

**Attachment C**

Loss Prevention Observation  
Form

# Loss Prevention Observation

Observer Name		Observer Title		Project/Project Number	
Date _____ Time ____ <input type="checkbox"/> AM <input type="checkbox"/> PM		Project Type / Task Observed			
<b>Background Information</b>					
<b>List Critical Work Procedures</b>					
<b>List Issue/Items Requiring Corrective Action</b>					
<b>Root Cause Analysis</b>					
1. Employee lacks the skill or knowledge to carry out duties 2. Procedures, work standards, or expectations were not communicated 3. Procedures or work standards were not developed or were inadequate 4. Equipment, systems, or tools were inadequate			5. Employee chose not to take the time or put forth the effort to do the job properly 6. Supervisor did not require the employee to follow the standard procedure 7. Employee doesn't see any advantage to doing the job to standard. 8. Uncontrollable.		
Criterion #	RCA #	Corrective Action Identified	Responsible Individual	Due Date	Closure Date
<b>Results of Corrective Action</b>					
Reviewed by		Date	Reviewed by		Date

# Environmental Operations

		Correct	Questionable	Comments
1.	<b>PRE-TASK PREPARATION</b>			
2.	Health and Safety Plan / MSDSs on site			
3.	Employee familiar / trained on task			
4.	OSHA-required training/medical surveillance			
5.	Utility mark out / check performed			
6.	Traffic hazard addressed / work area marked			
7.	Walking / working surfaces free of hazards			
8.	Tailgate safety meeting performed			
9.	Impact on nearby residence/business evaluated			
10.	Communicates intentions to other personnel			
11.	Knowledge of emergency procedures			
12.	Distance between equipment and power lines			
13.	Personal protective equipment			
14.	Air monitoring equipment on site, calibrated			
15.	First aid kit / fire extinguisher on site			
16.	One person trained in first aid / CPR			
17.	Work zones established and marked			
18.	<b>PERFORMING TASK</b>			
19.	Employee trained in task to be performed			
20.	Correct body positioning			
21.	Proper lifting / pushing / pulling techniques			
22.	Keep hands / body away from pinch points			
23.	Walking / working surfaces kept clear of debris			
24.	Faces traffic as appropriate			
25.	Vehicles/ barricades to protect against traffic			
26.	Drill rig located properly, blocked / chocked			
27.	Drill rig moved only with derrick lowered			
28.	Excavator located on stable ground			
29.	Eye contact made with equipment operator			
30.	Spoil at least 2 feet back from edge of excavation			
31.	Excavation shored/sloped/benched			
32.	Excavation entry controlled			
33.	Equipment/tools used properly			
34.	Electrical equipment connected through GFCI			
35.	Power tools handled properly			
36.	Electrical cords inspected / in good condition			
37.	Follows lockout / tagout procedures			
38.	Air monitoring conducted/action levels understood			
39.	Equipment decontaminated properly			
40.	Personnel decon prior to eating/drinking/smoking			
41.	Decontamination effective			
42.	<b>POST – TASK</b>			
43.	Procedures / JSA adequate			
44.	Equipment / tools stored properly			
45.	Proper storage of soil / water / waste material			
46.	Work area secured			
47.	Other			

**Attachment D**

Health and Safety Inspection Form

<b>Project Name:</b>	<b>Date:</b>			
<b>Project Number:</b>	<b>Location:</b>			
<b>Prepared By:</b>	<b>Project Manager:</b>			
<b>Auditor:</b>	<b>HSS On Site:</b>			
	<b>YES</b>	<b>NO</b>	<b>N/A</b>	<b>COMMENTS</b>
<b>GENERAL</b>				
Is the HASP on site?				
Is the HASP finalized and approved?				
Is the OSHA poster displayed?				
Are emergency telephone numbers posted?				
Is emergency eyewash immediately available?				
Is an emergency shower immediately available?				
Are emergency notification means available (radio, telephone)?				
Is a first-aid kit immediately available?				
Is the first-aid kit adequately stocked?				
Is there a proper sanitation facility on site?				
<b>DOCUMENTATION AND RECORDKEEPING</b>				
Are only personnel listed and approved in the HASP on site?				
Are all personnel properly trained? (Check company-issued wallet cards.)				
Is the daily field log kept by the Site Manager?				
Are levels of PPE recorded?				
Are contaminant levels recorded?				
Are site surveillance records kept by HSS?				
Is a copy of current fit test records on site?				
Are calibration records maintained for air monitoring equipment?				
Are accident / incident forms on site?				
Are field team review sheets signed?				
Are additional hospital route directions available?				
Is the visitors' logbook being accurately maintained?				
Are MSDSs available for all chemicals on site?				
Are HASP revisions recorded?				
Is the first-aid kit inspected weekly?				
Are daily safety meetings held?				
Are emergency procedures discussed during safety meetings?				

	YES	NO	N/A	COMMENTS
<b>EMERGENCY RESPONSES</b>				
Is a vehicle available on site for transportation to the hospital?				
Are fire extinguishers on site and immediately available at designated work areas?				
Is at least one person trained in CPR and first aid on site at all times during work activities?				
Do all personnel know who is trained in CPR / first aid?				
<b>PERSONAL PROTECTIVE EQUIPMENT (PPE)</b>				
Is proper PPE being worn as specified in HASP?				
Level of PPE being worn.				
Is PPE adequate for work conditions?				
If not, give reason.				
Upgrade/downgrade to PPE level.				
Does any employee have facial hair that would interfere with respirator fit?				
If yes, willing to shave, as necessary?				
Fit-tested within the last year? (Documentation present)				
If Level B, is a back-up / emergency person suited up (except for air)?				
Does the HSS periodically inspect PPE and equipment?				
Is the PPE not in use properly stored?				
Is all equipment required in the HASP on site?				
Properly calibrated?				
In good condition?				
Used properly?				
Other equipment needed?				
List.				
Is monitoring equipment covered with plastic to minimize contamination?				
<b>PERSONNEL AND EQUIPMENT DECONTAMINATION</b>				
Is the decontamination area properly designated?				
Is appropriate cleaning fluid used for known or suspected contaminants?				
Are appropriate decontamination procedures used?				
Are decontamination personnel wearing proper PPE?				
Is the equipment decontaminated?				

	YES	NO	N/A	COMMENTS
<b>PERSONNEL AND EQUIPMENT DECONTAMINATION (continued)</b>				
Are sample containers decontaminated?				
Are disposable items replaced as required?				
<b>WORK PRACTICES</b>				
Was proper collection and disposal of potentially contaminated PPE performed?				
Was proper collection and disposal of decontamination fluid performed?				
Is water available for decontamination?				
Is the buddy system used?				
Is equipment kept off drums and the ground?				
Is kneeling or sitting on drums or the ground prohibited?				
Do personnel avoid standing or walking through puddles or stained soil?				
Are work zones established?				
If night work is conducted, is there adequate illumination?				
Is smoking, eating, or drinking in the exclusion or CRZ prohibited?				
To the extent feasible, are contaminated materials handled remotely?				
Are contact lenses not allowed on site?				
Is entry into excavations not allowed unless properly shored or sloped?				
Is a competent person on site during excavation?				
Are all unusual situations on site listed in HASP?				
If not, when?				
Action taken?				
HASP revised?				
<b>CONFINED SPACE ENTRY</b>				
Are employees trained according to 1910.146 – Confined Space Entry?				
Are all confined spaces identified? If not, list:				
Is all appropriate equipment available and in good working order?				
Is equipment properly calibrated?				
Are confined space permits used?				
Are confined space permits completely and correctly filled out?				

\*N/A = Not Applicable

ARCADIS

**Attachment E**

Safety Meeting Log



<b>Project:</b>	<b>Location:</b>
<b>Date / Time:</b>	<b>Activity:</b>
<b>1. Work Summary</b>	
<b>2. Physical / Chemical Hazards: Has JSA been reviewed/modified to address changing conditions?</b>	
<b>3. Protective Equipment/Procedures</b>	
<b>4. Emergency Procedures</b>	
Is there anyone with any medical conditions that they would like the team to know about? For example: Medic Alert, Allergic to bee stings, nitro for chest pains, etc.	
Location of medical equipment: fire extinguishers, first aid kit, route to hospital, auto-injectors, etc.	
<b>5. Signatures of Attendees</b>	

ARCADIS

**Attachment F**

Air Monitoring Log

Date:

**Air Monitor:**

### Activity:

**Level of Protection:**

[illegible]

**Attachment G**

Underground/Overhead Utilities  
Checklist

<b>Project Name:</b>	<b>Date:</b>
<b>Project Number:</b>	<b>Location:</b>
<b>Prepared By:</b>	<b>Project Manager:</b>

This checklist must be completed for any intrusive subsurface work such as excavation or drilling. It documents that overhead and underground utilities in the work area are identified and located. The Project Manager shall request utility markouts before the start of field operations to allow the client and utility companies sufficient time to provide them. If complete information is not available, a magnetometer or other survey shall be performed to locate obstacles prior to intrusive subsurface activities.

**Procedure:** A diagram of the work area depicting the proposed location of intrusive subsurface work sites (i.e., boring locations, excavation locations) must be attached to this form. The diagram must clearly indicate the areas checked for underground structures / utilities, and overhead power lines. This form and the diagram must be signed by the BBL Project Manager (if present), the BBL Site Supervisor, and the client representative.

Type of Structure	Present	Not Present	Method of Markout
Electric Power Line			
Natural Gas Line			
Telephone Line			
Water Line			
Product Line			
Sewer Line			
Steam Line			
Drain Line			
Underground Tank			
Underground Cable			
Overhead Power Line			
Overhead Product Line			
Other (Specify)			

Reviewed By		
Name	Job Title	Date
	Client Representative	
	BBL Project Manager	
	BBL Site Supervisor	



**Attachment 5**

DNAPL Contingency Plan

**National Fuel Gas Distribution Corporation**

**Appendix D**  
**DNAPL Contingency Plan**

Dunkirk Former Manufactured Gas Plant Site  
(Site No. 9-07-035)  
Dunkirk, New York

February 2009

## **I. Scope and Application**

This document has been prepared to guide drilling activities at sites where there is a reasonable expectation that dense, non-aqueous phase liquid (DNAPL) may be present, and provide procedures to be implemented in the event that DNAPL is encountered during subsurface investigations. These procedures are proposed to limit the potential of remobilizing DNAPL, if any, in response to drilling and sampling activities. In addition, the procedures are designed to optimize the recovery of encountered DNAPL (if any) in a safe and efficient manner. This DNAPL Contingency Plan was developed based on a similar document prepared by DNAPL expert Bernard H. Kueper, Ph.D., P.Eng., of Queens University, for an EPA Region 1 Superfund Site (Kueper, May 1995).

Downward DNAPL mobilization from overburden into the bedrock may occur in response to drilling activities (short-circuiting along drill stem and/or completed well screen) and groundwater extraction (creation of downward hydraulic gradient in excess of previously measured downward gradients). This DNAPL Contingency Plan addresses drilling-related issues.

## **II. Personnel Qualifications**

DNAPL contingency field activities will be performed by persons who have been trained in proper drilling and well installation procedures under the guidance of an experienced field geologist, engineer, or technician.

## **III. Equipment List**

The following materials will be available during soil boring and monitoring well installation activities, as required:

- Work Plan, Field Sampling Plan (FSP), and site Health and Safety Plan (HASP)
- personal protective equipment (PPE), as required by the HASP
- equipment specified under drilling and well installation SOPs
- hydrophobic dye (Oil Red O or Sudan IV), pertinent at chlorinated solvent sites



- disposable polyethylene pans for performing soil-water pan tests
- clean, empty jars for performing soil-water shake tests

#### **IV. Cautions**

The presence or absence of DNAPL at a site can have significant implications in terms of site management, health and safety, and the feasibility of potential remedial alternatives. Therefore, field personnel must be attentive to the potential for DNAPL, recognize when DNAPL is encountered during drilling, and accurately document field observations indicating the presence of DNAPL and interpreted DNAPL depth. In addition, opportunities to characterize DNAPL, when present, may be rare. When practicable, DNAPL samples should be collected and analyzed for physical and chemical characteristics.

#### **V. Health and Safety Considerations**

Field activities associated with this DNAPL Contingency Plan will be performed in accordance with the site HASP, a copy of which will be present on site during such activities.

#### **VI. Procedure**

##### **DNAPL Screening During Overburden Drilling**

To screen for the potential presence of DNAPL in soil, drilling procedures must allow for high-quality porous media samples to be taken. Split-spoon samples or direct-push samplers should be taken continuously in 2-foot intervals ahead of the auger or drill casing. Upon opening each split-spoon sampler or direct-push plastic liner sleeve, the soil will immediately be screened for the presence of organic vapors using a portable photoionization detector (PID) or organic vapor analyzer (OVA). During screening, the soil will be split open using a clean spatula or knife and the PID or OVA probe will be placed in the opening and covered with a gloved hand. Such readings will be obtained along the entire length of the sample.

If the PID or OVA examination reveals the presence of organic vapors above 100 parts per million (ppm), the sample will undergo further detailed evaluation for visible non-aqueous phase liquid (NAPL). The assessment for NAPL will include a combination of the following tests/observations:

- Evaluation for Visible NAPL Sheen or Free-Phase NAPL in Soil Sampler – The NAPL sheen will be a colorful iridescent appearance on the soil sample. NAPL may also appear as droplets or continuous accumulations of liquid with a color typically ranging from yellow to brown to black, depending on the type of NAPL. Creosote DNAPL (associated with wood-treating sites) and coal-tar DNAPL (associated with manufactured gas plant [MGP] sites) are typically black and have a characteristic, pungent odor. Pure chlorinated solvents may be colorless in the absence of hydrophobic dye. Solvents mixed with oils may appear brown.
- Soil-Water Pan Test – A portion of the selected soil interval with the highest PID or OVA reading > 100 ppm will be placed in a disposable polyethylene dish along with a small volume of potable or distilled water. The dish will be gently tilted back and forth to mix the soil and water, and the surface of the water will be viewed in natural light to observe the development of a sheen, if any. A small quantity of Oil Red O or Sudan IV hydrophobic dye powder will be added and the soil and dye will be manually mixed for approximately 30 to 60 seconds and smeared in the dish to create a paste-like consistency using a new nitrile glove-covered hand. A positive test result will be indicated by a sheen on the surface of the water and/or a bright red color imparted to the soil following mixing with dye.
- Soil-Water Shake Test – A small quantity of soil (up to 15 cc) will be placed in a clear, colorless, 40-mL vial containing an equal volume of potable or distilled water. After the soil settles into the water, the surface of the water will be evaluated for a visible sheen. The jar will be closed and gently shaken for approximately 10 to 20 seconds. Again, the surface of the water will be evaluated for a visible sheen or a temporary layer of foam. A small quantity (approximately 0.5 to 1 cc) of Oil Red O or Sudan IV powder will be placed in the jar. The sheen layer will be evaluated for a reaction to the dye (change to bright red color). The jar will be closed and gently shaken for approximately 10 to 20 seconds. The contents in the closed jar will be examined for visible bright red dyed liquid inside the jar. A positive test result will be indicated by the presence of a visible sheen and foam on the surface of water, a reaction between the dye and the sheen layer upon first addition of the dye powder, a bright red coating the inside of the vial (particularly above the water line), or red-dyed droplets within the soil.
- Estimation of Relative Degree of NAPL Saturation – When NAPL is interpreted as present in a particular portion of soil, the field geologist will attempt to estimate the relative degree of NAPL saturation in the soil. Specifically, based on the apparent, visible continuity of NAPL within the soil, an interpretation will be made as to whether the observed NAPL is pooled (continuous section of soil across entire diameter of soil sample in which the pore spaces are filled with a mixture of

NAPL and water) or residual (isolated droplets or blebs of NAPL, surrounded by pore spaces containing only water).

If NAPL is obviously present upon opening the soil sampler or evaluating the soil sample within the split-spoon sampler or direct-push liner sleeve, it is not necessary to perform a soil-water pan test or soil-water shake test. In addition, it is not necessary to perform both a soil-water pan test and a soil-water shake test. Either test method is acceptable. The pan test may be preferred in some circumstances because the presence of a sheen may be easier to see on a wider surface.

The results of each test or observation will be recorded in the field notebook.

### **DNAPL Screening During Bedrock Drilling**

To screen for the potential presence of DNAPL in bedrock, drilling fluids, rock cuttings, and/or core samples are monitored for the presence of sheens. During drilling using rotary methods (coring or roller bit drilling with water or drilling mud), the return fluid will be screened with a PID or OVA and evaluated continuously for the presence of a sheen in the recirculation tub. Where core samples are obtained, they will be carefully evaluated for the presence of a sheen on fracture surfaces. During drilling using air-rotary methods, rock cuttings will be continuously screened using a PID or OVA and evaluated for the presence of a sheen. During drilling with rotary methods, the positive head level at the borehole will reduce the potential for DNAPL short-circuiting via the borehole.

If a sheen is observed with any of these methods, drilling will be temporarily discontinued and an evaluation will be undertaken to determine whether pooled DNAPL is present. The drill stem will be retracted to a few feet above the apparent depth where the sheen was first encountered. Groundwater will be extracted from the borehole to produce a drawdown of 5 to 10 feet below the approximate static, non-pumping water level for a period of 20 minutes to test for the presence of pooled, mobilizable DNAPL in the fractures surrounding the open borehole. The bottom of the borehole will then be evaluated for the presence of DNAPL using an interface probe or bottom-loading bailer. If no DNAPL is observed, the interpretation will be made that the sheen was not produced by pooled DNAPL. In this case, if drilling by the rotary method, the recirculation water will be replaced by clean water and drilling will continue. Replacing the recirculation water reduces the potential for cross-contamination and facilitates observation of a newly created sheen, if any, at a deeper interval. Accumulation of DNAPL in the bottom of the borehole, however, indicates that the boring has encountered pooled DNAPL. If DNAPL has accumulated, it will be removed using a bottom-loading bailer or pump.

### Data Collection Below Zone Containing Pooled DNAPL

If pooled DNAPL is encountered in a borehole and deeper drilling is required to collect data below a zone containing pooled DNAPL, one of the following actions will be taken.

1. Adjustment of Drilling Location - The boring where pooled DNAPL was encountered will be abandoned by tremie grouting using neat cement grout and a replacement boring will be re-attempted at a nearby location.
2. DNAPL Sump Installation - A DNAPL collection well will be installed with a blank sump properly grouted in place below the screen and the boring will be re-attempted at a nearby location. In this case, after removing the DNAPL in the borehole, the boring may be advanced an additional 2 to 3 feet to accommodate a blank sump below the interval with apparent pooled DNAPL.
3. Casing Off DNAPL Layers - If pooled DNAPL is found to be present throughout an area where deeper drilling is essential, a permanent, grouted casing should be installed. The bottom of the pooled DNAPL likely coincides with the top of a relatively fine-grained, low permeability, stratum (capillary barrier). Permanent casing will be installed to the bottom of the borehole and grouted in place using the displacement method prior to advancing the borehole any further. In this case, after removing any DNAPL that may have accumulated in the borehole, the boring may be advanced a few feet into the top of the underlying confining layer or up to 5 feet in bedrock prior to grouting the casing to assist in isolating the zone containing apparently pooled DNAPL. When the casing is grouted in place and the grout has set, the drilling recirculation water will be replaced with clean water to prevent cross-contamination and facilitate observation of a newly created sheen (if any) at a deeper interval, and drilling will continue.

### DNAPL Monitoring

New wells installed in borings where DNAPL was encountered during drilling will be monitored for DNAPL accumulation in the DNAPL sump using an oil-water interface probe or bottom-loading bailer within approximately one day following initial installation. If DNAPL is encountered, a bottom-loading bailer or pump will be used to remove the DNAPL, the final DNAPL thickness will be recorded, and the DNAPL thickness will be reassessed after another day of accumulation (if any). This process will be repeated until DNAPL no longer accumulates overnight, at which point the accumulation monitoring and removal period will extend to one-week intervals. If no DNAPL accumulation is observed over a period of one week, further DNAPL monitoring may be continued with a longer period between monitoring events.

Any DNAPL recovered during drilling and monitoring activities should be analyzed for chemical composition, DNAPL-water interfacial tension, density, and viscosity. The physical tests should be performed at the approximate groundwater temperature at the site where the DNAPL sample was obtained, typically between 10°C and 20°C. These parameters will allow for correlation of groundwater chemistry with suspected DNAPL locations and will allow an estimate to be made of the volume and potential mobility of DNAPL, if any, in the formation.

## **VII. Waste Management**

DNAPL removed from wells will be temporarily stored on-site in metal drums for subsequent appropriate off-site disposal. The locations and volumes of recovered DNAPL will be noted.

## **VIII. Data Recording and Management**

Any occurrence of DNAPL encountered during subsurface investigations will be documented in an appropriate field notebook in terms of the drilling location (boring or well identification), depth below surface, type of geologic material DNAPL was observed within, field screening and testing results, and apparent degree of DNAPL saturation (pooled or residual). DNAPL locations and depths will be recorded on subsurface log forms, as appropriate.

## **IX. Quality Assurance**

DNAPL can be mobilized downward as a result of drilling operations. It is very difficult to drill through DNAPL without bringing about vertical DNAPL mobilization. This opinion is stated by USEPA (1992): "In DNAPL zones, drilling should generally be minimized and should be suspended when a potential trapping layer is first encountered. Drilling through DNAPL zones into deeper stratigraphic units should be avoided." The DNAPL screening procedure outlined in this plan should, therefore, be implemented while drilling at all locations and depths within overburden or bedrock where potential DNAPL presence is suspected. If data collection is required below a zone containing DNAPL, the interval containing DNAPL will be cased off prior to drilling deeper.

## **X. References**

Kueper, B.H., May 11, 1995. DNAPL Contingency Plan. [Prepared at the request of *de maximis, inc.*].

United States Environmental Protection Agency (USEPA), 1992. Memorandum from D. Clay: Considerations in Ground-Water Remediation at Superfund Sites and RCRA Facilities – Update. OSWER Directive No. 9283.1-06.



**Attachment 6**

Community Air Monitoring Plan

## **National Fuel Gas Distribution Corporation**

### **Community Air Monitoring Plan**

Dunkirk Former Manufactured Gas Plant Site  
Dunkirk, New York

March 2012





## **Community Air Monitoring Plan**

Dunkirk Former Manufactured  
Gas Plant Site  
Dunkirk, New York

Prepared for:  
National Fuel Gas Distribution Corporation

Prepared by:  
ARCADIS of New York, Inc.  
6723 Towpath Road  
P O Box 66  
Syracuse  
New York 13214-0066  
Tel 315.446.9120  
Fax 315.446.8053

Our Ref.:  
B0023301.0001.00002

Date:  
March 2012

<b>1. Introduction</b>	<b>1</b>
1.1 General	1
1.2 Site Description	1
1.3 Summary of Investigation Activities	2
1.4 Air/Odor Emissions and Control Measures	2
<b>2. Air Monitoring Procedures</b>	<b>3</b>
2.1 General	3
2.2 Monitoring Location Selection	3
2.3 VOCs Monitoring	3
2.4 Particulate Matter Monitoring	4
2.5 Action Levels	4
2.5.1 Action Levels for VOCs	4
2.5.2 Action Level for PM <sub>10</sub>	5
2.6 Meteorological Monitoring	6
2.7 Instrument Calibration	6
<b>3. Monitoring Schedule and Data Collection and Reporting</b>	<b>7</b>
3.1 General	7
3.2 Monitoring Schedule	7
3.3 Data Collection and Reporting	7

**Attachments**

- |   |  |
|---|--|
| A | NYSDOH Generic Community Air Monitoring Plan (from NYSDEC DER-10/Technical Guidance for Site Investigation and Remediation [May 2010]) |
| B | Monitoring Equipment Specifications  |

## **1. Introduction**

### **1.1 General**

This *Community Air Monitoring Plan* (CAMP) has been prepared to support the implementation of investigation activities at the Dunkirk Former Manufactured Gas Plant (MGP) site (hereafter referred to as “site”), in Dunkirk, Chautauqua County, New York. The purpose of this CAMP is to describe the activities that will be conducted to monitor for potential airborne releases of constituents of concern during investigation activities. This CAMP fulfills the requirements set forth in the New York State Department of Environmental Conservation’s (NYSDEC’s) DER-10/Technical Guidance for Site Investigation and Remediation (May 2010) (DER-10). The DER-10 CAMP requirements are identified in DER-10 Appendix 1A, New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan, dated December 2009; and Appendix 1B, Fugitive Dust and Particulate Monitoring. DER-10 Appendices 1A and 1B are provided in Attachment A to this CAMP. The intent of this CAMP is to provide for a measure of protection of the downwind communities from potential airborne releases of constituents of concern during investigation activities. As such, this CAMP specifies the potential air emissions, air monitoring procedures, monitoring schedule and data collection and reporting for the investigation activities to be conducted, as described below.

### **1.2 Site Description**

The approximately three-acre site is located at 31 West 2<sup>nd</sup> Street at the southeastern corner of the intersection of Swan Street and West 2<sup>nd</sup> Street in Dunkirk, Chautauqua County, New York. The site comprises a generally rectangular piece of land that is located in a mixed commercial and residential area. Lake Erie is located about 600 feet north of the site. The site is bordered by Swan Street to the west, West 2<sup>nd</sup> Street to the north, Eagle Street to the east, and an elevated railroad bed to the south. A Baptist Church is located near the southeastern corner of the site; however, a narrow strip of National Fuel property borders the church property to the south.

A National Fuel Service Center building sits on the northeastern quadrant of the site. The Service Center building consists of a high-bay garage located south of the attached office area. Two other buildings are present at the property – a small metal sided storage building and a brick gas regulator building, which are both located south-south west of the Service Center building. A fuel pump island is located west of the metal sided storage building and consists of a pump island supported by an above

ground storage tank (AST) containing diesel and an underground storage tank (UST) containing gasoline.

Refer to Figure 2 of the Site Characterization Work Plan (ARCADIS, 2009) for a visual depiction of site features.

### **1.3 Summary of Investigation Activities**

As defined in the NYSDOH's Generic CAMP (included as Attachment A), investigation activities to be performed at the site have the potential to generate localized impacts to air quality. Activities covered by this CAMP may include:

- drilling soil borings
- excavating test pits or trenches
- sampling soil
- sampling groundwater from monitoring wells

### **1.4 Air/Odor Emissions and Control Measures**

Air emissions control and fugitive dust suppression techniques will be used during the investigation activities identified above, as necessary, to limit the air/odor emissions from the site. Air monitoring for the specific purpose of protecting the community from site activity impacts (and verification thereof) will take place during both intrusive and non-intrusive investigation activities. Odor and dust control measures will be available at the site and used when necessary during these activities. The following vapor and dust control measures may be used during these activities, depending upon specific circumstances, visual observations, and air monitoring results:

- Polyethylene sheeting (for covering drill cuttings, etc.)
- Water/BioSolve<sup>®</sup> spray
- Minimizing excavation surface area to be exposed at any given time.
- Vapor suppression foam

Polyethylene sheeting/BioSolve<sup>®</sup>/foam would be used to control nuisance odors and volatile organic compound (VOC) emissions, as needed. Also, dust emissions at the site will be controlled by spraying water on exposed dry surface soil areas (e.g. stockpiled drill cuttings, etc., as appropriate), through the use of silt fences, and by covering soil stockpiles. Odor and dust control measures will be implemented based on visual or olfactory observations, and the results of airborne particulate and VOC monitoring.

## **2. Air Monitoring Procedures**

### **2.1 General**

Real-time air monitoring will be implemented at the site for VOCs, and particulate matter less than 10 microns in diameter (PM<sub>10</sub>). A site boundary will be established for the purpose of air monitoring. Upwind and downwind monitoring locations will be determined through visual observation (wind vane, windsock, or similar technique). Monitoring will occur at each sample location and will include the use of hand-held direct-reading survey instruments.

### **2.2 Monitoring Location Selection**

Monitoring activities will be determined daily based on visual observation of a wind direction. One upwind and one downwind monitoring location will be selected daily where both VOC and PM<sub>10</sub> will be recorded. This upwind location will be established at the start of the workday, each day before the start of activities. Sampling activities will continue in the downwind direction throughout the day. If wind direction during the workday shifts greater than approximately +/-60 degrees from original upwind, then new upwind and downwind monitoring locations will be established. Any location changes will be documented in the field logbook.

### **2.3 VOCs Monitoring**

As required by the NYSDOH guidance for community air monitoring during intrusive activities, VOCs will be monitored continuously during ground intrusive activities (installation of soil borings and excavating test pits/trenches) with instrumentation that is equipped with electronic data-logging capabilities. A MiniRAE 2000 (or equivalent) will be used to conduct the real-time VOC monitoring. Attachment B provides detailed information on the MiniRAE 2000. All 15-minute readings will be recorded in the field logbook, as well as any instantaneous readings taken to facilitate activity decisions.

During non-intrusive site activities (collection of soil samples, well development, collection of groundwater samples), VOCs will be monitored periodically. Periodic monitoring may include monitoring upon arrival at the sample location, monitoring while opening a well cap, monitoring during well bailing and/or purging, and/or monitoring prior to leaving a sample location. However, if a sampling location is near

potentially exposed individuals, VOCs will be monitored continuously during sampling activities at that location.

## **2.4 Particulate Matter Monitoring**

As required by the NYSDOH guidance (Attachment A), real-time particulate matter will be monitored continuously during intrusive site activities using instrumentation equipped with electronic data-logging capabilities. A MIE DataRAM (or equivalent) will be used to conduct the real-time PM<sub>10</sub> monitoring. Attachment B provides detailed information on the MIE DataRAM. All 15-minute readings will be recorded in the field logbook, as well as any instantaneous readings taken to facilitate activity decisions.

Fugitive dust migration will be visually assessed during all work activities, and reasonable dust suppression techniques will be used during any site activities that may generate fugitive dust. These activities and their design controls were discussed previously in Section 1.4 of this plan.

## **2.5 Action Levels**

The action levels provided below are to be used to initiate response actions, if necessary, based on real-time monitoring.

### **2.5.1 Action Levels for VOCs**

As outlined in the NYSDOH guidance document (Attachment A), if the ambient air concentration of total VOCs exceeds 5 parts per million (ppm) above the background (upwind location) for the 15-minute average, intrusive site activities will be temporarily halted while monitoring continues. If the total VOC concentration readily decreases (through observation of instantaneous readings) below 5 ppm above background, then intrusive site activities can resume with continuous monitoring.

If the ambient air concentrations of total VOCs persist at levels in excess of 5 ppm above background but less than 25 ppm above background, intrusive site work activities will be halted, the source of the elevated VOC concentrations identified, corrective actions to reduce or abate the emissions undertaken, and air monitoring will be continued. Once these actions have been implemented, intrusive site work activities can resume provided the following two conditions are met:

- The 15-minute average VOC concentrations remain below 5 ppm above background.
- The VOC level 200 feet downwind of the sample location or half the distance to the nearest potential receptor or residential/commercial structure (whichever is less but in no case less than 20 feet) is below 5 ppm over background for the 15-minute average.

If the ambient air concentrations of total VOCs are above 25 ppm above background, the intrusive site activities must cease, and emissions control measures must be implemented.

Periodic monitoring for VOCs is required during non-intrusive activities such as collection of soil samples, well development, and the collection of groundwater samples from monitoring wells. If these activities are undertaken at the site, ambient direct-reading (instantaneous) VOC data will be periodically collected at the location of the non-intrusive activity and recorded in the field activity logbooks.

#### 2.5.2 Action Level for PM<sub>10</sub>

As required by the NYSDOH guidance (Attachment A), if the ambient air concentration of PM<sub>10</sub> at any one (or more) of the sampling locations is noted at levels in excess of 100 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) above the background (upwind location), or if airborne dust is observed leaving the work area, intrusive site activities will be temporarily halted. The source of the elevated PM<sub>10</sub> concentration is to be identified, corrective actions to reduce or abate the emissions will be undertaken, and air monitoring will continue. Work may continue following the implementation of dust suppression techniques provided the PM<sub>10</sub> levels do not exceed 150  $\mu\text{g}/\text{m}^3$  above background.

If, after implementation of dust suppression techniques, PM<sub>10</sub> levels are greater than 150  $\mu\text{g}/\text{m}^3$  above background, work must be stopped and site activities must be re-evaluated. Work may only resume provided that the dust suppression measures and other controls are successful in reducing PM<sub>10</sub> levels less than 150  $\mu\text{g}/\text{m}^3$  above background and in preventing visible dust from leaving the site.

If the ambient air concentration of PM<sub>10</sub> is above 150  $\mu\text{g}/\text{m}^3$  above background, the intrusive site activities must cease and emissions control measures must be implemented.

## **2.6 Meteorological Monitoring**

Wind direction is the only meteorological information considered relevant for the investigation activities and CAMP. Meteorological monitoring will be conducted periodically at the site using a windsock, wind vane, or other appropriate equipment. Wind direction will be established at the start of each work day and may be re-established at any time during the work day if a significant shift in wind direction is noted.

## **2.7 Instrument Calibration**

Calibration of the VOC and PM<sub>10</sub> instrumentation will occur in accordance with each of the equipment manufacturer's calibration and quality assurance requirements. The VOC and PM<sub>10</sub> monitors will be calibrated at least daily, and calibrations will be recorded in the field activity logbook.



### **3. Monitoring Schedule and Data Collection and Reporting**

#### **3.1 General**

The proposed monitoring schedule and data collection and reporting requirements are discussed below.

#### **3.2 Monitoring Schedule**

Real-time VOC and PM<sub>10</sub> monitoring will be performed continuously throughout the remedial action during intrusive site/materials handling activities. VOC monitoring will also be performed during non-intrusive sampling-type activities. Wind direction will be determined at the start of each day and at any other appropriate time during investigation activities.

#### **3.3 Data Collection and Reporting**

Air monitoring data will be collected continuously from VOC and PM<sub>10</sub> monitors during intrusive site activities by an electronic data-logging system. The data management software will be set up so that instantaneous observed readings would be recorded by the electronic data acquisition system and averaged over 15-minute time periods. The 15-minute readings and instantaneous readings taken to facilitate activity decisions will be recorded and archived for review by NYSDOH and NYSDEC personnel.



#### **Attachment A**

NYSDOH Generic Community Air  
Monitoring Plan (from NYSDEC  
DER-10/Technical Guidance for  
Site Investigation and  
Remediation [May 2010])

## APPENDIX 1A

### New York State Department of Health Generic Community Air Monitoring Plan

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

#### **Community Air Monitoring Plan**

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for volatile organic compounds (VOCs) and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate NYSDEC/NYSDOH staff.

**Continuous monitoring** will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

**Periodic monitoring** for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

### **VOC Monitoring, Response Levels, and Actions**

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.
- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

All 15-minute readings must be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

### **Particulate Monitoring, Response Levels, and Actions**

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter ( $\text{mcg}/\text{m}^3$ ) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150  $\text{mcg}/\text{m}^3$  above the upwind level and provided that no visible dust is migrating from the work area.
- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150  $\text{mcg}/\text{m}^3$  above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150  $\text{mcg}/\text{m}^3$  of the upwind level and in preventing visible dust migration.

All readings must be recorded and be available for State (DEC and DOH) personnel to review.



## Fugitive Dust Suppression and Particulate Monitoring Program (TAGM - 4031)

<b>To:</b>	Regional Hazardous Waste Remediation Engrs., Bur. Directors & Section Chiefs
<b>From:</b>	Michael J. O'Toole, Jr., Director, Division of Hazardous Waste Remediation (signed)
<b>Subject:</b>	Technical and Administrative Guidance Memorandum -- Fugitive Dust Suppression and Particulate Monitoring Program at Inactive Hazardous Waste Sites
<b>Date:</b>	Oct 27, 1989

### 1. Introduction

Fugitive dust suppression, particulate monitoring, and subsequent action levels for such must be used and applied consistently during remedial activities at hazardous waste sites. This guidance provides a basis for developing and implementing a fugitive dust suppression and particulate monitoring program as an element of a hazardous waste site's health and safety program.

### 2. Background

Fugitive dust is particulate matter--a generic term for a broad class of chemically and physically diverse substances that exist as discrete particles, liquid droplets or solids, over a wide range of sizes--which becomes airborne and contributes to air quality as a nuisance and threat to human health and the environment.

On July 1, 1987, the United States Environmental Protection Agency (USEPA) revised the ambient air quality standard for particulates so as to reflect direct impact on human health by setting the standard for particulate matter less than ten microns in diameter (PM<sub>10</sub>); this involves fugitive dust whether contaminated or not. Based upon an examination of air quality composition, respiratory tract deposition, and health effects, PM<sub>10</sub> is considered conservative for the primary standard--that requisite to protect public health with an adequate margin of safety. The primary standards are 150 ug/m<sup>3</sup> over a 24-hour averaging time and 50 ug/m<sup>3</sup> over an annual averaging time. Both of these standards are to be averaged arithmetically.

There exists real-time monitoring equipment available to measure PM<sub>10</sub> and capable of integrating over a period of six seconds to ten hours. Combined with an adequate fugitive dust suppression program, such equipment will aid in preventing the off-site migration of contaminated soil. It will also protect both on-site personnel from exposure to high levels of dust and the public around the site from any exposure to any dust. While specifically intended for the protection of on-site personnel as well as the public, this program is not meant to replace long-term monitoring which may be required given the contaminants inherent to the site and its air quality.

### 3. Guidance

A program for suppressing fugitive dust and monitoring particulate matter at hazardous waste sites can be developed without placing an undue burden on remedial activities while still being protective of health and environment. Since the responsibility for implementing this program ultimately will fall on the party performing the work, these procedures must be incorporated into appropriate work plans. The following fugitive dust suppression and particulate monitoring program will be employed at hazardous waste sites during construction and other activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.
2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Such activities shall also include the excavation, grading, or placement of clean fill, and control measures therefore should be considered.
3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM<sub>10</sub>) with the following minimum performance standards:

Object to be measured: Dust, Mists, Aerosols

Size range: <0.1 to 10 microns

Sensitivity: 0.001 mg/m<sup>3</sup>

Range: 0.001 to 10 mg/m<sup>3</sup>

Overall Accuracy: ±10% as compared to gravimetric analysis of stearic acid or reference dust

Operating Conditions:

Temperature: 0 to 40°C

Humidity: 10 to 99% Relative Humidity

Power: Battery operated with a minimum capacity of eight hours continuous operation

Automatic alarms are suggested.

Particulate levels will be monitored immediately downwind at the working site and integrated over a period not to exceed 15 minutes. Consequently, instrumentation shall require necessary averaging hardware to accomplish this task; the P-5 Digital Dust Indicator as manufactured by MDA Scientific, Inc. or similar is appropriate.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the entity operating the equipment to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.
5. The action level will be established at 150 ug/m<sup>3</sup> over the integrated period not to exceed 15 minutes. While conservative, this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m<sup>3</sup>, the upwind background level must be measured immediately using the same portable monitor. If the working site particulate measurement is greater than 100 ug/m<sup>3</sup> above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see Paragraph 7). Should the action level of 150 ug/m<sup>3</sup> be exceeded, the Division of Air Resources must be notified in writing within five working days; the notification shall include a description of the control measures implemented to prevent further exceedences.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure  $PM_{10}$  at or above the action level. Since this situation has the potential to migrate contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.
7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:
  1. Applying water on haul roads.
  2. Wetting equipment and excavation faces.
  3. Spraying water on buckets during excavation and dumping.
  4. Hauling materials in properly tarped or watertight containers.
  5. Restricting vehicle speeds to 10 mph.
  6. Covering excavated areas and material after excavation activity ceases.
  7. Reducing the excavation size and/or number of excavations.

Experience has shown that utilizing the above-mentioned dust suppression techniques, within reason as not to create excess water which would result in unacceptable wet conditions, the chance of exceeding the  $150 \text{ ug/m}^3$  action level at hazardous waste site remediations is remote. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. If the dust suppression techniques being utilized at the site do not lower particulates to an acceptable level (that is, below  $150 \text{ ug/m}^3$  and no visible dust), work must be suspended until appropriate corrective measures are approved to remedy the situation. Also, the evaluation of weather conditions will be necessary for proper fugitive dust control--when extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended.

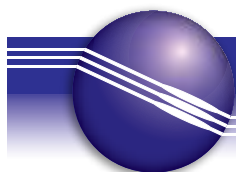


There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require appropriate toxics monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.



## **Attachment B**

Monitoring Equipment  
Specifications



# MiniRAE 2000

## Portable Handheld VOC Monitor

The rugged MiniRAE 2000 is the smallest pumped handheld volatile organic compound (VOC) monitor on the market. Its Photoionization Detector's (PID) extended range of 0 to 10,000 ppm makes it an ideal instrument for applications from environmental site surveying to HazMat/Homeland Security.

### Key Features

- **Proven PID technology** The patented sensor provides a 3-second response up to 10,000 ppm and sets a new standard for resistance to moisture and dirt.
- **Wireless communication enabled and certified**
- **Self-cleaning lamp and sensor** The patented self-cleaning lamp and sensor minimize the need for maintenance and calibration.
- **The MiniRAE 2000 lamp and sensor can be taken apart in seconds for easy maintenance without tools!**
- **Measure more chemicals than with any other PID.** With over 100 Correction Factors built into the MiniRAE 2000 memory and the largest printed list of Correction Factors in the world (300+), RAE Systems offers the ability to accurately measure more ionizable chemicals than any other PID. When a gas is selected from the MiniRAE 2000's library, the alarm points are automatically loaded into the meter.
- **User friendly** screens make it easy to use for simple applications and flexible enough for sophisticated operations.
- **Drop-in battery** When work schedules require putting in more than the 10 hours supplied by the standard NiMH battery, the drop-in alkaline pack supplied with every MiniRAE 2000 lets you finish the job.
- **Rugged Rubber Boot** The standard rubber boot helps assure that the MiniRAE 2000 survives the bumps and knocks of tough field use.
- **Strong, built-in sample pump** draws up to 100 feet (30 m) horizontally or vertically.
- **Tough, flexible inlet probe**
- **Large keys** operable with 3 layers of gloves.
- **Easy-to-read display** with backlight.
- **Stores up to 267 hours of data** at one-minute intervals for downloading to PC.
- **3-year 10.6 eV lamp warranty**

### Applications

#### HazMat/Homeland Security

- Initial PPE (personal protective equipment) assessment
- Leak detection
- Safety perimeter establishment and maintenance
- Spill delineation
- Decontamination
- Remediation

#### Industrial Hygiene/Safety

- Confined Space Entry (CSE)
- Indoor Air Quality (IAQ)
- Worker exposure studies

#### Environmental

- Soil and water headspace analysis
- Leaking underground storage tanks
- Perimeter fence line monitoring
- Fugitive emissions (EPA Method 21)
- Vapor recovery breakthrough
- Landfill monitoring

 **AutoRAE Compatible**

 **Wireless**



ver12\_04.07

[www.raesystems.com](http://www.raesystems.com)

ATEX



# MiniRAE 2000

## Specifications\*

### Detector Specifications

<b>Size</b>	8.2" L x 3.0" W x 2.0" H (21.8 x 7.62 x 5.0 cm)
<b>Weight</b>	20 oz with battery pack (553 g) w/o rubber boot
<b>Sensor</b>	Photoionization sensor with standard 10.6 eV or optional 9.8 eV or 11.7 eV UV lamp
<b>Battery</b>	<ul style="list-style-type: none"><li>• Rechargeable, external, field-replaceable Nickel-Metal-Hydride (NiMH) battery pack</li><li>• Alkaline battery holder (for 4 AA batteries)</li></ul>
<b>Operating Period</b>	10 hours continuous operation
<b>Display</b>	Large LCD, backlight activated manually, by alarms or by darkness
<b>Keypad</b>	1 operation and 2 programming keys
<b>Direct Readout</b>	<ul style="list-style-type: none"><li>• VOCs as ppm by volume</li><li>• High and low values</li><li>• STEL and TWA (in hygiene mode)</li><li>• Battery and shut down voltage</li></ul>
<b>Alarms</b>	<p>90 dB buzzer and flashing red LED to indicate exceeded preset limits:</p> <ul style="list-style-type: none"><li>• High: 3 beeps and flashes per second</li><li>• Low: 2 beeps and flashes per second</li><li>• STEL and TWA: 1 beep and flash per second</li><li>• Alarms automatic reset or latching with manual override</li><li>• Optional plug-in pen size vibration alarm</li><li>• User adjustable alarm limits</li></ul>
<b>Calibration</b>	Two-point field calibration of zero and standard reference gas. Calibration memory of 8 calibration gases, alarm limits, span values and calibration date
<b>Datalogging</b>	267 hours (at one-minute intervals) with date/time. Header information includes monitor serial number, user ID, site ID, date and time
<b>Sampling Pump</b>	<ul style="list-style-type: none"><li>• Internal, integrated flow rate of 400 cc/min</li><li>• Sample from 100' (30 m) horizontally or vertically</li></ul>
<b>Low Flow Alarm</b>	Auto shut-off pump at low flow condition
<b>Communication</b>	Download data and upload instrument set-up from PC through RS-232 link to serial port. Wireless communication enabled and certified (requires RAElink2 and ProRAE Remote to use)
<b>Temperature</b>	14° F to 104° F (-10° C to 40° C)
<b>Humidity</b>	0% to 95% relative humidity (non-condensing)
<b>EM/RFI</b>	Highly resistant to EMI/RFI. Compliant with EMC Directive 89/336/EEC
<b>IP-rating</b>	IP-55: protected against dust, protected against low-pressure jets of water from all directions
<b>Hazardous Area Approval</b>	<ul style="list-style-type: none"><li>• <b>US and Canada:</b> UL and cUL, Classified for use in Class I, Division 1, Groups A, B, C and D hazardous locations</li><li>• <b>Europe:</b> ATEX II IG EEx ia IIC T4</li></ul>
<b>Attachment</b>	Durable bright yellow rubber boot w/belt clip & wrist strap
<b>Warranty</b>	Lifetime on non-consumable components (per RAE Systems Standard Warranty), 3 years for 10.6V PID lamp, 1 year for pump and battery

\* Specifications are subject to change

\*\* Performance based on isobutylene calibration

### Default Sensor Settings\*\*

Gas Monitor (ppm)	Range (ppm)	Resolution Time (T90)	Response
<b>VOCs</b>	0 to 99.9 ppm	0.1 ppm	< 3 sec
	100 to 10,000 ppm	1 ppm	< 3 sec

## MiniRAE 2000 and Accessories

### Monitor only includes:

- RAE Systems UV lamp: 10.6 eV, 9.8 eV or 11.7 eV as specified
- ProRAE Suite software package for Windows® 98, NT, 2000 and XP
- Computer interface cable
- 5-inch Flex-I-Probe
- External filter
- Rubber boot with belt clip
- Alkaline battery adapter
- Tool kit
- Lamp cleaning kit
- Nickel-Metal-Hydride (NiMH) battery
- 120/230 V AC/DC wall adapter (if specified)
- Operation and maintenance manual

### Monitor with accessories kit adds:

- Hard transport case with pre-cut foam padding
- 5 porous metal filters and O-rings
- Organic vapor zeroing adapter
- Gas outlet port and tubing

### Optional calibration kit adds:

- 10 ppm isobutylene calibration gas, 34L
- Calibration regulator and flow controller

### Optional Guaranteed Cost of Ownership Program:

- 4-year repair and replacement guarantee
- Annual maintenance service

DISTRIBUTED BY:

ver12\_04.07

<b>RAE Systems Inc.</b>	USA/Canada	1-877-723-2878
3775 North First Street	Europe/Russia	+45 8652 5155
San Jose, CA 95134 USA	Middle East/Australia	971 50 429 1385
raesales@raesystems.com	China	8610 58858788
	Asia	+852 2669 0828

[www.raesystems.com](http://www.raesystems.com)



## Product Overview

All these applications  
in one small unit

- Indoor air quality monitoring
- Walk-through surveys
- Personal exposure monitoring
- Time & motion studies
- Workplace & plant monitoring
- Fixed-point continuous monitoring
- Remediation personal surveillance
- Remote alarming
- Mobile monitoring in vehicles & aircraft
- Toxicology & epidemiology studies
- Emergency response
- Testing air filtration efficiency



## personalDataRAM™ Series

Measures airborne particulate concentration in real time

- pDR-1000AN  
For passive air sampling applications
- pDR-1200  
For active air sampling applications

## Measure airborne particulate concentration in real-time

The *personalDataRAM* (pDR-1000AN) measures mass concentrations of dust, smoke, mists, and fumes in real time, and sounds an audible alarm whenever the user-defined level is exceeded. Conventional filter-based monitoring methods cannot indicate dangerous, real-time dust levels. In contrast, the pDR-1000AN alerts you to a problem within seconds, allowing you to take immediate action. With the datalogging enabled, the instrument automatically tags and time stamps the data collected, and stores it for subsequent retrieval, printing, or graphing through a computer.

## Highest performance of any real-time personal particulate monitor

With a measurement range from 0.001 to 400 mg/m<sup>3</sup> (auto-ranging), and an optical feedback stabilized sensing system, the pDR-1000AN sets the standard for sensitivity, long-term stability and reliability.

The palm-sized pDR-1000AN weighs only 18 oz (0.5 kg) for easy portability and attachment to a belt or a shoulder strap. The absence of any moving parts, such as pumps, motors and valves, and the use of low-power semiconductors housed in a ruggedized case ensures long life and dependable operation.

## High correlation with gravimetric measurement

The pDR-1000AN is a light-scattering photometer (i.e., nephelometer) incorporating a pulsed, high output, near-infrared light emitting diode source, a silicon detector/hybrid preamplifier, and collimating optics and a source reference feedback PIN silicon detector. The intensity of the light scattered over the forward angle of 50° to 90° by airborne particles passing through the sensing chamber is linearly proportional to their concentration. This optical configuration produces optimal response to particles in the size range of 0.1-10 µm, achieving high correlation with standard gravimetric measurements of the respirable and thoracic fractions.

## Simple zeroing and calibration

The pDR-1000AN arrives practically ready to use after the easy zeroing step. The unit comes gravimetrically calibrated in mg/m<sup>3</sup> (NIST traceable) using standard SAE Fine test dust (ISO Fine). Zeroing with particle-free air is accomplished quickly and effectively under field conditions using the zeroing kit included with the instrument. Internal firmware controls an automatic calibration check. To maximize efficiency in the field, gravimetric calibration can be performed by comparison with a filter sampler and programming of the calibration constant.

## Standard Accessories

- Universal voltage power supply
- PC communications software
- Zeroing kit
- Belt clip kit
- Instruction manual
- Carrying case
- Signal output cables

## Optional Accessories

- Rechargeable battery pack (NiMH)
- Active sampling kit (converts pDR-1000AN to pDR-1200)
- Portable pump unit
- Shoulder strap
- Remote alarm interface
- Wall mounting bracket





## pDR-1200

Active aerosol monitor/datalogger, plus aerodynamic sizing

### Designed for active particulate monitoring applications

The *personaDataRam*™ (model pDR-1200) performs active sampling applications and aerosol sizing. The pDR-1200 requires a vacuum pump module to perform particle size selective measurements under field conditions. The separate pump (not included) is required for active sampling and aerosol sizing. With optional inlet accessories, the pDR-1200 is excellent for ambient air measurements under variable wind and high humidity conditions. It is ideal for respirable, thoracic, and PM<sub>2.5</sub> monitoring, as well as continuous emission and test chamber monitoring. With an isokinetic sampling set, the pDR-1200 can be used for stack and duct extractive sampling monitoring. Membrane filters can be used to capture particles for subsequent laboratory analysis.

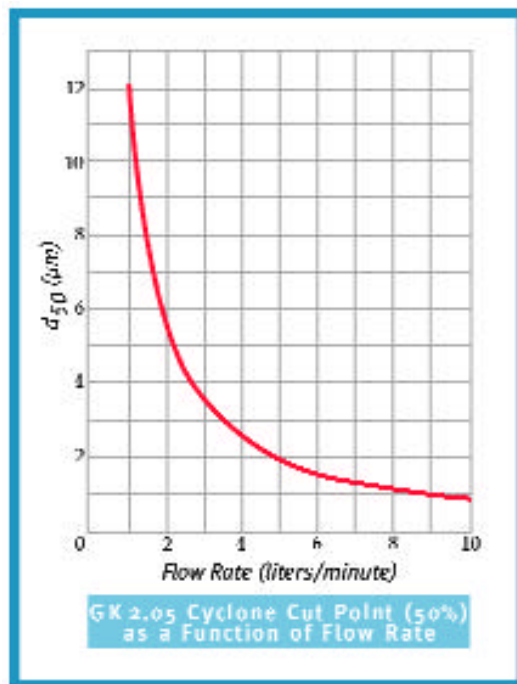
### Aerodynamic particle sizing

The pDR-1200 incorporates an optimally designed metal cyclone (BGI Model GK 2.05) or the optional low flow cyclone (BGI Model Triplex SCC1.062-CUST) especially selected for PM<sub>2.5</sub> collection at 1.5 LPM.

By operating the pump at specific sampling flow rates, the pDR-1200 cyclone preseparator provides precisely defined particle size cuts.

### Primary calibration and particle samples by filter collection

An integral filter holder directly downstream of the photometric sensing stage accepts 37 mm filters. The calibration constant of the pDR-1200 is simply adjusted to coincide with the filter-determined concentration. Primary gravimetric calibration of the instrument concentration readout is easily accomplished under actual field conditions by means of this integral filter. Use membrane filters for chemical analysis or concurrent gravimetric measurements.



### pDR-PU Attachable Pump Module

This optional accessory is designed for use with the *personaDataRAM* Model pDR-1200. It incorporates a dual-chamber diaphragm pump, a volumetric flow sensing, and control unit. The pump module operates from either an optional, rechargeable NiMH battery pack or from AC line current using the power supply/charger supplied with the *personaDataRAM*. The pDR-PU is designed as a modular unit that can be used in various combinations.

- Flow rate (user adjustable): 1 to 4 liters/minute
- Typical Conditions: 2 LPM @ 10 in H<sub>2</sub>O (25 mbar) for up to 4 hours
- Maximum Conditions: 2 LPM @ 30 in H<sub>2</sub>O
- Precision of constant flow rate control: ±2%
- Power: 9 VDC, 200 mA at 4 liters/minute (approximate)
- Dimensions:
  - 4 in (100 mm) H x
  - 3.6 in (90 mm) W x
  - 1.8 in (45 mm) D
- Weight: 1 lb (0.45 kg)

### personalDataRAM™ Series

At last,  
a compact,  
versatile,  
real-time  
aerosol monitor

## Specifications

### Concentration Measurement Range (auto-ranging)

Referred to gravimetric calibration with SAE  
Fine test dust ( $mmd = 2$  to  $3\text{ mm}$   $sg = 2.5$ , as aerosolized)  
0.001 to  $400\text{ mg/m}^3$

### Scattering Coefficient Range

$1.5 \times 10^{-6}$  to  $0.6\text{ m}^{-1}$  (approx) @  
 $\lambda = 880\text{ nm}$

### Precision/Repeatability Over 30 Days (2-sigma at constant temperature and full battery voltage)

- $\pm 2\%$  of reading or  $\pm 0.005\text{ mg/m}^3$ , whichever is larger, for 1 second averaging time
- $\pm 0.5$  of reading or  $\pm 0.0015\text{ mg/m}^3$ , whichever is larger, for 10 second averaging time
- $\pm 0.2\%$  of reading or  $\pm 0.0005\text{ mg/m}^3$ , whichever is larger, for 60 second averaging time

### Accuracy

Referred to gravimetric calibration with SAE  
Fine test dust ( $mmd = 2$  to  $3\text{ mm}$ ,  $sg = 2.5$ , as aerosolized)  
 $\pm 5\%$  of reading  $\pm$  precision

### Resolution

0.1% of reading or  $0.001\text{ mg/m}^3$ , whichever is larger

### Particle Size Range of Maximum Response

0.1 to  $10\text{ }\mu\text{m}$

### Flow Rate Range (model pDR-1200)

1-10 liters/min (external pump required)

### Aerodynamic Particle Sizing Range

1.0 to  $10\text{ }\mu\text{m}$  (pDR-1200 only)

### Concentration Display Updating Interval

1 second

### Concentration Display Averaging Time (user selectable)

1 to 60 seconds

### Alarm Level Adjustment Range (user selectable)

Selectable over entire measurement range

### Alarm Averaging Time (user selectable)

Real-time (1 to 60 seconds) or STEL (15 minutes)

### Datalogging Averaging Periods (user selectable)

1 second to 4 hours

### Total Number of Data Points That Can Be Logged in Memory

More than 13,300

### Number of Data Tags (data sets)

99 (maximum)

### Logged Data

- Each data point: average concentration, time/date, and data point number
- Run summary: overall average and maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration, and time/date of occurrence, averaging (logging) period, calibration factor, and tag number

### Analog Signal Output

0 to 5 V and 4 to 20 mA, with selectable full scale ranges between 0.1 and  $400\text{ mg/m}^3$

### Power

- Internal battery 9 V alkaline, 20 hour run time (typical)

- Internal battery 9 V lithium, 40 hour run time (typical)
- AC source universal voltage adapter (included) 100-250 volts, 50-60 Hz (CE marked)
- Optional battery pack rechargeable NiMH, 72 hour run time typical (pDR-BP)

### Readout Display

LCD 16 characters (4 mm height) x 2 lines

### Serial Interface

RS232, 4800 baud

### Computer Requirements

PC compatible, 486 or higher, Windows 95® or higher

### Storage Environment

$-20^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$  to  $158^{\circ}\text{F}$ )

### Operating Environment

$-10^{\circ}\text{C}$  to  $50^{\circ}\text{C}$  ( $14^{\circ}\text{F}$  to  $122^{\circ}\text{F}$ ),  
10 to 95% RH, non-condensing

### Dimensions (max external)

153 mm (6.0 in) H x 92 mm (3.6 in) W x 63 mm (2.5 in) D (pDR-1000AN)  
160 mm (6.3 in) H x 205 mm (8.1 in) W x 60 mm (2.4 in) D (pDR-1200 including cyclone and filter holder)

### Weight

0.5 kg (18 oz) (pDR-1000AN)  
0.68 kg (24 oz) (pDR-1200)

### Approvals

- Intrinsic safety approval by US Mine Safety & Health Administration (MSHA) coal-mining environments containing methane gas (the pDR-PU pump is not approved by MSHA)
- US FCC Rules (Part 15)
- CE certified

## About Thermo

Thermo Electron Corporation, the world's leading maker of high-tech instruments, provides instruments, equipment, software, and solutions that help laboratory and industrial customers advance scientific knowledge, enable drug discovery, improve manufacturing

processes, and protect people and the environment. With annual revenue exceeding \$2 billion, Thermo is a global leader employing 11,000 people in 30 countries worldwide. The company is based in Waltham, Massachusetts.

LITPERSONALDATARAMSERIES 4.03

Thermo Electron

27 Forge Parkway

Franklin MA USA 02038

[www.thermo.com/ih](http://www.thermo.com/ih)

1.866.282.0430

+1.508.520.0430

+1.508.520.1460 fax

Analyze • Detect • Measure • Control™

**Thermo**  
ELECTRON CORPORATION





**Attachment 7**

SVI Standard Operating  
Procedures

**Soil-Gas Sampling and  
Analysis Using USEPA Method  
TO-17 and TO-15**

SOP #112409

Rev. #: 1

Rev Date: July 9, 2010

## I. Scope and Application

This document describes the procedures to collect subsurface soil-gas samples from sub-slab sampling ports and soil vapor monitoring points for the analysis of volatile organic compounds (VOCs) including volatile polyaromatic hydrocarbons (PAHs) by United States Environmental Protection Agency (USEPA) Method TO-17 (TO-17) and USEPA Method TO-15.

The TO-17 method uses a glass or stainless steel tube packed with a sorbent material. Sorbents of increasing strength and composition are packed within the tube. The specific sorbent material packed within each tube is selected based on the target compounds and desired reporting limits. A measured volume of soil-gas is passed through the tube during sample collection.

The TO-15 method uses 1-liter 3-liter or 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA canister (less than 28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5 liters when allowed to fill to a vacuum of approximately 6 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv). Optionally the canister sample can also be analyzed for fixed gasses such as Helium, Carbon dioxide and oxygen. .

Following sample collection the TO-17 tube and TO-15 canister is sent to the laboratory where the sampling media is analyzed for the target compounds.

The following sections list the necessary equipment and provide detailed instructions for the collection of soil-gas samples for analysis using TO-17 and TO-15.

Soil vapor samples can be collected from sub-slab sample probes or soil-vapor ports. Refer to the appropriate standard operating procedure (SOP) from the ARCADIS SOP library for a description of construction methods.

## II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR), as needed. ARCADIS field sampling personnel will be well versed in the relevant standard operating procedures (SOPs) and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS personnel responsible for leading soil-gas sample collection activities must have previous soil-gas sampling experience.

### III. Health and Safety Considerations

All sampling personnel should review the appropriate health and safety plan (HASP) and job loss analysis (JLA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. For sub-slab vapor probe installation, drilling with an electric concrete impact drill should be done only by personnel with prior experience using such a piece of equipment and with the appropriate health and safety measures in place as presented in the JLA

### IV Equipment List

The equipment required for collect soil-gas samples for analysis using method TO-15 and TO-17 is presented below:

- Appropriate personal protective equipment (PPE; as presented in the site specific HASP and the JLA)
- TO-17 tubes pre-packed by the laboratory with the desired sorbent. Specific sorbents will be recommended by the laboratory considering the target compound list and the necessary reporting limits;
- TO-17 sample flow rate calibration tubes (provided by the laboratory);
- Stainless steel SUMMA<sup>®</sup> canisters (1-liter, 3-liter, or 6-liter; order at least 5% extra, if feasible) (batch certified canisters or individual certified canisters as required by the project)
- Flow controllers with in-line particulate filters and vacuum gauges; flow controllers are pre-calibrated to specified sample duration (e.g., 30 minutes, 8 hours, 24 hours) or flow rate (e.g., 200 milliliters per minute [mL/min]); confirm with the laboratory that the flow controller comes with an in-line particulate filter and pressure gauge (order at least 5% extra, if feasible). Flow rate should be selected based on expected soil type (see below).
- Two decontaminated Swagelok or stainless-steel or comparable two-way ball or needle valve (sized to match sample tubing).
- 1/4-inch outer diameter (OD) tubing (Teflon<sup>®</sup> or Teflon-lined polyethylene);
- Stainless steel or comparable Swagelok<sup>®</sup> or equivalent compression fittings for 1/4-inch OD tubing;

- Stainless steel “T” fitting (if sample train will be assembled with an inline vacuum gauge a four-way fitting will be needed);
- Three Stainless steel duplicate “T” fittings ;
- 2 Portable vacuum pumps capable of producing very low flow rates (e.g., 10 to 200 mL/min) with vacuum gauge;
- Vacuum gauge if monitoring vacuum reading during sample collection is necessary and portable vacuum pump is not equipped with a vacuum gauge;
- Rotameter or an electric flow sensor if vacuum pump does not have a flow gauge (Bios DryCal or equivalent);
- Tracer gas testing supplies (refer to Administering Tracer Gas SOP #41699);
- Photoionization Detector (PID) (with a lamp of 11.7 eV);
- Appropriate-sized open-end wrench (typically 9/16-inch, 1/2-inch , and 3/4-inch);
- 2 Tedlar bags;
- Portable weather meter, if appropriate;
- Chain-of-custody (COC) form;
- Sample collection log;
- Gel ice; and
- Field notebook.

#### V. Cautions

The following cautions and field tips should be reviewed and considered prior to collecting soil-gas samples.

- Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens (sharpies), wear/apply fragrances, or smoke cigarettes/cigars before and/or during the sampling event.
- Care should be taken to ensure that the appropriate sorbent is used in the TO-17 tube preparation. Sorbent should be selected in consultation with the analytical laboratory and in consideration of the target compound list, the necessary reporting limits and the expected range of concentrations in field samples. The expected range of concentrations in field samples may be estimated from previous site data, release history and professional judgment informed by the conceptual site model.
- Flow rates for sample collection with TO-17 sorbent tubes should be determined well in advance of field work in consultation with the laboratory.
- A Shipping Determination must be performed, by DOT-trained personnel, for all environmental samples that are to be shipped, as well as some types of environmental equipment/supplies that are to be shipped.
- At the sampling location, keep the tubes in their storage and transportation container to equilibrate with ambient temperature prior to attaching to the sample train.
- Always use clean gloves when handling sampling tubes.
- Seal clean, blank sorbent tubes and sampled tubes using inert, Swagelok®-type fittings and PTFE ferrules. Wrap capped tubes individually in uncoated aluminum foil. Use clean, sealable glass jars or metal cans containing a small packet of activated charcoal or activated charcoal/silica gel for storage and transportation of multiple tubes. This activated charcoal is not analyzed, but serves as a protection for the analytical sorbent tube. Store the multi-tube storage container in a clean environment at 4°C.
- Keep the sample tubes inside the storage container during transportation and only remove them at the monitoring location after the tubes have reached ambient temperature. Store sampled tubes in a refrigerator at 4°C inside the multi-tube container until ready for analysis.
- The purge flow rate of 100 ml/min should be suitable for a variety of silt and sand conditions but will not be achievable in some clays without excessive vacuum. A low vacuum (<10" of mercury) should be maintained. Record the measured flow rate and vacuum pressure during sample collection.

The cutoff value for vacuum differs in the literature from 10" of water column (ITRC 2007) to 136" of water column or 10" of mercury ([http://www.dtsc.ca.gov/lawsregspolicies/policies/SiteCleanup/upload/SMBR\\_ADV\\_activesoilgasinvst.pdf](http://www.dtsc.ca.gov/lawsregspolicies/policies/SiteCleanup/upload/SMBR_ADV_activesoilgasinvst.pdf)). A detailed discussion of the achievable flow rates in various permeability materials can be found in Nicholson 2007. Related issues of contaminant partitioning are summarized in ASTM D5314-92. Passive sampling approaches can be considered as an alternative for clay soils. However most passive sampling approaches are not currently capable of quantitative estimation of soil gas concentration.

- It is important to record the canister pressure, start and stop times and ID on a proper field sampling form. You should observe and record the time/pressure at a mid-point in the sample duration. It is a good practice to lightly tap the pressure gauge with your finger before reading it to make sure it isn't stuck.
- Ensure that there is still measureable vacuum in the SUMMA® after sampling. Sometimes the gauges sent from labs have offset errors, or they stick.
- When sampling carefully consider elevation. If your site is over 2,000' above sea level or the difference in elevation between your site and your lab is more than 2,000' then pressure effects will be significant. If you take your samples at a high elevation they will contain less air for a given ending pressure reading. High elevation samples analyzed at low elevation will result in more dilution at the lab, which could affect reporting limits. Conversely low elevation samples when received at high elevation may appear to not have much vacuum left in them. [http://www.uigi.com/Atmos\\_pressure.html](http://www.uigi.com/Atmos_pressure.html).
- If possible, have equipment shipped a two or three days before the sampling date so that all materials can be checked. Order replacements if needed.
- Requesting extra canisters and extra sorbent tubes from the laboratory should also be considered to ensure that you have enough equipment on site in case of an equipment failure.
- Shallow exterior soil-gas sampling should not proceed within 5 days following a significant rain event (1/2-inch of rainfall or more).

## VI. Procedure

### Soil-Gas Sample Preparation

#### Selection of Sorbent and Sampling Volume (to be completed prior to sampling event)

1. Identify the necessary final reporting limit for the target compound(s) in accordance with the project quality assurance plan and/or in consultation with the data end user.
2. Identify the necessary method reporting limit(s). The laboratory will be helpful in providing this information as it is typically specific to the sensitivity of the instrumentation.
3. The minimum sampling volume is the volume of soil-gas sample that must be drawn through the sorbent in order to achieve the desired final reporting limit. Calculate the minimum sampling volume using the following equation:

$$\text{Minimum Sampling Volume (L)} = \frac{\text{Final Reporting Limit } (\mu\text{g})}{\text{Action Level } (\mu\text{g}/\text{m}^3)} \times \frac{1,000 \text{ L}}{\text{m}^3}$$

Where:

L = liters

$\mu\text{g}$  = microgram

m = meter



4. If a timed sample duration is specified in the work plan, calculate the minimum flow rate. The minimum flow rate is the flow rate necessary to achieve the minimum sampling volume using the following formula:

$$\text{Minimum Flow Rate (L/min)} = \frac{\text{Minimum Sampling Volume (L)}}{\text{Sample Duration (min)}}$$

Where:

min = minutes

Then compare the minimum flow rate calculated to the requirements for maximum soil gas sampling without excessive danger of short circuiting, normally stated as 0.2 liters/minute, although it can be lower in tight soils. Soil vapor sampling flow rates should not exceed 200 ml/min.

5. Compare the minimum sampling volume to the safe sampling volume (SSV) for the sorbents selected. SSV for specific sorbents can be provided by the manufacturer or the laboratory, being used (Table 1 and Appendix 1 in Method TO-17). Ensure that the compound will not breakthrough when sampling the volume calculated above.

### Soil-Gas Sample Collection

#### Calibration of the sample pump prior to assembly of sampling train

1. Attach the sample flow rate calibration tube provided by the laboratory to the inlet of the sample pump using a section of tubing. Attach the flow calibrator to the inlet of the sample flow rate calibration tube. The sample flow rate calibration tube should be clearly marked by the laboratory with an arrow indicating flow direction (or as otherwise specified by the laboratory).
2. Turn on the sample pump and adjust the flow rate on the sample pump to achieve the desired minimum flow rate (calculated above) as measured by the flow calibrator.
3. Repeat until each sampling pump has been properly calibrated to its appropriate flow rate.

Assembly of combined TO-17 and TO-15 sampling train

1. Record the following information in the field notebook, if appropriate (contact the local airport or other suitable information source [e.g., site-specific measurements, [weatherunderground.com](http://weatherunderground.com)] to obtain the information):
  - a. wind speed and direction;
  - b. ambient temperature;
  - c. barometric pressure; and
  - d. relative humidity.
2. If samples are being collected from temporary or permanent soil vapor points simply remove the cap or plug and proceed to step 3. When collecting samples from a sub-slab port remove the cap or plug from the sampling port. Connect a short piece of Teflon or Teflon-lined tubing to the sampling port using a Swagelok or equivalent stainless-steel or comparable compression fitting.
3. Connect the Teflon or Teflon-lined tubing to a stainless steel T fitting using a Swagelok or equivalent stainless-steel or comparable compression fitting.
4. Remove the brass cap from the SUMMA® canister and connect the flow controller with in-line particulate filter and vacuum gauge to the SUMMA® canister. Do not open the valve on the SUMMA® canister. Record in the field notebook and COC form the flow controller number with the appropriate SUMMA® canister number.
5. Connect the flow controller to the stainless steel T fitting using a Swagelok or equivalent stainless-steel or comparable compression fitting. The TO-15 leg of the combined sampling train is now complete.
6. Attach a length of Teflon or Teflon-lined tubing to the free end of the stainless steel T fitting using a Swagelok or equivalent stainless-steel or comparable compression fitting.
7. Complete the remainder of the sampling train as depicted in Figure 1.

Purge Sampling Assembly and Sampling Point Prior to Sample Collection.

1. Ensure the two-way valve next to the flow rate calibration tube is open and the two way valve next to the TO-17 sampling tubes is closed. Purge three volumes of air from the vapor probe and sampling line using the portable pump. Measure organic vapor levels with the PID. Lower flow rates may be necessary in silt or clay to avoid excessive vacuum. Vacuum reading greater than 136 inches of water column are clearly excessive. Other available sources cite a cutoff of greater than 10 inches of water column.
2. Check the seal established around the soil vapor probe and the sampling train fittings by using a tracer gas (e.g., helium) or other method established in applicable regulatory guidance documents. [Note: Refer to ARCADIS SOP "Administering Tracer Gas," adapted from NYSDOH 2005, for procedures on tracer gas use.]
3. When three volumes of air have been purged from the vapor probe and sampling line stop the purge pump and close the valve next to the flow rate calibration tube.

TO-15 Sample Collection

1. Open the SUMMA® canister valve to initiate sample collection. Record on the sample log (attached) the time sampling began and the canister pressure.

If the initial vacuum pressure registered is not between -30 and -25 inches of Hg, then the SUMMA® canister is not appropriate for use and another canister should be used.

2. Take a photograph of the SUMMA® canister and surrounding area (unless photography is restricted by the property owner).
3. Check the SUMMA canister approximately half way through the sample duration and note progress on sample logs.

TO-15 Sample Termination

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the sampling interval.

2. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valves. The canister should have a minimum amount of vacuum (approximately 6 inches of Hg or slightly greater).
3. Record the date and time of valve closing in the field notebook, sample collection log, and COC form.

#### TO-17 Sample Collection

1. Record in the field notebook and COC form the tube number on the TO-17 tube.
2. Open the two-way valve next to the TO-17 tubes
3. Turn on the sample pump to begin sample collection. Use a stopwatch to ensure accuracy in pumping time. Record in the field notebook and the field sample log the time sampling began and the flow rate from each of the sample pumps.

#### Termination of Sample Collection

1. Stop the sample pumps after the desired volume of soil-gas has passed through the sorbent, and close the two-way valves next to the TO-17 sample tubes.
2. Record the stop time.
3. Detach the Tedlar bag from each sample pump and measure the helium concentration in the soil-gas collected by the Tedlar bag. Record any detections in the field book and sample collection log.
4. Open the two-way valve to permit flow through the flow rate calibration tube. Reconnect each of the sampling pumps and measure the flow rate. Record the post-sampling flow rates in the field log book and the sample collection logs. The post-sampling flow rate should match within 10% of the pre-sample flow rate. Average the pre-sampling and post-sampling flow rate and record in the field log book, and the sample collection log.
5. Calculate the sample volume using the average of the pre-sample and post-sample flow rate. Record the sample volume in the field log book, the sample collection log, and on the COC.
6. Package the tubes according to laboratory protocol on gel ice and ship to the laboratory for analysis.

## **VII. Waste Management**

The waste materials generated during sampling activities should be minimal. PPE, such as gloves and other disposable equipment (i.e., tubing), will be collected by field personnel for proper disposal.

## **VIII. Data Recording and Management**

Measurements will be recorded in the field notebook at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location (e.g., GPS coordinates, distance from permanent structure), tube type and number and sample volume. Field sampling logs and COC records will be transmitted to the Project Manager.

## **IX. Quality Assurance**

Duplicate samples should be collected in the field as a quality assurance step. Generally, duplicates are taken of 10% of samples, but project specific requirements should take precedence. Duplicate soil gas samples should be collected via a split sample train, allowing the primary and duplicate sample to be collected from the soil-gas probe simultaneously.

Quality assurance planning for method TO-17 should take careful note of the method requirement for distributed volume pairs. Although in some circumstances this requirement may be waived, this does constitute a deviation from the method as written. It is wise to discuss this decision with clients and/or regulators before sampling.

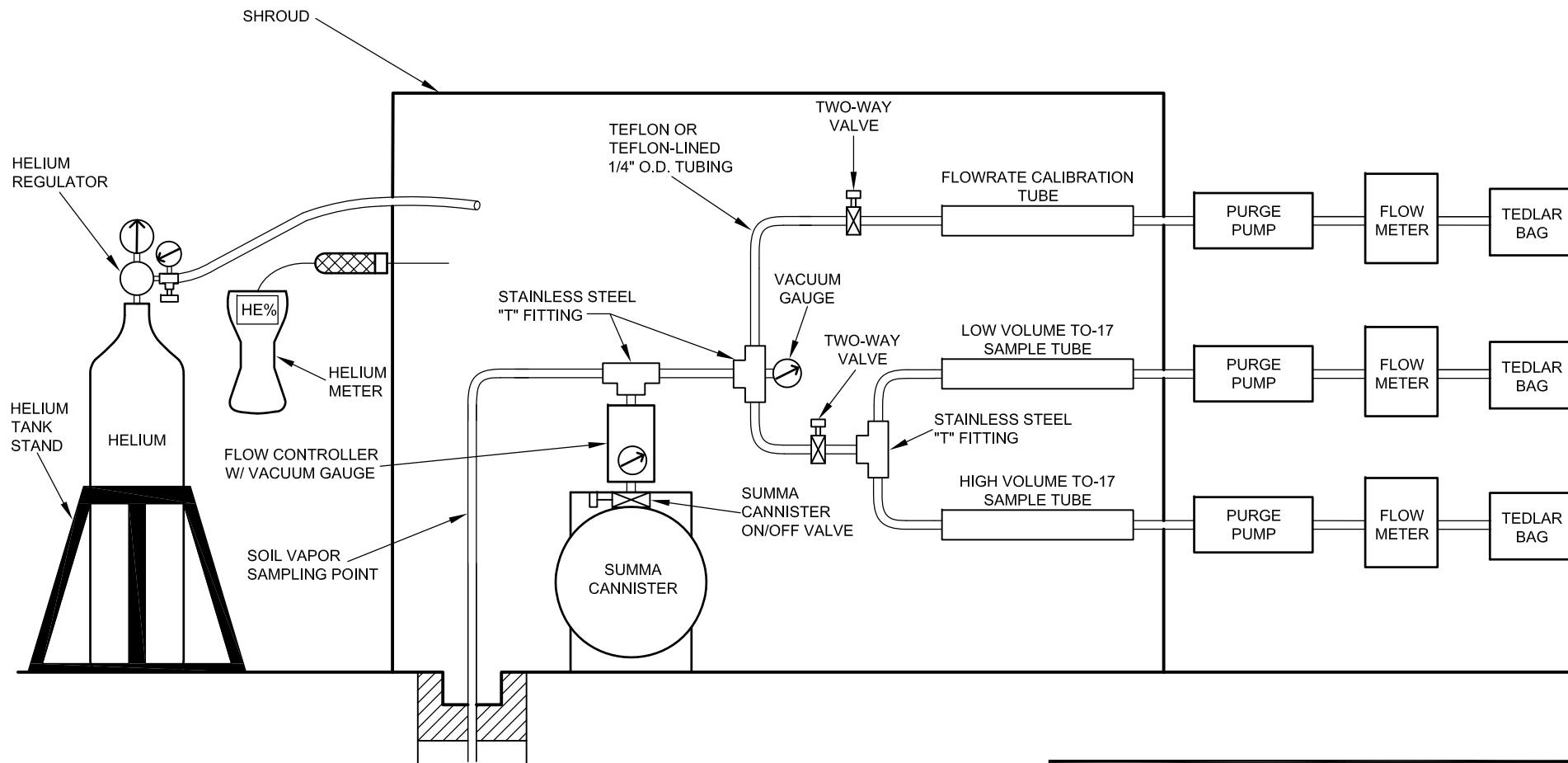
Soil-gas sample analysis will be performed using USEPA TO-17 methodology for a site specific constituent list defined in the work plan. Constituent lists and reporting limits must be discussed with the laboratory prior to mobilizing for sampling. Quality assurance parameters should be confirmed with the laboratory prior to sampling. Field quality assurance parameters should be defined in the site-specific work plan. A trip blank sample should accompany each shipment of soil-gas samples to the laboratory for analysis. Trip blanks assess potential sample contamination resulting from the transportation and storing of samples. Soil-gas sample analysis will generally be performed using USEPA TO-15 methodology or a project specific constituent list. Method TO-15 uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits (typically 0.5-ppbv for most VOCs).

## **X. References**

New York State Department of Health (NYSDOH). 2005. DRAFT "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" February 23, 2005.

AirToxics Ltd. "Sorbent & Solution Sampling Guide."

XREFS: IMAGES: PROJECTNAME: ---



## SOIL VAPOR SAMPLING EQUIPMENT ARRANGEMENT



FIGURE

1

**Administering Helium Tracer Gas  
for Leak Checks of Soil Gas or  
Sub-slab Sampling Points**

SOP #416199

Rev. #: 3

Rev Date: July 7, 2010



## I. Scope and Application

When collecting subsurface vapor samples as part of a vapor intrusion evaluation, a tracer gas serves as a quality assurance/quality control method to verify the integrity of the vapor port seal and the numerous connections comprising the sample train. Without the use of a tracer, verification that a soil vapor sample has not been diluted by ambient or indoor air is difficult.

This standard operating procedure (SOP) focuses on using helium as a tracer gas. However, depending on the nature of the contaminants of concern, other compounds can be used as a tracer including sulfur hexafluoride (SF<sub>6</sub>), butane and propane (or other gases). In all cases, the protocol for using a tracer gas is consistent and includes the following basic steps: (1) enrich the atmosphere in the immediate vicinity of the sample port where ambient air could enter the sampling train during sampling with the tracer gas; and (2) measure a vapor sample from the sample tubing for the presence of elevated concentrations (> 10%) of the tracer. A plastic pail, bucket, garbage can or even a plastic bag can serve to keep the tracer gas in contact with the port during the testing.

There are two basic approaches to testing for the tracer gas:

1. Include the tracer gas in the list of target analytes reported by the laboratory; and/or
2. Use a portable monitoring device to analyze a sample of soil vapor for the tracer prior to sampling for the compounds of concern. (Note that tracer gas samples can be collected via syringe, Tedlar bag, etc. They need not be collected in SUMMA® canisters or minicans.)

This SOP focuses on monitoring helium using a portable sampling device, although helium can also be analyzed by the laboratory along with other volatile organic compounds (VOCs). Real-time tracer sampling is generally preferred as the results can be used to confirm the integrity of the port seals prior to formal sample collection.

During the initial stages of a subsurface vapor sampling program, tracer gas samples should be collected at each of the sampling points. If the results of the initial samples indicate that the port seals are adequate, the Project Manager can consider reducing the number of locations at which tracer gas samples are used in future monitoring rounds. At a minimum, at least 5% of the subsequent samples should be supported with tracer gas analyses. When using permanent soil vapor points as part of a long-term monitoring program, the port should be tested prior to the first sampling event. Tracer gas testing of subsequent sampling events may often be reduced or eliminated unless conditions have changed at the site. Soil gas port integrity should certainly be

rechecked with Tracer gas if land clearing/grading activities, freeze thaw cycles, or soil dessication may have occurred. Points should also be rechecked if more than 2 years have elapsed since the last check of that port.

## **II. Personnel Qualifications**

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR), as needed. ARCADIS field sampling personnel will be well versed in the relevant SOPs and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS personnel responsible for leading the tracer gas testing must have previous experience conducting similar tests.

## **III. Health and Safety Considerations**

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field staff should review the attachment on safely handling compressed gas cylinders prior to commencing field work.

## **IV. Equipment List**

The equipment required to conduct a helium tracer gas test is presented below:

- Appropriate PPE for site (as required by the Health and Safety Plan)
- Helium (laboratory grade)
- Regulator for helium tank
- Shroud (plastic bucket, garbage can, etc)
  - The size of the shroud should be sufficient to fit over the sample port. It is worth noting that using the smallest shroud possible will minimize the volume of helium needed; this may be important when projects require a large number of helium tracer tests.
  - The shroud will need to have three small holes in it. These holes will include one on the top (to accommodate the sample tubing), and two

on the side (one for the helium detector probe, and one for the helium line).

- The shroud should ideally enclose the sample port and as much as possible of the sampling train.
- Helium detector capable of measuring from 1 - 100% (Dielectric MGD-2002, Mark Model 9522, or equivalent)
- Tedlar bags
- Seal material for shroud (rubber gasket, modeling clay, bentonite, etc) to keep helium levels in shroud high in windy conditions. Although the sealing material is not in direct contact with the sample if leakage does not occur, sealing materials with high levels of VOC emissions should be avoided, since they could contaminate a sample if a leak occurs.
- Sample logs
- Field notebook

## V. Cautions

Helium is an asphyxiant! Be cautious with its use indoors! Never release large volumes of helium within a closed room!

Compressed gas cylinders should be handled with caution; see attachment on the use and storage of compressed gasses before beginning field work.

Care should be taken not to pressurize the shroud while introducing helium. If the shroud is completely air tight and the helium is introduced quickly, the shroud can be over-pressurized and helium can be pushed into the ground. Provide a relief valve or small gap where the helium can escape.

Because minor leakage around the port seal should not materially affect the usability of the soil vapor sampling results, the mere presence of the tracer gas in the sample should not be a cause for alarm. Consequently, portable field monitoring devices with detection limits in the low ppm range are more than adequate for screening samples for the tracer. If high concentrations (> 10%) of tracer gas are observed in a sample, the port seal should be enhanced and fittings within the sampling train should be checked and/or tightened to reduce the infiltration of ambient air and the tracer test readministered. If the problem cannot be rectified, a new sample point should be installed or an alternate sampling train used.

## VI. Procedure

The procedure used to conduct the helium tracer test should be specific to the shroud being used and the methods of vapor point installation. The helium tracer test can be conducted when using temporary or permanent sampling points and inside or outside a facility. When using the tracer gas within indoor areas you must provide adequate ventilation as helium is an asphyxiant.

1. Attach Teflon or nylon (Nylaflow) sample tubing to the sample point. This can be accomplished utilizing a number of different methods depending on the sample install (i.e., most typically Swage-Lok brand compression fittings, but some quick release fittings could also be used etc.).
2. Place the shroud over the sample point and tubing.
3. Pull the tubing through hole in top of shroud. Seal opening at top of shroud with modeling clay.
4. Place weight on top of shroud to help maintain a good seal with the ground.
5. Insert helium tubing and helium detector probe into side of shroud. Seal both with modeling clay to prevent leaks.
6. Fill shroud with helium. Fill shroud slowly, allowing atmospheric air to escape either by leaving a gap where the shroud meets the ground surface or by providing a release valve on the side of the shroud.
7. Use the helium detector to monitor helium concentration within the shroud from the lowest hole drilled in the shroud (bottom of the shroud nearest where the sample tubing intersects the ground). Helium should be added until the environment inside the shroud has > 60% helium.
8. Purge the sample point through the sample tubing into a Tedlar bag using a hand held sampling pump. The purge rate should at least match the sample collection rate but not exceed 100 ml/min. Test the air in the Tedlar bag for helium using portable helium detector. If the point is free of leaks there should be very low helium in the purge air from the soil. The natural concentration of helium in the atmosphere is 0.00052% by volume and there are few if any natural sources of helium to soil gas.
9. If > 10% helium is noted in purge air, add more clay or other material to the seal the sample port and repeat the testing procedure. If the seal cannot be fixed, re-install sample point.

10. Monitor and record helium level in shroud before, during and after tracer test.
11. Monitor and record helium level in purge exhaust.
12. At successful completion of tracer test and sample point purging, the soil vapor sample can be collected (if the helium shroud must be removed prior to sample collection be mindful not disturb the sample tubing and any established seals).

## **VII. Data Recording and Management**

Measurements will be recorded on the sample logs at the time of measurement with notations of the project name, sample date, sample start and finish time, sample location, and the helium concentrations in both the shroud and the purge air before, during, and after tracer testing. Any problems encountered should also be recorded in the field notes.

**ATTACHMENT: Compressed Gases—Use and Storage**

In general, a compressed gas is any material contained under pressure that is dissolved or liquefied by compression or refrigeration. Compressed gas cylinders should be handled as high-energy sources and therefore as potential explosives and projectiles. Prudent safety practices should be followed when handling compressed gases since they expose workers to both chemical and physical hazards.

**Handling**

- Safety glasses with side shields (or safety goggles) and other appropriate personal protective equipment should be worn when working with compressed gases.
- Cylinders should be marked with a label that clearly identifies the contents.
- All cylinders should be checked for damage prior to use. Do not repair damaged cylinders or valves. Damaged or defective cylinders, valves, etc., should be taken out of use immediately and returned to the manufacturer/distributor for repair.
- All gas cylinders (full or empty) should be rigidly secured to a substantial structure at 2/3 height. Only two cylinders per restraint are allowed in the laboratory and only soldered link chains or belts with buckles are acceptable. Cylinder stands are also acceptable but not preferred.
- Handcarts shall be used when moving gas cylinders. Cylinders must be chained to the carts.
- All cylinders must be fitted with safety valve covers before they are moved.
- Only three-wheeled or four-wheeled carts should be used to move cylinders.
- A pressure-regulating device shall be used at all times to control the flow of gas from the cylinder.
- The main cylinder valve shall be the only means by which gas flow is to be shut off. The correct position for the main valve is all the way on or all the way off.
- Cylinder valves should never be lubricated, modified, forced, or tampered with.
- After connecting a cylinder, check for leaks at connections. Periodically check for leaks while the cylinder is in use.
- Regulators and valves should be tightened firmly with the proper size wrench. Do not use adjustable wrenches or pliers because they may damage the nuts.
- Cylinders should not be placed near heat or where they can become part of an electrical circuit.
- Cylinders should not be exposed to temperatures above 50 °C (122 °F). Some rupture devices on cylinders will release at about 65 °C (149 °F). Some small cylinders, such as lecture bottles, are not fitted with rupture devices and may explode if exposed to high temperatures.

- Rapid release of a compressed gas should be avoided because it will cause an unsecured gas hose to whip dangerously and also may build up enough static charge to ignite a flammable gas.
- Appropriate regulators should be used on each gas cylinder. Threads and the configuration of valve outlets are different for each family of gases to avoid improper use. Adaptors and homemade modifications are prohibited.
- Cylinders should never be bled completely empty. Leave a slight pressure to keep contaminants out.

### **Storage**

- When not in use, cylinders should be stored with their main valve closed and the valve safety cap in place.
- Cylinders must be stored upright and not on their side. All cylinders should be secured.
- Cylinders awaiting use should be stored according to their hazard classes.
- Cylinders should not be located where objects may strike or fall on them.
- Cylinders should not be stored in damp areas or near salt, corrosive chemicals, chemical vapors, heat, or direct sunlight. Cylinders stored outside should be protected from the weather.

### *Special Precautions*

#### Flammable Gases

- No more than two cylinders should be manifolded together; however several instruments or outlets are permitted for a single cylinder.
- Valves on flammable gas cylinders should be shut off when the laboratory is unattended and no experimental process is in progress.
- Flames involving a highly flammable gas should not be extinguished until the source of the gas has been safely shut off; otherwise it can reignite causing an explosion.

#### Acetylene Gas Cylinders

- Acetylene cylinders must always be stored upright. They contain acetone, which can discharge instead of or along with acetylene. Do not use an acetylene cylinder that has been stored or handled in a nonupright position until it has remained in an upright position for at least 30 minutes.
- A flame arrestor must protect the outlet line of an acetylene cylinder.
- Compatible tubing should be used to transport gaseous acetylene. Some tubing like copper forms explosive acetylides.

Lecture Bottles

- All lecture bottles should be marked with a label that clearly identifies the contents.
- Lecture bottles should be stored according to their hazard classes.
- Lecture bottles that contain toxic gases should be stored in a ventilated cabinet.
- Lecture bottles should be stored in a secure place to eliminate them from rolling or falling.
- Lecture bottles should not be stored near corrosives, heat, direct sunlight, or in damp areas.
- To avoid costly disposal fees, lecture bottles should only be purchased from suppliers that will accept returned bottles (full or empty). Contact the supplier before purchasing lecture bottles to ensure that they have a return policy.
- Lecture bottles should be dated upon initial use. It is advised that bottles be sent back to the supplier after one year to avoid accumulation of old bottles.



**Sub-Slab Soil-Gas Sampling  
Using Method TO-15 –  
Temporary Probe Approach**

SOP # 427199

Rev. #: 4

Rev Date: July 8, 2010

## **I. Scope and Application**

This document describes the procedures for installing temporary sub-slab sampling probes and collect sub-slab soil gas samples for the analysis of volatile organic compounds (VOCs) by United States Environmental Protection Agency (USEPA) Method TO-15. Method TO-15 uses a 1-liter, 3-liter, or 6-liter SUMMA® passivated stainless steel canister. An evacuated 6-liter SUMMA canister (less than 28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5 liters when allowed to fill to a vacuum of 5 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GC/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

These procedures are not recommended if the probe is to be sampled more than once. Under those conditions refer to ARCADIS SOP for permanent sub-slab soil gas installations. The following sections list the necessary equipment and detailed instructions for installing temporary sub-slab soil gas probes and collecting soil-gas samples for VOC analysis.

## **II. Personnel Qualifications**

ARCADIS field sampling personnel will have current health and safety training, including 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training. Site supervisor training, site-specific training, first-aid, and cardiopulmonary resuscitation (CPR) may be appropriate at some sites. ARCADIS field sampling personnel will be well versed in the relevant SOPs and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS personnel responsible for leading sub-slab soil-gas sample collection activities must have previous sub-slab soil-gas sampling experience.

## **III. Health and Safety Considerations**

All sampling personnel should review the appropriate health and safety plan (HASP) and job loss analysis (JLA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. Field sampling must be carefully conducted to minimize the potential for injury and the spread of hazardous substances. For sub-slab vapor probe installation, drilling with an electric concrete impact drill should be done only by personnel with prior experience using such a piece of equipment and with the appropriate health and safety measures in place as presented in the JLA. It is possible to encounter high concentrations of VOCs in sub-slab soil gas, so the amount of time the borehole remains open should be minimized. For the same reason, when installing sub-slab probes in spaces with minimal dilution potential, such as closets, it is advisable to provide local ventilation. Finally, sub-slab

probe installation should be completed 24 hours in advance or after any indoor air sampling to avoid cross contamination of the indoor air samples.

#### IV. Equipment List

The equipment required to install a temporary sub-slab vapor probe is presented below. Modifications to account for project- or regulatory-specific requirements should be noted in the accompanying work plan:

- Appropriate personal protective equipment (PPE; as required by the HASP and the JLA);
- Hammer drill (Hilti, Bosch Hammer, or equivalent);
- 1/2 inch-diameter concrete drill bit (drill bit length contingent on slab thickness);
- Hand tools including open-end wrench (typically 9/16-inch), pliers, channel lock pliers, etc;
- 1/4-inch OD tubing (Teflon, nylon, or Teflon-lined); Note that Nylaflow tubing has a somewhat higher background level of BTEX and much poorer recovery of trichlorobenzene and naphthalene than Teflon, so should not be used on sites where these compounds are a concern (Hayes, 2006).
- Teflon® tape;
- Work gloves;
- Nitrile gloves;
- Hydrated bentonite, VOC-free modeling clay that complies with ASTM D4236 (McMaster Carr 6102T11 recommended) or wax to seal drill hole (see cautions section);
- Whisk broom and dust pan;
- Bottle brush;
- Ground fault circuit interrupter (GFCI);
- Extension cords rated for amperage required for hammer drill;
- Plastic sheeting; and

- Shop vacuum with clean fine-particle filter.

The equipment required for sub-slab soil gas sample collection is presented below:

- 1, 3, or 6-liter stainless steel SUMMA® canisters (order at least one extra, if feasible) (batch certified canisters or individual certified canisters as required by the project) ;
- Flow controllers with in-line particulate filters and vacuum gauges; flow controllers are pre-calibrated to specified sample duration (e.g., 30 minutes, 8 hours, 24 hours) or flow rate (e.g., 200 milliliters per minute [mL/min]); confirm with the laboratory that the flow controller comes with an in-line particulate filter and pressure gauge (order at least one extra, if feasible);
- Extra 1/4-inch Swagelok front and back compression sleeves;
- Swage-Lok fittings;
- Decontaminated stainless steel Swagelok or comparable “T” fitting and needle valve for isolation of purge pump;
- Two 3-inch lengths of 1/4-inch OD Teflon tubing;
- Stainless steel duplicate “T” fitting provided by the laboratory (if collecting duplicate [i.e., split] samples);
- Portable vacuum pump capable of producing very low flow rates (e.g., 100 to 200 milliliters per minute [mL/min]); vacuum pump should also be equipped with a vacuum gauge;
- Rotameter or an electric flow sensor if vacuum pump does not have and accurate flow gauge;
- Tracer gas testing supplies if applicable (refer to SOP “Administering Tracer Gas” #416199);
- Appropriate-sized open-end wrench (typically 9/16-inch and 1/2”);

- Photo Ionization Detector (PID) with a lamp of 11.7 eV; detectable to ppb range (optional);
- Tedlar bag to collect purge air;
- Portable weather meter, if appropriate (temperature, barometric pressure, humidity, etc);
- Quick setting grout or sika flex to seal abandoned holes;
- Chain-of-custody (COC) form;
- Sample collection log (attached); and
- Field notebook.

## V. Cautions

The following cautions and field tips should be reviewed and considered prior to installing or collecting a sub-slab soil gas sample.

- When drilling sample collection holes be mindful of utilities that may be in the area. Always complete utility location, identification and marking before installing subslab ports as required by the ARCADIS Utility Location Policy and Procedure. Be aware that public utility locator organizations frequently do not provide location information within buildings so alternative lines of evidence must be used. If the driller is concerned about a particular location, consult the project manager about moving it to another location. Don't be hesitant to use your Stop Work Authority, if something doesn't seem right stop and remedy the situation.
- Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke cigarettes/cigars before and/or during the sampling event.
- Ensure that the flow controller is pre-calibrated to the proper sample collection duration (confirm with laboratory). Sample integrity can be compromised if sample collection is extended to the point that the canister reaches atmospheric pressure. Sample integrity is maintained if sample collection is terminated prior to the target duration and a measurable vacuum (e.g., 3–7 inches Hg) remains in the canister when sample collection is terminated. Do not let sample canister reach atmospheric pressure (e.g., 0-inches Hg).

- Field personnel will properly seal the vapor probe at the slab surface to prevent leaks of atmosphere into the soil vapor probe during purging and sampling. Temporary points should be fit snug into the pre-drilled hole using Teflon® tape or modeling clay and sealed with hydrated bentonite, clay or wax at the surface. If this is not done properly, the integrity of the sample port may be compromised.
- Modeling clay or other materials used to seal the hole should only be obtained from an approved ARCADIS source and should not be purchased off the shelf from an unapproved retail source. Data indicate that some modeling clays may contain VOCs that can affect sample results.
- It is important to record the canister pressure, start and stop times and sample identification on a proper field sampling form. Often Summa canisters are collected over a 24 hour period. The time/pressure should be recorded at the start of sampling, and then again one or two hours later. It is a good practice to lightly tap the pressure gauge with your finger before reading it to make sure it isn't stuck. If the canister is running correctly for a 24 hour period then the vacuum will have decreased slightly after an hour or two (for example from 29" to 27"). Consult your project manager (PM), risk assessor or air sampling expert by phone if the Summa canister does not appear to be working properly.
- Ensure that there is still measureable vacuum in the Summa after sampling. Sometimes the gauges sent from the lab have offset errors, or they stick.
- When sampling carefully consider elevation. If your site is over 2,000' above sea level or the difference in elevation between your site and your lab is more than 2,000' then pressure effects will be significant. If you take your samples at a high elevation they will contain less air for a given ending pressure reading. High elevation samples analyzed at low elevation will result in more dilution at the lab, which could affect reporting limits. Conversely low elevation samples when received at high elevation may appear to not have much vacuum left in them [http://www.uigi.com/Atmos\\_pressure.html](http://www.uigi.com/Atmos_pressure.html).
- If possible, have equipment shipped two to three days before the scheduled start of the sampling event so that all materials can be checked. Order replacements if needed.
- Requesting extra canisters from the laboratory should also be considered to ensure that you have enough equipment on site in case of an equipment failure.

- Check the seal around the soil-gas sampling port by using a tracer gas (e.g., helium) or other method established in the appropriate guidance document.

## **VI. Procedure**

Temporary sub-slab soil vapor probes are installed using equipment and procedures that allows the point to be installed quickly and abandoned after an initial sample is collected. These procedures are not recommended if the probe is to be sampled more than once. Under those conditions refer to ARCADIS SOP for permanent sub-slab soil gas installations.

### **Sub-slab Soil Gas Point Installation**

1. Complete the ARCADIS Utility Locate SOP prior to drilling activities.
2. Remove, only to the extent necessary, any covering on top of the slab (e.g., carpet).
3. Lay down plastic sheeting to keep the work area clean. Check to make sure shop vacuum is working properly and fine concrete particles will not pass through filter
4. Drill a 1/2-inch-diameter hole into the concrete slab using the electric drill. Do not fully penetrate the slab at this time. Stop drilling approximately 1 inch short of penetrating the slab.
5. Use the shop vacuum, bottle brush and dust broom to clean up the work area and material that may have fallen into and around the drill hole..
6. Advance the 1/2-inch drill bit the remaining thickness of the slab and approximately 3 inches into the sub-slab material to create an open cavity. Note (if possible) from the drill cuttings any evidence for the types of materials in the immediate sub-slab – i.e. moisture barriers, sand, gravel, shrinkage gap?
7. Use the bottle brush, whisk broom, and dust pan to quickly clean material around and within the hole. The hole should not be left open for any extended length of time to ensure that VOCs below the slab do not migrate into indoor air. Do not use the shop vacuum to clean up the drill hole after the full thickness of the slab has been penetrated.



8. Re-drill the 1/2 – inch hole to ensure it remains clear. This can also be accomplished using a piece of steel rod, sample tubing, or even a piece of heavy wire (coat hanger).
9. Wrap the tubing with Teflon® tape or modeling clay, to the extent necessary, for a snug fit of tubing and hole.
10. Insert the tubing approximately 2 to 3 inches into the slab; tubing should not contact material beneath the slab. Tubing should be capped with clay or other fitting so it does not provide a pathway for vapor movement.
11. Prepare a hydrated bentonite mixture and apply bentonite at slab surface around the tubing. Instead of hydrated bentonite, either VOC free modeling clay (McMaster-Carr #6102T11) or wax may be used for the temporary seal around the tubing where it enters the slab.
12. Proceed to soil gas sample collection after waiting a minimum of 1 hour for equilibration following probe installation.

### **Sub-Slab Soil Gas Sample Collection**

Once the temporary sample probe is installed, the following procedure should be used to collect the sample in the Summa canister.

1. Record the following information on the sample log, if appropriate (contact the local airport or other suitable information source [e.g., site-specific measurements, [weatherunderground.com](http://weatherunderground.com)] to obtain the information):
  - a. wind speed and direction;
  - b. ambient temperature;
  - c. barometric pressure; and
  - d. relative humidity.
2. Assemble the sample train by removing the cap from the SUMMA canister and connecting the Swagelok T-fitting to the can using a short length of 1/4-inch OD Teflon tubing. The flow controller with in-line particulate filter and vacuum gauge is then attached to the T-fitting. The Swagelok (or similar) two-way valve is connected to the free end of the T-fitting using a short length of 1/4-inch OD Teflon tubing.

3. When collecting duplicate or other quality assurance/quality control (QA/QC) samples as required by applicable regulations and guidance, couple two SUMMA canisters using stainless steel Swagelok duplicate sample T-fitting supplied by the laboratory. Attach flow controller with in-line particulate filter and vacuum gauge to duplicate sample T-fitting provided by the laboratory.
4. Perform a leak-down-test by replacing the nut which secures sample tubing with the cap from the canister. This will create a closed system. Open the canister valve and quickly close it; the vacuum should increase approaching 30" Hg. If there are no leaks in the system this vacuum should be held. If vacuum holds proceed with sample collection; if not attempt to rectify the situation by tightening fittings.
5. Attach Teflon sample tubing from the temporary probe to the flow controller using Swagelok fittings.
6. Connect the two-way valve and the portable purge pump using a length of Teflon sample tubing.
7. Record on the sample log and COC form the flow controller number with the appropriate SUMMA® canister number.
8. If appropriate, the seal around the soil-gas sampling port and the numerous connections comprising the sampling train will be evaluated for leaks using helium as a tracer gas. The helium tracer gas will be administered according to the methods established in the appropriate guidance documents and SOP: Administering Helium Tracer Gas.
9. Open the two-way valve and purge the soil-gas sampling port and tubing with the portable sampling pump. Purge approximately three volumes of air from the soil-gas sampling port and sampling line using a flow rate of 200 mL/min or less. Purge volume is calculated by the following equation "purge volume = 3 x  $\pi$  x inner radius of tubing<sup>2</sup> x length of tubing. Purge air will be collected into a Tedlar bag to provide that VOCs are not released into interior spaces. Measure organic vapor levels and tracer gas within the Tedlar bag, as appropriate.
10. Close the two-way valve to isolate the purge pump.
11. Open the SUMMA® canister valve to initiate sample collection. Record on the sample log (attached) the time sampling began and the canister pressure.

If the initial vacuum pressure registers less than -25 inches of Hg, then the SUMMA® canister is not appropriate for use and another canister should be used.

Sampling flow rate should be 200 mL/min or less.

12. Take a photograph of the SUMMA® canister and surrounding area unless prohibited by the building owner.
13. Check the SUMMA canister approximately half way through the sample duration and note progress on sample logs.

#### **Termination of Sample Collection**

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the required sampling interval in order to have sufficient time to terminate the sample collection.
2. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valves. The canister should have a minimum amount of vacuum (ideally 3-7 inches of Hg or slightly greater).
3. Record the date and local time (24-hour basis) of valve closing on the sample collection log and COC form.
4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install the brass plug on the canister fitting, and tighten with the appropriate wrench.
5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.
6. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with a string).
7. Complete the COC form and place the requisite copies in a shipping container. Close the shipping container and affix a custody seal to the container closure. Ship the container to the laboratory via overnight carrier (e.g., Federal Express) for analysis.

8. A Shipping Determination must be performed, by DOT-trained personnel, for all environmental and geotechnical samples that are to be shipped, as well as some types of environmental equipment/supplies that are to be shipped.
9. Remove the tubing and grout the hole in the slab with quick-setting hydraulic cement powder, Sika-Flex, or other material similar to the slab. This step must be done carefully to ensure that the abandoned sampling point does not become a preferential flow pathway.
10. Replace the surface covering (e.g., carpet) to the extent practicable. Sample collection location should be returned to pre-sampling conditions/

#### **VII. Waste Management**

The volume of waste materials generated by these activities should be minimal. Personal protective equipment, such as gloves and other disposable equipment (i.e., tubing) should be collected by field personnel for proper disposal.

#### **VIII. Data Recording and Management**

Information collected in the field should be recorded in the field notebook as well as written on the field sampling log and COC, as appropriate. The field notebook and sampling log must include the project name, sample date, sample start and finish time, sample location (e.g., global positioning system [GPS] coordinates, distance from permanent structure [e.g., two walls, corner of room]), canister serial number, flow controller serial number, initial vacuum reading, and final pressure reading. Field sampling logs and COC records will be transmitted to the PM.

#### **IX. Quality Assurance**

Duplicate samples should be collected in the field as a quality assurance step. Generally, duplicates are taken of 10% of samples, but project specific requirements should take precedence.

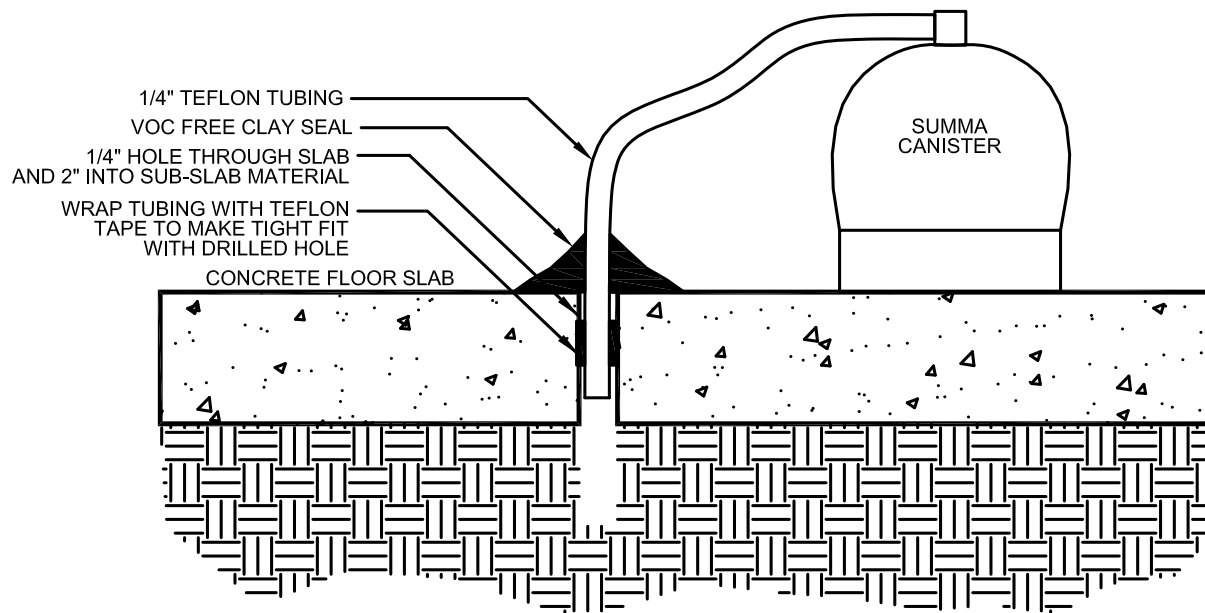
Soil-gas sample analysis will generally be performed using USEPA TO-15 methodology or a project specific constituent list. Method TO-15 uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits (typically 0.5-ppbv for most VOCs).

#### **X. References**

ASTM – “Standard Guide for Soil Gas Monitoring in the Vadose Zone”, D5314-92.

Hayes, H. C., D.J. Benton and N. Khan "Impact of Sampling media on Soil Gas Measurements" Presented with short paper at AWMA Vapor Intrusion Conference January 2006, Philadelphia PA.

ITRC "Vapor Intrusion Pathway: A Practical Guide", January 2007, Appendix F: "regulators Checklist for Reviewing Soil Gas Data"



**DIAGRAM OF TEMPORARY  
SUB-SLAB SAMPLE POINT**

## **Ambient Air Sampling and Analysis Using USEPA Method TO-15**

Rev. #: 1

Rev Date: March 13, 2009

## **I. Scope and Application**

This standard operating procedure (SOP) describes the procedures to collect ambient air samples for the analysis of volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA® canister (<28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5.5 liters when allowed to fill to a vacuum of 2-7 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and detailed instructions for placing the sampling device and collecting ambient air samples for VOC analysis.

## **II. Personnel Qualifications**

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. ARCADIS field sampling personnel will be well versed in the relevant SOPs and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS personnel responsible for leading ambient air sample collection activities must have previous ambient air sampling experience.

## **III. Equipment List**

The equipment required for ambient air sample collection is presented below:

- 6-liter, stainless steel SUMMA® canisters (order at least one extra, if feasible);
- Flow controllers with in-line particulate filters and vacuum gauges (flow controllers are pre-calibrated by the laboratory to a specified sample duration [e.g., 8-hour]). Confirm with lab that flow controller comes with in-line particulate filter and pressure gauge (order an extra set for each extra SUMMA® canister, if feasible);
- Appropriate-sized open-end wrench (typically 9/16-inch);
- Chain-of-custody (COC) form;
- Field notebook;



- Sample collection log (attached);
- Camera;
- Lock and chain; and
- Ladder or similar to hold canister above the ground surface (optional).

#### **IV. Cautions**

Care must be taken to minimize the potential for introducing interferences during the sampling event. As such, care must be taken to keep the canister away from public roadways to prevent collection of automobile source pollutants (unless this is the objective of the study). Care must also be taken to keep the canister away from heavy pedestrian traffic areas (e.g., main entranceways, walkways). If the canister is not to be overseen for the entire sample duration, precautions should be taken to maintain the security of the sample (e.g., do not place in areas regularly accessed by the public, fasten the sampling device to a secure object using lock and chain, label the canister to indicate it is part of a scientific project, place the canister in secure housing that does not disrupt the integrity/validity of the sampling event). Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke cigarettes/cigars before and/or during the sampling event.

Care should also be taken to ensure that the flow controller is pre-calibrated to the proper sample collection time (confirm with laboratory). Sample integrity is maintained if the sampling event is shorter than the target duration, but sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure.

A Shipping Determination must be performed, by DOT-trained personnel, for all environmental and geotechnical samples that are to be shipped, as well as some types of environmental equipment/supplies that are to be shipped.

#### **V. Health and Safety Considerations**

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances.

#### **VI. Procedure**

##### **Preparation of SUMMA®-Type Canister and Collection of Sample**

1. Record the following information in the field notebook (contact the local airport or other suitable information source [e.g., [weatherunderground.com](http://weatherunderground.com)] to obtain the following information):
  - ambient temperature;
  - barometric pressure; and
  - relative humidity.
2. Choose the sample location in accordance with the sampling plan. If a breathing zone sample is required, place the canister on a ladder, tripod, or other similar stand to locate the canister orifice 3 to 5 feet above ground. If the canister will not be overseen for the entire sampling period, secure the canister as appropriate (e.g., lock and chain).
3. Record SUMMA® canister serial number and flow controller number in the field notebook and COC form. Assign sample identification on canister ID tag and record in the field notebook, sample collection log (attached), and COC form.
4. Remove the brass dust cap from the SUMMA® canister. Attach the flow controller with in-line particulate filter and vacuum gauge (leave swage-lock cap on the vacuum gauge during this procedure) to the SUMMA® canister with the appropriate wrench. Tighten with fingers first, then gently with the wrench.
5. Open the SUMMA® canister valve to initiate sample collection. Record the date and local time (24-hour basis) of valve opening in the field notebook, sample collection log, and COC form.
6. Record the initial vacuum pressure in the SUMMA® canister in the field notebook and COC form. If the initial vacuum pressure does not register less than -28 inches of Hg, then the SUMMA® canister is not appropriate for use and another canister should be used.
7. Take a photograph of the SUMMA® canister and surrounding area.

### **Termination of Sample Collection**

1. Arrive at the SUMMA® canister location at least 10 to 15 minutes prior to the end of the sampling interval (e.g., 8-hour).

2. Stop collecting the sample when the canister vacuum reaches approximately 2-7 inches of Hg (leaving some vacuum in the canister provides a way to verify if the canister leaks before it reaches the laboratory) or when the desired sample time has elapsed.
3. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valve. Record the date and local time (24-hour basis) of valve closing in the field notebook, sample collection log, and COC form.
4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install brass plug on canister fitting, and tighten with wrench.
5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.
6. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with string).
7. Complete COC forms and place requisite copies in shipping container. Close shipping container and affix custody seal to container closure. Ship to laboratory via overnight carrier (e.g., Federal Express) for analysis.

## **VII. Waste Management**

No specific waste management procedures are required.

## **VIII. Data Recording and Management**

Measurements will be recorded in the field notebook at the time of measurement, with notations of project name, sample date, sample start and finish times, sample location (e.g., GPS coordinates if available), canister serial number, flow controller number, initial vacuum reading, and final vacuum reading. Field sampling logs and COC records will be transmitted to the Project Manager.


## **IX. Quality Assurance**

Ambient air sample analysis will be performed using USEPA Method TO-15. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5 ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-

analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode.

## **X. References**

[Click here and enter Text]

 <b>ARCADIS</b> <i>Infrastructure, environment, facilities</i>		<b>Indoor/Ambient Air Sample Collection Log</b>	
		Sample ID:	
<b>Client:</b>		<b>Outdoor/Indoor:</b>	
<b>Project:</b>		<b>Sample Intake Height:</b>	
<b>Location:</b>		<b>Miscellaneous Equipment:</b>	
<b>Project #:</b>		<b>Time On/Off:</b>	
<b>Samplers:</b>		<b>Subcontractor:</b>	

**Instrument Readings:**

Time	Canister Pressure (inches of HG)	Temperature (F or C)	Relative Humidity (%)	Air Speed (ft/min)	Pressure Differential (inches of H2O)	PID (ppm or ppb)

**SUMMA Canister Information:**

Size (circle one): 1 L    6 L

Canister ID:

Flow Controller ID: \_\_\_\_\_

**General Observations/Notes:**


Please record current weather information including wind speed and direction, ambient temperature, barometric pressure, and relative humidity via suitable information source (e.g., weatherunderground.com).