10.2
STANDARD OPERATING PROCEDURES FOR SOIL VAPOR SAMPLING
Last Review or Revision: September 2020

I. PURPOSE

The purpose of this standard operating procedure (SOP) is to provide general guidance and recommended standard practices for installing and sampling soil-gas for temporary or semi-permanent soil-gas monitoring points.

II. SOIL-GAS INSTALLATION AND SAMPLING EQUIPMENT

i. General
- Level D or applicable personal protective equipment (PPE).
- Site Safety and Health Plan.
- Site map.
- Tape measure.
- Camera.
- Decontamination equipment (wash and rinse solutions, distilled water, brushes, Alconox® or Luminox®).
- Safety cones.
- Field notebook and appropriate soil vapor field data forms.

ii. Manual Method
- Manual slide hammer.
- Manual slide hammer anvil, 1-inch outer diameter (OD) or 1.25-inch OD.
- Manual probe rod jack.
- Probe rod tooling:
  - ⇒ Hollow steel rods, 1-inch or 1.25-inch OD.
  - ⇒ "O" rings for terminal end of rods, 1-inch or 1.25-inch OD.
  - ⇒ Expendable drive point, 1-inch or 1.25-inch OD.
  - ⇒ ¼-inch solid steel rods with point popper to disengage expendable drive point.
- Post-Run Tubing (PRT) system for temporary points:
  - ⇒ PRT expendable drive point holder, 1-inch or 1.25-inch OD.
  - ⇒ PRT adaptor for 3/16-inch inner diameter (ID) tubing or 5/16-inch ID tubing.
  - ⇒ "O" Rings for PRT adaptor connection to point holder.
- Semi-permanent soil-gas monitoring points:

- ⇒ Stainless steel soil-gas point or screen, sized for project specific sampling objectives.
- ⇒ Sand filter pack sized to soil-gas point or screen.

- Tubing (3/16-inch ID or 5/16-inch ID): Teflon®, Nylaflow®, or polyetheretherketone (PEEK).
- Hydrated Bentonite, Bentonite Grout (5% Bentonite / 95% Portland Cement), or neat cement.

iii. Power Hammer Method

- Jack hammer.
- Jack hammer anvil adaptor.
- Manual probe rod jack.
- Generator with extension cords.
- Probe rod tooling:
  - ⇒ Hollow steel rods, 1-inch OD or 1.25-inch OD.
  - ⇒ "O" rings for terminal end of rods, 1-inch or 1.25-inch OD.
  - ⇒ Expendable drive point, 1-inch or 1.25-inch OD.
  - ⇒ ¼-inch solid steel rods with point popper to disengage expendable drive point.
- PRT system for temporary points:
  - ⇒ PRT expendable drive point holder, 1-inch or 1.25-inch OD.
  - ⇒ PRT adaptor for 3/16-inch ID tubing or 5/16-inch ID tubing.
  - ⇒ "O" Rings for PRT adaptor connection to point holder.
- Semi-permanent soil-gas monitoring points:
  - ⇒ Stainless steel soil-gas point or screen, sized for project specific sampling objectives.
  - ⇒ Sand filter pack sized to soil-gas point or screen.
- Tubing (3/16-inch OD or 5/16-inch OD): Teflon®, Nylaflow®, or PEEK.
- Hydrated Bentonite, Bentonite Grout (5% Bentonite / 95% Portland Cement), or neat cement.

iv. Direct-Push Drill Rig Method

- Drill rig.
- Probe rod tooling:
  - ⇒ Hollow steel rods, 1-inch OD or 1.25-inch OD.
  - ⇒ "O" rings for terminal end of rods, 1-inch or 1.25-inch OD.
  - ⇒ Expendable drive point, 1-inch or 1.25-inch OD.
  - ⇒ ¼-inch solid steel rods with point popper to disengage expendable drive point.
  - ⇒ Drive cap, 1-inch OD or 1.25-inch OD.
  - ⇒ Pull cap, 1-inch OD or 1.25-inch OD.
- PRT system for temporary points:
  - ⇒ PRT expendable drive point holder, 1-inch or 1.25-inch OD.
  - ⇒ PRT adaptor for 3/16-inch ID tubing or 5/16-inch OD tubing.
  - ⇒ "O" Rings for PRT adaptor connection to point holder.
- Semi-permanent soil-gas monitoring points:

⇒ Stainless steel soil-gas point or screen, sized for project specific sampling objectives.

⇒ Sand filter pack sized to soil-gas point or screen.

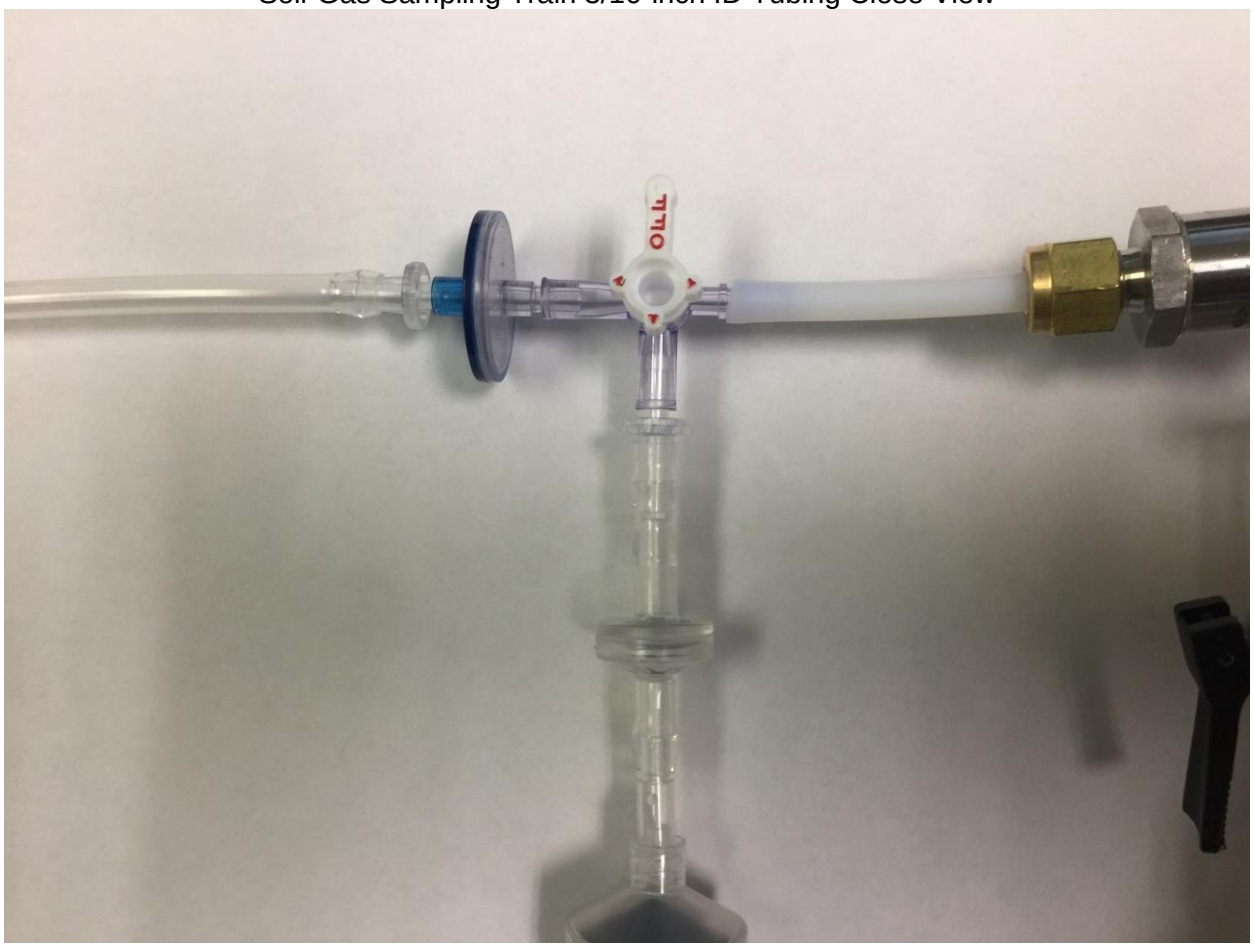
- Tubing (3/16-inch ID or 5/16-inch ID): Teflon®, Nylaflow®, or PEEK.
- Hydrated bentonite, bentonite grout (5% bentonite / 95% Portland Cement), or neat cement.

v. Soil-Gas Sampling Train

- Soil-Gas Sampling Train – 3/16-inch ID Tubing

Soil-Gas Sampling Train 3/16-inch ID Tubing

Soil-Gas Sampling Train 3/16-inch ID Tubing Close View



Soil-Gas Sampling Train 3/16-inch ID Tubing Part List

⇒ (As Needed): 3/16-inch ID Teflon® tubing.
⇒ (2): Polycarbonate male luer slip x 3/16-inch hose barb.
⇒ (1): Polycarbonate luer connection moisture trap.
⇒ (1): Polycarbonate stopcock with luer connections and male luer slip, 4-way valve.
⇒ (As Needed): 3/16-inch ID thick wall Teflon® tubing (laboratory provided).
⇒ (1): Swagelok® nut and ferrule set for ¼-inch tubing (laboratory provided).
⇒ (1): Polycarbonate 3/16-inch ID by 3/16-inch ID standard check valve, silicone diaphragm material.
⇒ Air sampling canister equipped with low-flow regulator [(i.e., <200 milliliters per minute (ml/min)] and vacuum gauge.

- Soil-Gas Sampling Train – 3/16-inch ID Tubing Two Tee Manifold

Soil-Gas Sampling Train 3/16-inch ID Tubing Two Tee Manifold

Soil-Gas Sampling Train 3/16-inch ID Tubing Two Tee Manifold Close View

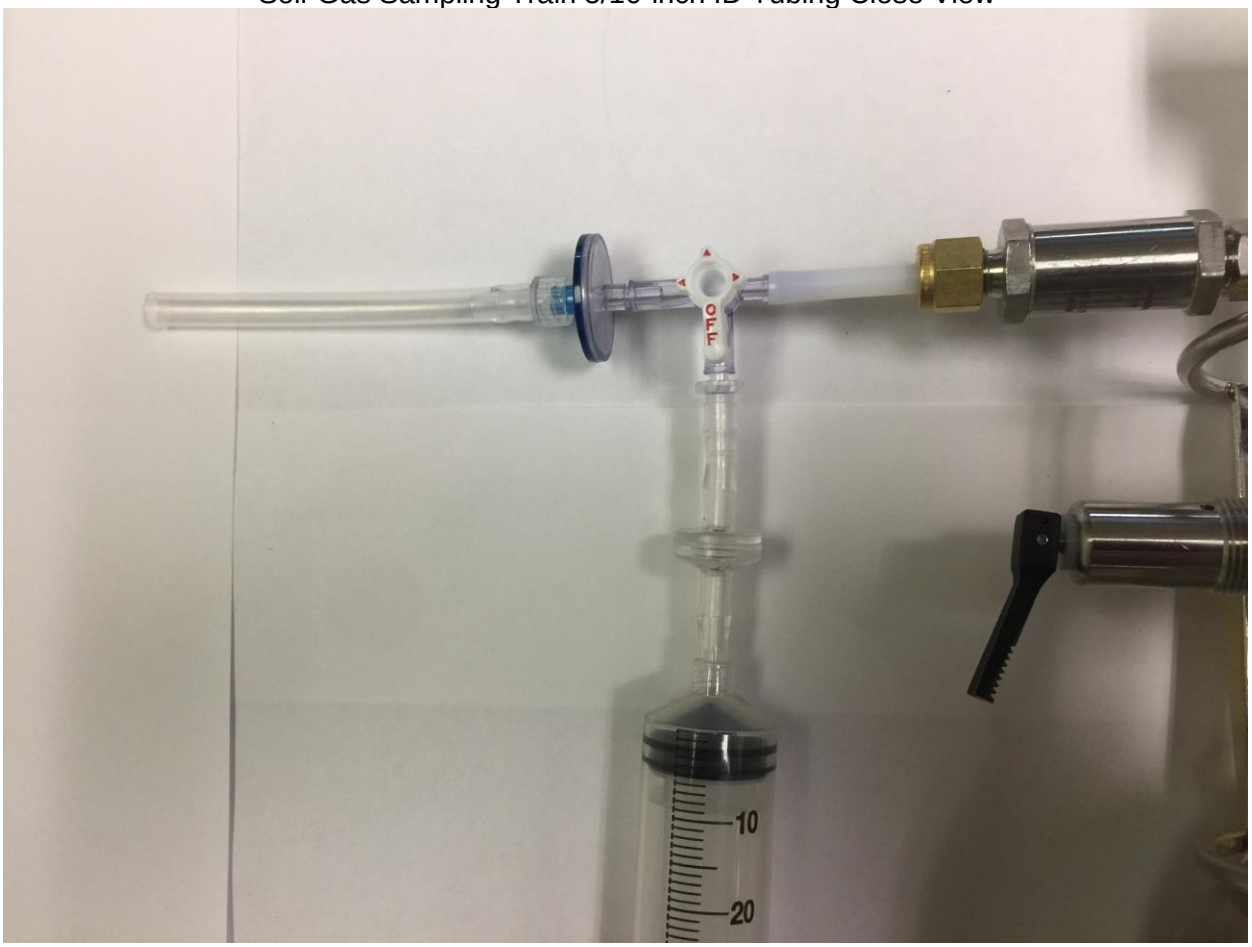
Soil-Gas Sampling Train 3/16-inch ID Tubing Two Tee Part List

- ⇒ (As Needed): 3/16-inch ID Teflon® tubing.
- ⇒ (1): Polycarbonate male luer slip x 3/16-inch hose barb.
- ⇒ (1): Polycarbonate luer connection moisture trap.
- ⇒ (As Needed): 3/16-inch ID thick wall Teflon® tubing (laboratory provided).
- ⇒ (1): Swagelok® nut and ferrule set for ¼-inch tubing (laboratory provided).
- ⇒ (1): Polycarbonate 3/16-inch ID by 3/16-inch ID standard check valve, silicone diaphragm material.
- ⇒ (1): Swagelok® tee and 3/16-inch ID barbed fitting set (laboratory provided).
- ⇒ Air sampling canister equipped with low-flow regulator [(i.e., <200 milliliters per minute (ml/min)] and vacuum gauge.

- Soil-Gas Sampling Train – 5/16-inch ID Tubing

Soil-Gas Sampling Train 5/16-inch ID Tubing

Soil-Gas Sampling Train 5/16-inch ID Tubing Close View



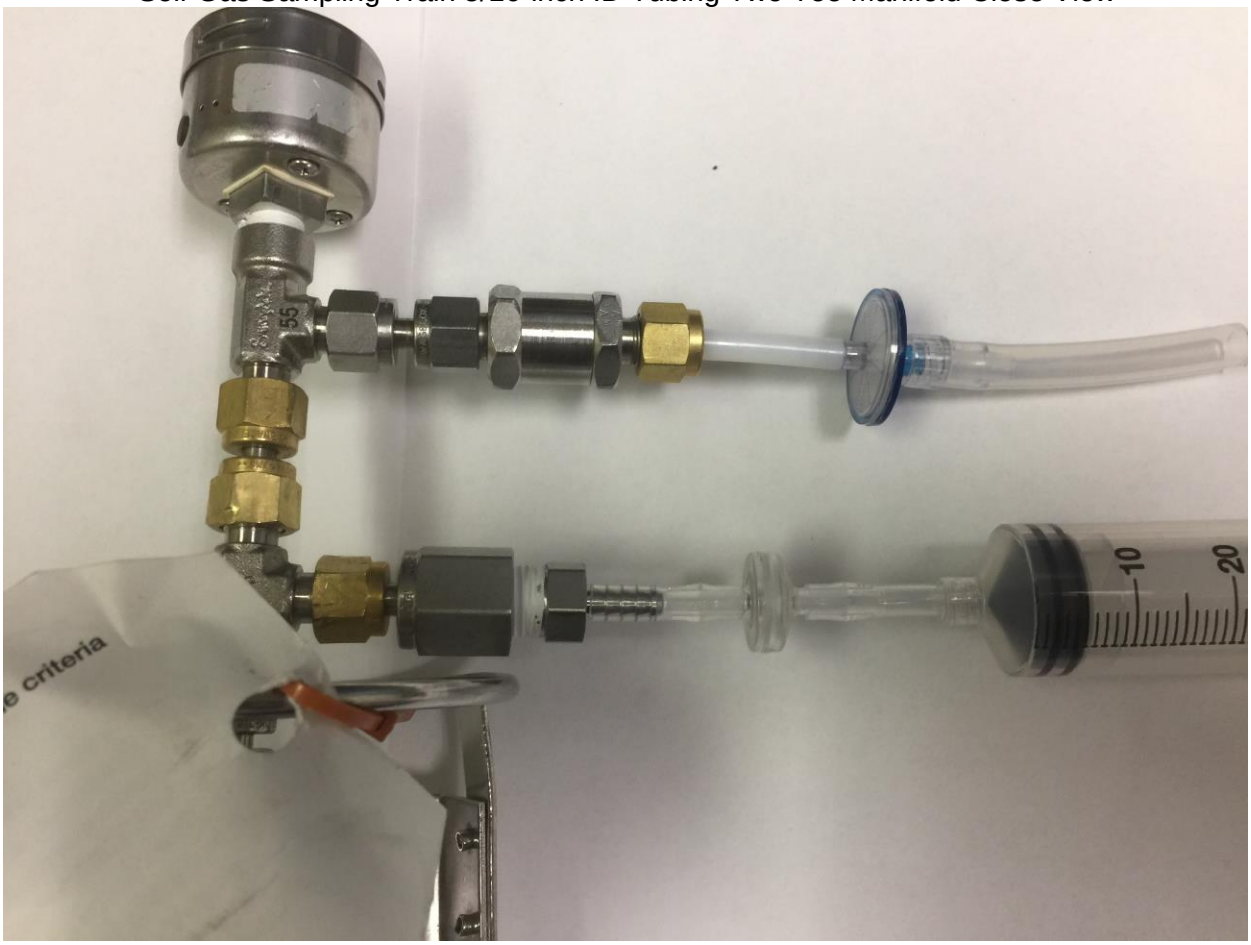
Soil-Gas Sampling Train 5/16-inch ID Tubing Part List

- ⇒ (As Needed): 5/16-inch ID Teflon® tubing.
- ⇒ (As Needed): 3/16-inch ID Teflon® tubing.
- ⇒ (1): Polycarbonate male luer with lock ring x 3/16-inch hose barb.
- ⇒ (1): Polycarbonate male luer slip x 3/16-inch hose barb.
- ⇒ (1): Polycarbonate luer connection moisture trap.
- ⇒ (1): Polycarbonate stopcock with luer connections and male luer slip, 4-way valve.
- ⇒ (As Needed): 3/16-inch ID thick wall Teflon® tubing (laboratory provided).
- ⇒ (1): Swagelok® nut and ferrule set for ¼-inch tubing (laboratory provided).
- ⇒ (1): Polycarbonate 3/16-inch ID by 3/16-inch ID standard check valve, silicone diaphragm material.
- ⇒ Air sampling canister equipped with low-flow regulator (i.e., <200 ml/min) and vacuum gauge.

- Soil-Gas Sampling Train – 5/16-inch ID Tubing Two Tee Manifold

Soil-Gas Sampling Train 5/16-inch ID Tubing Two Tee Manifold

Soil-Gas Sampling Train 5/16-inch ID Tubing Two Tee Manifold Close View



Soil-Gas Sampling Train 3/16-inch ID Tubing Two Tee Part List

- ⇒ (As Needed): 5/16-inch ID Teflon® tubing.
- ⇒ (As Needed): 3/16-inch ID Teflon® tubing.
- ⇒ (1): Polycarbonate male luer slip x 3/16-inch hose barb.
- ⇒ (1): Polycarbonate luer connection moisture trap.
- ⇒ (As Needed): 3/16-inch ID thick wall Teflon® tubing (laboratory provided).
- ⇒ (1): Swagelok® nut and ferrule set for ¼-inch tubing (laboratory provided).
- ⇒ (1): Polycarbonate 3/16-inch ID by 3/16-inch ID standard check valve, silicone diaphragm material.
- ⇒ (1): Swagelok® tee and 3/16-inch ID barbed fitting set (laboratory provided).
- ⇒ Air sampling canister equipped with low-flow regulator [(i.e., <200 milliliters per minute (ml/min)] and vacuum gauge.

vi. Soil-Gas Sampling Equipment

- Soil-gas sampling train purging equipment (will vary based on user preference and project specific sampling objectives):
  - ⇒ Peristaltic pump.
  - ⇒ Lung box and vacuum pump.
  - ⇒ Indoor air sampling pump.
  - ⇒ Graduated syringe (alternative to pumps for purging).
- Vacuum gauge (if not provided with air sampling canister).
- Tedlar® Bags (to collect soil-gas sample for screening with field instruments – not for sample collection).
- Chain of Custody, field data sheets, logbook, etc.
- Photoionization detector (PID) equipped with appropriate lamp.
- Landfill Gas or Multi-Gas Meter (CH4, CO2, O2, Balance Gas)

III. PROCEDURES

i. Soil-Gas Sampling Equipment Preparation and Decontamination Procedures

- Decontamination procedures prior to mobilization to the project site:
  - ⇒ Decontaminate reusable, expendable, and/or dedicated metallic sampling components (i.e., probe rods, expendable drive points, expendable drive point holders, PRT adaptors, stainless steel soil-gas points, or stainless-steel screens) using a detergent wash with brush followed a distilled water rinse.
  - ⇒ Allow probe rod to air dry on a clean surface (i.e., plastic table top, plastic sheet, or tin foil). After probe rods dry wrap with plastic or tin foil for transportation to project site.
  - ⇒ Put decontaminated reusable, expendable, and/or dedicated metallic sampling components (i.e., expendable drive points, expendable drive point holders, PRT adaptors, stainless steel soil-gas points, or stainless-steel screens) into steel bowl and place into oven set at 230 degrees Celsius, or approximately 450-degree Fahrenheit, for 1 hour. Remove steel bowl from oven, place in clean space, and allow to air cool for approximately 4 hours or until components have cooled to air temperature. Place sampling into sealable plastic bag(s) for transportation to project site.

- Assembly of soil-gas sampling components at office prior to mobilization to the project site:
  - ⇒ Calculate total approximate length of tubing required for proposed soil-gas sampling work at project site including additional length of tubing required as a safety factor (i.e., additional 10 percent of tubing required). Take the total approximate length of tubing from tubing stock located in soil-gas sampling supply area, place into sealable plastic bag, and place into field soil-gas sampling kit for transportation to project site.

⇒ Collect soil-gas sampling train components (tubing connectors, fittings, and valves) from the soil-gas sampling supply area. Collect enough components for each soil-gas sampling train proposed for soil-gas sampling work at project site including additional components required as a safety factor (i.e., additional 10 percent of components required). Assemble soil-gas sampling train components for proposed soil-gas sampling work, place into sealable plastic bag, and place into field soil-gas sampling kit for transportation to project site.

- During work at project site:
  - ⇒ Remove decontaminated metallic soil-gas sampling equipment from travel wrap or bag for use at project site.
  - ⇒ Decontaminate reusable metallic sampling components between sampling locations using a detergent wash with brush followed by a distilled water rinse.
  - ⇒ Use new disposable soil-gas sampling train equipment (tubing, tubing connectors, fittings, and/or valves) at each soil-gas sampling location. Remove tubing and preassembled soil-gas sampling components from their travel plastic bags within the soil-gas sampling kit immediately prior to their use. Following collection of soil-gas samples, place used disposable soil-gas sampling equipment into trash receptacle or recycling receptacle as appropriate.

ii. Utility Locate
- Locate public and private utilities in work area.

iii. Manual Method and Direct-Push Drill Rig Method
- Install “O” rings on the threading connections of the rods, expendable drive point, expendable drive point holder, and adapters.
- Assemble the leading probe rod, expendable drive point holder, and expendable drive point and push the leading end of the assembly into the ground surface.
- Place hammer anvil or drive cap onto the top end of the assembly.
- Advance the rod, expendable point holder, and expendable point into the ground. Add additional probe rods as necessary to reach the desired depth.

iv. Power Hammer Method
- Install “O” rings on the threading connections of the rods, expendable drive point, expendable drive point holder, and adapters.
- Assemble the leading probe rod, expendable drive point holder, and expendable drive point and push the leading end of the assembly into the ground surface.
- Place power hammer adaptor onto top end of the assembly.

- Use a stable platform to stand on while lifting and using the Power Hammer to drive the rods into the ground. Add additional probe rods as necessary to reach the desired depth.

v. PRT Sampling Set-Up
   - After the desired depth has been achieved, disengage the expendable drive point. Retract the rods approximately 4 inches to 6 inches using the rod jack to create a void in the soil. Insert ¼-inch solid steel rods with point popper into rods and push through base of expendable point holder to verify disengagement of expendable drive point.
   - Insert the PRT adapter end attached to tubing down the center of the probe rods. Feed the tubing down the rods until it hits bottom on the expendable point holder. Allow approximately 2 to 4 feet of tubing to extend out of the top of the probe rods before cutting it.
   - Grasp the excess tubing end and apply some downward pressure while turning it in a counter-clockwise motion to thread the PRT adapter on the expendable point holder. Continue turning until the PRT adapter “O” ring connects to the expendable point holder.
   - Continue turning tubing and PRT adaptor until a slight clockwise rotation occurs when tubing at surface released. Pull up lightly on the tubing to test the connection between the adapter and point holder. Failure of the PRT adapter to connect could mean that intrusion of soil may have occurred during advancement of the rods or disengagement of the expendable drive point.
   - Apply hydrated bentonite around the exterior of the probe rods at the ground surface.
   - Proceed to soil-gas sample collection procedures.

vi. Semi-Permanent Point Construction
   - After the desired depth has been achieved, either the probe rods may be removed if the borehole remains open and does not collapse or the sample point may be installed down the hollow probe rods.
   - Place appropriate amount of filter pack into borehole below targeted sample point interval as specified.
   - Place sampling point and tubing down the borehole and place at targeted sample point interval.
   - Place appropriate amount of filter pack into borehole above targeted sample point interval as specified.
   - Fill annular space of borehole above filter pack with hydrated bentonite, bentonite grout, or neat cement as specified.
   - Install surface completion as specified.
   - Proceed to soil-gas sample collection procedures.

vii. Soil-Gas Sample Collection

- Remove preassembled soil-gas sampling train components from their travel plastic bag within the soil-gas sampling kit. Attach the soil-gas sampling train to the air sampling canister.
- After the sampling train is placed onto the air sampling canister, a vacuum “shut in” leak test is conducted. The leak test is conducted by isolating the sample point with a valve or cap so that the entire sampling train is closed. Using a syringe or purge pump, apply a vacuum to the sample train and monitor the vacuum reading for a minimum of five minutes. If the vacuum does not change then the assembly passed the leak check. If the vacuum changed, then a leak exists which must be corrected, and additional leak checks conducted until no leaks exist.
- Connect sample train to subsurface sample point tubing to allow the sample train and subsurface tubing to be purged. Using a syringe or purge pump, purge approximately two volumes of “dead air” from the sampling train. The purging should be conducted at a low-flow rate (i.e., less than 200 ml/min). The dead volume equals the aggregate volume of all tubing, fittings, and ports from the in-ground sample point to the air sampling canister. Upon completion of the purging the purge port valve is closed to isolate the purge line from the sampling train.
- To begin sampling, ensure valve on purge tubing is closed. Open valve on air sampling canister and record canister vacuum. Initial vacuum reading should be approximately 30 +/- 3 inches of mercury. If air sampling canister is not under full vacuum, do not use canister for sample collection. Record time sample collection began.
- Close air sampling canister valve when the vacuum on the canister reaches near 2 to 3 inches of mercury of vacuum. Record the time sampling was completed and the final vacuum reading on the chain-of-custody. Final vacuum reading is recorded for comparison with the vacuum measured upon laboratory receipt to identify possible canister leaks during sample shipment.
- Attach a PID to the sampling train. If applicable, use a multi-gas meter to collect additional field gas measurements. Record highest PID or multi-gas reading over a one-minute period.
- If tight soil conditions are encountered which prohibit the screening of soil-gas within the sampling train, a peristaltic pump may be used to collect soil-gas for field screening. Attach the influent end of peristaltic pump tubing to the effluent of the one-way purge valve. Attach a Tedlar® bag to the effluent end of peristaltic pump tubing. Open valve on Tedlar® bag to allow flow into the bag and then turn on the peristaltic pump to collect soil-gas sample for screening.
- Following completion of soil-gas sampling, disassemble sampling train from subsurface tubing and air sampling canister. If sampling PRT, remove rod assembly from subsurface and abandon borehole per requirements of the Minnesota Department of Health (MDH) Well Code. If sampling semi-permanent point, place

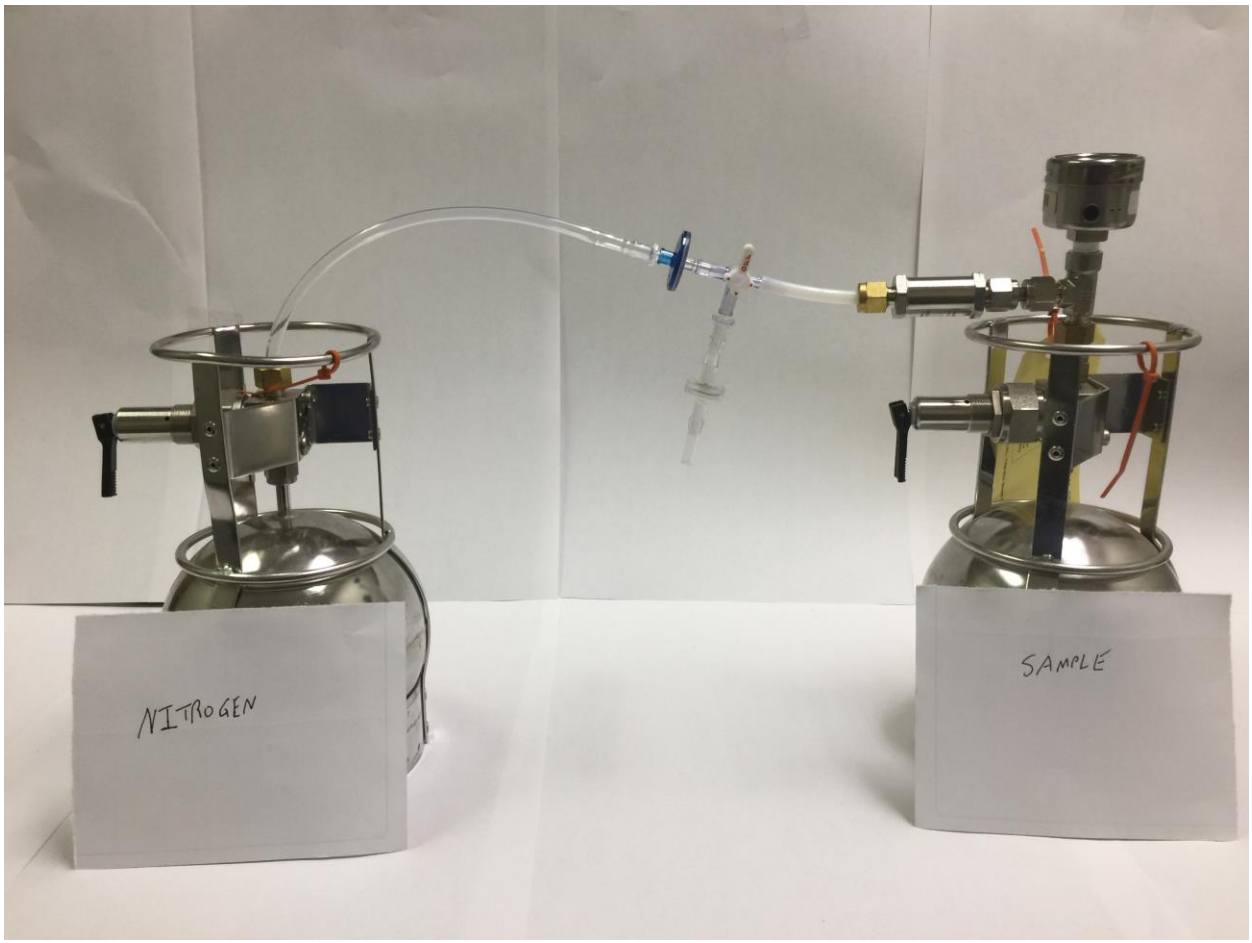
cap onto top end of subsurface tubing, place tubing into near-surface completion, and affix protective cover to secure point.

- Deliver/ship sampling canisters maintaining chain of custody. Sampling canisters are typically sent back to the laboratory in originally-supplied box and packaging and do not require cooling/chilling.

viii. Soil-Gas Equipment Blank Sample Collection

- Soil-gas equipment blanks will be collected on a basis of one (1) equipment blank per ten (10) samples collected, or a minimum of one (1) equipment blank per site.
- Soil-gas equipment blanks will be collected using laboratory provided nitrogen verified free of the analytes for which the sample will be analyzed.
- Soil-gas equipment blank samples will be collected using the following procedure:
  - ⇒ Connect the leading end of the sampling train Teflon® tubing to a laboratory provided air canister filled with nitrogen as illustrated in photograph below:

Soil-Gas Equipment Blank Sample Setup



- ⇒ Conduct a vacuum “shut in” leak test. Using a syringe or purge pump, apply a vacuum to the sample train and monitor the vacuum reading for a minimum of five minutes. If the vacuum does not change then the assembly passed the leak check. If the vacuum changed, then a leak exists which must be corrected, and additional leak checks conducted until no leaks exist.
- ⇒ After successful completion of the vacuum “shut in” leak test, open the valve of the nitrogen air canister and allow nitrogen to fill sampling train.
- ⇒ Using a syringe or purge pump, purge approximately two volumes of “dead air” from the sampling train. Upon completion of the purging, close the purge port valve to isolate the purge line from the sampling train.
- ⇒ To begin sampling, ensure valve on purge tubing is closed. Open valve on air sampling canister and record canister vacuum. Initial vacuum reading should be approximately 30 +/- 3 inches of mercury vacuum. If air sampling canister is not under full vacuum, do not use canister for sample collection. Record time sample collection began, initial vacuum, and sample container and flow regulator identifiers on the chain-of-custody.
- ⇒ Close air sampling canister valve when the vacuum on the air sampling canister reaches near 2 to 3 inches of mercury vacuum. Record the time sampling was completed and the final vacuum reading on the chain-of-custody. Final vacuum reading is recorded for comparison with the vacuum measured upon laboratory receipt to identify possible canister leaks during sample shipment.
- ⇒ Close valve on air canister filled with nitrogen.
- ⇒ Remove soil-gas sampling train from air canister filled with nitrogen and from equipment blank air canister. Place soil-gas sampling train onto new, unused air sampling canister for use at next sampling point.

ix. Field Duplicate Soil-Gas Sample Collection

- Field duplicate soil-gas samples will be collected on a basis of one (1) duplicate per ten (10) samples collected, or a minimum of one (1) duplicate per site.
- Field duplicate soil-gas samples will be collected by attaching the soil-gas sampling train to a flow regulator, with the effluent of the regulator split to two (2) separate air sampling canisters as illustrated in the photograph below:

Field Duplicate Soil-Gas Sample Collection Setup

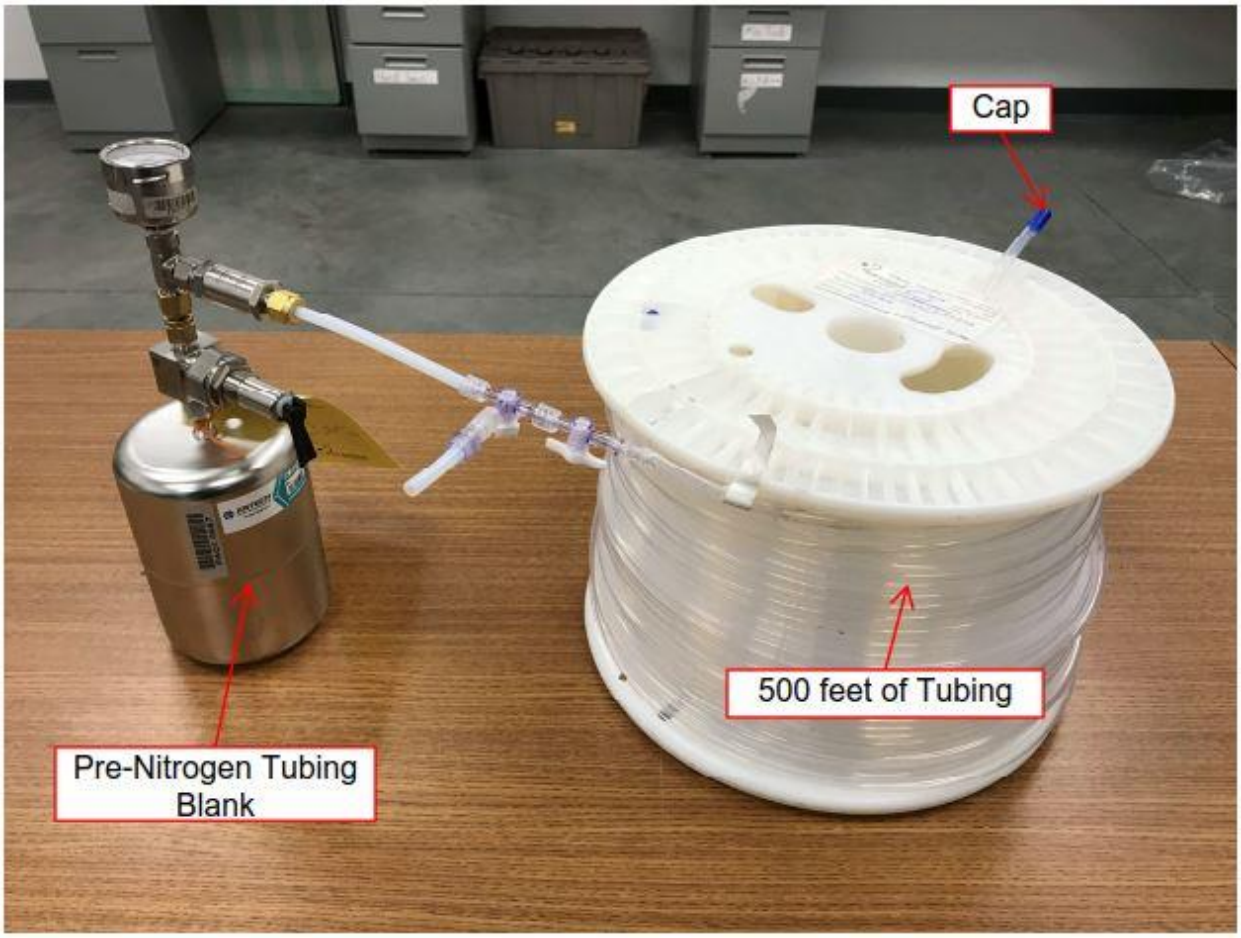
- Vacuum “shut in”, purging, and sampling will be conducted in accordance with *Section VII Soil-Gas Sample Collection* described above.

x. Ambient Air Sample Collection
- Ambient air samples will be collected on a basis of one (1) ambient air sample per ten (10) samples collected, or a minimum of one (1) ambient air sample per site.
- Ambient air samples will be collected in conjunction with collection of a soil-gas sample. Ambient air sample will be collected in close proximity to the soil-gas sampling location.
- Ambient air samples will be collected using an air sampling canister of the same volume and equipped with a similar flow regulator as the soil-gas sampling location.
- Ambient air sampling will be initiated at the same time that collection of soil-gas sample is initiated. Ambient air sampling will be initiated by opening the valve on the canister immediately following the opening of the valve on the soil-gas sample. Initial vacuum reading should be approximately 30 +/- 3 inches of mercury. If air sampling canister is not under full vacuum, do not use canister for sample collection. Record time sample collection began.
- Close ambient air sampling canister valve immediately following closure of the valve on the soil-gas sample canister, or when the vacuum on the air sampling canister reaches near 2 to 3 inches of mercury vacuum. Record the time sampling was completed and the final vacuum reading on the chain-of-custody. Final vacuum reading is recorded for comparison with the vacuum measured upon laboratory receipt to identify possible canister leaks during sample shipment.

xi. Soil-Gas Tubing Equipment Blank Sample Collection
- Soil-gas tubing equipment blanks will be collected on a basis of one (1) set of samples for each new 500 foot (ft) roll of tubing or as determined appropriate. Two equipment blank samples will be collected from the new roll of tubing (EB Tubing). The first sample will be collected prior to the tubing being purged with laboratory grade nitrogen and the second sample will be collected from the tubing after it has been purged with nitrogen (EB N2 Tubing).
- The “N2 Tubing” blank will be collected using laboratory provided nitrogen verified free of the analytes for which the sample will be analyzed.
- This SOP is based upon data collected from a 500 foot roll of ¼-inch outer diameter by 3/16-inch inner diameter solid Teflon tubing with a volume of about 2.5 liters and a six liter canister contain 2 to 3 atmospheres (atm) or 30 to 40 pounds per square inch (psig) of laboratory grade nitrogen that equates to 12 to 16 liters of nitrogen. Note, the flow rate of the nitrogen purges was not measured or controlled during the development of this SOP.
- Tubing equipment blank samples will be collected using the following procedure:

- Connect the leading end of the sampling train Teflon® tubing to the end of the new 500 ft roll of tubing as illustrated in the photograph below:

Tubing Equipment Blank Sample Setup



⇒ Calculate the volume of the tubing to be sampled and select an appropriate size individually laboratory certified sampling air sampling canister equipped with low-flow regulator [i.e., <200 milliliters per minute (ml/min)] and vacuum gauge and obtain an appropriate amount of laboratory grade nitrogen (at least five times the tubing volume).

⇒ Conduct a vacuum “shut in” leak test. Using a syringe or purge pump, apply a vacuum to the sample train and monitor the vacuum reading for a minimum of five minutes. If the vacuum does not change then the assembly passed the leak check. If the vacuum changed, then a leak exists which must be corrected, and additional leak checks conducted until no leaks exist.

⇒ To begin, open valve on air sampling canister and record canister vacuum. Initial vacuum reading should be approximately 30 +/- 3 inches of mercury

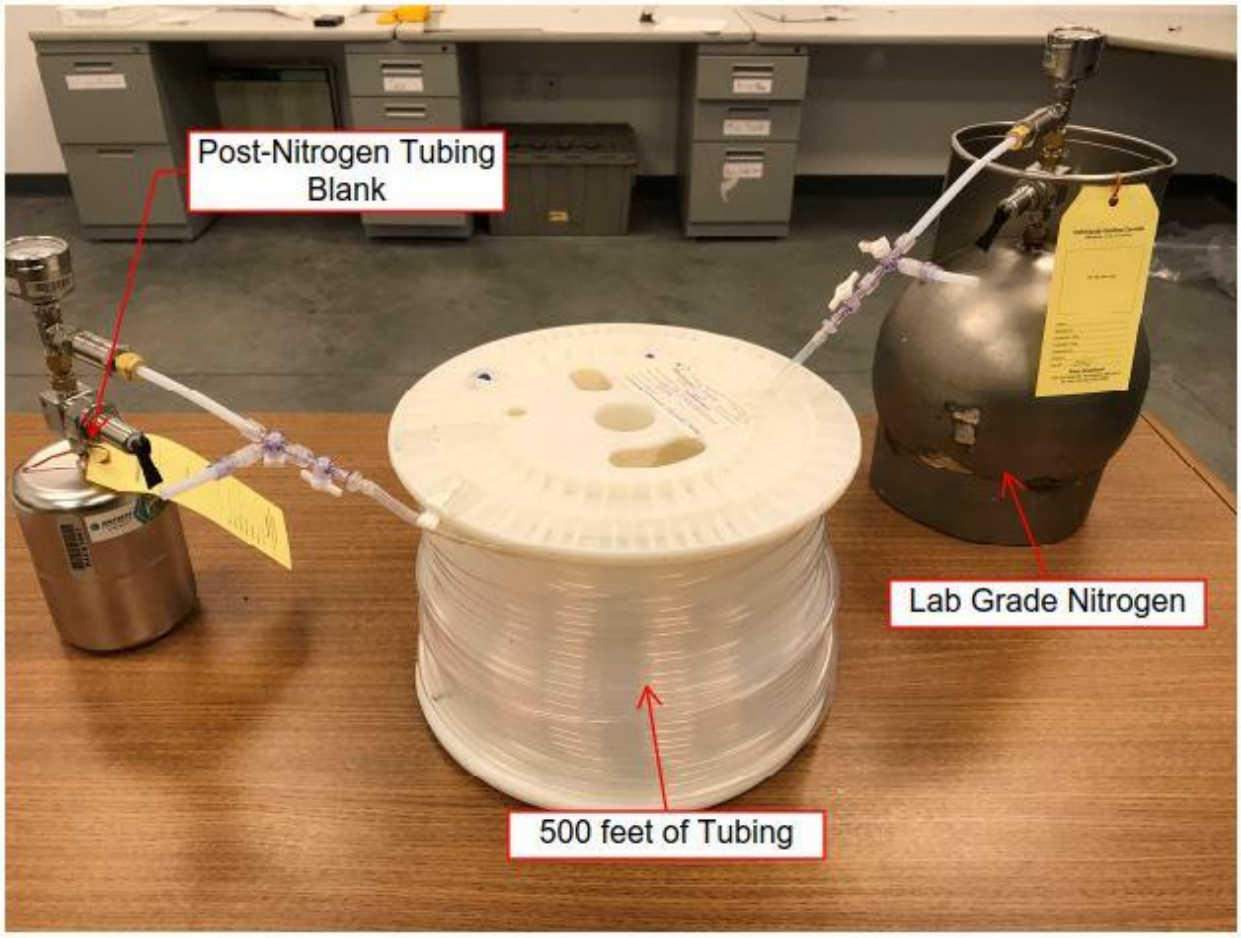
vacuum. If air sampling canister is not under full vacuum, do not use canister for sample collection. Record time sample collection began, initial vacuum, and sample container and flow regulator identifiers on the chain-of-custody. Open the valve between the sampling train and the roll of tubing.

⇒ Close air sampling canister valve when the vacuum on the air sampling canister reaches near 2 to 3 inches of mercury vacuum. Record the time sampling was completed and the final vacuum reading on the chain-of-custody. Final vacuum reading is recorded for comparison with the vacuum measured upon laboratory receipt to identify possible canister leaks during sample shipment.

⇒ After the tubing blank is collected from the roll of tubing, Remove the cap at the start of the tubing, if present and accessible. Connect the canister containing nitrogen to the starting end of the roll of tubing and an appropriate size individually laboratory certified sampling air sampling canister equipped with low-flow regulator [(i.e., <200 milliliters per minute (ml/min)] and vacuum gauge size canisters to the sampling train already connected to the end of the roll of tubing. Preform leak tests on both sampling trains to ensure there are no leaks.

⇒ After successful leak tests, open the valves of the nitrogen canister and associated sampling train and allow nitrogen to fill the sample train and 500 ft roll of tubing. The valve to the nitrogen tubing blank sample canister remains closed. Purge the tubing by allowing the entire canister of nitrogen to pass through the tubing. Close the valves on the canister and the sampling train once the nitrogen canister is empty (see the photograph below).

Soil-Gas Post-Nitrogen Tubing Blank Sample Setup



⇒ To begin sampling, ensure valve on purge tubing is closed. Open valve on air sampling canister and record canister vacuum. Initial vacuum reading should be approximately 30 +/- 3 inches of mercury vacuum. If air sampling canister is not under full vacuum, do not use canister for sample collection. Open the valve between the sampling train and the roll of tubing. Record time sample collection began, initial vacuum, and sample container and flow regulator identifiers on the chain-of-custody. If time permits the nitrogen may be allowed to equilibrate within the tubing for several hours to a few days before the nitrogen tubing blank is collected, although limited testing does not indicate there a significant difference in the results.

⇒ Close air sampling canister valve when the vacuum on the air sampling canister reaches near 2 to 3 inches of mercury vacuum. Record the time sampling was completed and the final vacuum reading on the chain-of-custody. Final vacuum reading is recorded for comparison with the vacuum

measured upon laboratory receipt to identify possible canister leaks during sample shipment.

⇒ Label the new roll of tubing after tubing blanks are collected. See illustration below:

Labeled 500 ft of tubing

⇒ If the starting end of the tubing is not accessible and not capped, the tubing blank sample, nitrogen purge, and the post nitrogen purge samples may be collected using the exposed end of the roll of tube. In this scenario, the tubing blank sample will be collected by connecting an individually laboratory certified canister to the roll of tubing using a sampling train to collect a sample of the air within the roll of tubing. The sampling train is then connected to the nitrogen cannister. The nitrogen is then used to purge the roll of tubing until the canister is empty and the tubing filled with nitrogen. The nitrogen canister is then removed and replaced with an individually laboratory certified canister. The sampling train is then purged with a syringe to leak check the sampling train. If the sampling train passes the leak check the purge valve is closed and the canister opened to collect sample from the nitrogen filled tubing. This

scenario assumes that as the sample is collected the air coming into the tubing displaces the nitrogen evenly across the width of the tubing.

⇒ If the starting end of the tubing is not accessible and not capped, the tubing blank sample and the post nitrogen purge samples may be collected using the exposed end of the roll of tube as described above. However, the nitrogen purge process is completed by alternating purging and filling of the tubing with nitrogen five times or until the nitrogen is canister is empty.

⇒ The purging procedures in the SOP have not been tested on larger diameter tubing, but should provide similar results if the volume of nitrogen used to purge the tubing is at least five times the volume of the tubing.