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Environment & Remediation Support Services

Standard Operating Procedure

for **SAMPLING FOR SUB-ATMOSPHERIC AIR**

APPROVAL SIGNATURES:

Subject Matter Expert:	**Organization**	**Signature**	**Date**
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1.0 PURPOSE AND SCOPE

The purpose of this procedure is to describe the process of sampling sub-atmospheric air at the Los Alamos National Laboratory (Laboratory) for the Environment & Remediation Support Services (ERSS).

2.0 BACKGROUND AND PRECAUTIONS

2.1 Background

This procedure is used in conjunction with an approved Site-Specific Health and Safety Plan (SSHASP).

The sample train is the primary component of the sub-atmospheric air-sampling system. It provides an interface between the vapor port and the down-hole packer sampling system. Several sampling instruments are necessary for subsurface air sampling:

- The Brüel and Krajer (B&K) Multi-gas Analyzer quantifies gaseous concentrations of several contaminants in the subsurface air sample;
- The SUMMA canister captures and contains an air sample for transport to an analytical laboratory; and
- The Adsorbent Column captures and contains water for tritium analysis by an analytical laboratory.

2.2 Precautions

- Properly documented field procedures must be followed to ensure wells and boreholes do not become damaged or contaminated during sampling activities;
- Waste generated from sampling activities must be handled in accordance with EP-ERSS-SOP-5022, Management of ER Project Wastes;
- Personnel safety procedures, such as safety practices and site-specific requirements determined by the Site Safety Officer (SSO) and the Site-Specific Health and Safety Plan (SSHASP) shall be observed to prevent exposure to hazardous materials and physical hazards;
- This procedure requires the use of compressed gas cylinders, pumps, and field-screening instruments. Instructions to ensure safe handling of compressed air systems are included in the Integrated Work Document (IWD);
- All equipment and materials must be handled in a safe manner consistent with the limitations stated by the manufacturer;
- All warning labels associated with the equipment must be read carefully;
- A material safety data sheet (MSDS) must be obtained from the SSO or manufacturer for all compressed gases and reagents;
- The Field Team Leader (FTL) shall ensure all Field Team Members have reviewed the MSDS of each gas or reagent before starting sampling operations;
- Vapor ports extend from the borehole cover and are connected to tubing and descend down the borehole. The vapor ports must be handled with care;

- Because of the harsh conditions in the field, the plastic tubing of the sampling lines and vapor ports may degrade over time, depth tags on the tubing or ports may become unreadable, or plugs may be lost. Any unusual conditions of the sampling lines (tubing) or vapor ports must be documented in the field logbook;
- Special care should be taken during the installation of the adsorbent columns into the sample train to minimize exposure to ambient air and to properly orient the column so the air stream flows in the correct direction through the column during sampling;
- Radon contamination may be present on some of the sampling lines or vapor ports. Invariably, radon will collect on the sampling lines or vapor ports because the plastic has a slightly negative static charge;
- When connecting the tubing or ports to the sample train, the Field Team Members may receive a radon dose, particularly from tubing or vapor ports at ground level;
- The human body has a slight positive charge, and the hands may attract minute amounts of radon when they come in contact with the vapor ports or plastic tubing. Clapping the hands to eliminate any built-up static charge may alleviate this problem. Nitrile gloves should be worn for protection, and they may also alleviate the problem of static charge; and
- Before the packer system is lowered into an open borehole, the borehole must be checked for any irregularities. This check may be done using a down-hole camera system.

3.0 EQUIPMENT AND TOOLS

- Sample Train;
- B&K Photo-acoustic Multi-gas Analyzer;
- SUMMA Canisters;
- Adsorbent Columns;
- Subsurface Vapor Ports; and
- Packer Sampling System.

4.0 STEP-BY-STEP PROCESS DESCRIPTION

4.1 Preparation		
Project Leader	1.	Prepare an equipment and supply checklist, if applicable, for use during implementation of this procedure.
Project Team Members	2.	Use only the equipment and supplies authorized by the responsible Project Leader.
	3.	Report to the Project Leader any equipment or supply item listed that is not available for use, and the need for equipment or supply items in addition to, or different from, the equipment and supplies listed on the equipment and supply checklist.

4.2	**Field Documentation**	
Field Team Leader	1.	Ensure the documentation of all field logbook entries in accordance with EP-ERSS-SOP-5009, Notebook Documentation for Environmental Restoration Technical Activities.
	2.	Document the following pre-sampling activities into the field logbook: • sample train inspection; • calibration; • port conditions; • tubing problems/solutions; • B&K operational check;
4.3	**Pre-sampling Activities**	
Field Team Members	1.	Identify appropriate sampling techniques to be used (i.e., B&K samples to determine the extent of contamination of chlorinated organic vapor in the subsurface air, SUMMA canisters to collect laboratory quality air samples for shipping, or adsorbent columns to sample subsurface water vapor in subsurface air).
	2.	Inspect all tubing, fittings, and valves on the sample train.
	3.	Inspect Swagelok fittings for degradation.
	4.	Tighten, as necessary, all fittings and valves that make up the assembly.
	5.	Ensure the power supply is functional.
	6.	Perform B&K operational check, if needed. [NOTE: The purpose of the operational check is to introduce a laboratory-certified organic gas mixture to the B&K to check the unit for proper operation.]
	7.	Sample three mixes of the Laboratory-certified calibration gas using the B&K. [NOTE: If the B&K reports a concentration equal to or better than 80% of the laboratory-certified concentration, the B&K is functioning properly.]
	8.	If the B&K operational check does not quantify the results of the analysis within 80% of the laboratory-certified concentrations, perform one or more of the following actions: • change the setup parameter (refer to B&K 1305 Operational Manual for instructions); • inspect the Tedlar™ bags [NOTE: The bags may degrade and fail (leak) over time]; or • call the manufacturer (California Instruments) at (714) 974-5560.
	9.	Before operating the B&K unit, read the Operational Manual for the B&K 1305 Unit.

Field Team Members (Continued)	10.	Adjust setup conditions of the B&K to ambient pressure and temperature.
	11.	Refer to the B&K 1305 Operational Manual for definitions of error messages.
	12.	Ensure the following equipment is available: • B&K Unit; • CGA 590 Bolt Compressed Gas Regulator; • three Tedlar™ bags; • a large adjustable wrench; • a length of ¼-inch Teflon™ tubing; and • calibration gas representative of the expected compounds and concentration ranges.
	13.	Inspect the ON/OFF switch, the functional buttons, power cord, the inlet line, and the outlet line.
	14.	Ensure the B&K has a functional power source.
	15.	Fill the Tedlar™ bags as the first step in the operational check. [NOTE: The Tedlar™ bags must be filled with gases that are contained in pressurized tanks and must be handled very carefully.]
	16.	Identify the concentration of the calibration gas.
	17.	Confirm the calibration gas concentration and the Tedlar™ bag calibration gas concentration label agree.
	18.	Use each bag only for a specific gas mix.
	19.	Ensure the regulator valve is closed.
	20.	Connect the regulator to the calibration gas bottle, and connect the Tedlar™ bag to the regulator.
	21.	Open the valve on the Tedlar™ bag and the valve on the bottle.
	22.	Slowly open the regulatory valve and fill the Tedlar™ bag.
	23.	Close the regulatory valve, the Tedlar™ bag valve, and the bottle valve.
	24.	Remove the Tedlar™ bag from the regulator.

Field Team Members (Continued)	25.	Open and close the regulator valve to release any gas in the regulator.
	26.	Remove the regulator from the gas bottle.
	27.	Turn on the B&K.
	28.	Connect the Tedlar™ bag to the B&K inlet line.
	29.	Open the Tedlar™ bag valve.
	30.	Begin continuous monitoring of the B&K. [NOTE: Refer to the B&K Operational Manual for instructions.]
	31.	Allow the B&K to take several samples of gas from the Tedlar™ bag.
	32.	Observe the B&K gas concentration display. [NOTE: The goal is to achieve concentration values equal to or greater than 80% of the laboratory-certified concentrations of the calibration gas mix.]
	33.	Document the operational check results in the field logbook.
	34.	Close the Tedlar™ bag valve and remove it from the inlet line.
	35.	If a packer system is used for sampling, check the inflatable packers and air line fittings for leaks before it is sent down-hole.

4.4 Sampling Activities (General)

Field Team Members	1.	Confirm bore-hole number and location.
	2.	Document the start of sampling activities in field logbook.
	3.	Identify and correlate the bore-hole number with field logbook bore-hole number.
	4.	Inspect the vapor port.
	5.	Document any abnormal conditions of the vapor port in the field logbook.
	6.	Purge the sample train for approximately 10 to 15 minutes with the purge pump to remove all stagnant air within the tubing and valves.
	7.	Connect the sample train inlet line to the vapor port.

4.5 B&K Sampling

Field Team Members	1.	Disconnect the B&K inlet line from the sample train.
	2.	Ensure the B&K is in “Continuous Monitoring” mode.
	3.	Press the “Standby” button on the B&K control display to start the sampling cycle.
	4.	Allow the B&K to take three ambient air readings, and record the gas concentrations for each in the field logbook.
	5.	Press the “Standby” button to stop the sampling cycle.
	6.	Connect the B&K inlet line to the B&K outlet of the sample train.
	7.	Ensure the sample train valve is on “Purge”.
	8.	Ensure the CO_2 meter inlet line is connected to the purge pump outlet line and is operating.
	9.	Activate the purge pump and purge the vapor sampling line to depth.
	10.	Observe the CO_2 measurement carefully while purging the line.
	11.	When the CO_2 level stabilizes, read and record the measurement into the field logbook.
	12.	Deactivate the pump and quickly turn the sample train valve from “Purge” to “B&K”.
	13.	Press the “Standby” button on the B&K control panel to start the sampling cycle.
	14.	Record the measurement of the B&K analysis and the current date and time in the field logbook.
	15.	Press the “Standby” button to stop the sampling.
	16.	Disconnect the sample train inlet line from vapor port.

4.6 SUMMA Sampling

Field Team Members	1.	Ensure the action steps from Section 4.4 are completed.
	2.	Activate the purge pump and purge the vapor sampling line to depth.
	3.	Observe the CO_2 measurement carefully while purging the line.
	4.	When the CO_2 level stabilizes, record the measurement in the field logbook.
	5.	Disconnect the sample train from the vapor port.
	6.	Connect pressure valve with the vacuum gauge to the vapor port.
	7.	Ensure all the valves are closed.
	8.	Attach the SUMMA canister to the pressure valve.
	9.	Open the valve on the SUMMA canister and check the vacuum gauge for proper vacuum.
	10.	Open the pressure valve. [NOTE: The SUMMA canister will draw an air sample because of the vacuum in the canister.]
	11.	Close the valve on the canister when the gauge indicates the pressures in the canister and atmospheric pressure have equilibrated.
	12.	Complete the identification tag of the canister.
	13.	Document SUMMA canister sampling in the field logbook, in the sample collection log, and on the chain-of-custody forms.
	14.	Disconnect pressure valve from vapor port.
	15.	Store the canister in the shipping container, and ship to the Laboratory SMO in accordance with EP-ERSS-SOP-5057, Handling, Packaging, and Shipping of Samples.

4.7 Adsorbent Column Sampling

Field Team Members	1.	Ensure the action steps from Section 4.4 are completed.
	2.	Measure the mass of the adsorbent columns before field activities start, and record the data in the field logbook.
	3.	Activate purge pump and purge the vapor sampling line to depth.
	4.	Observe the CO_2 measurement carefully while purging the line.
	5.	When the CO_2 level stabilizes, record the measurement in the field logbook.
	6.	Connect the adsorbent column to the exhaust of the sample train.
	7.	Activate pump to pull air through the adsorbent column until the mass of the column is increased by at least 5 g.
	8.	Quickly remove column and seal the ends.
	9.	Document the adsorbent column sample in the field logbook, in the sample collection log, and on the chain-of-custody forms.
	10.	Submit samples to the Laboratory's SMO in accordance with EP-ERSS-SOP-5057, Handling, Packaging, and Shipping of Samples.

4.8 Sampling Through the Packer System

Field Team Members	1.	Connect the proper size packer along with the desired separation between packers (if using two packers) and record the information in the logbook.
	2.	Lower the packer(s) to the desired depth, and record the information in the logbook.
	3.	Inflate the packer(s) to the desired pressure.
	4.	Record the pressure in the logbook, and continue to monitor the pressure throughout the sampling process.
	5.	If the pressure drops below 1 psi, re-inflate the packer(s). [NOTE: Low pressure indicates the sample zone may not be isolated.]
	6.	Connect the sample line to the sample train.
	7.	Deflate the packer(s) before pulling them out of the borehole.

4.9 Post-sampling Activities		
Field Team Members	1.	Dispose of any tubing that is visibly damaged or contaminated.
	2.	Ensure purge indicator gas concentrations (i.e., CO_2) remain constant. [NOTE: They should remain constant if the sample stream is free of leaks and a proper purge is achieved.]
	3.	Ensure the quality of the sample by eliminating any leaks in the system.
	4.	Whenever two or more gas lines are connected, confirm the connection is free of visible and audible leaks.
	5.	Whenever data quality is questionable or possibly compromised, inspect all connections for leaks.

4.10 Records		
Field Team Leader	1.	Submit the following records generated by this procedure to the Records Processing Facility: • Completed chain-of-custody/request for analysis forms; • Closed out field logbooks; and • Completed sample collection logs.

5.0 PROCESS FLOW CHART

Flow chart is to be included at a later date.

6.0 ATTACHMENTS

None.

7.0 REVISION HISTORY

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Revision No. *[Enter current revision number, beginning with Rev.0]*	Effective Date *[DCC inserts effective date for revision]*	Description of Changes *[List specific changes made since the previous revision]*	Type of Change *[Technical (T) or Editorial (E)]*
0.0	02/09/07	New document number, reformatted and renumbered. Supersedes SOP-06.31	E

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