HELIUM LEAK TESTING OF INSTALLED SOIL GAS VAPOR PROBES

CONTENTS

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HELIUM LEAK TESTING OF INSTALLED SOIL GAS VAPOR PROBES

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) outlines the procedure to conduct a leak check of installed soil gas vapor probes using helium gas. A leak check is used to ensure the integrity of a sub-slab or sub-surface soil gas probe by determining if ambient air is being drawn into the soil gas sample during collection. The procedures outlined in this SOP are intended for use by all personnel conducting soil gas vapor probe sampling using Tedlar® bag or passivated canister sampling methods. Refer to SOP #ERT-PROC-2102, *Tedlar® Bag Sampling* and SOP #ERT-PROC-1704, *Passivated Canister Sampling*. Sub-slab vapor probes described herein are installed according to SOP #ERT-PROC-2082, *Construction and Installation of Permanent Sub-Slab Soil Gas Vapor Probes.*

A Quality Assurance Project Plan (QAPP) in Uniform Federal Policy (UFP) format describing the project objectives must be prepared prior to deploying for a sampling event. The sampler needs to ensure the methods used are adequate to satisfy the data quality objectives (DQOs).

The procedures in this SOP may be varied or changed as required, dependent on site conditions, equipment limitations or other procedural limitations. In all instances, the procedures employed must be documented on a Field Change Form and attached to the QAPP. These changes must be documented in the final deliverable.

2.0 DESCRIPTION

To check the integrity of installed soil gas vapor probes, a shroud, with three or more apertures, such as fittings, cord grips or grommets, is placed over the probe, sealed, and filled with helium gas. The openings allow introduction of helium gas, detection of the gas concentration with a handheld instrument and collection of a soil gas vapor sample utilizing a Tedlar® bag. To adequately cover the soil gas vapor probes being tested, the shrouds may be constructed of varied materials and be of many sizes, dependent on the type and installation method of the probes.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

This section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

- The sub-slab soil gas vapor probe may be installed through a concrete slab, hard packed dirt, or other surfaces. The probe should be installed in an area where the surface to be drilled through is smooth and level.

- If the surface surrounding the probe is uneven or of a rough texture, the shroud may not seal properly. This may prevent the desired concentration of helium gas from being achieved beneath the shroud and deplete the quantity of gas on hand before all probes can be tested. Additional compressible rubber gaskets, or other materials such as clay, may be required to create an effective seal to prevent the loss of the helium gas.

- The location where the sub-slab soil gas vapor probe is installed should be of sufficient distance from any wall, column, or other structural member to allow correct placement of the leak check shroud. Shrouds of different diameters and fitting placement may be needed to enable all installed probes to be leak checked. The type of shroud required to perform the leak check should be determined during the probe installation. Measurements and photographs of the installed probe location can be used to determine the type of shroud required.

- A shroud with tubing attached may tip, breaking the seal between the shroud and the surface surrounding the probe. It may be necessary to hold the shroud down to the surface by hand or place weight on the top of the shroud to keep the seal intact.

- Leak checks may need to be performed on sub-surface soil gas vapor probes. There may be a grouping of probes, which are installed to different depths below ground. This type of installation may require shrouds of various diameters, height, and fitting placement. The base of the shroud may be below the surface. The base may need to be surrounded by soil, sand, or clay to create a seal. The type of shroud required, and the type and quantity of material needed to create an effective seal should be determined during the installation of the probes. A large shroud will require an increase in the quantity of helium gas needed and some helium loss may still occur. The quantity of gas that may be needed for the leak check process should be determined during the installation of the probes. Measurements and photographs of the installed probe locations can be used to determine the type of shroud required.

- High relative humidity (RH) levels greater than or equal to (≥) 50% may affect accuracy and sensitivity of the helium probe. In these cases, the moisture cartridge filter may only last a few hours.

5.0 EQUIPMENT/APPARATUS

A combination of the following items may be used, according to site requirements.

- Polyvinyl chloride (PVC) pipe (Length and diameter of pipe varies according to need)
- PVC pipe coupling (Same diameter as the pipe being used)
- PVC adapter (Same diameter as the pipe being used)
- PVC plug (Size to match the adapter required)
- PVC pipe bushing (Same diameter as the pipe being used)
- PVC pipe cap (Same diameter as the pipe being used)
- Plastic bucket (Size varies according to need)
- Bowl (Stainless steel or plastic. Size varies according to need)
- Swagelok® ¼ inch (") bulkhead fitting. Stainless steel or Teflon®
- Cord grip. Size PG-9
- Rubber O-rings 7/16" and 5/8" inside diameter (ID)
- Rubber grommets 7/16" hole diameter 1/4” ID
- Teflon® tubing, 1/4" outside diameter (OD)
- Tubing cap, 1/4" ID
- Teflon® 1/4" nuts and ferrules
- Silicone tubing, 3/16" ID
- Compressible rubber gasket material. 12" x 12" sheets x 1/8" thickness
- Caulking cord
- Modeling clay
- Bentonite
- Tedlar® bag
- Vacuum box
- Vacuum pump
- Dielectric MGD-2002 Multi Gas Leak Detector® or equivalent.
- Helium gas cylinder, containing Standard or Ultra High Purity grade.
- Helium gas cylinder regulator
- Cordless drill with 3/8" chuck

- Multi-diameter step drill bit
- 1/4" high speed drill bit
- Razor knife
- Scissors
- (2) 9/16" open end wrenches
- (2) 5/8" open end wrenches
- (2) small adjustable wrenches
- Ground Penetrating Radar (GPR)

6.0 REAGENTS

This section is not applicable to this SOP.

7.0 PROCEDURES

7.1 General Procedures

To test a sub-slab soil gas vapor probe installed using the procedure outlined in SOP #ERT-PROC-2082, a compressible rubber gasket or other sealing material, such as clay, is placed on the surface surrounding the probe or on the bottom edge of the shroud. The gasket or other material must completely contact the bottom edge of the shroud and the surface surrounding the sub-slab vapor probe. The seal created allows a concentration of helium gas to collect beneath the shroud. Other types of sub-slab probes may be tested in the same manner. If testing near slab soil gas probes or probes not installed through a slab, the shroud may also be sealed by encasing its base in soil, sand, or clay.

A continuous length of Teflon® sample tubing is attached to the vapor probe and passed through one fitting, cord grip or grommet on the shroud. If multiple vapor probes are covered by the shroud, additional fittings, cord grips or grommets may be installed on the shroud to accommodate additional lengths of sample tubing. This will allow consecutive sampling of all the probes at a specific location without removing the shroud. The other end of the sample tubing is inserted into a vacuum box and attached to a Tedlar® bag. A pump evacuates air from the vacuum box, using the pressure differential to pull air out of the probe and into the Tedlar® bag without exchange of outside air. Refer to SOP #ERT-PROC-2102 for the full sampling procedure.

Another fitting, cord grip or grommet provides for the connection of a tank containing helium gas to the shroud. One end of a length of sample tubing is connected to the helium tank regulator and the opposite end of the sample tubing is connected to the shroud. The remaining fitting, cord grip or grommet provides for the connection of a helium detection instrument to the shroud. One end of a length of sample tubing is connected to the instrument and the opposite end of the sample tubing is connected to the shroud. A continuous flow of helium gas is introduced into the shroud until 30-90% percent (%) is achieved as registered on the detection instrument. Do not pressurize the shroud. A soil gas sample is drawn from the vapor probe into the Tedlar® bag. Once the sample is obtained, the sample bag is attached to the detection instrument and analyzed for helium gas concentration.

If a concentration of helium ≥ 5% of the concentration in the shroud is detected in the sample bag, then the soil gas vapor probe may be leaking. The leak may be caused by improper installation of the probe or a loose connection on the sample tubing beneath the shroud. Corrective action must be taken before a valid sample can be obtained. If a concentration of helium less than (<) 5% of the concentration in the shroud is detected in the sample bag, then the soil gas vapor probe is considered

free of leaks and the integrity of the sample is not compromised.

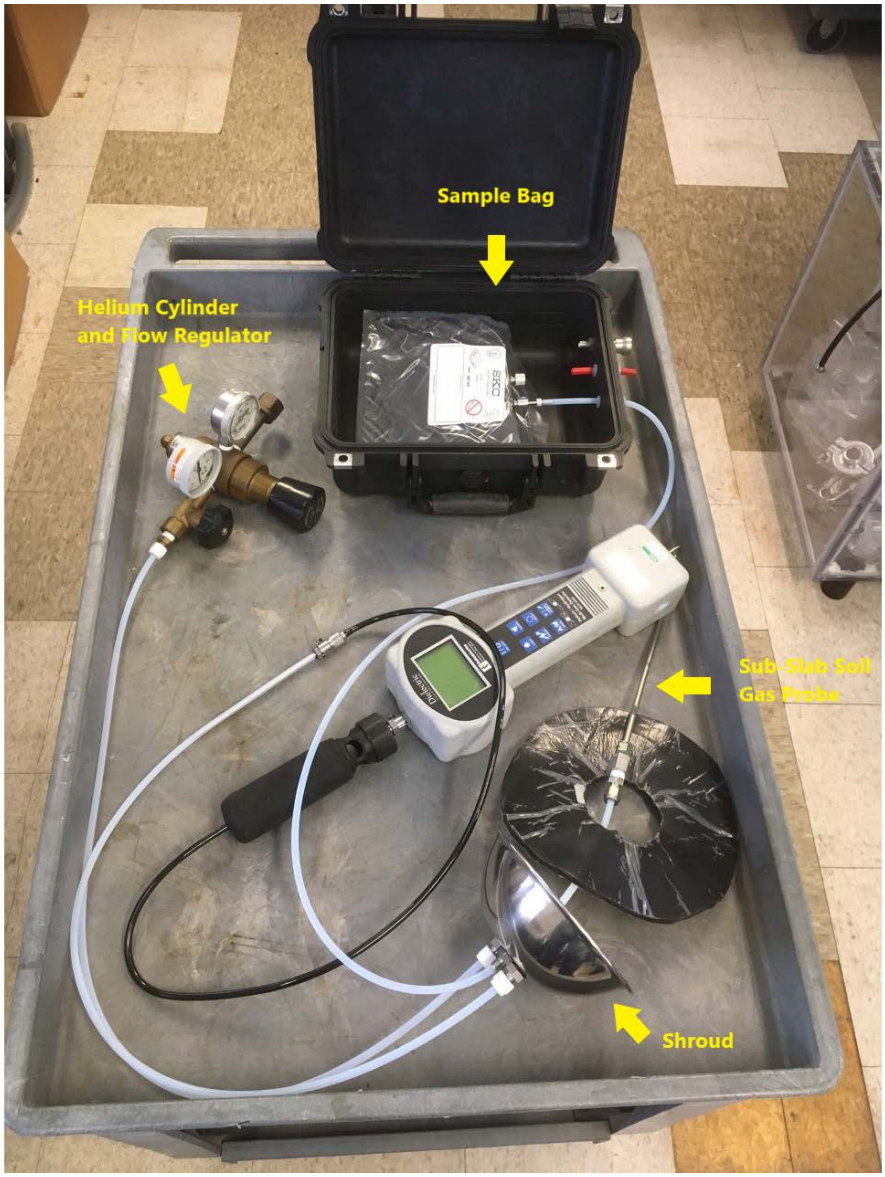

Figure 1. Helium leak testing apparatus with bowl shroud.

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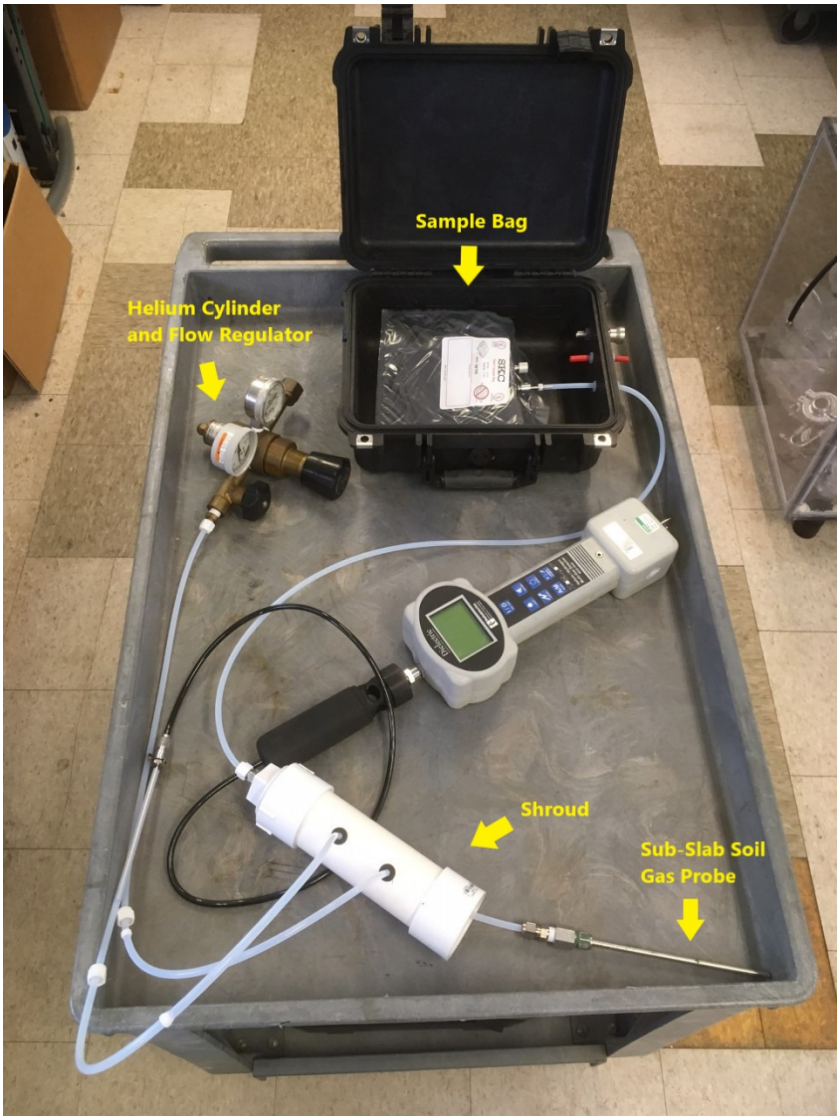

Figure 2. Helium leak testing apparatus with PVC pipe shroud.

7.2 Shroud Assembly with 1/4" Swagelok® Bulkhead Fittings

- Select a bowl, bucket, or PVC pipe for use as the shroud.
- If a length of PVC pipe is selected, install a PVC pipe cap or plug on one end.
- When using a bucket or bowl, drill a minimum of three 7/16" diameter holes through the bottom. Additional holes may be drilled through the bottom to sample multiple probes covered by a single shroud.

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Figure 3. PVC pipes, bowls, and fittings for use as shroud.

- When using a length of PVC pipe with a cap or plug, drill one 7/16" diameter hole through the center of the cap or plug and two 7/16" diameter holes through the side of the pipe. Additional holes may be drilled through the cap or plug to sample multiple probes covered by a single shroud. The diameter of the cap or plug must be of sufficient size to allow the locking nut of each bulkhead fitting to be tightened flush to the surface.
- Each bulkhead fitting to be used for collection of the soil gas sample must be modified to allow one single length of 1/4" Teflon® tubing to be used. The modified bulkhead fitting allows the tubing attached to the sample probe to pass through the fitting on the shroud and directly into the vacuum box for the sample collection.

Figure 4. Tubing which connects sub-slab soil gas probe to sample bag in vacuum box.

- Run a 1/4" high-speed drill bit through the center of each bulkhead fitting to create clearance for the Teflon® tubing.
- Install a 1/4" Swagelok® bulkhead fitting in each hole drilled in the shroud. Place a rubber, 7/16" ID O-ring, on the interior and exterior surface of the shroud, over the drilled holes, to seal the fittings. Install the fitting and tighten the two locking nuts. Do not over tighten the nuts.

7.3 Shroud Assembly with Cord Grips or Grommets

- A PG-9 cord grip may be used in place of a bulkhead fitting. The cord grip requires a 5/8" diameter hole for installation.
- A 1/4" ID rubber grommet may be used in place of a bulkhead fitting. The grommet requires a 7/16" diameter hole for installation.
- Ensure there is sufficient distance between the holes, so the shoulder of the cord grips and the edge of the grommets do not overlap.
- Do not over tighten the cord grip-locking nut.

Figure 5. PVC pipe with grommets as shroud.

7.4 Shroud Placement on Sub-Slab Probes Using Compressible Gasket Material

- Select the gasket material. Ensure that the gasket is of sufficient size to extend beyond the entire edge of the shroud. Uneven or rough surfaces surrounding the probe may require additional gaskets to create an effective seal.
- Cut a 2" diameter hole in the gasket material. The hole must match the location of the vapor probe when the gasket is placed on the surface surrounding the probe.
- Attach one end of a length of 1/4" OD Teflon® tubing to the vapor probe. The opposite end of the tubing should be capped to avoid any exchange between the soil gas and ambient air. The tubing must be of sufficient length through the shroud to be inserted into the vacuum box and attached to the Tedlar® sample bag.
- Place the gasket on the surface surrounding the probe. The probe and attached tubing should be centered in the 2" diameter hole in the gasket. The gasket should cover no portion of the probe.
- Slide the shroud down to the gasket surrounding the probe, with the tubing passing through one bulkhead fitting, cord grip or grommet installed on the shroud. It may be necessary to remove the tubing cap to pass the tubing through. Replace the cap once the tubing extends outside the shroud.
- If a bulkhead fitting is used, push down on the shroud while tightening the 1/4" Swagelok® nut and ferrule on the fitting. This will hold the shroud in place on the tubing and against the gasket material.
- If a cord grip is used, push down on the shroud while tightening the cord grip nut. This will hold the shroud in place on the tubing and against the gasket material.
- With the shroud in contact with the gasket, ensure that the gasket extends beyond the entire edge of the shroud.

Figure 6. A compressible gasket or clay may be used as sealing material.

7.5 Shroud Placement on Sub-Slab Probes Using Other Sealing Material

- Select a sealing material such as clay or caulk.
- Apply the sealing material along the entire edge of the shroud. Ensure that the sealing material is of sufficient thickness so that it will compress evenly along the edge and fill uneven or rough sections of the surface where the seal is to be created.
- Attach one end of a length of 1/4" OD Teflon® tubing to the vapor probe. The opposite end of the tubing should be capped to avoid any exchange between the soil gas and ambient air. The tubing must be of sufficient length to be inserted into the vacuum box and attached to the Tedlar® sample bag.
- Slide the shroud down to the surface surrounding the probe, with the tubing passing through one fitting, cord grip or grommet installed on the shroud. It may be necessary to remove the tubing cap to pass the tubing through the shroud. Replace the cap once the tubing extends outside the shroud.
- With the shroud contacting the surface, press down on the shroud to ensure that the sealing material has compressed and spread evenly along the edge of the shroud. There should be no gaps between the edge of the shroud and the surface surrounding the probe.
- If a bulkhead fitting is used, push down on the shroud while tightening the 1/4" Swagelok® nut and ferrule on the fitting. This will hold the shroud in place on the tubing and the surface surrounding the probe.
- If a cord grip is used, push down on the shroud while tightening the cord grip nut. This will hold the shroud in place on the tubing and the surface surrounding the probe.

7.6 Shroud Placement on Sub-Surface Soil Gas Probes

- Select a sealing material such as clay or caulk.
- Apply the sealing material along the entire edge of the shroud. Ensure that the sealing material is of sufficient thickness so that it will compress evenly along the edge and fill uneven or rough sections of the surface where the seal is to be created.
- Attach one end of a length of 1/4" OD Teflon® tubing to the vapor probe. The opposite end of the tubing should be capped to avoid any exchange between the soil gas and ambient air. The tubing must be of sufficient length through the shroud to be inserted into the vacuum box and attached to the Tedlar® sample bag.
- Slide the shroud down to the surface surrounding the probe, with the tubing passing through one fitting, cord grip or grommet installed on the shroud. It may be necessary to remove the tubing cap to pass the tubing through. Replace the cap once the tubing extends outside the shroud.
- With the shroud contacting the surface, press down on the shroud to ensure that the sealing material has compressed and spread evenly along the edge of the shroud. There should be no gaps between the edge of the shroud and the surface surrounding the probe.
- If a bulkhead fitting is used, push down on the shroud while tightening the 1/4" Swagelok® nut and ferrule on the fitting. This will hold the shroud in place on the tubing and against the surface surrounding the probe.
- If a cord grip is used, push down on the shroud while tightening the cord grip nut. This will hold the shroud in place on the tubing and the surface surrounding the probe.
- The sealing material on the edge of the shroud alone may not create a proper seal on sub-surface probes. The surface surrounding the probe may consist of sand, gravel, or rocks. The base of the shroud may need to be encased in several inches of clay, sand, soil, or Bentonite to create an effective seal.

7.7 Connect Vapor Probe Tubing to the Tedlar® Bag

- Remove the cap from the end of the length of tubing that is attached to the vapor probe.
- Refer to SOP #ERT-PROC-2102 for the connection procedures.

7.8 Connect Tubing to the Helium Cylinder

- Attach one end of a length of 1/4" OD Teflon® tubing to the shroud and attach the opposite end of the tubing to the helium cylinder regulator.
- If a bulkhead fitting is used on the shroud, attach the tubing using a 1/4” Swagelok® nut and ferrule.
- If a cord grip is used on the shroud, ensure that the tubing extends a short distance inside the shroud prior to tightening the locking nut.
- If a grommet is used on the shroud, ensure that the tubing extends a short distance inside the shroud to prevent the tubing from slipping out of the grommet.
- Attach the tubing to the helium cylinder regulator using a 1/4" Swagelok® nut and ferrule.

7.9 Connect the Helium Detector Tubing to the Shroud

- Attach one end of a length of 1/4" OD Teflon® tubing to the shroud and cap the opposite end of the tubing. Do not connect the tubing to the helium detector.
- If a bulkhead fitting is used on the shroud, attach the tubing using a 1/4" Swagelok® nut and

ferrule.

- If a cord grip is used on the shroud, ensure that the tubing extends a short distance inside the shroud prior to tightening the locking nut.
- If a grommet is used on the shroud, ensure that the tubing extends a short distance inside the shroud to prevent the tubing from slipping out of the grommet.

7.10 Perform Helium Leak Test

7.10.1 Turn ON the Helium Detector

- Turn ON the detector by pressing the ON/OFF button. The detector will perform a power on test for approximately 60 seconds. Ensure the detector is not near the helium cylinder or previously used sample bags, which may contain helium.
- The detector liquid crystal display (LCD) will display the approaching zero symbol.
- The LCD will display “0” parts per million (PPM) after a zero point of reference is established. Refer to Appendix A for the MGD-2002 Multi Gas Leak Detector® instruction manual.
- Attach a short length of 3/16" ID silicone tubing to the end of the helium detector probe. The silicone tubing will connect the detector probe to the tubing attached to the shroud.

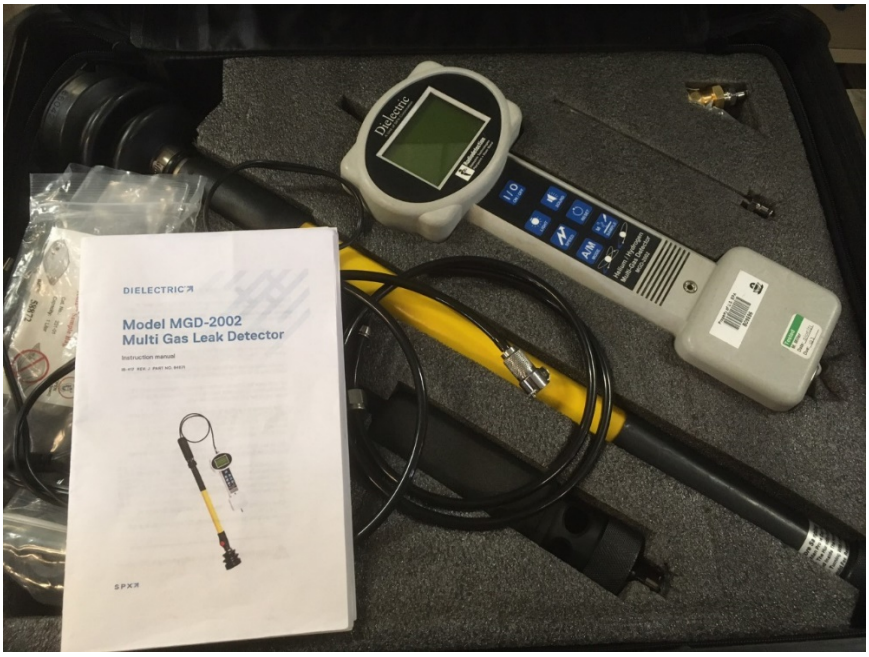

Figure 7. Helium Detector.

7.10.2 Open the Helium Cylinder and Connect the Helium Detector

- Once the helium detector has finished zeroing, turn the cylinder shut off valve counterclockwise to open the cylinder.
- Turn on the regulator shut-off valve to allow the helium gas to enter the shroud and

turn the outlet pressure adjustment knob to set the outlet pressure to 3-5 pounds per square inch (PSI), as indicated on the outlet pressure gauge.

- Uncap the 1/4" OD Teflon® tubing connected to the shroud and attach it to the detector using the short length of 3/16" ID silicone tubing.

7.10.3 Monitor the Helium Gas Concentration

- Observe the helium gas concentration on the detector's digital display screen and adjust the helium cylinder regulator as needed until a concentration of 30-90% is reached inside the shroud.
- Maintain the concentration while the bag sample is being collected.

7.10.4 Collect the Tedlar® Bag Sample

- While maintaining a minimum concentration of 30-90% helium gas inside the shroud, refer to SOP #ERT-PROC-2102 and collect the Tedlar® bag sample.

7.10.5 Analyze the Tedlar® Bag Sample

- After sample collection, turn the cylinder shut off valve clockwise to close the cylinder.
- Disconnect the helium detector from the tubing connected to the shroud. Cap the end of the tubing to prevent loss of gas from within the shroud.
- Allow the detector to sample ambient air until the concentration of helium reaches 0% as indicated on the instrument display.
- Remove the Tedlar® sample bag from the vacuum box and connect the bag to the helium detector using the short length of silicone tubing. Open the sample bag.
- If the detector displays a sample bag concentration of helium $\geq$ 5% of the concentration in the shroud, then the vapor probe may be leaking. The leak may be caused by improper installation of the probe or a loose connection on the sample tubing beneath the shroud. Corrective action must be taken and additional leak checks performed before a valid sample can be obtained.
- If the detector displays a sample bag concentration of helium <5% of the concentration in the shroud, the soil gas vapor probe may be sampled without corrective action.
- The initial sample bag may be analyzed, or subsequent samples may be taken from the same vapor probe using additional sample bags. Refer to SOP #ERT-PROC-1704 for sampling with passivated canisters.
- If additional vapor probes are beneath the shroud, the concentration of helium gas must be maintained throughout the sampling event. Additional sample tubing should be capped when not connected to the vacuum box, sample bag, helium detector or cylinder regulator to prevent loss of the gas.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

An additional collocated soil gas vapor probe may be installed with the frequency of 10% or as specified in the site-specific UFP-QAPP. The following general Quality Control (QC) procedures apply:

1. Draw a rough sketch of the area where the probe is installed with the major areas noted on the sketch. This information may be transferred to graphing software for incorporation into the final deliverable.
2. Take a digital photograph of the probe and the surrounding slab to document any pre-existing damage to the slab, such as cracks or water leaks.
3. Use a global positioning system (GPS) unit to document coordinates outside of a structure as a reference point.
4. Clean, inspect and test equipment used for the installation of sampling probes prior to deployment.

Specific QA/QC requirements are as follows:

1. Check the replaceable moisture cartridge filter frequently to maintain optimal filter performance.
2. Ensure that the battery is fully charged before use.
3. Perform the self-check and zeroing routine prior to use.
4. Ensure the helium concentration in the Tedlar bag is <5% of the concentration in the shroud. If the helium concentration is ≥ 5% of the concentration in the shroud, then corrective action must be taken before a valid sample can be obtained.
5. An annual factory recalibration is recommended if used on a frequent basis; otherwise, this can be extended to every two years.

10.0 DATA VALIDATION

Data verification (completeness checks) must be conducted to ensure that all data inputs are present for ensuring the availability of sufficient information. This may include but is not limited to sampling data sheets, chain of custody forms, logbooks, location information, GPS coordinates, digital photographs, and area sketches. These data are essential to providing an accurate and complete final deliverable. The contractor's Project Manager is responsible for completing the UFP-QAPP verification checklist for each project.

11.0 HEALTH AND SAFETY

Based on Occupational Safety and Health Administration (OSHA) requirements, a site-specific health and safety plan (HASP) must be prepared for response operations under the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard, 29 CFR 1910.120. Field personnel working for EPA's ERT should consult the Emergency Responder Health and Safety Manual currently located at https://response.epa.gov/_HealthSafetyManual/manual-index.htm for the development of the HASP, required PPE and respiratory protection.

Utilization of a GPR by a qualified operator to locate subsurface infrastructure is highly recommended.

12.0 REFERENCES

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U.S. EPA/ERT. SOP #ERT-PROC-2102, *Tedlar® Bag Sampling*, current version.

U.S. EPA/ERT. SOP #ERT-PROC-1704, *Passivated Canister Sampling*, current version.

13.0 APPENDICES

This section is not applicable to this SOP.