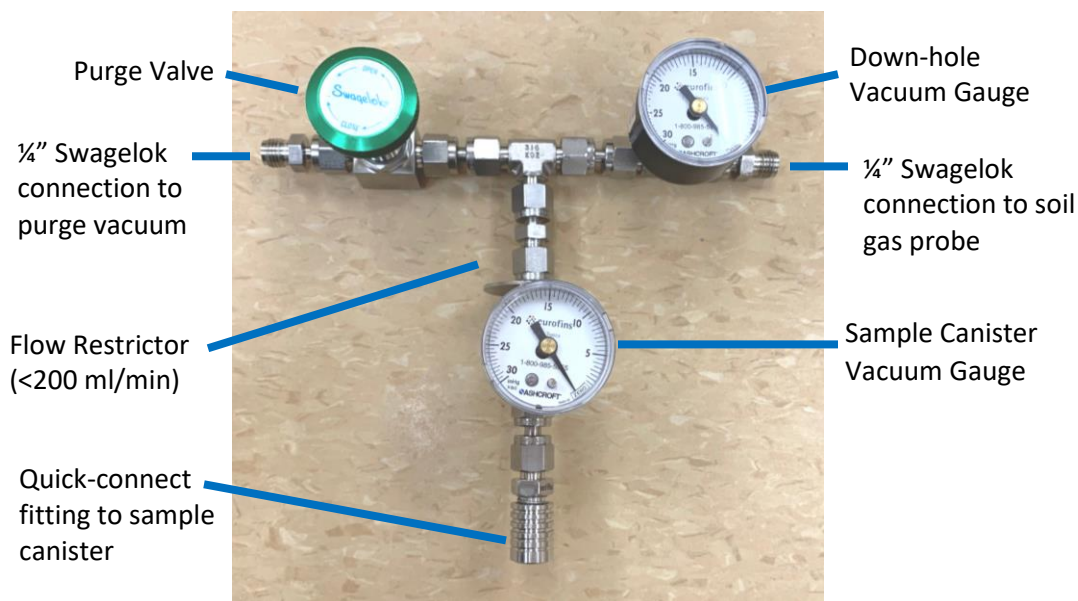


Eurofins Air Toxics Soil Gas Manifold Sampling Guide

The soil gas manifold (SGM) is designed to provide the field sampler with a simple way to:

- 1) Conduct a shut-in test to verify canister sampling train is free of leaks prior to collection;
- 2) Purge the soil gas probe to remove ambient air prior to sampling; and
- 3) Monitor the vacuum in the subsurface during purging and sample collection.

The components of the SGM provided by the lab are shown below:



The purge vacuum source attached to the SGM can be a:

- 6L evacuated canister equipped with a 150 ml/min flow controller/vacuum gauge assembly;
- Calibrated vacuum pump; or
- Syringe with a 3-way valve.

Recommended SGM procedures using each of these purge options are outlined in this guide.

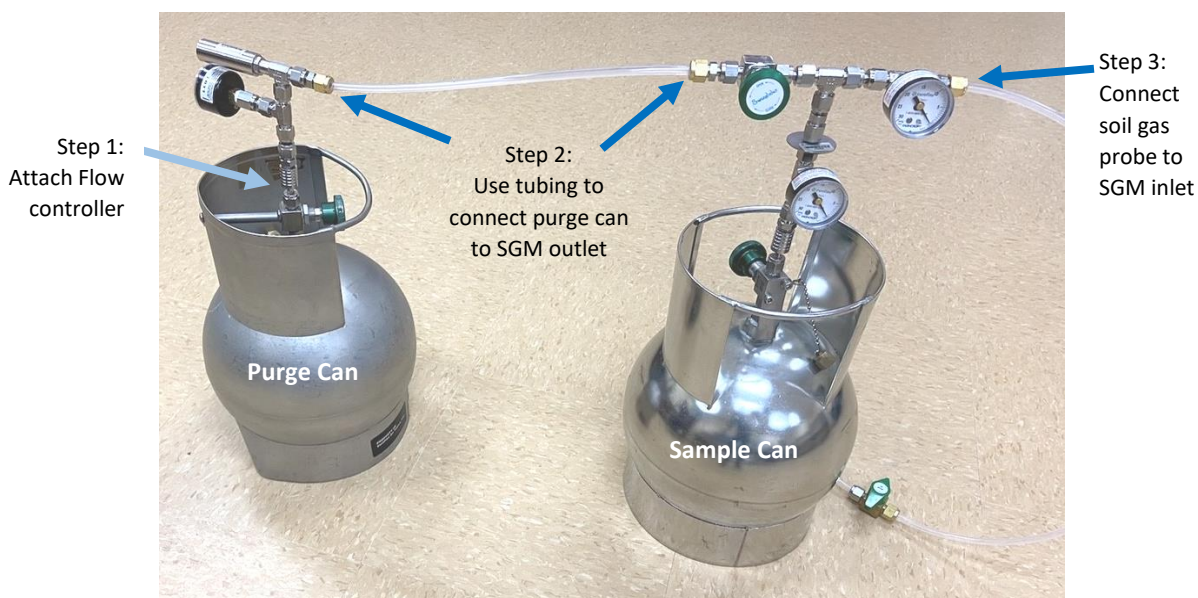
Additionally, sample collection procedures using the SGM and the dimensions of the SGM are described on pages 9 and 10 respectively. Please note that it is the user's responsibility to ensure the procedures used in the field for soil gas collection meet the applicable regulatory guidance and are appropriate for the site conditions.

SGM Sampling Procedures Using a 6L Purge Canister

Overview: The laboratory can provide a 6L evacuated canister equipped with a 150 mL/min flow restrictor and a rough vacuum gauge to attach to the SGM. A 6L purge canister is a convenient vacuum source to conduct the shut-in test and purge the lines and is best suited for sampling events with limited number of soil gas samples and total purge volume for each probe on the order of 1L or less. The total purge volume can easily be monitored by changes in the purge canister's vacuum. Recommendations on conducting the shut-in test and purging sample lines using the SGM coupled with a 6L purge canister are outlined below.

Assembly:

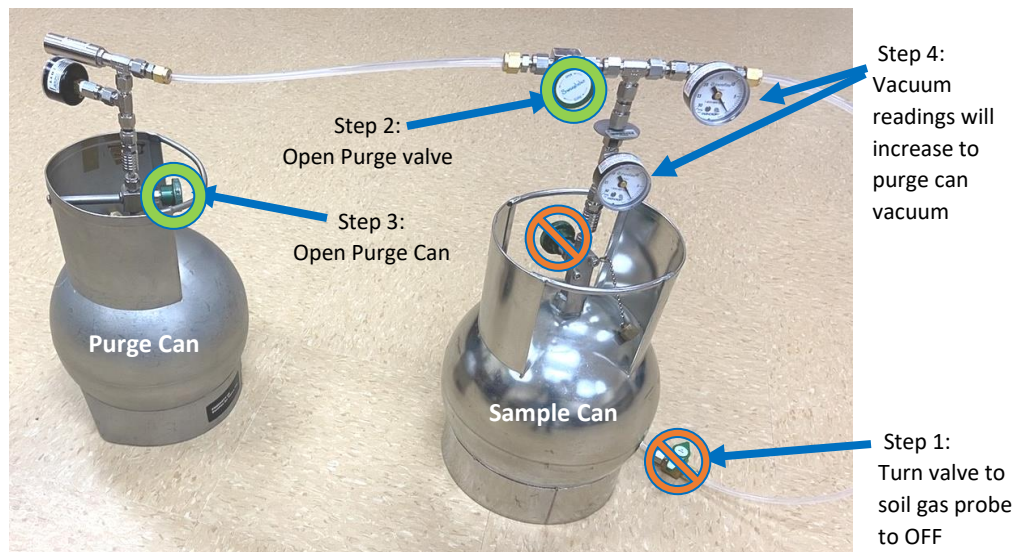
- 1) Prepare the purge canister by attaching the provided flow controller with the built-in vacuum gauge onto the purge canister using the quick connect fitting.
- 2) Attach the purge canister sampling inlet to the SGM outlet using a segment of $\frac{1}{4}$ " Teflon tubing with a Swagelok nut and ferrule on each end. Tighten each connection using a 9/16" wrench.
- 3) Connect the inlet of the SGM to the soil gas probe tubing. If using $\frac{1}{4}$ " Teflon tubing, use a $\frac{1}{4}$ " nut and ferrule and tighten using a 9/16" wrench.



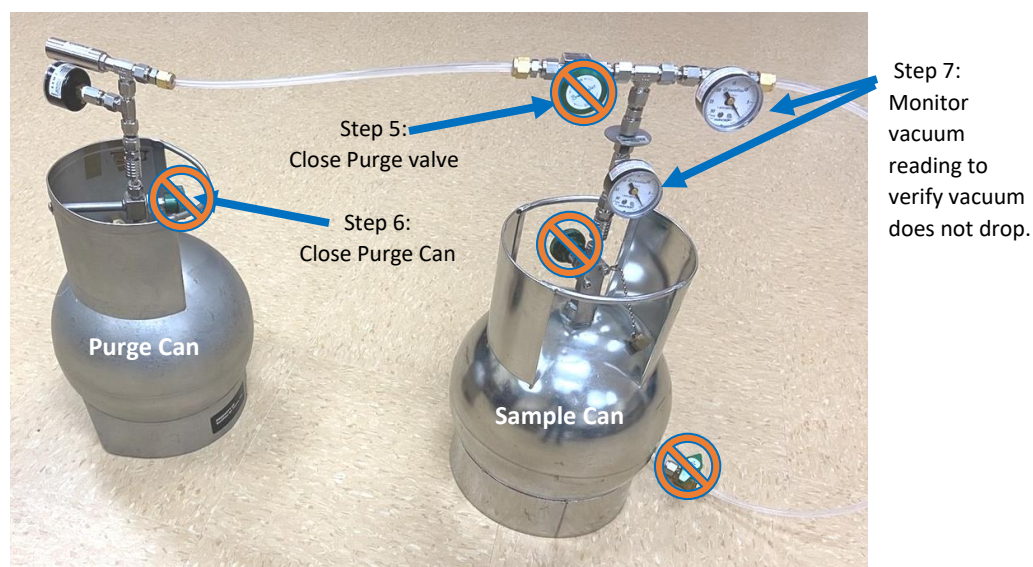
The 6L purge canister option is ideal for sampling events with small number of samples and total purge volumes < 1L.

Shut-in Test with Purge Canister:

- 1) To isolate the canister sampling train, turn the valve to the soil gas probe to the off position.
- 2) Open the SGM purge valve.
- 3) Open the purge can valve to initiate a vacuum on the system.
- 4) Both gauges on the SGM will show an increasing vacuum reading and equilibrate with the purge canister vacuum reading. For example, if the purge canister is at 20 in Hg, the two gauges on the SGM will increase in vacuum to approximately 20 in Hg. Note that the gauges on the equipment are rough gauges with expected accuracy of $\sim \pm 5$ in Hg.

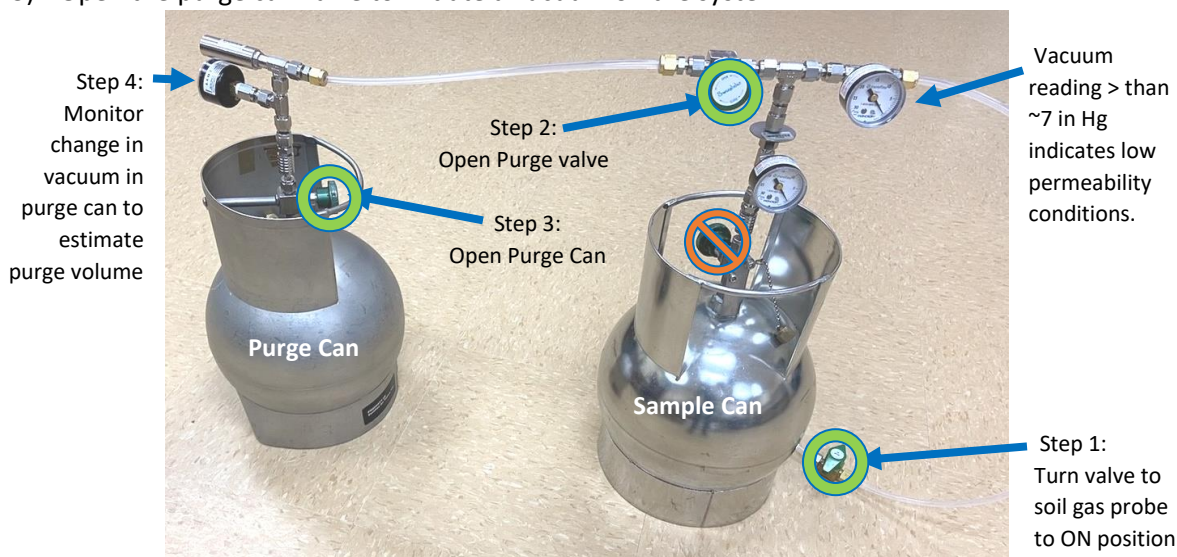


- 5) Close the purge valve on the SGM.
- 6) Close the valve on the purge canister.
- 7) Monitor the vacuum gauges on the SGM. Vacuum reading should be stable. If vacuum decreases toward ambient, tighten connections and repeat the shut-in test.



Purging Lines using Purge Canister:

- 1) To initiate purging of the soil gas line, turn the valve to the soil gas probe to the ON position.
- 2) Open the SGM purge valve.
- 3) Open the purge can valve to initiate a vacuum on the system.



- 4) To determine the purge volume collected using a purge canister with a 150 ml/min flow restrictor, the time can be monitored to estimate the volume and/or the change in the purge canister vacuum can be monitored. (Note that the estimating the total volume using time elapsed and assuming a 150 ml/min flow rate is best used when the purge canister vacuum is greater than 15 in Hg since flow rate will decrease as the canister fills to ambient pressure.)

Recommended option: Since the change in vacuum in the purge canister is proportional to the purge volume collected, the purge volume can be estimated by determining the minimum change in vacuum to achieve the desired total purge volume. Table 1 is a guide to correlate vacuum changes to purge volumes in a 6L canister. Alternatively, use equation below to calculate a specific purge volume:

$$\Delta \text{ Vacuum (in Hg)} = P_v (\text{L}) * 30 \text{ in Hg}/6 \text{ L, where } P_v = \text{Targeted total purge volume in Liters}$$

Table 1. Purge Volume Estimated by Vacuum Change (6L canister)

Vacuum Change (in Hg)	Purge Volume (L)
1.0	0.20
2.0	0.40
5.0	1.0

- 5) When desired purge volume has been reached, close the purge valve on the soil gas manifold and the valve on the purge canister.

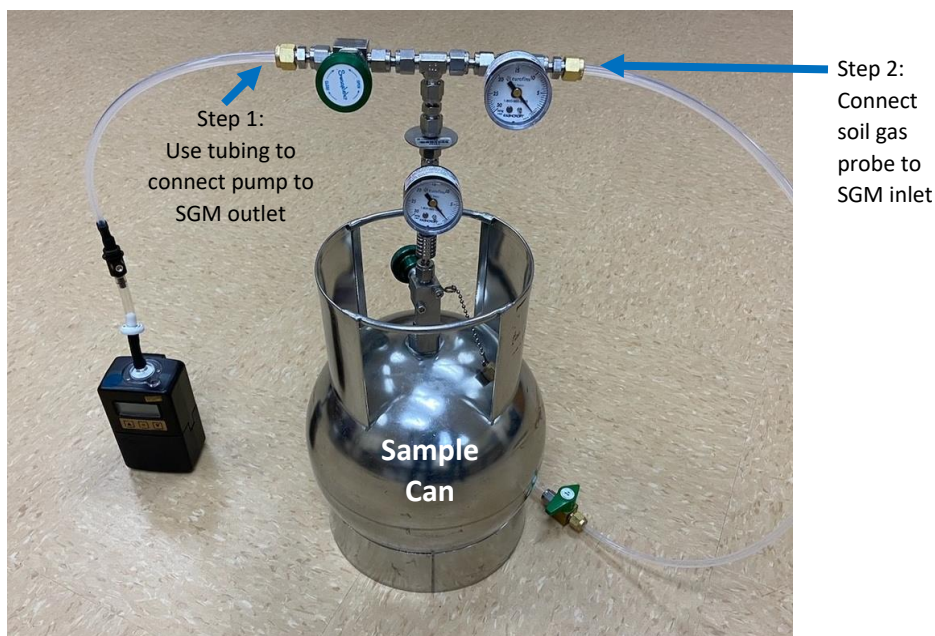
Monitor the downhole vacuum gauge while purging. A reading of greater than 7 in Hg indicates low permeability conditions, restricting the flow of soil gas.

SGM Sampling Procedures Using a Calibrated Vacuum Pump

Overview: A calibrated vacuum pump can be attached to the SGM as a vacuum source. Pumps are best suited for sampling events with a large number of soil gas samples and/or sites requiring large total purge volumes (e.g. >4 liters). While the default flow rate for the pump is generally <200 mL/min for purging, the specific pump flow rate used for purging may vary depending on the site conditions. In some cases, flow rates >200 mL/min may be appropriate if purge times are long due to large purge volume requirements. Pumps are not provided by the laboratory and must be secured by the client. Recommendations on conducting the shut-in test and purging sample lines using the SGM coupled with a vacuum pump are outlined below.

Assembly:

- 1) Attach the pump inlet to the to the SGM outlet using a segment of ¼" Teflon tubing with a Swagelok nut and ferrule to attach to SGM. Tighten the connection using a 9/16" wrench.
- 2) Connect the inlet of the SGM to the soil gas probe tubing. If using ¼" Teflon tubing, use a ¼" nut and ferrule and tighten using a 9/16" wrench.

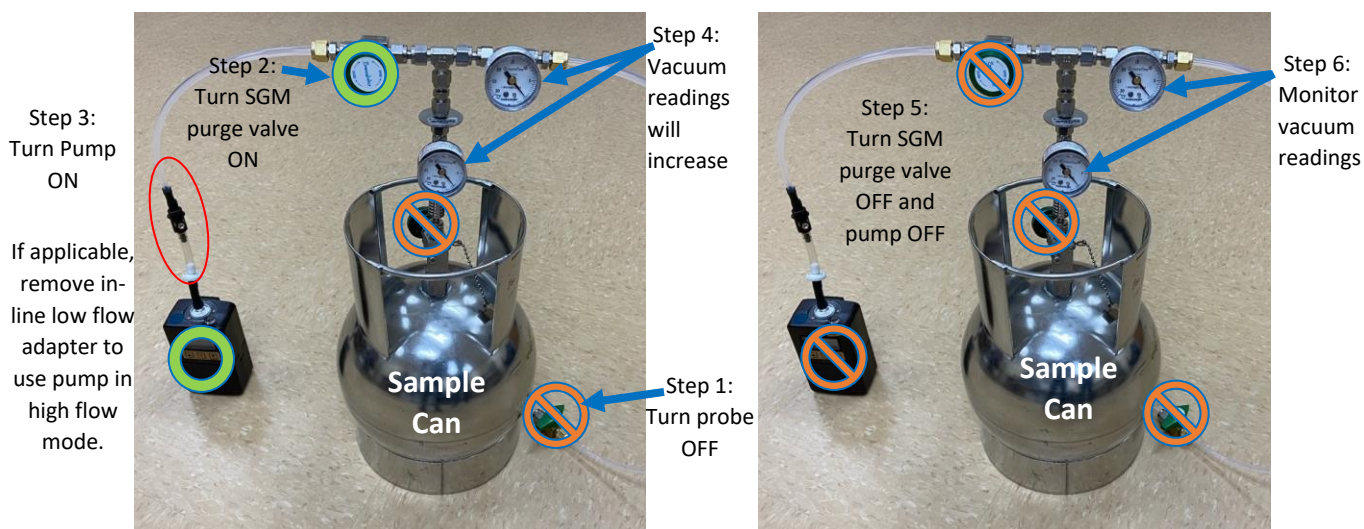


The calibrated pump option is ideal for sampling events with large number of samples and/or total purge volumes < 4L.

Shut-in Test with Vacuum Pump:

Note: A constant pressure low flow pump calibrated to 200 mL/min pulls a small vacuum on the canister sampling train and is **not** recommended to conduct a shut-in test. If the pump can easily be converted to a higher flow configuration (>1000 ml/min), a high vacuum is expected to be quickly pulled on the train and allow for an effective shut-in test. Please refer to the pump's operating manual for additional information and guidance. As an easy alternative to using a pump, the shut-in test can be conducted using a gas-tight syringe. See page 8 for details.

- 1) To isolate the canister sampling train, turn the valve to the soil gas probe to the off position.
- 2) Open the SGM purge valve.
- 3) With the pump in high flow mode, turn on the pump.
- 4) Both gauges on the SGM will show an immediate increase vacuum reading and quickly reach at least 10 in Hg.

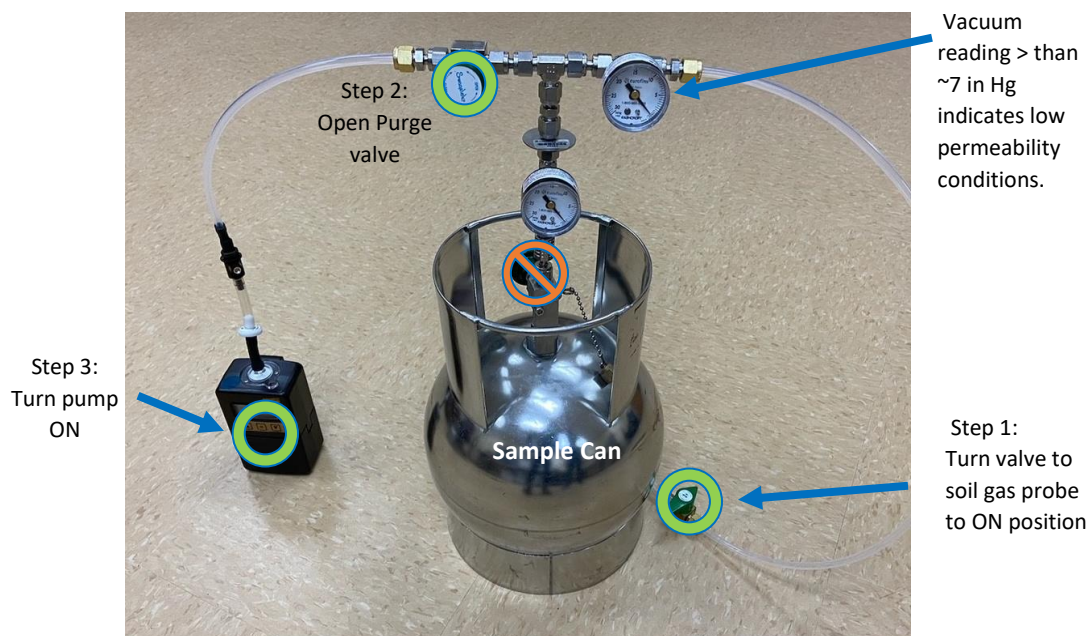


- 5) Close the purge valve on the SGM and immediately shut off the pump.
- 6) Monitor the vacuum gauges on the SGM. Vacuum reading should be stable. If vacuum decreases toward ambient, tighten connections and repeat the shut-in test.

A constant pressure low flow pump generates a small vacuum and is not recommended for a shut-in test.

Purging Lines using a calibrated vacuum pump:

- 1) To initiate purging of the soil gas line, turn the valve to the soil gas probe to the ON position.
- 2) Open the SGM purge valve.
- 3) Turn on the calibrated pump to start purging at the desired flow rate, noting the start time.



- 4) When desired purge volume has been reached, turn off the pump and close the SGM purge valve.

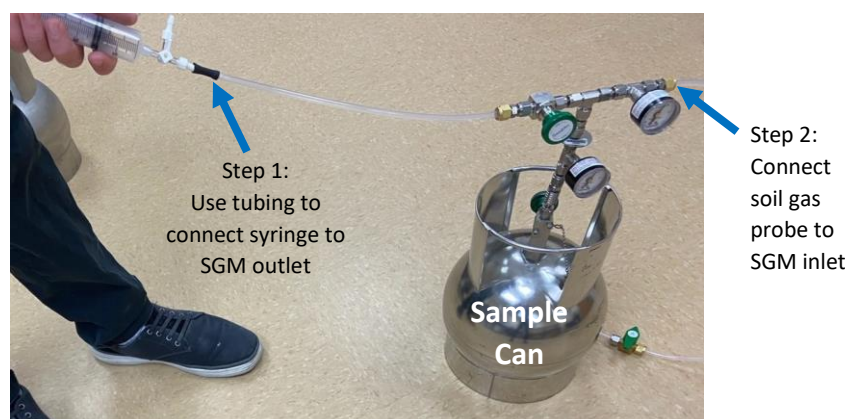
Monitor the downhole vacuum gauge while purging. A reading of greater than 7 in Hg indicates low permeability conditions, restricting the flow of soil gas.

SGM Sampling Procedures Using a Gas-tight syringe

Overview: A gas-tight syringe equipped with a 3-way valve can be attached to the SGM as a vacuum source. Syringes are best suited for sites requiring very small purge volumes (<500 mL) and/or as an alternative vacuum source for a shut-in test. The laboratory can provide a 50 cc disposable syringe, equipped with a 3-way valve assembly that is compatible with ¼" Teflon tubing. One syringe can be used for multiple SGMs.

Assembly:

- 1) Attach the syringe to the SGM outlet using a segment of ¼" Teflon tubing with a Swagelok nut and ferrule to attach to SGM. Tighten the connection using a 9/16" wrench.
- 2) Connect the inlet of the SGM to the soil gas probe tubing. If using ¼" Teflon tubing, use a ¼" nut and ferrule and tighten using a 9/16" wrench.



Shut-in Test using a Syringe:

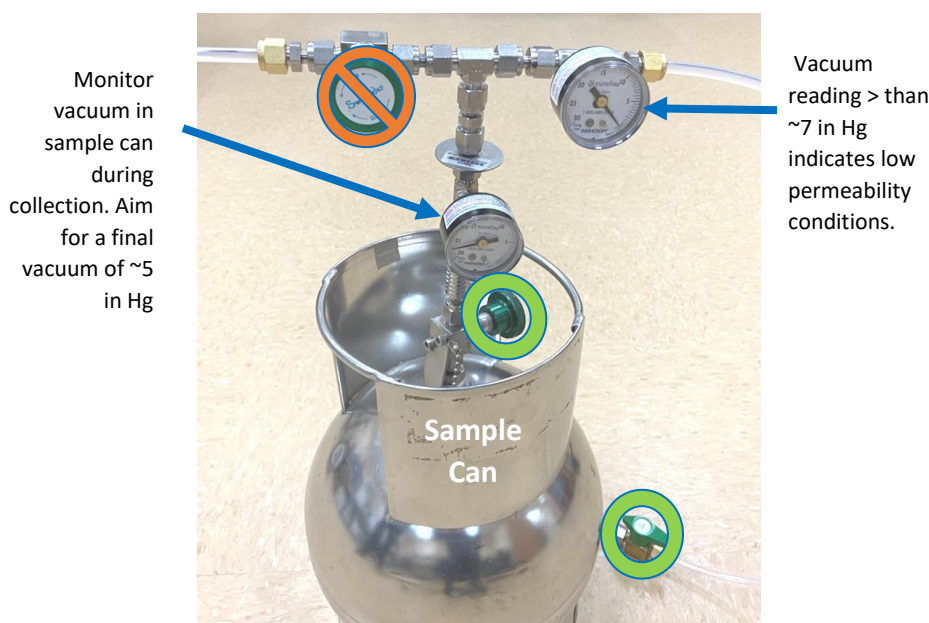
- 1) To isolate the canister sampling train, turn the valve to the soil gas probe to the off position.
- 2) Open the SGM purge valve.
- 3) With the 3-way syringe valve opened to the purge line, pull the plunger to quickly initiate vacuum. Both gauges on the SGM will show an immediate increase vacuum reading and quickly reach at least 10 in Hg.
- 4) While holding the plunger to maintain vacuum on the system, turn the 3-way syringe valve to close the purge line.
- 5) Close the SGM purge valve.
- 6) Monitor the vacuum gauges on the SGM. Vacuum reading should be stable. If vacuum decreases toward ambient, tighten connections and repeat the shut-in test.

Purging Lines using a syringe:

- 1) To initiate purging of the soil gas line, turn the valve to the soil gas probe to the ON position.
- 2) Open the SGM purge valve.
- 3) With the 3-way valve on the syringe positioned to the purge line, slowly pull the syringe plunger to the desired volume. Switch the 3-way valve to the vent position to empty the syringe barrel. A bag can be connected to the vent position if desired. Repeat step 3 until the desired volume has been extracted.
- 4) When complete, close the SGM purge valve.

Sample Collection using the SGM:

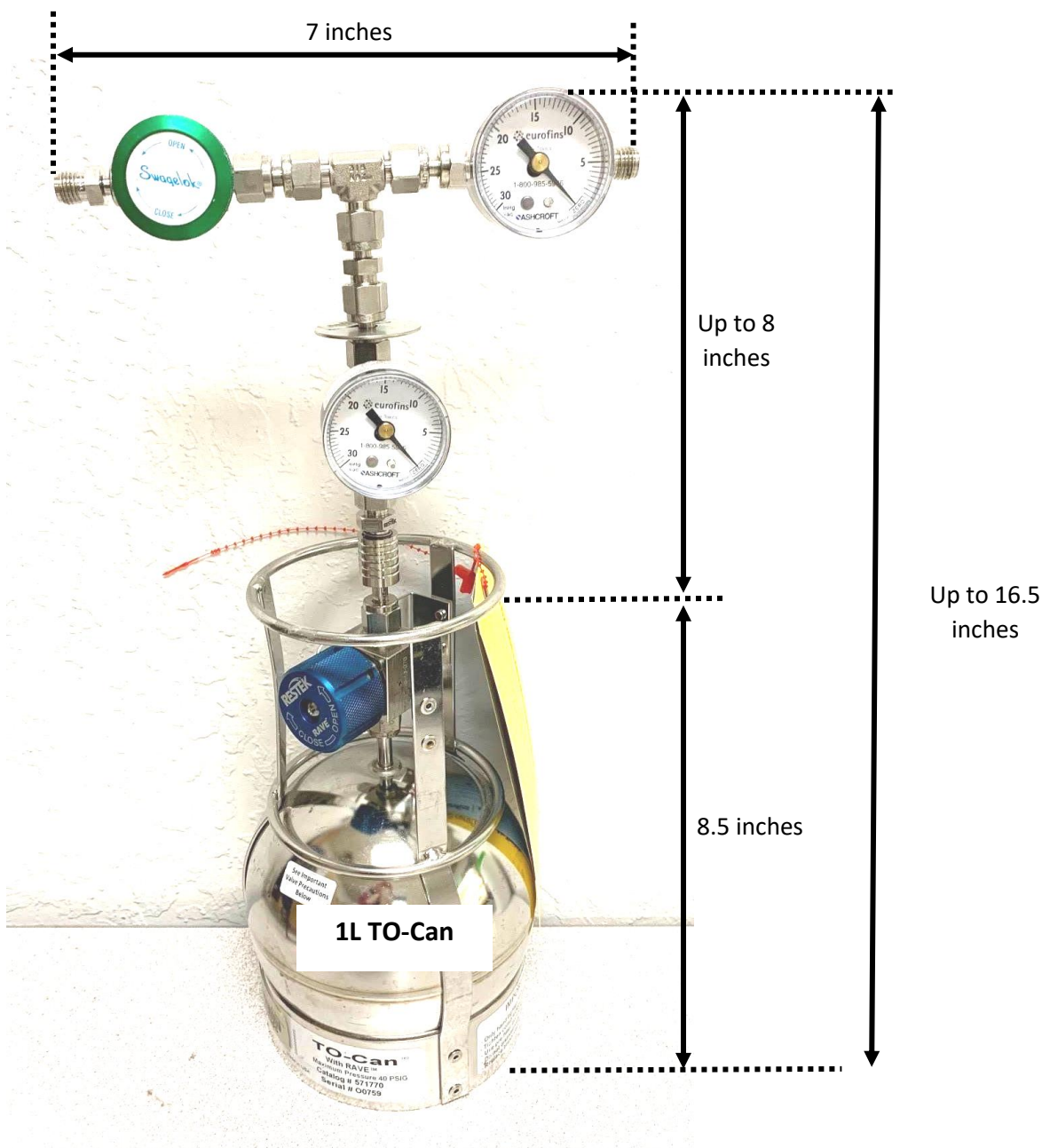
- 1) To start sample collection, keep the valve to the soil gas probe open and the SGM purge valve closed.
- 2) Open the sample collection canister valve, and verify the canister vacuum gauge registers approximately >25 in Hg at the start of sampling. Record your initial vacuum on the COC.
- 3) Monitor the downhole vacuum gauge during sample collection to ensure vacuum reading is below ~7 in Hg. A high vacuum reading means that low permeability conditions likely exist, restricting the flow of soil gas into the canister. If high vacuum conditions are encountered in the process of sample collection, please consult with regulatory guidance for options.
- 4) Close sample canister valve when vacuum gauge reading is approximately 5 in Hg or as indicated in your sampling plan.



- 5) Record your final vacuum on the COC.
- 6) Disconnect the soil gas line and the vacuum source from the SGM using a 9/16" wrench.
- 7) Uncouple the quick connect fitting between the SGM and the sample canister.
- 8) Send the canister and the SGM back to the laboratory in the original packing along with the completed COC.

Monitor the downhole vacuum gauge while sampling. A reading of greater than 7 in Hg indicates low permeability conditions, restricting the flow of soil gas into the canister.

Dimensions of the SGM paired with a 1L TO-Canister



Using a 6L canister will add approximately 4 in to the overall height of the SGM sampling train as compared to the 1L TO-can.