the span has to be set below 3.0, calibrate the instrument internally or return to equipment maintenance for repair.

e. Record in the field logbook: the instrument ID no. (EPA decal or serial number if the instrument is a rental); the initial and final span settings; the date and time; concentration and type of calibration gas used; and the name of the person who calibrated the instrument.

Operation

a. Follow the start-up procedure, operational check, and calibration check.

b. Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0-20 ppm range. Adjust it if necessary.

c. While taking care not to permit the HNu to be exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the site specific Health and Safety Plan.

d. When the activity is completed or at the end of the day, carefully clean the outside of the HNu with a damp disposable towel to remove any visible dirt. Return the HNu to a secure area and place on charge.

e. With the exception of the probe's inlet and exhaust, the HNu can be wrapped in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside in the event of precipitation.