



March 30, 2020

Mr. Jacob Hassan
Federal On-Scene Coordinator
U.S. Environmental Protection Agency Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604

Subject: Final Sampling and Analysis Plan – Revision 3
Ortek Site- RV
EPA Contract No.: 68-HE-0519-D0005
Task Order-Task Order Line Item No.: F0069-0002AI049
Document Tracking No.: 0233A

Dear Mr. Hassan:

The Tetra Tech, Inc. (Tetra Tech) Superfund Technical Assessment and Response Team (START) is submitting the Final Sampling and Analysis Plan (SAP) that summarizes sampling activities and an asbestos survey planned for Spring 2020 at the Ortek Site in McCook, Cook County, Illinois. This revision addresses comments provided by EPA on Revision 3 of the Draft SAP, submitted by Tetra Tech to EPA on March 27, 2020.

Please call me at (312) 201-7759 if you have any questions or comments regarding this submittal.

Sincerely,

A handwritten signature in black ink, appearing to read 'Cordell Renner'.

Cordell Renner
START V Project Manager

Enclosures (2)

cc: Task Order-Task Order Line Item file

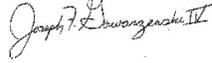
**FINAL SAMPLING AND ANALYSIS PLAN
 ORTEK SITE - RV
 7601 WEST 47TH STREET
 MCCOOK, COOK COUNTY, ILLINOIS**

Revision 2

Prepared for

**U.S. ENVIRONMENTAL PROTECTION AGENCY
 Superfund and Emergency Management Division
 Region 5
 77 West Jackson Boulevard
 Chicago, Illinois 60604**



TASK ORDER-TASK ORDER LINE ITEM NO.:	F0069-0002AI049
EPA OSC:	Jacob Hassan
SITE NAME:	Ortek – RV
SITE LOCATION:	7601 West 47 th Street, McCook, IL
SAMPLING ACTIVITIES:	AST and UST sampling, catch basin sampling, asbestos survey
SAMPLING START DATE:	Spring 2020
SAP PREPARER:	Cordell Renner
SIGNATURE/DATE:	 3/30/2020
QC REVIEWER:	Joseph Gawarzewski
SIGNATURE/DATE:	 3/30/2020
EPA OSC:	Jacob Hassan
SIGNATURE/DATE:	 03/30/2020
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- 1 EPA ERT STANDARD OPERATING PROCEDURES

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) identifies sample collection activities and associated quality assurance/quality control (QA/QC) measures specific to the Ortek - RV site, located at 7601 West 47th Street in McCook, Cook County, Illinois. A site location map is presented in Figure 1 (Appendix A). This SAP is designed to provide defensible data to the U.S. Environmental Protection Agency (EPA) Region 5 regarding hazardous wastes stored in several aboveground storage tanks (AST) and a single underground storage tank (UST) and to identify on- and off-site soil and water impacts resulting from on-site releases. The site-specific sampling, analytical, and QA/QC procedures described in this SAP address the project scope of work and requirements specified by EPA.

Under Task Order-Task Order Line Item Number (TO-TOLIN) F0069-0002AI049, EPA Region 5 tasked the Tetra Tech, Inc. (Tetra Tech) Superfund Technical Assessment and Response Team (START) to assist with sampling activities at the site. The goal of the sampling effort is to assess potential human health and environmental concerns that meet criteria for a time-critical removal action as provided in the National Oil and Hazardous Substances Pollution Contingency Plan, 40 Code of Federal Regulations (CFR) Part 300.415(b)(2) at the site and the surrounding area.

2.0 SCOPE OF WORK

The EPA On-Scene Coordinator (OSC) tasked Tetra Tech START with the following activities:

- Collect waste characterization samples from up to 90 ASTs located both on- and off-site;
- Collect waste characterization samples from a suspected UST located on-site;
- Quantify the amount and type of wastes in tanks located on- and off-site;
- Perform an asbestos survey using an Illinois-licensed asbestos inspector;
- Collect waste characterization samples inside the culvert and soil samples from the soil surrounding the culvert in the parcel directly to the south of the site;
- Collect photographic documentation of sampling activities and locations;
- Collect written documentation in the site logbook, including a general map of sampling locations;
- Package and ship samples to the subcontracted laboratory (TBD); and
- Document and summarize the findings in a site assessment report.

This SAP describes the sampling, analytical, and QA/QC requirements for activities to be completed at the site. Appendix A contains figures depicting the site location and layout. Appendix B includes Table 1, which lists a sample summary, including all QC samples, analytical methods, sample volumes, containers, preservation techniques, and holding times. Appendix C contains Tetra Tech standard operating procedures (SOP) that will be used during the site assessment. Attachment 2 contains EPA's Environmental Response Team (ERT) Asbestos Sampling SOP.

3.0 SITE LOCATION AND DESCRIPTION

The site consists of eight parcels¹ totaling approximately 285,000 square feet, or 6.5 acres, and is located at 7601 West 47th Street in McCook, Cook County, Illinois (Figure 1). The main production facility is primarily made up of parcels 18-12-101-011, 18-12-101-021, and 18-12-101-049; however, the southern border of the site also shares easements consisting of the remaining five parcels (Figure 3). The site is bounded to the north by 47th Street with a bowling alley and residential properties beyond; to the east by a wooded area and the Des Plaines River beyond; to the south by railroad tracks and the Des Plaines River beyond; and to the west by and Denton Cartage Company with several commercial/industrial properties beyond (Figure 2).

¹ Site parcels are as follows: 18-12-101-049, 18-12-101-021, 18-12-101-048, 18-12-101-022, 18-12-500-003, 18-12-101-023, 18-12-101-024, 18-12-101-011

The Ortek facility received two separate Notices of Violation (NOV) from the Resource Conservation and Recovery Act (RCRA) division EPA Region 5. An unannounced sampling inspection of the facility took place on March 30, 2016 (EPA 2016). EPA personnel inspected the facility as part of an ongoing enforcement investigation to evaluate the facility's compliance with the RCRA and the facility's implementation of regulations found in the Illinois Administrative Code and the Code of Federal Regulations for their Facility Response Plan (FRP) and their Spill Prevention, Control, and Countermeasure Plan (SPCC). As part of the investigation, EPA sampled a single AST (Tank 101). Results from the sample indicated that the tank contained varying levels of benzene, ethylbenzene, methylene chloride, tetrachloroethene (PCE), toluene, trichloroethene (TCE), and xylenes. Based on the analytical results, EPA suspected Tank 101 previously stored various wastes such as waste oil and solvents.

As a part of a removal assessment, EPA tasked START with collecting vertical samples and a sludge sample from Tank 101 on November 16, 2016. Five soil samples were also collected from the site to determine whether releases from the tank had impacted the soil. The analytical results indicated that no soil samples had concentrations of contaminants that exceeded the EPA industrial removal management levels (RML). The analytical results from the vertical samples taken from Tank 101 indicated that the tank contained concentrations of benzene, TCE, and PCE above the Maximum Concentration of Contaminants for Toxicity Characteristic in Table 1 of 40 CFR 261.24. Benzene was also detected in the sludge from collected from Tank 101. Both the liquid and the sludge had flashpoints below 140 degrees Fahrenheit (°F), classifying them as ignitable waste according to 40 CFR Part 261.21(a)(1).

Between the sampling event in November 2016 and the initiation of a removal action in October 2019, additional material had been added to Tank 101. Tank 101 was observed to be approximately 50% full in 2016 and was observed to be approximately 90% full by 2019. It is unknown what substance(s) had been added to the tank. As mentioned previously, a removal action was initiated in October 2019 to mitigate and prevent a substantial threat of discharge by removing and disposing of the contents from Tank 101 and rendering the tank unusable in accordance with 40 CFR Part 300.415(c)(1)(i).

Once on site for the removal action, a laboratory with various hazardous substances and pollutants or contaminants was discovered. EPA also observed that a release of unknown contents from an unknown source had occurred in the secondary containment within Area 1 (Figure 2). EPA also observed that a mixture of the unknown materials within the secondary containment and rainwater had been released

from the containment through cracks in the containment walls as well as through a compromised sump. The oily wastes were observed to have flowed into to a low-lying area south of Area 1.

Due to the nature of the chemicals stored in the tanks and transported through exterior pipes on the property, it is suspected that asbestos-containing materials (ACM) are possibly used for insulation. The insulation has been observed to be weathered and damaged, potentially threatening human health and the environment if not removed or encapsulated.

4.0 PROPOSED SCHEDULE

When full laboratory reports become available, a Tetra Tech START chemist will validate laboratory analytical data. Tetra Tech START will then provide EPA with a site assessment report containing validated analytical results and other findings. The table below outlines the anticipated schedule. The initial sampling at parcel 18-12-101-011 is anticipated to take 5 days.

Proposed Schedule

Activities	Dates (Month/Day/Year)		Deliverables	Deliverable Due Date
	Anticipated Date(s) of Initiation	Anticipated Date of Completion		
HASP Preparation, SAP Preparation, Meeting Planning	01/20/2020	02/07/2020	HASP and SAP	02/07/2020
Sample Collection and Screening (18-12-101-049, 18-12-101-021, 18-12-500-003, 18-12-101-048, 18-12-101-022, 18-12-101-023, 18-12-101-024))	Late spring 2020	Late spring 2020	Log Books, Sampling and Screening Log	Not Applicable
Sample Collection and Screening (18-12-101-011)	Late winter/Early spring 2020	Late winter/Early spring 2020	Log Books, Sampling and Screening Log	Not Applicable
Laboratory Analysis	TBD	One month after sample shipment	Laboratory Analytical Reports	Not Applicable
Data Validation	TBD	TBD	Data Validation Reports	2 weeks after receiving the final laboratory analytical report
Draft Project Report	TBD	TBD	Draft Removal Assessment Report	2 weeks after receiving the data validation report(s)
Final Project Report	Upon receipt of comments to the draft report	One week after receipt of client comments	Final Removal Assessment Report	1 month after DVR completion

Notes:

TBD-To be determined

HASP- Health and safety plan

SAP- Sampling and plan

DVR- Data validation report

5.0 ABOVEGROUND STORAGE TANK SURVEY AND SAMPLING

START will collect liquid and solid samples from up to 90 ASTs with unknown levels and contents (Figure 2) on two difference parcels (Tax Parcel 18-12-101-021 and 18-12-101-011). EPA currently has access to parcel 18-12-101-011, which is owned by the Village of McCook. Parcel 18-12-101-021, which is located immediately to the west of the Village's parcel, is currently owned by a private entity and access has not been granted for this work. Individual parcels are shown in Appendix A, Figure 3. EPA will proceed with the required sampling on the parcel which access has been granted. Once access has been obtained to the remaining parcels, EPA will return to complete the sampling.

Tetra Tech personnel will record all relevant information concerning the tanks, such as the type, capacity, markings, condition, and suspected contents in the field logbook. After inspecting the tanks, field personnel will dress in Level C personal protection equipment (PPE) to sample the tanks. Any vents or pressure release valves will be opened slowly to allow the tank to vent to atmospheric pressure. Air monitoring for explosive gases and toxic vapors will be conducted using a MultiRAE Pro during the venting process, which will be done in accordance with Tetra Tech SOP 003 "Organic Vapor Air Monitoring."

The sampling will be conducted in 2 phases to address health and safety concerns as well as limited access to the tanks.

Phase 1 Sampling (liquid sampling):

An evaluation of all the AST will be conducted to determine which tanks contain free phase liquids and/or a sludge layer as well as to identify tanks that have accessible sampling ports. Tanks that are identified as having free phased liquids will have one sample collected and analyzed as outlined in Table 2. If the tank has multiple phases, a sample will be collected from the layer that is most consistent with the oil. Analytical results will be used to determine if the tanks contain CERCLA hazardous substance constituents or used oil. Using the 20 times rule, tanks that contain CERCLA hazardous substance constituents and have a parameter identifying it as potentially being a CERCLA hazardous waste, will be grouped for waste characterization sampling. Composite waste characterization sampling will be done as a part of the disposal process once tank groupings have been established.

Phase 2 Sampling (Sludge Sampling):

Sludge sampling will be conducted once the free phase liquid has been removed from the tank. This is to ensure the sampling can be conducted safely and that a representative aliquot is collected from the sludge layer. Using the analytical data from Phase 1, tanks that have a sludge layer will be grouped based on their analytical results. Tanks containing sludge oil will be grouped for sampling and a representative aliquot from each tank will be composited for waste characterization. This process will be duplicated for tanks that contain CERCLA hazardous substance constituents. Waste characterization sampling will be a composite sample consisting of 4 aliquot samples (one sample per tank) or every 3,000 gallons of sludge. Aliquots will be representative of the full the sludge profile within the tank.

Samples will be collected in accordance with Tetra Tech SOP 006-4, "Sediment and Sludge Sampling", Tetra Tech SOP 008-2, "Containerized Liquid, Sludge, and Slurry Sampling", and Scientific, Engineering, Response & Analytical Services SERAS SOP 2010-1, "Tank Sampling". ERRS will use an oil-level meter to gauge the volume of the tanks and tank contents. Once the presence of waste is confirmed, a sample will be collected using a Sludge Judge®, or similar device. Once the media is collected, the Sludge Judge® will be emptied into a 5-gallon bucket and a sample will be collected. If sludge and liquid media are present, the different phases and their levels will be documented. If possible, a sample from each media will be collected. The Sludge Judge® and any other sampling equipment will be decontaminated between each tank and decontamination procedures are fully discussed in Section 10.

Contaminants to be analyzed for will be based on the Maximum Concentration of Contaminants for Toxicity Characteristic in Table 1 of 40 CFR 261.24. Liquid waste will be analyzed for totals of the contaminants and compared to TCLP values using the 20 times rule. Solid waste (sludge) will be analyzed utilizing the toxicity characteristic leaching procedure (TCLP). Sample numbers, descriptions, sample methods, preservation, and holding times are provided in Tables 1 and 2 (Appendix B).

AST samples will be labeled with a site-wide generic nomenclature consisting of a site identifier (OS = Ortek Site), sample description (AST = above ground storage tank) and tank number, media (sludge [S] or liquid [L]), sample number, and the date. An example of an AST sample ID is as follows: OS-AST101-S-01-02032020.

6.0 UNDERGROUND STORAGE TANK SURVEY AND API SEPARATOR SAMPLING

START will collect samples from a suspected UST and American Petroleum Institute (API) separator in the northeast corner of the site (Figure 2). Before conducting the sampling, Tetra Tech personnel will

record all relevant information concerning the tank, such as the type, capacity, markings, condition, and suspected contents in the field logbook. After inspecting the tank, field personnel will don Level C PPE to sample the tank. Any vents or pressure release valves will be opened slowly to allow the tank to vent to atmospheric pressure. Air monitoring for explosive gases and toxic vapors will be conducted with a MultiRAE Pro during the venting process, which will be done in accordance with Tetra Tech SOP 003 “Organic Vapor Air Monitoring.”

START will locate a sample port for the UST and use an oil-level meter to determine the presence and amount of waste. If waste is discovered, START will use a Sludge Judge®, or similar device, to collect samples. If sludge and liquid media are present, the different phases and their levels will be documented. If possible, a sample from each media will be collected. The media will be emptied into a 5-gallon bucket and each media present (liquid or sludge) will be sampled.

Contaminants to be analyzed for will be based on the Maximum Concentration of Contaminants for Toxicity Characteristic in Table 1 of 40 CFR 261.24. Liquid waste will be analyzed for total VOCs, semi-volatile organic compounds (SVOC), polychlorinated biphenyls (PCB), and RCRA 8 metals. Solid waste (sludge) will be analyzed with the use of TCLP VOCs, TCLP semi-volatile organic compounds (SVOC), total polychlorinated biphenyls (PCB), and TCLP RCRA 8 metals. Sample numbers, descriptions, sample methods, preservation, and holding times are provided in Tables 1 and 2 (Appendix B).

UST samples will be labeled with a site-wide generic nomenclature consisting of a site identifier (OS = Ortek Site), sample description (UST = underground storage tank) and tank number, media (sludge [S] or liquid [L]), sample number, and the date. An example of a UST sample ID is as follows: OS-UST101-S-01-02032020.

7.0 SOUTH PARCEL SAMPLING

START will collect surface soil samples from a parcel directly south of the Ortek site. The secondary containment within Area 1 (Figure 2) was observed by EPA to be compromised, allowing waste to migrate into a low-lying area located directly south of the site. EPA tasked START with collecting waste samples from a basin located within the parcel as well as surface soil samples from the area surrounding the basin.

7.1 Surface Soil Sampling

START will collect soil samples from areas around the catch basin that are visually observed to be impacted. Samples will be collected in accordance with Tetra Tech SOP 005-3, "Soil Sampling." Up to 10 soil samples will be collected using a stainless-steel trowel and a stainless-steel bowl, each will be decontaminated in accordance with Tetra Tech SOP 002-4, General Equipment Decontamination. In addition to the waste samples, an equipment rinsate sample will be collected daily from the bowl. Samples for volatile organic compounds (VOC) will be collected directly from the sample point; samples for other analytes will be collected after homogenization. Sample locations will be determined in the field the day of sampling based on field observations. Surface soil samples will be sent for analysis of total VOCs, semi-volatile organic compounds (SVOC), polychlorinated biphenyls (PCB), and RCRA 8 metals. Sample numbers, descriptions, sample methods, preservation, and holding times are shown in Tables 1 and 2 (Appendix B).

Soil samples will be labeled with a site-wide generic nomenclature consisting of a site identifier (OS = Ortek Site), sample description (SS = surface soil), sample number, and date. An example of a soil sample ID is as follows: OS-SS-01-02032020. Sample locations will be marked in the field using a global positioning system (GPS) unit.

7.2 Railroad Sump Sampling

During ongoing removal activities, a railroad sump was observed to have free product. EPA tasked START with collecting up to two waste samples from the sump, which is grated and constructed of concrete. START will insert a Sludge Judge®, or a similar waste sampler, between the grates (or remove the grates, if necessary) to collect the product in the sump. Product in the sump will be analyzed based on the Maximum Concentration of Contaminants for Toxicity Characteristic in Table 1 in 40 CFR 261.24. Liquid waste will be analyzed for total VOC's, SVOC's, PCB's, RCRA-8 Metals, and reactive sulfides. Solid waste (sludge) will be analyzed for TCLP VOC's, TCLP SVOC's, PCB's, and TCLP Metals.

Sample numbers, descriptions, sample methods, preservation, and hold times are provided in Tables 1 and 2 (Appendix B).

Sump samples will be labeled with a site-wide generic nomenclature consisting of a site identifier (OS = Ortek Site), sample description (SU = sump), sample number, and date. An example of a catch basin sample ID is as follows: OS-SU-01-02032020. Sample locations will be marked in the field using a GPS unit.

8.0 ASBESTOS SURVEY

The asbestos survey will include collecting bulk samples of suspect ACM, determining if the ACM can be secured in place or if it needs to be removed, and quantifying the amount of ACM present.

START will use a licensed Illinois asbestos inspector, accompanied by EPA personnel, who will collect bulk samples of suspect ACM. First, the inspector will conduct a visual inspection of the exterior Ortek pipelines and storage tanks that have been compromised due to weathering. Suspect ACM and their locations will be identified and documented during the visual inspection.

The number of bulk samples of each suspect ACM and the sampling locations will be determined after the visual inspection is complete. The inspector will collect a representative number of bulk samples for each suspect ACM identified at exterior locations that can be safely accessed. The samples will be analyzed using Polarized Light Microscopy (PLM) for asbestos concentrations using a Tetra Tech-procured, National Voluntary Laboratory Accreditation Program (NVLAP) laboratory. The inspector will document sampling activities and sampling locations, including recording pertinent notes in the site logbook or field sheets and providing a general map of sampling locations. Sample numbers, descriptions, sample methods, preservation, and hold times are shown in Tables 1 and 2 (Appendix B).

ACM samples will be labeled with a site-wide generic nomenclature consisting of a site identifier (OS = Ortek Site), sample description (ACM = asbestos containing material), sample number, and the date. An example of an ACM sample ID is as follows: OS-ACM-01-02032020.

9.0 SAMPLE HANDLING

Sampling locations will be noted in the site logbook in accordance with Tetra Tech SOP No. 024-2, “Recording Notes in Field Logbooks” (Attachment 1). The collected samples will be labeled, packaged, and shipped in accordance with procedures outlined in Worksheets 26 and 27 of Tetra Tech’s START Quality Assurance Project Plan (QAPP) (Tetra Tech 2019).

10.0 DECONTAMINATION

Tetra Tech START will primarily use non-disposable equipment (i.e., stainless steel scoops) during the collection of samples. That equipment will be decontaminated following work at each sampling location by use of a hand-brush, Liquinox wash, and tap water rinse. Distilled water will be used for decontamination. Decontamination will accord with Tetra Tech SOP No. 002-4, “General Equipment Decontamination” (see Appendix C).

In addition to the standard decontamination procedures, a power washer will be used as needed in order to effectively decontaminate the sludge judge after each sampling. A decontamination area will be set up and used when decontaminating with the power washer. Rinsate water will be containerized on site in 55-gallon drums by ERRS. A composite sample will be collected and analyzed for total VOC’s, SVOC’s, PCB’s, RCRA-8 Metals, and reactive sulfides. Solid waste (sludge) will be analyzed for TCLP VOC’s, TCLP SVOC’s, PCB’s, and TCLP Metals.

Disposal of rinsate water will occur on site by discharging it onto the (hard) ground surface. Paper towels may be used to soak up small amounts of water, and if so, disposal of them will occur with the dry industrial waste. The used dedicated sampling equipment and PPE will be double-bagged and disposed of as dry, industrial waste. Used dedicated sampling equipment will be left in place, and PPE will be double-bagged and stored on site pending decisions about future removal actions.

11.0 QUALITY ASSURANCE/ QUALITY CONTROL

QC samples will be collected to evaluate field sampling methods and the overall reproducibility of the laboratory analytical results. Specifically, QC samples will be collected at the following frequencies:

- Field duplicate samples (surface soil and asbestos samples only)
 - 1 per 10 investigative samples

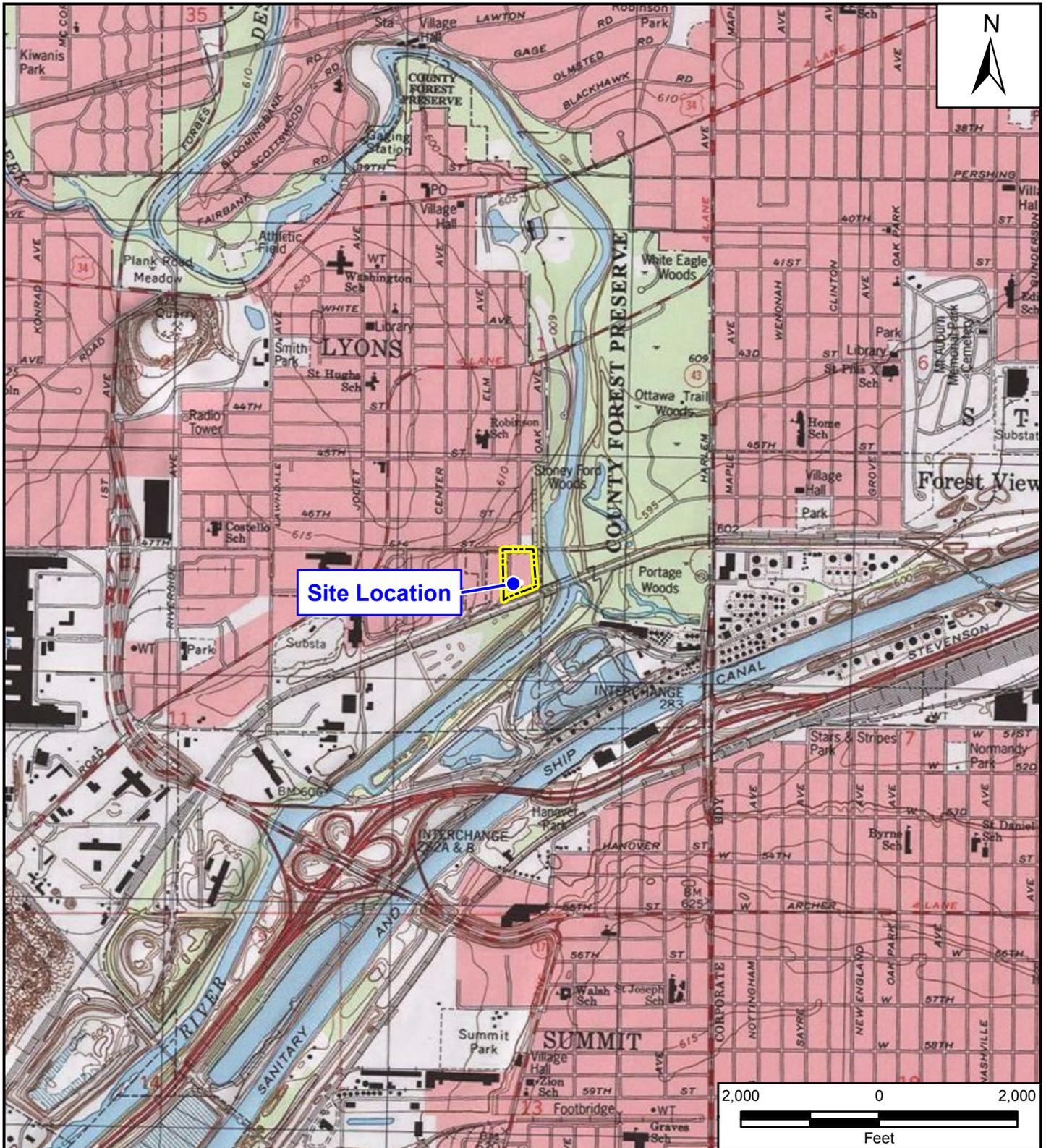
- Matrix spike/matrix spike duplicate samples (surface soil samples only)
 - 1 per 20 investigative samples
- Rinsate Sample
 - 1 per day per sample method

Field duplicate samples for surface soil samples will be collected from the homogenized sample material removed from the same disposable polyethylene bag as its associated investigative sample. Field duplicate samples will be processed, stored, packaged, and analyzed by the same methods as the investigative samples. Due to the hazardous nature of the waste samples and difficulties in collecting volume, QA/QC samples will not be collected for waste samples. Sample nomenclature specific to QC samples will include a D at the end of the sample name for duplicates. For field duplicates, the relative percent difference between the duplicate and the investigative sample will be calculated by the Tetra Tech START QA reviewer and will be summarized in a data validation report.

12.0 REFERENCES

- Scientific, Engineering, Response and Analytical Services, 2016. Tank Sampling, SOP 2010, Revision 1.0. November.
- Scientific, Engineering, Response and Analytical Services, 2017. Asbestos Air Sampling, SOP 2015, Revision 1.1. November.
- Tetra Tech. 2019. Quality Assurance Project Plan, Superfund Technical Assessment and Response Team (START V), Revision 1, U.S. Environmental Protection Agency Region 5, Solicitation No. 68HE0519D005. August.
- Tetra Tech. 2000. Containerized Liquid, Sludge, and Slurry Sampling, SOP No. 008-2. January.
- Tetra Tech. 2010. Sediment and Sludge Sampling, SOP No. 006-4. May.
- Tetra Tech. 2009. Organic Vapor Air Monitoring, SOP No. 003-3. July.
- Tetra Tech. 2014. Recording Notes in Field Logbooks, SOP No. 024-2. November.
- Tetra Tech. 2017. Soil Sampling, SOP No. 005-3. June.
- Tetra Tech. 2018. General Equipment Decontamination, SOP No. 002-4. March.
- Table 1: Maximum concentration of contaminants for the “toxicity” characteristic, as determined by the TCLP (“D” list), 40 C.F.R. § 261.24 (2006).
- U.S. Environmental Protection Agency (EPA). 2016. RCRA Sampling Inspection Report, Ortek, Inc., ILD000646786. March.
- Weaver Consultants Group. 2015. Completion Report, Notice of Violation: SPCC 40 CFR 112 and RCRA-05-2015-0012. December.

APPENDIX A
Figures
(Three Pages)



Site Location

Legend

 Approximate Site Boundary

Ortek Site
7601 47th Street
McCook, Cook County, Illinois

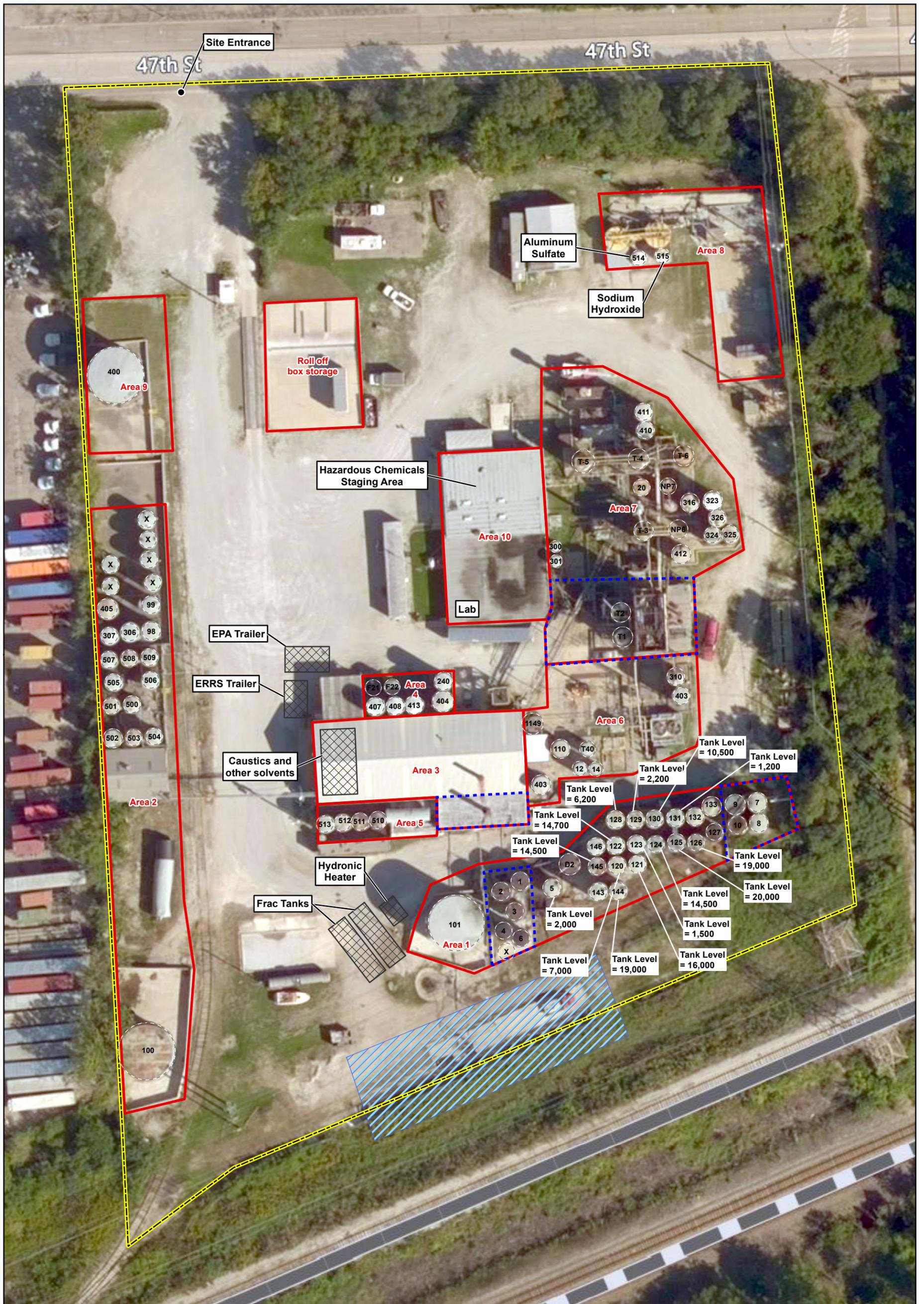
Figure 1
Site Location Map



Source: USGS 7.5-Minute Topographic Quadrangle Map: La Grange, IL 1982

Prepared For: EPA

Prepared By: Tetra Tech Inc.



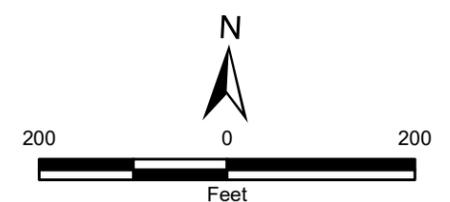
<p>Legend</p> <ul style="list-style-type: none"> Approximate Site Boundary Functional Areas Suspected ACM South Parcel Catch Basin Area X Tank no longer exist 	<p>Source: Bing Maps Hybrid 2016</p> <p>N</p>  <p>50 0 50</p> <p>Feet</p>	<p style="text-align: center;">Ortek Site 7601 47th Street McCook, Cook County, Illinois</p> <p style="text-align: center;">Figure 2 Site Layout Map</p> <p style="text-align: center;"> TETRA TECH</p> <p>Prepared For: EPA Prepared By: Tetra Tech Inc.</p>
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- Legend**
- Parcel to be Sampled in early spring
 - Parcel to be sampled in late spring



Ortek Site 7601 47th Street McCook, Cook County, Illinois	
Figure 3 Sample Locations	
Prepared For: EPA	Prepared By: Tetra Tech Inc.

APPENDIX B
Tables
(Two Pages)

TABLE 1: TOTAL SAMPLE SUMMARY

Matrix	Number of Samples	Number of Field Duplicates	Number of MS/MSDs	Number of Blanks (Field, Trip, Equipment Rinsate)	Total Number of Samples to Lab^a
Sludge (solid waste)	50	0	0	0 ¹	50
Waste Liquid	90	0	0	1	91
Soil	10	1	1	1	13
Potential bulk ACM	20	2	0	0	22

1 – sludge and liquid rinsates will be collected from the same sampling equipment

TABLE 2: SAMPLE ANALYTICAL SUMMARY

Matrix	Analytical Parameter	Analytical Method	Containers (Numbers, Size, and Type)	Holding Times	Preservation Requirements
Sludge (solid waste)	TCLP VOCs	SW1311/8260B	Three 8-oz glass jars, zero headspace	14 days	Cool to 4°C
Sludge (solid waste)	TCLP SVOCs	SW1311/8270C		14 days	Cool to 4°C
Sludge (solid waste)	PCBs	SW8082		14 days	Cool to 4°C
Sludge (solid waste)	TCLP RCRA 8 metals	SW1311/6020/7470		180 days/ 28 days (mercury)	Cool to 4°C
Sludge (solid waste)	Sulfide, Reactive	SW7.3.4.2		7 days	Cool to 4°C
Sludge (solid waste)	Flash Point (Closed Cup)	SW1010		14 days	Cool to 4°C
Sludge (solid waste)	pH	SW9045C		Immediately	Cool to 4°C
Sludge (solid waste)	Solids, Total	D2974		NA	Cool to 4°C
Waste Liquid	Total VOCs	SW8260B		Two 16-oz glass jars	14 days
Waste Liquid	Total SVOCs	SW8270C	14 days		Cool to 4°C
Waste Liquid	PCBs	SW8082	14 days		Cool to 4°C
Waste Liquid	RCRA 8 Metals	SW6020	180 days/ 28 days (mercury)		Cool to 4°C
Waste Liquid	Sulfide, Reactive	SW7.3.4.2	7 days		Cool to 4°C
Waste Liquid	pH	SW9045C	Immediately		Cool to 4°C
Waste Liquid	Flash Point (Closed Cup)	SW1010	14 days		Cool to 4°C
Soil	VOCs	SW8260B	Three 40-ml VOA vials (Terracore Kit)		14 days
Soil	SVOCs	SW8270C	Two 8-oz glass jars	14 days	Cool to 4°C
Soil	PCBs	SW8082		14 days	Cool to 4°C
Soil	RCRA 8 Metals	SW6020		180 days/ 28 days (mercury)	Cool to 4°C
Potential bulk ACM	Asbestos	EPA Method 600/R-93/116	Sealable plastic bag	NA	None

Notes:

MS/MSD – Matrix Spike/Matrix Spike Duplicate
 PCB – Polychlorinated Biphenyls
 VOC- Volatile Organic Compound
 SVOC- Semi-volatile Organic Compound
 TCLP- Toxicity Characteristic Leaching Procedure

APPENDIX C

Tetra Tech Standard Operating Procedures

SOP 002-4

SOP 003-3

SOP 005-3

SOP 006-4

SOP 008-2

SOP 024-2

SOP APPROVAL FORM

TETRA TECH EM INC.
ENVIRONMENTAL STANDARD OPERATING PROCEDURE

GENERAL EQUIPMENT DECONTAMINATION

SOP NO. 002

REVISION NO. 4

Last Reviewed: March 2018



Quality Assurance Approved

March 9, 2018

Date

1.0 BACKGROUND

All nondisposable field equipment must be decontaminated before and after each use at each sampling location to obtain representative samples and to reduce the possibility of cross-contamination.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for decontaminating equipment in the field.

1.2 SCOPE

This SOP applies to decontaminating general nondisposable field equipment. All sampling equipment must be thoroughly cleaned before each use to prevent contamination of samples.

1.3 DEFINITIONS

Alconox: Phosphate-containing soap, obtained in powder form and dissolved in water

Liquinox: Phosphate-free soap, obtained in liquid form for mixing with water

1.4 REFERENCES

U.S. Environmental Protection Agency (EPA). 1992a. “Guide to Management of Investigation-Derived Wastes.” Office of Solid Waste and Emergency Response. Washington, DC. EPA 9345.3-03FS. January.

EPA. 1992b. “RCRA Ground-Water Monitoring: Draft Technical Guidance.” Office of Solid Waste. Washington, DC. EPA/530-R-93-001. November.

EPA. 2015. “Field Equipment Cleaning and Decontamination.” Science and Ecosystem Support Division SESDPROC-205-R3 (Rev. 3, 12/18/15). <https://www.epa.gov/quality/field-equipment-cleaning-and-decontamination>

1.5 REQUIREMENTS AND RESOURCES

The equipment and supplies to conduct decontamination may include the following:

- Scrub brushes
- Large wash tubs or buckets
- Squirt bottles
- Alconox or Liquinox (Note: Alconox contains phosphates, and phosphates have been banned in many household cleaning products based on their adverse effect on the environment.)
- Tap water
- Distilled water
- Deionized water
- Plastic sheeting
- Aluminum foil
- Isopropanol (laboratory grade)

2.0 PROCEDURE

The procedures below discuss decontamination of personal protective equipment (PPE) as well as equipment for drilling and monitoring well installation, borehole soil sampling, general sampling, water level measurement, and groundwater sampling. PPE as outlined in the site-specific health and safety plan should be used during decontamination procedures. Special handling of used PPE and wastewater generated from decontamination procedures may be required if the type of contamination is considered hazardous according to the Resource Conservation and Recovery Act (RCRA). Any special handling should also be outlined in the site-specific health and safety plan or the sampling and analysis plan.

Some clients may have additional requirements for decontamination procedures. For example, phosphate-free detergent may be a requirement and, therefore, it would not be appropriate to use Alconox.

Source water for decontamination should be selected based on site-specific conditions and contaminants. Organic-free water would be more appropriate to use at sites where organic compounds are being investigated; conversely, laboratory-grade deionized water would be more appropriate where low levels of contaminants are being investigated. Standard distilled water, readily available at grocery stores, may be appropriate at other times. Refer to the site-specific sampling and analysis plan for details concerning source water.

In general, conduct field activities to move from cleaner to more contaminated locations to minimize the potential for cross contamination between locations.

2.1 PERSONAL PROTECTIVE EQUIPMENT DECONTAMINATION

Personnel working in the field are required to follow specific procedures for decontamination prior to leaving the work area so that contamination is not spread off site or to clean areas. Refer to the site-specific health and safety plan as the first resource for types of PPE; not all types of PPE nor methods for decontamination discussed below will be appropriate for every site. All used disposable protective clothing, such as Tyvek, coveralls, gloves, and booties, will be containerized for later disposal. Decontamination water will be containerized in 55-gallon drums (refer to Section 3.0).

Personnel decontamination procedures will be as follows:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Wash neoprene boots (or neoprene boots with disposable booties) with Liquinox or Alconox solution and rinse with clean water. Remove booties and retain boots for subsequent reuse.
3. Remove outer gloves and place into plastic bag for disposal.
4. Remove Tyvek or coveralls. Containerize Tyvek for disposal and place coveralls in plastic bag for reuse.
5. Remove air purifying respirator (APR), if used, and place the spent filters in a plastic bag for disposal. Filters should be changed daily or sooner, depending on use and application. Place the respirator into a separate plastic bag after it has been cleaned and disinfected according to the instructions for the respirator.
6. Remove disposable gloves and place them in plastic bag for disposal.
7. Thoroughly wash hands and face in clean water and soap.

2.2 DRILLING AND MONITORING WELL INSTALLATION EQUIPMENT DECONTAMINATION

All drilling equipment should be decontaminated at a designated location on site before drilling operations begin, between borings, and at completion of the project. Decontamination may be conducted on a temporary decontamination pad constructed at a satellite location within the site. The purpose of the decontamination pad is to contain wash waters and potentially contaminated soil generated during decontamination procedures. Decontamination pads may be constructed of concrete, wood, or plastic sheeting, depending on the site-specific needs and plans. Wash waters and contaminated soil generated during decontamination should be considered investigation-derived waste (IDW) and, thus, should be collected and containerized for proper disposal.

Monitoring well casing, screens, and fittings are assumed to be delivered to the site in a clean condition. However, they may be steam cleaned and placed on polyethylene sheeting on site before they are used downhole, if required by the site-specific work plan. The drilling subcontractor will typically furnish the steam cleaner and water.

The drilling auger, bits, drill pipe, any portion of drill rig that is over the borehole, temporary casing, surface casing, and other equipment used in or near the borehole should be decontaminated by the drilling subcontractor as follows:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Remove loose soil using shovels, scrapers, wire brushes, and any related material.
3. Steam clean or pressure wash to remove all visible dirt. Use appropriate PPE (for example, a face shield and Tyvek/coveralls) as necessary.
4. If equipment has directly or indirectly contacted contaminated media and is known or suspected of being contaminated with oil, grease, polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), or other hard-to-remove organic materials, rinse equipment with laboratory-grade isopropanol.
5. To the extent possible, allow components to air dry; drying helps limit the spread of contamination through contact.
6. All wastewater from decontamination procedures should be containerized.

2.3 BOREHOLE SOIL SAMPLING DOWNHOLE EQUIPMENT DECONTAMINATION AND GENERAL SOIL SAMPLING EQUIPMENT DECONTAMINATION

All soil sampling equipment should be decontaminated before use and after each sample as follows:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Scrub the split-barrel sampler and sampling tools in a wash bucket or tub using a stiff, long-bristle brush with a solution of tap water with Liquinox or Alconox.
3. Rinse equipment thoroughly with tap water or distilled water.
4. Perform a final rinse with deionized or distilled water. Refer to the site-specific sampling and analysis plan for requirements for deionized or distilled water.
5. Place cleaned equipment in a clean area on plastic sheeting or aluminum foil and allow to air-dry.
6. Containerize all water and rinsate; disposable single-use sampling equipment should also be containerized.

2.4 WATER LEVEL MEASUREMENT EQUIPMENT DECONTAMINATION

Field personnel should decontaminate the well sounder and interface probe before inserting and after removing them from each well. The following decontamination procedures should be used:

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Wipe the tape and probe with a disposable Alconox- or Liquinox-impregnated cloth or paper towel.
3. If immiscible layers are encountered, the interface probe may require steam cleaning or washing with laboratory-grade isopropanol.
4. Rinse with distilled or deionized water.
5. Containerize all water and rinsate for proper disposal.

2.5 GROUNDWATER SAMPLING EQUIPMENT

The following procedures are to be employed to decontaminate equipment used for groundwater sampling. Decontamination is not necessary when using disposable (single-use) pump tubing or bailers. Bailer and downhole pumps decontamination procedures are described in the following sections.

2.5.1 Bailers

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Remove and containerize any purge water remaining in the bailer.
3. Scrub the inside and outside of the bailer in a wash bucket or tub using a stiff, long-bristle brush with a solution of tap water with Liquinox or Alconox. Select cleaning equipment that will not scratch or damage the bailer.
4. Rinse the bailer thoroughly with tap water or distilled water.
5. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard-to-remove organic materials, rinse equipment with laboratory-grade isopropanol.
6. Perform a final rinse with deionized or distilled water.
7. Allow the cleaned bailer to air dry.
8. Wrap the bailer in aluminum foil or a clean plastic bag for storage.
9. Containerize the decontamination wash waters for proper disposal.

2.5.2 Downhole Pumps

1. Select an area removed from sampling locations that is both downwind and downgradient. Decontamination must not cause cross-contamination between sampling points.
2. Remove and containerize any purge water in the pump and tubing and dispose of tubing.
3. Dismantle the pump as much as possible and scrub components in a wash bucket or tub using a stiff brushes of appropriate size with a solution of tap water with Liquinox or Alconox.
4. Rinse pump components thoroughly with tap water or distilled water.

5. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard-to-remove organic materials, rinse the pump and tubing with laboratory-grade isopropanol.
6. Perform a final rinse with deionized or distilled water.
7. Allow components to air dry.
8. Wrap pump in aluminum foil or a clean plastic bag for storage.
9. Containerize the used tubing and decontamination wash waters for proper disposal.

3.0 INVESTIGATION-DERIVED WASTE

IDW can include disposable single-use PPE and sampling equipment, soil cuttings, and decontamination wash waters and sediments. Requirements for waste storage may differ from one facility to the next. Facility-specific directions for waste storage will be provided in project-specific documents, or separate direction will be provided by the project manager. The following guidelines are provided for general use:

1. Assume that all IDW generated from decontamination contains the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. Waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.
2. Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility.
3. Label IDW storage containers with the facility name and address, date, contents, company generating the waste, and an emergency contact name and phone number.
4. Temporarily store the IDW in a protected area that provides access to the containers and allows for spill/leak monitoring, sampling of containers, and removal after the disposal method has been identified.

SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

ORGANIC VAPOR AIR MONITORING

SOP NO. 003

REVISION NO. 3

Last Reviewed: July 2009

K. Riesing

July 28, 2009

Quality Assurance Approved

Date

Title: Organic Vapor Air MonitoringRevision No. 3, July 2009
Last Reviewed: July 2009

1.0 BACKGROUND

Exposure to airborne organic contaminants can present a significant threat to worker health and safety. Identifying and quantifying these contaminants through air monitoring is essential for reconnaissance activities. Reliable measurements of airborne organic contaminants are necessary for selecting or upgrading personal protective equipment (PPE), delineating areas where protection is needed, assessing the potential health effects of exposure, and determining the need for specific medical monitoring. Organic vapor air monitoring is also commonly used as a screening tool to identify relatively impacted environmental media and to provide a real-time basis for selecting samples for chemical analysis.

Various types of air monitoring instruments are available for measuring organic vapors. Common organic vapor monitoring instruments used by Tetra Tech include HNu® or Photovac 2020ComboPRO® photoionization detectors (PID), Foxboro® organic vapor analyzer (OVA) flame ionization detectors (FID), Photovac MicroFID, and MiniRae 2000 or 3000 PIDs. It should be noted that this standard operating procedure (SOP) discusses only some of the air monitoring instruments available to field personnel. The particular type of meter or monitoring system to be used should be identified in the project work plan or field sampling plan and selected on a site-specific basis depending on the data collection needs, the types of organic vapors to be monitored, and the sampling procedures to be used.

1.1 PURPOSE

This SOP establishes the general requirements and procedures for using various instruments to conduct organic vapor air monitoring in the field. It also discusses general factors to consider when conducting organic vapor air monitoring.

1.2 SCOPE

This SOP applies to general procedures for calibrating and operating organic vapor air monitoring instruments in the field. The project work plan or field sampling plan should identify the types of instruments to be used and the actual project-specific field parameters to be measured. The project-specific health and safety plan should identify chemical-specific action levels for health and safety purposes. For each type of air monitoring instrument, the manufacturer's manual should be consulted for specific operating instructions.

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1.3 DEFINITIONS

Flame ionization: A process by which a sample gas is ionized with a flame, allowing a count of carbon atoms to determine organic vapor concentration.

Flame ionization detector (FID): A portable instrument used to detect, measure, and provide a direct reading of organic vapor concentrations in a gas sample that is ionized with a flame.

Ionization potential: The amount of energy needed to strip an electron from the orbit of its resident molecule, expressed in electron volts.

Organic vapor: Airborne compounds composed of carbon, hydrogen, and other elements with chain or ring structures.

Organic vapor analyzer (OVA): A portable instrument used to detect, measure, and provide a direct reading of the concentration of a variety of trace organic gases in the atmosphere through flame ionization.

Photoionization: A process involving the absorption of ultraviolet light by a gaseous molecule, leading to ionization.

Photoionization detector (PID): A portable instrument used to detect, measure, and provide a direct reading of the concentrations of a variety of trace organic gases in the atmosphere through photoionization.

Breathing zone: The area where field workers would be inhaling potentially impacted air, generally from about 3 to 5 feet above the ground surface. The breathing zone will vary depending on the types of work activities being performed. Air monitoring is conducted in this zone to ensure that it is representative of the air being breathed by field team members.

Head space: The vapor mixture trapped above a solid or liquid in a sealed vessel.

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1.4 REFERENCES

National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard, and U.S. Environmental Protection Agency (EPA). 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." U.S. Government Printing Office. Washington, DC.

1.5 REQUIREMENTS AND RESOURCES

The following items are typically required to monitor organic vapors in air using this SOP:

- Organic vapor air monitoring meter
- Manufacturer-supplied calibration gas
- Manufacturer-supplied calibration kits including tubing and regulators
- Resealable plastic bags for conducting soil head space measurements (if applicable)
- Sample jars for conducting water head space measurements (if applicable)
- Sharpie or similar type of permanent marker
- Container to collect soil or water used for head space measurements (if applicable)
- Logbook or field data sheets

2.0 APPLICATIONS, DETECTION METHODS, AND LIMITATIONS

All direct-reading instruments have inherent constraints in their ability to detect gaseous organic compounds. They usually detect and/or measure only specific classes of chemicals. Generally, they are not designed to measure and/or detect airborne concentrations below 1 part per million (ppm). Finally, many direct-reading instruments that have been designed to detect one particular substance also detect other substances, causing interference and possibly resulting in false readings. The following subsections discuss general application, detection methods, and limitations when using a PID and an OVA FID.

2.1 APPLICATION

The PID can be used to detect total concentrations of many organic and some inorganic gases and vapors. It can also be used in conjunction with other detection devices such as colorimetric indicator detector

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tubes to identify specific compounds (see SOP No. 065, Colorimetric Indicator Detectors [Dräger Tubes]).

When set in the survey mode, the OVA FID can detect the total concentration of many organic gases and vapors. In the gas chromatography (GC) mode, the OVA FID can identify and measure the concentrations of specific compounds. In the survey mode, all organic compounds are ionized and detected at the same time. In the GC mode, volatile species are ionized and detected separately.

Each type of unit (PID or FID) has some limitations as to the detection of various categories of compounds or for specific organic compounds. Examples are described below in Section 2.2. The user manual for the specific instrument should be used to confirm its applicability for measurements of the organic vapors of concern at the site.

2.2 DETECTION METHODS

The PID ionizes molecules using ultraviolet (UV) radiation and can be used with a variety of electron voltage lamps best matched to the compound of concern at a site. The UV radiation strips electrons from the molecules, producing ions that produce a current proportional to the number of ions generated. The PID is more sensitive to aromatic and unsaturated compounds than the OVA FID. The PID is nonspecific for gas and vapor detection for organic and some inorganic compounds. The PID is also sensitive to 0.1 ppm of benzene. Sensitivity is related to the ionization potential of the compound being monitored. PIDs will only detect compounds that have ionization energies similar to the energy of the photons the detector uses. Gases with ionization potential values below the electron volt (eV) output of the lamp will be detected. The most common PID lamp used is the 10.6 eV lamp because it detects most volatile organic compounds; however, 9.5 eV and 11.7 eV lamps are also commonly available. It is recommended that the ionization potential of the chemicals of concern be known in order to select the most appropriate lamp for a specific project. Ionization potential information can be obtained from the vendor, in the manufacturer's manual, or on line (for example, at http://www.detectorsbyaic.com/ion_potential.html).

Organic gases and vapors are flame-ionized in the OVA FID. The ions produce a current that is proportional to the number of carbon atoms present. The current is interpreted by a deflection on the instrument's meter. In the survey mode, the OVA FID functions as a nonspecific total hydrocarbon analyzer. In the GC mode, the OVA FID can provide a tentative qualitative and quantitative

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identification of gases and vapors. The OVA FID is most sensitive to saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes), and aromatic hydrocarbons. The OVA FID is not suitable for inorganic gases such as chlorine, hydrogen cyanide, and ammonia. The OVA FID is also less sensitive to aromatics and unsaturated compounds than the PID. However, the OVA FID is less sensitive to high humidity than the PID. Gases and vapors that contain substituted function groups such as hydroxide (OH-) reduce the detector's sensitivity. Finally, if the operator monitors for a specific gas or vapor, the operator should use a calibration standard and GC column specific to that particular gas or vapor.

2.3 LIMITATIONS

The PID cannot be used to:

- Detect methane
- Detect a compound that has a higher energy level than the ionization potential of the PID light source
- Respond accurately to a mixture of gases or vapors
- Respond accurately in high humidity or very cold weather
- Respond accurately when interference from other sources is present

The OVA FID cannot be used to:

- Detect organic vapors at temperatures below 40 °F (4 °C)
- Identify specific organic vapors when operated in the survey mode; results must be reported relative to the calibration standard used (for example, as methane equivalents).
- Detect inorganic gases and vapors; the instrument also gives a lower response to oxygen-containing organic compounds (such as alcohols, ethers, and aldehydes) and nitrogen-containing organic compounds (such as amines, amides, and nitriles).

Detect high organic contaminant concentrations or detect contaminants in oxygen-deficient atmospheres; operation in these conditions requires system modification.

3.0 PROCEDURES

The procedures outlined in this SOP are general and typically apply to various types of monitoring instruments used to measure organic vapors in air. General procedures for testing and calibrating the instruments are presented first, followed by procedures for using the instruments and making field measurements, guidelines for recording information accurately, and a discussion of variables that may affect outdoor air monitoring. The particular monitoring instrument should be identified in the project work plan or field sampling plan and should be operated in accordance with the manufacturer's instruction manual.

3.1 TESTING AND CALIBRATION PROCEDURES

Each air monitoring instrument should be calibrated according to manufacturer's specifications. General procedures applicable to most equipment are as follows:

- Equipment should be thoroughly cleaned, and then calibrated and tested before the startup of sampling at each site.
- Equipment should be calibrated and tested using manufacturer-provided calibration gas and calibration connector kits.
- Batteries should be charged prior to startup of field work, and the battery charge level should be checked at the start of each day. The battery charge life will vary depending on the particular monitoring instrument to be used and the application.
- It is recommended that extra batteries be kept on hand when conducting field work.
- The PID can typically run continuously on a fully charged battery for at least 8 hours. The PID battery should be recharged for 14 hours.
- The OVA FID can typically run continuously on a fully charged battery for 8 hours alone or for 3 hours with a strip chart recorder. The OVA FID battery must be recharged every 8 hours or replaced, as needed.
- Calibration and testing of field equipment should be documented every time it is performed. Calibration and testing information should be recorded in field logbooks (or field data sheets, if applicable).
- If testing and calibration measurements are out of tolerance, the instrument must be serviced or repaired.

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3.2 FIELD MEASUREMENT PROCEDURES

Each air monitoring instrument should be operated according to manufacturer's specifications. The actual field procedures will vary depending on the type of air monitoring to be conducted. Almost all PIDs and OVA FIDs have a recommended warm-up period (see the manufacturer's operations manual for the specific type of meter to be used). Similarly, many instruments are affected by moisture, humidity, and dust. The use of an external filter on the probe tip is recommended in these situations. Finally, many instruments include a data logging option that can be used, if desired. A general procedural summary for air monitoring associated with health and safety and field screening applications is presented below.

3.2.1 Health and Safety Monitoring

The site-specific health and safety plan will specify the types of contaminants of concern, health and safety related action levels, and the types of PPE necessary. The goal of air monitoring for health and safety purposes is to ensure that field work is conducted in accordance with the health and safety plan and to identify conditions where upgrading the level of PPE may be necessary. General procedures for conducting health and safety air monitoring for organic vapors are as follows:

- Following the instrument manual, calibrate and test air monitoring equipment.
- Approach the sampling location from the upwind direction.
- Monitor organic vapors in the breathing zone (multiple levels of monitoring may be required depending on the work being performed).
- Monitor down-hole vapor concentrations, if drilling.
- Take readings at a frequency appropriate for the types of tasks being conducted, the types of organic vapors expected, and the levels of organic vapors being detected (monitor at a more frequent rate if organic vapors are detected and they are near the site-specific action levels specified in the health and safety plan).
- Record information in a field log book, on field data sheets, or on an air monitoring log sheet (record site name, date and time, sampling location, PID or FID readings, and pertinent weather information).
- Upgrade the level of PPE, implement engineering controls, or stop work if organic vapors are sustained in the breathing zone above action levels specified in the site-specific health and safety plan.

3.2.2 Field Screening

The site-specific work plan or field sampling plan will specify the media to be sampled, the sampling methods and procedures to be used, and field screening requirements. Typically, the goals of air monitoring for field screening purposes are to identify relatively higher organic vapor concentrations in soil, groundwater, or other media to select subsequent sampling locations, or to select environmental samples to send to a laboratory for chemical analysis. General procedures for conducting field screening air monitoring for organic vapors are as follows:

- Following the instrument manual, calibrate and test air monitoring equipment.
- Work from the upwind direction, when possible.
- Directly screen soil cores or drill cuttings by running the tip of the meter along the soil surface while taking care not to get soil into the probe.
- Depending on sampling protocol, dig into or freshly “break” the soil and measure vapors at the newly exposed surface.
- When collecting soil samples for head space measurements, place soil in a resealable plastic bag, record the sampling location and depth on the bag with a Sharpie or other type of permanent marker, wait at least 5 minutes for vapors to accumulate (the bag may be placed in direct sunlight or in a warm area while waiting), shake the bag vigorously, and then insert the probe into the bag without placing the tip directly in the soil (while taking care not to let vapors escape).
- Directly screen purged well water (or surface water) by running the tip of the meter along the water surface while taking care not to get water into the probe.
- When collecting water samples for head space measurements, place water in a jar and tightly close the lid, record the sampling location and depth on the jar with a Sharpie or other type of permanent marker, wait at least 5 minutes for vapors to accumulate (the jar may be placed in direct sunlight or in a warm area while waiting), shake the jar vigorously, and then slightly open the lid and insert the probe into the jar without placing the tip directly in the water (while taking care not to let vapors escape).
- Record information in a field log book, on field data sheets, or on an air monitoring log sheet (record site name, date and time, sampling location, PID or FID readings, and pertinent weather information).

3.3 ACCURATE RECORDING AND INTERPRETATION

Direct-reading instruments must be operated and the data interpreted by individuals who understand the operating principles and limitations of the instruments. At hazardous waste sites, where unknown and multiple contaminants are frequently encountered, instrument readings should be interpreted conservatively.

The following guidelines promote accurate recording and interpretation:

- Calibrate instruments in accordance with the manufacturer's instructions before and after every use.
- Conduct additional monitoring at any location where a positive response occurs.
- Report a reading of zero as nondetectable (ND) rather than as "clean." Quantities of chemicals may be present but at concentrations that are not detectable by the instrument.
- Repeat the air monitoring survey using other detection devices.

3.4 VARIABLES AFFECTING OUTDOOR AIR MONITORING

Complex environments containing many substances, such as those associated with hazardous waste sites, pose significant challenges to accurately and safely assess airborne contaminants. Several independent and uncontrollable variables (most notably temperature and weather conditions) can affect airborne concentrations. These factors must be considered when conducting air monitoring and interpreting data. The following environmental variables must be considered:

- **Temperature:** An increase in temperature increases the vapor pressure of most chemicals.
- **Wind speed:** An increase in wind speed can affect vapor concentration near a free-standing liquid surface. Dust and particulate-bound contaminants are also affected.
- **Rainfall:** Water from rainfall can essentially cap or plug vapor emission routes from open or closed containers, saturated soil, or lagoons, thereby reducing airborne emissions of certain substances.
- **Moisture:** Dusts, including finely divided hazardous solids, are highly sensitive to moisture. Moisture can vary significantly with respect to location and time and can also affect the accuracy of many sampling results.

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- **Background vapor emissions:** Vapor emission from other activities in the area of the field investigations can also impact readings. Operations such as vehicle maintenance or fueling facilities can affect readings associated with perimeter monitoring.
- **Work activities:** Work activities often require the mechanical disturbance of contaminated materials, which may change the concentration and composition of airborne contaminants and contribute to airborne emissions. Organic air emissions at a work site can also occur from operation of gasoline or diesel engines.

These conditions should be reported with organic vapor readings to provide a more accurate interpretation of monitoring results.

SOP APPROVAL FORM

TETRA TECH, INC.
EMI OPERATING UNIT

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

SOIL SAMPLING

SOP NO. 005

REVISION NO. 3

Last Reviewed: February 2017



Quality Assurance Approved

February 13, 2017

Date

1.0 BACKGROUND

Soil is sampled for three main reasons: (1) for chemical analysis in the laboratory, (2) for physical analysis in the laboratory, or (3) for evaluation in the field (for example, visual classification, assessment of staining, and field screening). These three sampling objectives can be achieved separately or in combination. Sampling locations are typically chosen to provide information in both the horizontal and vertical directions. A sampling and analysis plan or a site-specific quality assurance project plan (QAPP) is used to outline sampling methods and to provide a preliminary rationale for sampling locations. Sampling locations may be adjusted in the field based on the screening or sampling methods used and the physical features of the area.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for soil sampling. Soil is sampled to evaluate the chemical and physical characteristics of surface and subsurface soils.

1.2 SCOPE

This SOP describes procedures for soil sampling in different areas using various implements. It includes procedures for test pit, surface soil, and subsurface soil sampling and describes a variety of soil sampling devices.

1.3 DEFINITIONS

Bucket Auger: A type of auger that consists of a cylindrical bucket 10 to 72 inches in diameter with teeth arranged at the bottom.

Composite Sample: A sample that consists of soil combined from more than one discrete location. Typically, composite samples consist of soil obtained from several locations and homogenized in a stainless steel or Teflon bowl, tray, or plastic bag.

Core Sampler: A thin-walled cylindrical metal tube with diameter of 0.5 to 3 inches, a tapered nosepiece, a “T” handle to facilitate sampler deployment and retrieval, and a check valve (flutter valve) in the headpiece.

Direct-push technology (DPT): Investigation tools that drive or push small-diameter rods and tools (typically not exceeding 4 inches in diameter) into the subsurface by hydraulic or percussive methods. Geoprobe Systems is a manufacturer of DPT equipment, and its brand name is often used interchangeably with “DPT.”

EnCore Sampler: A disposable volumetric sampling device. It comes in sample sizes of 5 and 25 grams. It is a hermetically sealed, single-use soil sampler made from a high-tech, inert polymer. EnCore samplers are used to collect soil samples with zero headspace, as required for volatile organic compound (VOC) analysis (including purgeable total petroleum hydrocarbons). Each sample is collected using a reusable “T” handle.

Grab Sample: A sample collected from a discrete location or depth.

Hand Auger: An instrument attached to the bottom of a length of pipe that has a crossarm or “T” handle at the top. The auger can be closed-spiral or open-spiral.

Spatulas or Spoons: Stainless steel or disposable instruments for collecting loose unconsolidated material.

Split-Spoon (or Split-Barrel) Sampler: A thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to drill rods.

Terra Core Sampler: A disposable volumetric sampling device. It comes in sample sizes of 5 and 10 grams and is part of a sampling kit. It is a single-use sampler used to collect soil samples with zero headspace, as required for VOCs. Each sample is collected with the disposable coring device. However, unlike the EnCore sampler, the sample is placed directly into a 40-milliliter (mL) glass volatile organics analysis (VOA) vial after the soil is collected. The VOA vial is included in the sampling kit.

Thin-Wall Tube Sampler: A steel tube (1 to 3 millimeters thick) with a tapered bottom edge for cutting. The upper end is fastened to a check valve that is attached to drill rods.

Trier: A tube cut in half lengthwise with a sharpened tip that allows for collecting sticky solids or loosening cohesive soils.

Trowel: A metal or disposable tool with a scooped blade 4 to 8 inches long and 2 to 3 inches wide with a handle.

VOA Plunger: A disposable, plastic, single-use soil device to collect samples for analysis of VOCs.

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1.5 REQUIREMENTS AND RESOURCES

Soil sampling requires the use of one or more of the following types of equipment:

- Spoon and spatula
- Trowel
- Shovel or spade
- Trier
- Core sampler
- EnCore sampler

- Terra Core sampler
- VOA plunger
- Hand auger
- Bucket auger
- Split-spoon
- Thin-wall tube

In addition, the following equipment may also be needed for various methods:

- Sample containers, labels, and chain-of-custody forms
- Logbook and field forms
- Stakes or flags for marking sample locations
- Tape for measuring recovery
- Soil classification information
- Wax or caps for sealing ends of thin-wall tube
- “T” Handles
- Stainless steel or Teflon bowls, aluminum pans, or other vessels for composite sampling (made from material that will not interfere with the planned analyses)
- Plastic sheeting
- Decontamination equipment
- Drilling equipment
- Backhoe
- Health and safety equipment

2.0 SOIL SAMPLING PROCEDURES

This SOP presents procedures for collecting test pit, surface soil, and subsurface soil samples. The site sampling plan will specify which of the following procedures will be used.

Soil samples for chemical analysis should be collected in order of decreasing volatility, typically in the following order: (1) volatile organics, (2) semivolatile organics, and (3) metals. Samples for physical analysis can be containerized after the chemical samples have been containerized. Typical physical analyses conducted include (1) grain size distribution, (2) moisture content, (3) saturated permeability, (4) unsaturated permeability, and (5) Atterberg limits. Additionally, visual descriptions of samples, using the

Unified Soil Classification System (USCS, ASTM D2488-09a), should be recorded. Field tests such as head-space analysis can also be conducted using a photoionization detector or a flame ionization detector before samples are collected for chemical or physical analysis.

Soil samples for chemical analysis can be collected either as grab samples or as composite samples. A grab sample is collected from a discrete location or depth. A composite sample consists of soil combined from more than one discrete location. Typically, composite samples consist of soil obtained from several locations and homogenized in a stainless steel or Teflon bowl, tray, or plastic bag. Refer to the site-specific QAPP for the methodology for composite sample collection. Samples for VOC analysis should not be composited.

All non-disposable equipment used for soil sampling should be decontaminated between sampling locations in accordance with SOP 002, General Equipment Decontamination.

2.1 SOIL SAMPLE COLLECTION PROCEDURES

Soil samples can be collected as discrete samples for VOC analysis using specialized equipment for preservation in the laboratory or in the field. Samples for VOC analysis should not be composited. Soil samples collected for non-VOC analysis can be collected as either grab or composite samples using standard equipment.

2.1.1 Procedure for Preserving and Collecting Soil Samples for VOC Analysis

Samples collected for VOC analysis using traditional methods, such as collection in a jar with no preservation, are shown to yield nonrepresentative results based on loss of VOCs. Samples can be preserved with methanol or sodium bisulfite to reduce volatilization and biodegradation to minimize loss of VOCs. However, these preservatives are not compatible with all VOCs; refer to the unique requirements in the project-specific QAPP or work plan. Preservatives may be added to containers by the laboratory before samples are collected, or preservatives may be added in the field. Alternatively, samples may be collected directly using devices like the EnCore sampler, which minimizes soil contact with the atmosphere. The specific sampling methodology will be identified in the project-specific QAPP or work

plan. Be aware that other methods of sample preservation (such as freezing) are available (EPA 2014), but are not detailed in this SOP.

Soil samples to be preserved in the laboratory are collected using SW-846 Method 5035A (EPA 2002). For samples preserved in the field, laboratories may perform low-level analysis (sodium bisulfate preservation) or high- to medium-level analysis (methanol preservation), depending on the project-specific QAPP.

The following procedures outline the steps necessary for collecting soil samples to be preserved at the laboratory and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

2.1.1.1 Soil Samples to be Preserved at the Laboratory

EnCore Sampler

Soil samples collected for VOC analysis that are to be preserved at the laboratory may be obtained using a hand-operated, hermetically sealed sample vial such as an EnCore sampler. Each sample is collected using a reusable sampling handle (“T” handle) that can be provided with the EnCore sampler when it is requested and purchased. Collect the soil sample in the following manner for each EnCore sampler.

The EnCore sampler is loaded into the “T” handle with the plunger fully depressed. Press the “T” handle into the soil to be sampled. The plunger will be forced upward as the cavity fills with soil. When the sampler is full, rotate the plunger and lock it into place using the “T” handle. If the plunger does not lock, then it is not filled with soil. Soft soil may require several plunges or soil may be forced against a hard surface such as a decontaminated sample trowel to ensure headspace has been eliminated. Remove soil from the outside of the sampler so a tight seal can be made between the sample cap and the O-ring. With soil slightly piled above the rim of the sampler, force the cap on until it catches hook the side of the sampler. Remove any surface soil from outside of the sampler and place the sampler in the foil bag provided with the sampler. Seal the bag and label it with sample location information. Typically, collect three EnCore samplers per sample location. Decontaminate the “T” handle between sample locations.

Using the EnCore sampler eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each EnCore sampler.

After the EnCore samples are collected, they should be placed on ice immediately and delivered to the laboratory within 48 hours. The samples must be preserved by the laboratory within 48 hours after they are collected.

Terra Core Sampler

New sampling collection equipment such as Terra Core have been developed to compete with EnCore when samples are collected for VOC analysis. Depending on the laboratory conducting the analysis, one of these two common VOC sampling devices may be used. In the case that Terra Core samplers are provided, collect the soil sample in the following manner.

Each Terra Core sampling kit comes with one Terra Core sampler that collects either a 5- or a 10-gram aliquot into multiple containers: one methanol-preserved 40 mL VOA vial for high-level analysis, two 40-mL VOA vials containing stir bars for undiluted/low-level analysis, and one 60-gram sample jar for percent moisture analysis. To collect a sample, with the plunger seated in the handle, push the sampler into freshly exposed soil until the sample chamber is filled. Wipe any excess soil and debris from the exterior of the sampler and remove any soil that extends beyond the mouth of the sampler. Then, rotate the plunger that was seated in the handle top 90 degrees until it aligns with the slots in the body. Place the mouth of the sampler into the desired 40 mL VOA vial and extrude the sample by pushing the plunger down. Quickly place the lid back on the VOA vial. After all vials provided have been filled, the sampler is now contaminated and must be disposed of unless additional, bulk sampling will be conducted.

After the Terra Core samples are collected, they should be placed on ice immediately and delivered to the laboratory within 48 hours. The samples must be preserved by the laboratory within 48 hours after they are collected. Because the vials are pre-weighed, no additional labels should be added. Sampling information should be written directly on the label already on the vial.

2.1.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analysis using both the low-level (sodium bisulfate preservation) and the high- to medium-level (methanol preservation) methods. If samples effervesce when they are placed in preservative, it is necessary to collect a sample unpreserved, in deionized water. In

addition, an unpreserved sample for determination of moisture content must also be collected when soil samples to be preserved in the field are collected.

Methanol Preservation (High to Medium Level). Bottles may be pre-spiked with methanol in the laboratory or prepared in the field. Use 40- to 60-mL glass vials with septum-lined lids for soil samples to be preserved in the field with methanol. Fill each sample bottle with 25 mL of demonstrated analyte-free purge-and-trap grade 3 methanol. The preferred method for adding methanol to the sample bottle is by removing the lid and using a pipette or scaled syringe to add the methanol directly to the bottle.

Use a decontaminated (or disposable), small-diameter coring device such as a disposable VOA plunger to collect the soil. The outside diameter of the coring device must be smaller than the inside of the sample bottle neck. To collect the sample, pull the plunger back to the required location, insert it into the soil to be sampled, push the coring device into the soil, extrude the soil sample into the methanol-preserved sample bottle, and cap the bottle tightly. Swirl the sample (do not shake) in the methanol to break up the soil such that all of the soil is covered with methanol. After the samples are collected, place them on ice immediately and deliver to the laboratory within 48 hours.

Sodium Bisulfate Preservation (Low Level). Bottles may be prepared in the laboratory or in the field with sodium bisulfate solution. Samples to be preserved in the field using sodium bisulfate are collected using the same procedures described for methanol preservation.

2.1.2 Procedure for Collecting Soil Samples for Non-VOC Analysis

Samples collected for non-VOC analysis may be either grab or composite samples as follows. When collecting a grab sample, transfer a portion of soil to be analyzed to a stainless-steel or Teflon bowl, disposable inert plastic tray, or plastic bag. Avoid or remove vegetation and small stones. When a composite sample is collected, collect four to five discrete soil samples of roughly equal volume, based on the sample design in the QAPP. Remove roots, vegetation, sticks, and stones larger than the size of pea gravel (about ¼- to ½-inch diameter). Thoroughly mix the soil with a stainless-steel spoon to obtain as uniform a texture and color as practicable. Transfer the mixed soil to the appropriate sample containers and close the containers. Label the sample containers and immediately place on ice.

2.2 TEST PIT AND TRENCH SOIL SAMPLING

Test pit and trench soil samples are collected when a complete soil profile is required or as a means of locating visually detectable contamination. This type of sampling provides a detailed description of the soil profile and allows for multiple samples to be collected from specific soil horizons. The sampling team should ensure that the sampling area is clear of utility lines, subsurface pipes, and poles before any test pit or trench is excavated with a backhoe.

A test pit or trench is excavated by incrementally removing soil with a backhoe bucket. The excavated soil is placed on plastic sheeting well away from the edge of the test pit. A test pit should not be excavated to depths greater than 4 feet unless its walls are properly sloped or stabilized. No personnel may enter any test pit or trench excavation more than 4 feet deep; such action would constitute confined space entry and must conform with Occupational Safety and Health Administration (OSHA) regulations at Title 29 of the *Code of Federal Regulations* § 1910.

Personnel entering the test pit may be exposed to toxic or explosive gases and oxygen deficient environments. Air monitoring is required before they may enter the test pit, and use of appropriate respiratory gear and protective clothing is mandatory. At least two persons must be present at the test pit before sampling personnel may enter the excavation and begin soil sampling. Refer to project-specific health and safety plans for required safety procedures for excavations.

Soil samples can also be obtained directly from the backhoe bucket or from the excavated material after it has been removed and deposited on plastic sheeting. The sampling personnel may direct the backhoe excavator to obtain material from the selected depth and location within the excavation. The backhoe operator will set the backhoe bucket on the ground in a designated location, at a sufficient distance from the excavation to allow the sampler safe access to the bucket. The backhoe operator must disengage the controls and signal to the sampler that it is safe to approach the bucket. Collect the soil sample from the center of the backhoe bucket to reduce the potential for cross-contamination of the sample.

Test pits are not practical for sampling at depths greater than 15 feet. If soil samples are required from depths greater than 15 feet, samples should be obtained using test borings instead of test pits. Test pits are

also usually limited to a few feet below the water table. In some cases, a pumping system may be required to control the water level within the pits.

Access to open test pits should be restricted by flagging, tape, or fencing. If a fence is used, it should be erected at least 6 feet from the perimeter of the test pit. The test pit should be backfilled as soon as possible after sampling is completed.

Various equipment may be used to collect soil samples from the walls or bottom of a test pit. A hand auger, bucket auger, or core sampler can be used to obtain samples from various depths. A trier, trowel, EnCore sampler, Terra Core sampler, VOA plunger, or spoon can be used to obtain samples from the walls or pit bottom surface.

2.3 SURFACE SOIL SAMPLING

Surface soil samples can be used to investigate contaminants that exist in the near-surface environment. Contaminants detected in the near-surface environment may extend to considerable depths, potentially migrating to groundwater, surface water, the atmosphere, or biological systems. Sampling depths for surface soil are typically those that can be reached without use of a drill rig, DPT, or other mechanized equipment. Sample depths typically extend up to 1 foot below ground surface (bgs). However, the definition of “surface soil” and the resultant sample depths may vary based on risk assessment or other project requirements. Be aware of these site-specific constraints and follow the requirements of the QAPP to select the depths for surface soil samples.

2.3.1 Surface Soil Sampling Equipment

The surface soil sampling equipment presented in this SOP is best suited for sampling to depths of 0 to 6 feet bgs. The sample depth, analytical suite, soil type, and soil moisture will also dictate the most suitable sampling equipment. The sampling locations should be cleared of any surface debris such as twigs, rocks, and litter before samples are collected. The following table presents various surface soil sampling equipment and their effective depth ranges, operating means (manual or power), and sample types collected (disturbed or undisturbed).

Sampling Equipment	Effective Depth Range (feet below ground surface)	Operating Means	Sample Type
Hand Auger	0 to 6	Manual	Disturbed
Bucket Auger	0 to 4	Power	Disturbed
Core Sampler	0 to 4	Manual or Power	Undisturbed
EnCore or Terra Core Sampler	Not Applicable	Manual	Disturbed
Spoon/Spatula	0 to 0.5	Manual	Disturbed
Trowel	0 to 1	Manual	Disturbed
Volatile Organic Analysis (VOA) Plunger	Not Applicable	Manual	Disturbed

The procedures for using these various types of sampling equipment are discussed below.

2.3.1.1 Hand Auger

A hand auger equipped with extensions and a “T” handle is used to obtain samples from depths of up to 6 feet bgs. It is possible to hand auger deeper than 6 feet. However, hand-augering below this depth is uncommon because of the time, effort, and cost effectiveness when sampling to depths greater than 6 feet bgs. If necessary, a shovel may be used to excavate the topsoil to reach the desired subsoil level. If topsoil is removed, its thickness should be recorded. Samples obtained using a hand auger are disturbed in their collection; establishing the exact depth where samples are obtained is difficult.

The hand auger is screwed into the soil at an angle of 45 to 90 degrees from horizontal. When the entire auger blade has penetrated the soil, the auger is removed from the soil by lifting it straight up without turning it, if possible. If the desired sampling depth has not been reached, the soil is removed from the auger and deposited onto plastic sheeting. This procedure is repeated until the desired depth is reached and the soil sample is obtained. The auger is then removed from the boring and the soil sample is collected directly from the auger into an appropriate sample container.

2.3.1.2 Bucket Auger

A bucket auger, similar to the hand auger, is used to obtain disturbed samples from depths of up to 4 feet bgs. A bucket auger should be used when stony or dense soil is sampled that prohibits the use of a hand-operated core or screw auger. A bucket auger with closed blades is used in soil that cannot generally be penetrated or retrieved by a core sampler.

The bucket auger is rotated while downward pressure is exerted until the bucket is full. The bucket is then removed from the boring, the soil collected is placed on plastic sheeting, and this procedure is repeated until the appropriate depth is reached and a sample is obtained. The bucket is then removed from the boring and the soil sample is transferred from the bucket to an appropriate sample container.

2.3.1.3 Core Sampler

A hand-operated core sampler (Figure 1), similar to the hand auger, is used to obtain samples from depths of up to 4 feet bgs in uncompacted soil. The core sampler is capable of retrieving undisturbed soil samples and is appropriate when low concentrations of metals or organics are of concern. The core sampler should be constructed of stainless steel. A polypropylene core sampler is generally not suitable for sampling dense soils or sampling at greater depths.

The core sampler is pressed or driven (for example, using a slide hammer) into the soil at an angle of 45 to 90 degrees from horizontal and is rotated when the desired depth is reached. The core is then removed, and the sample is placed into an appropriate sample container.

2.3.1.4 Shovel

A shovel or spade may be used to obtain large quantities of soil that are not readily obtained with a trowel. A shovel is used when soil samples from depths of up to 6 feet bgs are to be collected by hand excavation; a tiling spade (sharpshooter) is recommended for excavation and sampling. A standard steel shovel may be used for excavation; either a stainless-steel or polypropylene shovel may be used for sampling. Soil excavated from above the desired sampling depth should be stockpiled on plastic sheeting. Soil samples should be collected from the shovel and placed into the sample container using a stainless-steel scoop, plastic spoon, or other appropriate tool.

2.3.1.5 Trier

A trier (Figure 2) is used to sample soil from depths up to 1 foot bgs. A trier should be made of stainless steel or polypropylene. A chrome-plated steel trier may be suitable when samples are to be analyzed for organics and heavy metal content is not a concern.

Samples are obtained by inserting the trier into soil at an angle of up to 45 degrees from horizontal. The trier is rotated to cut a core and is then pulled from the soil being sampled. The sample is then transferred to an appropriate sample container.

2.3.1.6 Trowel

A trowel is used to obtain surface soil samples that do not require excavation beyond a depth of 1 foot. A trowel may also be used to collect soil subsamples from profiles exposed in test pits. Use of a trowel is practical when sample volumes of approximately 1 pint (0.5 liter) or less are to be obtained. Excess soil should be placed on plastic sheeting until sampling is completed. A trowel should be made of stainless or galvanized steel. It can be purchased from a hardware or garden store. Soil samples to be analyzed for organics should be collected using a stainless-steel trowel. Samples may be placed directly from the trowel into sample containers.

2.4 SUBSURFACE SOIL SAMPLING

Subsurface soil sampling is accomplished in conjunction with borehole drilling for depths greater than approximately 6 feet bgs. Subsurface soil sampling is frequently coupled with exploratory boreholes or monitoring well installation. As described above for surface soil, the definition of “subsurface soil” may vary based on risk assessment or other project requirements. Be aware of site-specific constraints and follow the requirements of the QAPP to select the depths for subsurface soil samples.

2.4.1 Subsurface Soil Sampling Equipment and Methods

Subsurface soil may be sampled using a drilling rig, power auger, or DPT. Selection of sampling equipment depends on geologic conditions and the scope of the sampling program. Two types of samplers

used with machine-driven augers — the split-spoon sampler and the thin-wall tube sampler — are discussed below. All sampling tools should be cleaned before and after each use in accordance with SOP 002, General Equipment Decontamination. Both the split-spoon sampler and the thin-wall tube sampler can be used to collect undisturbed samples from unconsolidated soils. The procedures for DPT sampling are also presented below.

2.4.1.1 Split-Spoon Sampler

Split-spoon samplers are available in a variety of types and sizes. Site conditions and project needs, such as large sample volume for multiple analyses, dictate the specific type of split-spoon sampler to be used. Figure 3 shows a generic split-spoon sampler.

The split-spoon sampler is advanced into the undisturbed soil beneath the bottom of the casing or borehole using a weighted hammer and a drill rod. The relationship between hammer weight, hammer drop, and number of blows required to advance the split-spoon sampler in 6-inch increments indicates the density or consistency of the subsurface soil. After the split-spoon sampler has been driven to its intended depth, it should be removed carefully to avoid loss of sample material. A catcher or basket should be used to help retain the sample in noncohesive or saturated soil.

After the split-spoon sampler is removed from the casing, it is detached from the drill rod and opened. If VOA samples are to be collected, EnCore samplers, Terra Core samplers, or VOA plungers should be filled with soil taken directly from the split-spoon sampler. Samples for other specific chemical analyses should be taken as soon as the VOA sample has been collected. The remainder of the soil recovered can then be used for visual classification of the sample and containerized for physical analysis. The entire sample (except for the top several inches of possibly disturbed material) is retained for analysis or disposal.

2.4.1.2 Thin-Wall Tube Sampler

A thin-wall tube sampler, sometimes called the Shelby tube (Figure 4), is used to collect soil samples for geophysical analysis. Tube samplers are best suited for collecting cohesive soils such as clays and silts. The tube sampler may be pressed or driven into soil inside a hollow-stem auger flight, wash bore casing, or uncased borehole. The tube sampler is pressed into the soil, without rotation, to the desired depth or until

it meets refusal. If the tube cannot be advanced by pushing, it may be necessary to drive it into the soil without rotation using a hammer and drill rod. The tube sampler is then rotated to collect the sample from the soil and removed from the borehole.

After the tube sampler is removed from the drilling equipment, the tube sampler should be inspected for adequate sample recovery. The sampling procedure should be repeated until an adequate soil core is obtained (if the tube sampler can retain the sample material). The soil core obtained should be documented in the logbook. Any disturbed soil is removed from each end of the tube sampler. If chemical analysis is required, VOA samples must be collected immediately after the tube sampler is withdrawn. EnCore samplers, Terra Core samplers, or VOA plungers should be filled with soil taken directly from the tube sampler. Before use, and during storage and transport, the tube sampler should be capped with a nonreactive material. The tube is sealed using plastic caps for physical sampling parameters. The top and bottom of the tube sampler should be labeled and the tube sampler should be stored accordingly.

2.4.1.3 Direct-Push Technology Methods

In many cases, DPT is less expensive and faster than collecting soil samples with a standard drilling rig. In addition, the use of DPT causes minimal disturbance to the ground surface and generates little to no soil cuttings. DPT drill rigs, as well as traditional drill rigs, often use acetate or clear polyvinyl chloride sleeves or brass liners inside of split-spoon or thin-wall tube samplers for collecting soil samples.

The sample sleeve is extruded from the sampling rod when the sampling rod is retrieved from the ground. The sleeve is sliced lengthwise twice to open the sleeve. Soil samples can be collected directly from the opened sleeve. EnCore samplers, Terra Core samplers, or VOA plungers should be filled with soil taken directly from the opened DPT sampler if VOA samples are to be collected. Samples for other specific chemical analysis should be collected after the VOA sample. The remainder of the recovered soil can then be used for visual classification of the sample and containerized for physical analysis. The entire sample is retained for analysis or disposal.

FIGURE 1
HAND-OPERATED CORE SAMPLER

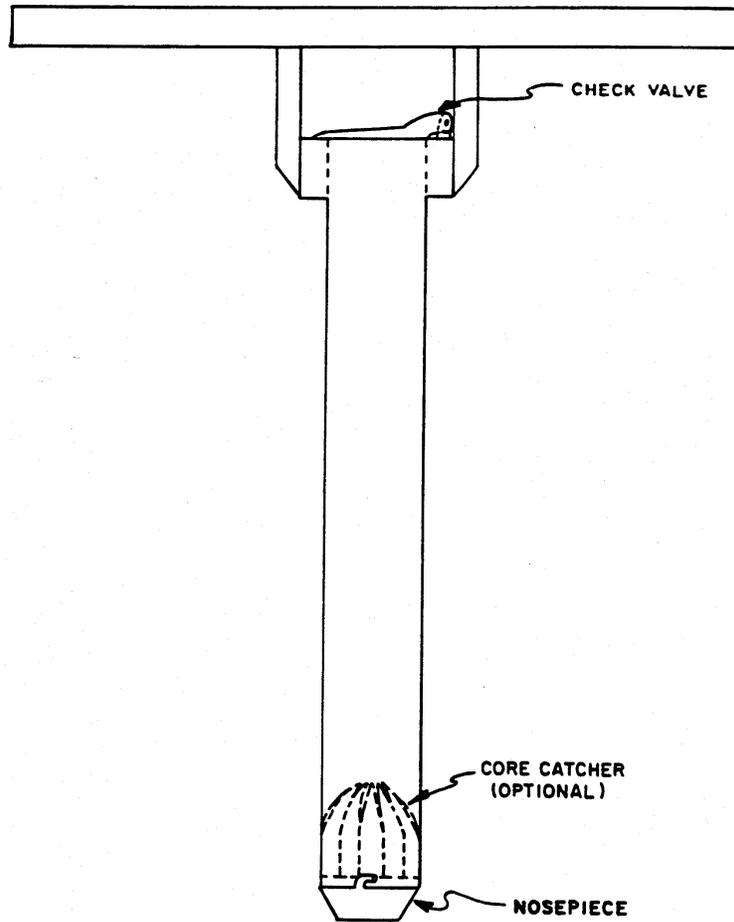


FIGURE 2

TRIER

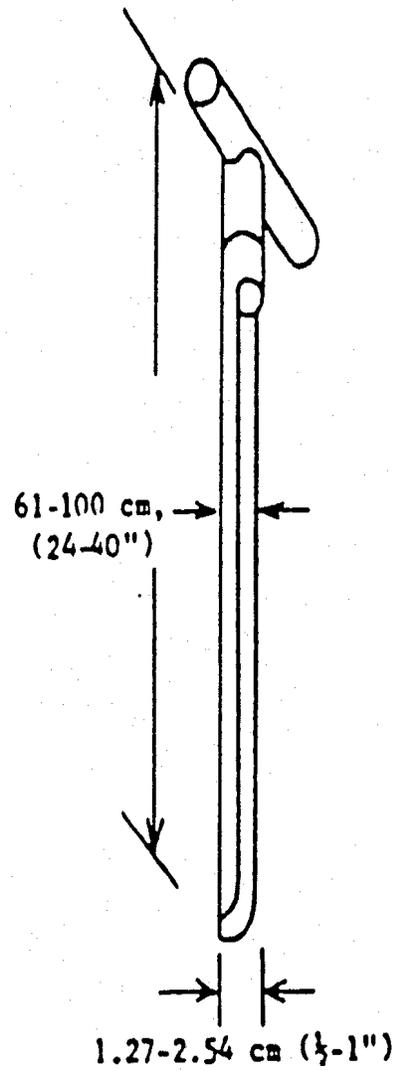


FIGURE 3
GENERIC SPLIT-SPOON SAMPLER

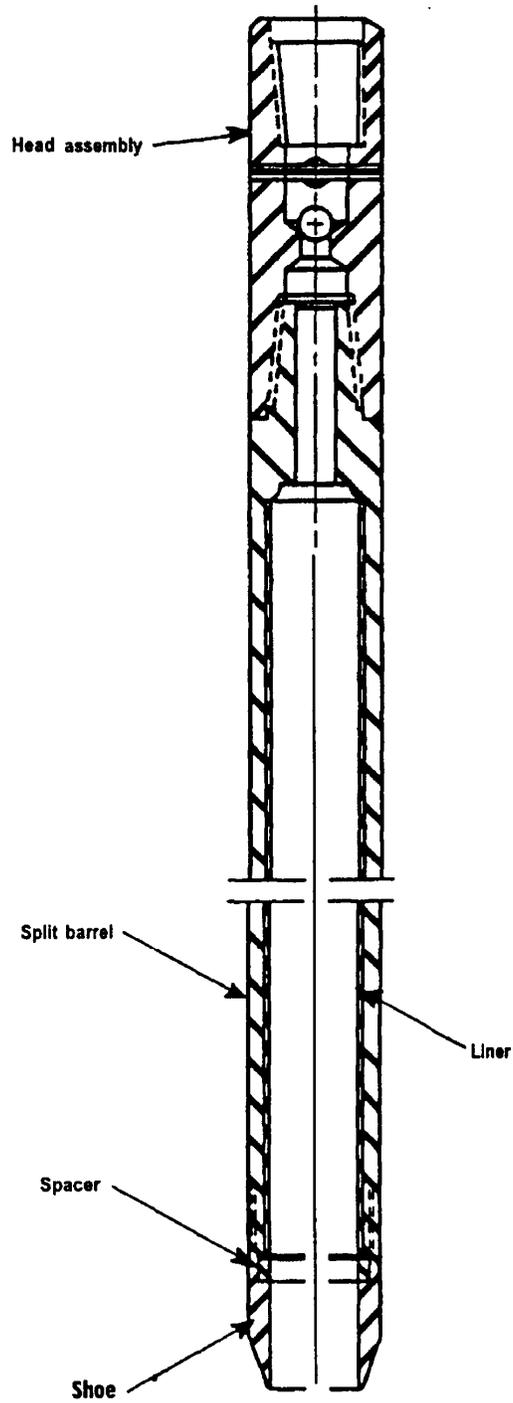
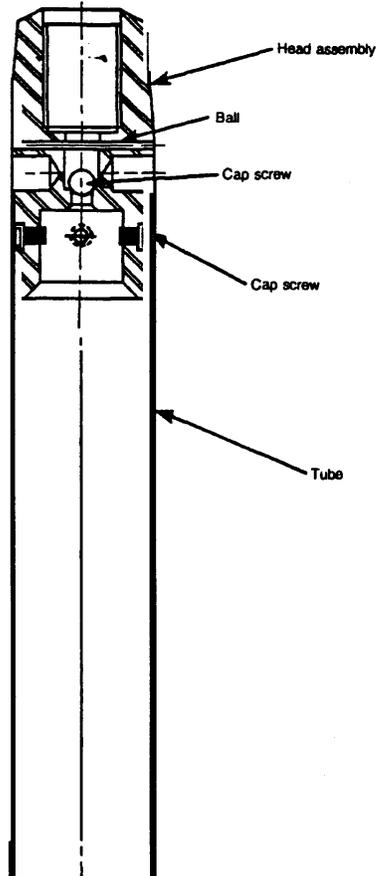


FIGURE 4
THIN-WALL TUBE SAMPLER



SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

SEDIMENT AND SLUDGE SAMPLING

SOP NO. 006

REVISION NO. 4

Last Reviewed: May 2010

K. Riesing

Quality Assurance Approved

May 5, 2010

Date

1.0 BACKGROUND

Sediments generally are materials deposited in surface impoundments or in natural waterways such as lakes, streams, rivers, oceans, and sloughs, as well as particulate matter deposited on the marsh or wetland surface.

Sludges are semisolid materials ranging from dewatered solids to high-viscosity liquids. Sludges generally accumulate as residuals of water-bearing waste treatment or industrial process systems. Sludges typically accumulate in tanks, drums, impoundments, or other types of containment systems.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for sampling sediment in lakes, streams, and rivers as well as sludge in open drums and shallow tanks (3 feet deep or less) or surface impoundments that are largely accessible. Sludge sampling as it pertains to drums or other containers with smaller or less accessible openings is described in SOP 008..

1.2 SCOPE

This SOP applies to collection of sediment and sludge samples. It provides detailed procedures for gathering such samples with specific equipment.

1.3 DEFINITIONS

Bottom Dredge Grab Sampler: A clamshell-type metal scoop activated by a counter-lever latching system.

Composite Sample: A sample comprised of multiple grab samples representing a physical average of the total number of grab samples.

Discrete Sample: A sample comprised of a portion of material representing conditions present at a single unit of space and time.

Electronic Vibration Corer: A type of sampler that uses an electrically powered vibrating head, which vibrates vertically along the axis of the sampler to penetrate the sediment.

Gravity Corer: Metal tube with a tapered nosepiece on the bottom and a check valve on the top. The nosepiece reduces core disturbance during penetration. The check valve allows air and water to pass through the sampler during deployment and prevents sample loss (washout) during retrieval.

Hand Corer: Thin-wall tube or core barrel sampler. Some models include a tapered nosepiece, a “T” handle to facilitate sampler deployment and retrieval, and a check valve on top. Some models are available with extension handles, core barrel liners, core catchers, and sample extruders.

Transect Sampling: A series of samples collected at several locations oriented in a straight line.

1.4 REFERENCES

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1.5 REQUIREMENTS AND RESOURCES

The selection of sampling equipment and procedures should be based on project objectives and site-specific conditions such as the type and volume of sediment or sludge to be sampled, sampling depth, and the type of sample required (disturbed or undisturbed). The selected sampling equipment should be constructed of inert materials that will not react with the sediment or sludge being sampled.

The following equipment may be required to sample sediment or sludge:

- Plastic sheeting
- Field logbook
- Stainless steel or disposable spoons or spatulas
- Stainless-steel or disposable scoop or trowel
- Stainless-steel bowls
- Telescoping or fixed-length pole/handle for scoop or trowel
- Hip waders, chest waders, or high rubber boots (depending on water depth)
- Boat (depending on water depth)
- Gravity corer
- Hand corer
- Sludge sampler
- Electronic vibration corer
- Bottom dredge sampler
- Stainless-steel or Teflon[®] tray
- Nylon rope
- Sample containers and labels
- Chain-of-custody and shipping materials
- Decontamination materials

2.0 PROCEDURES

This section provides general procedures for sampling sediment and sludge. Sections 2.1 through 2.5 specify the methods and equipment to be used for such sampling.

Sediment Sampling

Sediment can be sampled using a stainless-steel scoop or trowel (see Section 2.1), a hand corer (see Section 2.2), a gravity corer (see Section 2.3), an electronic vibration corer (see Section 2.4), or a bottom dredge grab sampler such as a Ponar grab sampler (see Section 2.5). Soil core catchers and brass, polycarbonate plastic, or Teflon[®] liners are often used with core samplers. A number of factors must be considered when selecting the type of sampler to be used. In streams, lakes, and impoundments, for instance, sediment is likely to demonstrate significant variations in composition.

For stream sediment sampling, the sampling location farthest downstream should be sampled first to avoid cross-contamination. Sediment samples collected in upstream and downstream locations should be obtained in similar depositional environments and, whenever possible, should be obtained from slow-moving pools. In addition, a sediment sample should be collected at approximately the same location as an associated aqueous sample. Aqueous samples should be obtained first to avoid collecting suspended particles that may result from sediment sampling. To avoid disturbing an area to be sampled, sampling locations in streams should always be approached from the downstream side.

Sediment samples collected from lakes and impoundments should also be collected at approximately the same locations as associated aqueous samples. As in stream sampling, aqueous samples should be collected first to avoid collecting suspended particles that may result from sediment sampling. Downgradient and background samples should be collected from similar depositional environments.

Typically, fine-grained sediments should be targeted as they have greater surface area available for adsorption of contaminants. In streams or rivers, low-velocity depositional areas (bends, areas behind obstructions, pooling areas) are preferred sampling locations. High velocity turbulent areas should be avoided, if possible. Samples may be collected at a single location, along a transect line, or as composite samples consisting of material from multiple grab samples.

Often times the top 10 centimeters (approximately top six inches) of sediment is targeted as the sample interval because most benthic organisms are found in this horizon. Sampling multiple locations can provide information on the horizontal distribution of contaminants in a given water body. A column of

sediment can provide information on the vertical distribution of contaminants with depth. Sampling locations, the number of samples to be collected, sampling rationale, and sampling approach (grab, transect, composite, etc.) should be discussed in the project-specific plans.

Exact sampling locations should be documented in field logbooks or on data sheets with respect to fixed reference points or located using global positioning satellite (GPS) technology. In addition, the presence of rocks, debris, or organic material in the sludge or sediment to be sampled may preclude use of some types of samplers or require modification of sampling equipment.

Sludge Sampling

Sludge can often be sampled using a stainless-steel scoop or trowel (see Section 2.1). Frequently sludge forms when components with higher densities settle out of a liquid. When this happens, the sludge may still have an upper liquid layer above the denser components. When the liquid layer is sufficiently shallow, the sludge may be sampled using a hand corer (see Section 2.2). Use of the hand corer is preferred because it results in less sample disturbance. The hand corer also allows for the collection of an aliquot of the overlying liquid. This prevents drying or excessive oxidation of a sample before analysis. The hand corer may also be adapted to hold a brass, polycarbonate plastic, or Teflon[®] liner.

A gravity corer may also be used to collect samples of most sludges and sediments (see Section 2.3). A gravity corer is capable of collecting an undisturbed sample that profiles the strata present in a sludge or sediment. Depending on the weight of the gravity corer and the density of the sludge or sediment, a gravity corer may penetrate the material up to 30 inches. If the layer is shallow (less than 1 foot), gravity corer and hand corer penetration may damage any underlying liner or confining layer. In such situations, a Ponar grab sampler may be used because it is generally capable of penetrating only a few inches (see Section 2.4).

The following subsections specify methods for sediment and sludge sampling with specific equipment.

2.1 SAMPLING WITH A SCOOP OR TROWEL

Sediment or sludge samples may be collected with a simple scoop or trowel. This method is more applicable to sludge but can be used for sediments provided that the water is very shallow (a few inches). However, using a scoop or trowel may disrupt the water-sediment interface and cause substantial sample alteration. This method provides a simple, quick means of collecting a disturbed sample of sludge or sediment.

The following procedure can be used for sampling sludge or sediment with a scoop or trowel:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Carefully insert a pre-cleaned scoop or trowel into the sludge or sediment and remove the sample. In the case of sludge exposed to air, remove the first 2 to 4 inches of material before collecting the sample. In the case of collecting sediment with abundant debris or vegetation at the surface, carefully remove the debris (avoid disturbing the sediment to the extent possible) before collecting the sample.
4. When compositing a series of grab samples, combine the samples in a stainless-steel bowl or Teflon[®] tray. Record pertinent information in the field logbook (sample description, color, odor, texture, etc.) or in a field data collection form, if applicable. If samples are to be collected for VOC analysis, fill the appropriate VOC containers first before compositing the sample and logging the sample information.
5. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
6. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
7. Ensure that a Teflon[®] liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.
8. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before and during shipment.
9. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

2.2 SAMPLING WITH A HAND CORER

The hand corer, sometimes called a hand auger (see Figure 1), is used in the same situations and for the same materials as those described for the use of a scoop or trowel (see Section 2.1). However, the hand

corer may be used to collect an undisturbed sample that can profile any stratification resulting from changes in material deposition thus allowing for sampling of the specific layer or layers of interest.

The exact type of hand corer will vary depending on the manufacturer, but the operational procedures discussed below are applicable to most types of hand corers. For example, some hand corers can be fitted with extension handles that allow collection of samples underlying a shallow layer of liquid. Most hand corers can be fitted with core catchers (Figure 1) to prevent sample loss upon retrieval and they can be adapted to hold liners, which are generally available in brass, polycarbonate plastic, or Teflon®. The type of hand corer and liner material should be chosen that will not compromise the intended analytical procedures.

The following procedure can be used for sampling sludge or sediment with a hand corer:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Position a pre-cleaned hand corer above the sampling location. If the sediment or sludge is non-cohesive, insert a core catcher into the end of the sampler. Carefully deploy the hand corer into the sludge or sediment using a smooth, continuous motion. Gently rotating the corer while it is being pushed may facilitate greater penetration and decrease core compaction.
4. When the hand corer is at the desired depth, rotate the “T” handle or the core barrel and retrieve the hand corer using a single, smooth motion. If the hand corer does not include a “T” handle, cap the top of the core barrel with your hand to provide additional suction during retrieval.
5. Remove the core catcher and nosepiece (if applicable) and extract the sample. Place the sample on a clean stainless-steel or Teflon® tray. When compositing a series of grab samples, combine the samples in a stainless-steel bowl or Teflon® tray. Record pertinent information in the field logbook (sample description, color, odor, etc.) or in a field data collection form, if applicable. If samples are to be collected for VOC analysis, fill the appropriate VOC containers first before compositing the sample and logging the sample information.

6. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
7. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
8. Ensure that a Teflon® liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.
9. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before and during shipment.
10. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

2.3 SAMPLING WITH A GRAVITY CORER

A gravity corer (see Figure 2) can collect essentially undisturbed samples to profile strata that develop in sediment and sludge during the deposition process. Depending on the sediment or sludge density and the gravity corer's weight, the sampler typically can penetrate the sediment or sludge to a depth of 30 inches, using the weight of the sampler to assist penetration. A gravity corer is lowered into the sediment from a fixed support (such as a boat or a portable tripod pole system).

Gravity corers should be used carefully in open drums, shallow tanks, or lagoons with liners. A gravity corer could penetrate beyond the sludge or sediment layer and damage the liner material.

The following procedure can be used for sampling sediment or sludge with a gravity corer:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.

3. Attach the required length of sample line to a pre-cleaned gravity corer. Braided, 3/16-inch nylon line is sufficient; however, 3/4-inch nylon line is easier to grasp during hoisting.
4. Secure the free end of the line to a fixed support to prevent accidental loss of the gravity corer.
5. Position the gravity corer above the sampling location. Allow the gravity corer to fall freely through the liquid and penetrate the sludge or sediment layer.
6. Retrieve the gravity corer with a smooth, continuous lifting motion. Do not bump the corer, as this may result in some sample loss.
7. Remove the core catcher and nosepiece (if applicable) from the gravity corer. Slide the sample out of the corer into a stainless-steel or Teflon® pan. When compositing a series of grab samples, combine the samples in a stainless-steel bowl or Teflon® tray. Record pertinent information in the field logbook (sample description, color, odor, etc.) or in a field data collection form, if applicable. If samples are to be collected for VOC analysis, fill the appropriate VOC containers first before compositing the sample and logging the sample information.
8. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
9. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
10. Ensure that a Teflon® liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.
11. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before and during shipment.
12. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

2.4 SAMPLING WITH AN ELECTRONIC VIBRATION CORE SAMPLER

Electronic vibration corers are commonly used core samplers because they can retrieve deep core samples in most types of sediment. For example, electronic vibration corers can be used from a boat to collect a sample from the shallow sea floor. Vibration corers typically are not appropriate for sludge sampling as they could penetrate beyond the sludge layer and damage the liner material of a container.

Vibration samplers have an electrically powered vibrating head, which vibrates vertically along the axis of the sampler to penetrate the sediment (Figure 3). The core barrel and liner are inserted into the head of the vibrator and the entire assembly is lowered into the water. A vibrating core sampler can penetrate compact sediments and collect core samples up to 10 meters long depending on the type of system used, the horsepower of the vibrating head, and weight of the sampler.

The two general types of vibrating core systems typically used include larger boat-deployed systems and portable pole systems. Larger vibrating core samplers require the use of an appropriately sized boat to maintain balance and provide adequate lift to break the head of the corer out of the sediment for sample retrieval (EPA 2001).

The following procedure can be used for sampling sediment with a submersible boat-deployed vibration corer:

1. Place all sampling equipment on plastic sheeting next to the sampling location if working next to the shore or stream bank. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Securely attach the vibrating corer assembly to the winch cable.
4. Position the vibrating corer above the sampling location. Using the winch, suspend and lower the corer until the core tube contacts the bottom.
5. Begin vibration and continue penetration until the core tube is fully buried or refusal occurs. Care should be taken to keep the cable taught ensuring that the core tube is vertical. Turn off vibration when coring is completed.

6. Retrieve the vibration corer with the winch, using vibration only if extraction is difficult. Keep the core tube in a near vertical position once retrieved.
7. Remove the core catcher, nosepiece, and liner from the core tube. Cap the ends of the liner, label the liner to identify the location, sample number, time of collection, and date. Transfer the sample on-shore for further processing. Record pertinent information in the field logbook (sample description, color, odor, etc.) or in a field data collection form, if applicable.
8. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
9. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
10. Ensure that a Teflon[®] liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.
11. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before shipment.
12. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

The following procedure can be used for sampling sediment with a portable pole system vibration corer:

1. Place all sampling equipment on plastic sheeting next to the sampling location if working next to the shore or stream bank. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Securely attach the retrieval lines to the core tube mounting cap.
4. Insert liner tube (core catcher end down) into mounting clamp and hand-tighten wing nuts evenly.

5. Insert desired length extension pole into mounting plate socket and secure with bolt and locknut. Slip flared lower end of the extension tube over the check-valve end of the core tube adapter while applying tension on the retrieval lines. Lower the system carefully until it contacts the bottom.
6. Press and vibrate the core tube until it is fully buried or refusal occurs. Note the depth of penetration by markings on the extension pole. Turn off vibration when coring is completed.
7. Disconnect the extension pole and manually retrieve the vibration corer with the retrieval lines or use a hand winch, if necessary. Keep the core tube in a near vertical position once retrieved.
8. Remove the core catcher, nosepiece, and liner from the core tube. Cap the ends of the liner, label the liner to identify the location, sample number, time of collection, and date. Transfer the sample on-shore for further processing. When compositing a series of grab samples, combine the samples in a stainless-steel bowl or Teflon[®] tray. Record pertinent information in the field logbook (sample description, color, odor, etc.) or in a field data collection form, if applicable. If samples are to be collected for VOC analysis, fill the appropriate VOC containers first before compositing the sample and logging the sample information.
9. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
10. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
11. Ensure that a Teflon[®] liner is present in the sample container cap. Secure the cap tightly on the sample container.
12. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before and during shipment.
13. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

2.5 SAMPLING WITH A BOTTOM DREDGE SAMPLER

Bottom dredge samplers are typically used to sample sediments that cannot be easily collected using trowels, scoops, or coring devices or in cases where large quantities of sample are desired. Bottom dredge samples are particularly effective when sampling from a boat where there are several feet of water above the sediment surface. Several types and sizes of dredges exist including the Peterson, Eckman, and Ponar. Dredges can be activated upon contact with the sediment or by using a “messenger” to close the buckets. The procedures discussed below are applicable to sampling with a Ponar dredge sampler. A Ponar grab sampler (see Figure 4) can be used to sample most types of sludges and sediments. A Ponar grab sampler is used by holding the grab sampler above the area to be sampled and lowering the grab sampler until it makes contact with the sediment. Its penetration depth into the sediment usually does not exceed several inches. The Ponar grab sampler, like other grab samplers, cannot collect undisturbed samples; therefore, this sampler should be used only after all overlying water samples have been collected.

The following procedure can be used for sampling sludge or sediment with a Ponar grab sampler:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Attach the required length of sample line to a precleaned Ponar grab sampler. Braided, 3/4-inch nylon line is recommended for ease in hoisting.
4. Measure the distance from the water surface or other reference point to the top of the sludge or sediment. Mark this measurement on the sample line. To avoid unnecessary disturbance of the sludge or sediment from lowering the Ponar grab sampler too quickly, it is recommended that a second mark be made on the sample line to indicate the proximity of the reference mark.
5. Open the Ponar sampler’s jaws until they are latched. The jaws will be triggered if the Ponar sampler comes in contact with or is supported by anything other than the sample line. Tie the free end of the sample line to a fixed support.

6. Position the Ponar grab sampler above the sampling location. Lower the sampler until the proximity mark is reached. Then, slowly lower the Ponar grab sampler until it touches and penetrates the sludge or sediment.
7. Allow the sample line to slacken a few inches to release the latching mechanism that closes the sampler's jaws. As the jaws close, they scoop the sludge or sediment up into the sampler. More slack may be required when sampling in surface waters with strong currents.
8. Retrieve the sampler, open the jaws carefully, and release its contents into a stainless-steel or Teflon[®] tray. When compositing a series of grab samples, combine the samples in a stainless-steel bowl or Teflon[®] tray. Record pertinent information in the field logbook (sample description, color, odor, etc.) or in a field data collection form, if applicable. If samples are to be collected for VOC analysis, fill the appropriate VOC containers first before compositing the sample and logging the sample information.
9. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
10. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
11. Ensure that a Teflon[®] liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.
12. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before and during shipment.
13. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

FIGURE 1
HAND CORER

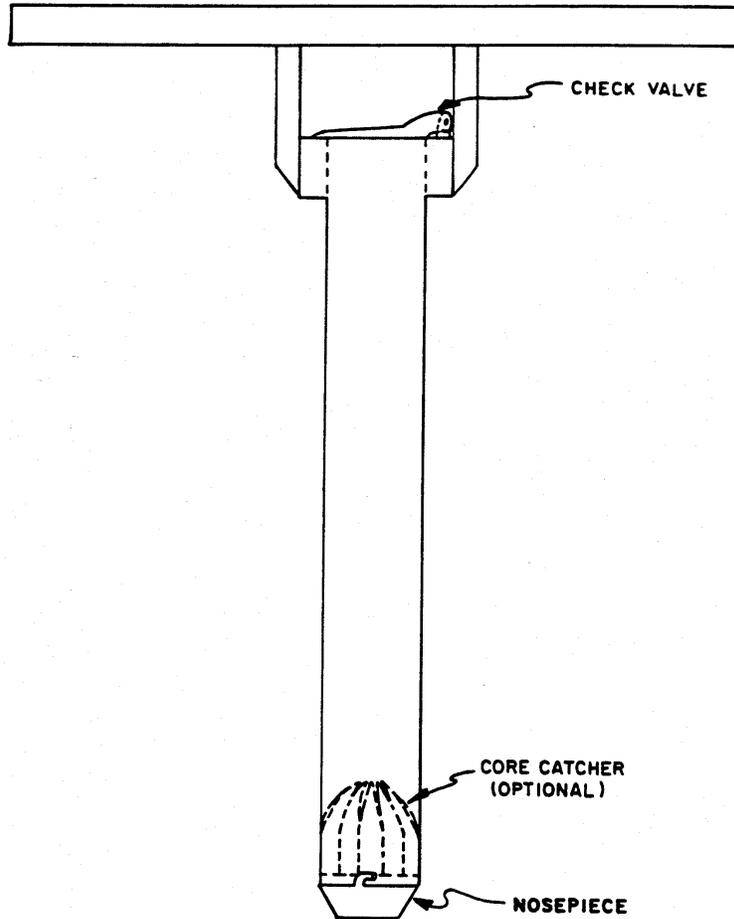


FIGURE 2
GRAVITY CORER

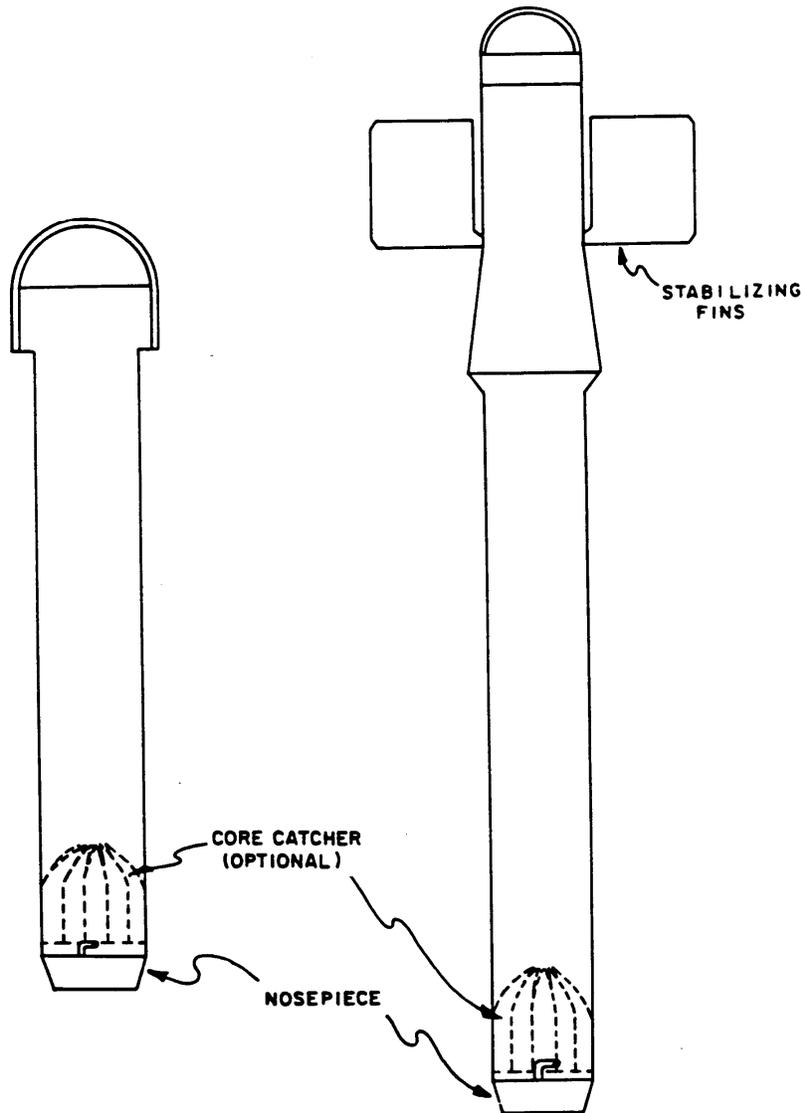


FIGURE 3
VIBRACORE SAMPLER

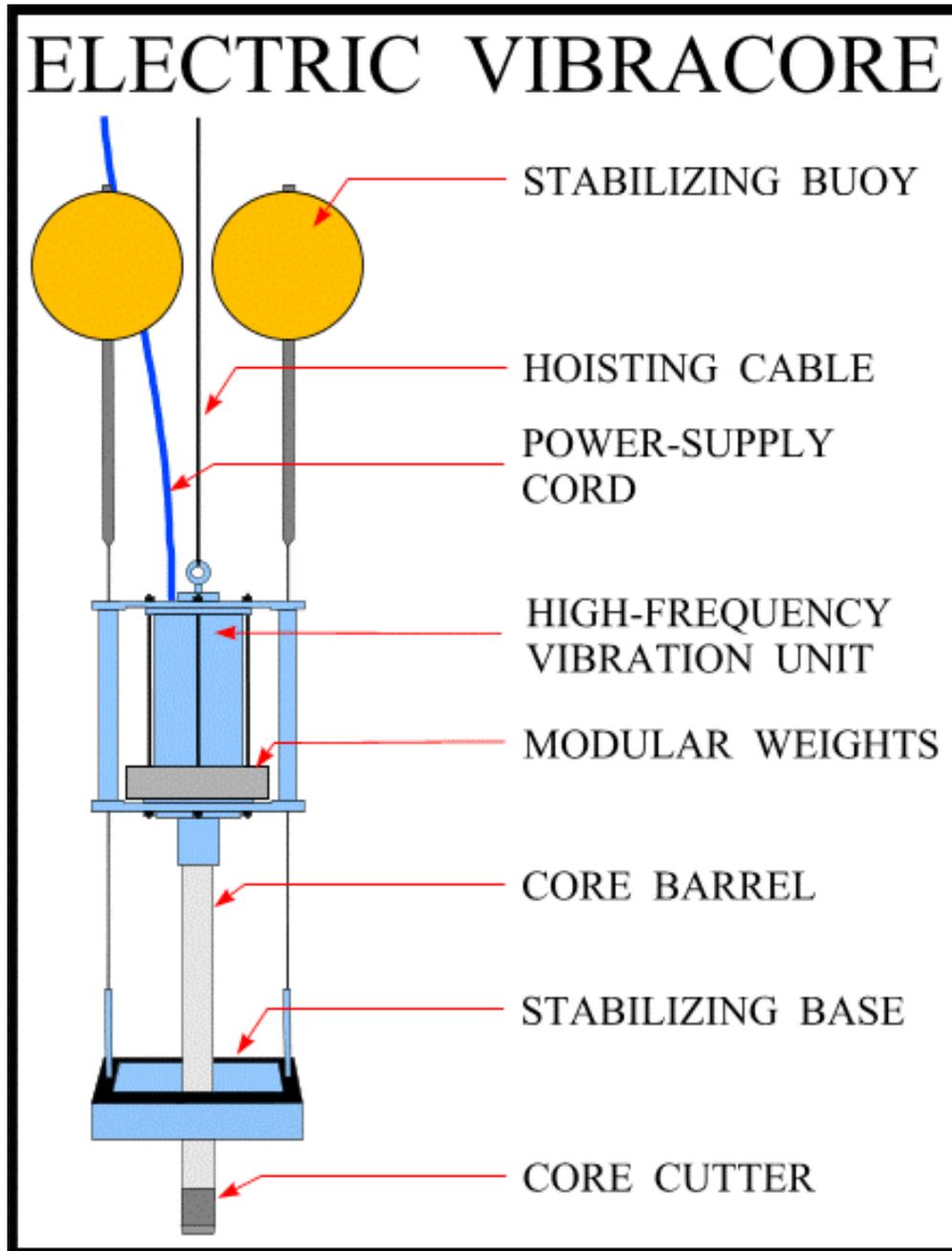
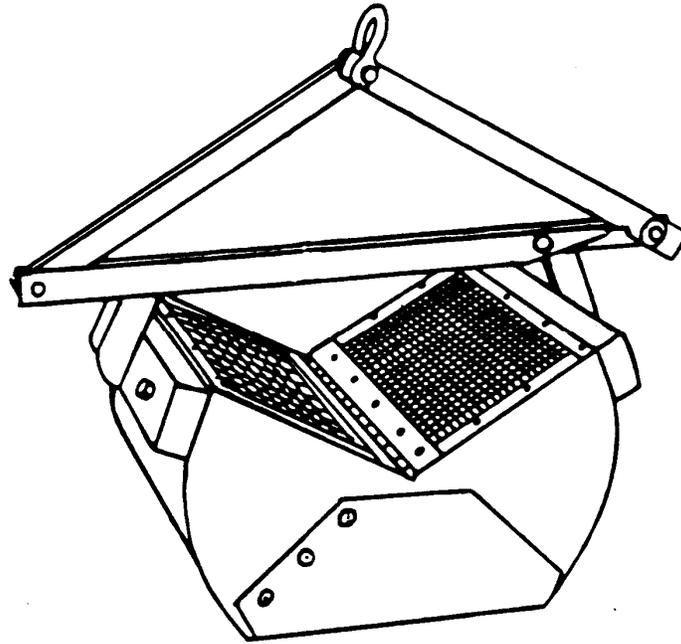


FIGURE 4

BOTTOM DREDGE GRAB SAMPLER



SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

CONTAINERIZED LIQUID, SLUDGE, AND SLURRY SAMPLING

SOP NO. 008

REVISION NO. 2

Last Reviewed: January 2000

K. Riesing

Quality Assurance Approved

May 18, 1993

Date

1.0 BACKGROUND

Taking samples of liquid, sludge, and slurry from drums or other containers can present some unique problems. Manmade containers are typically closed. Containers are usually accessed either through small ports, manways, hatches, taps, or bungs. The size, shape, construction material, and location of a container may limit the types of equipment and methods that can be used to collect samples.

1.1 PURPOSE

This standard operating procedure (SOP) establishes procedures for sampling liquid, sludge, and slurry from containers.

1.2 SCOPE

Opening a closed container is a potentially hazardous task because toxic vapors and gases potentially could be released causing explosive reactions. Whenever containers that may contain hazardous materials are to be opened for sampling or any other reason, the sampling team should follow appropriate guidelines provided in site-specific sampling plans, health and safety plans, and the general guidelines in this SOP.

How containers are opened will depend on the purpose of the sampling; site conditions; the number, type, and condition of the containers; and the anticipated type of media to be sampled. As a result, no comprehensive procedures can be defined for sampling all types of containerized liquid, sludge, and slurry. This SOP provides general guidelines for dealing with problems that may be encountered while opening containers and sampling the media. General procedures are provided for sampling containerized liquid, sludge, and slurry using glass tubes and composite liquid waste samplers (COLIWASA).

1.3 DEFINITIONS

Bung Remover: A device used to open the lid of a drum.

COLIWASA: Composite liquid waste sampler used to sample free-flowing liquids and slurries in containers.

Hazardous Samples: Hazardous samples include dangerous goods and hazardous substances. Hazardous samples shipped by air should be packaged and labeled in accordance with procedures specified by the International Air Transportation Association (IATA) Dangerous Goods Regulations (DGR); ground shipments should be packaged and labeled in accordance with the U.S. Department of Transportation (DOT) Hazardous Materials Regulations (HMR, *Code of Federal Regulations*, Title 49 [49 CFR] Parts 106 through 180). See SOP No. 019 (Packaging and Shipping Samples) for additional information.

Photoionization Detector (PID): A direct-reading air monitoring instrument used to measure organic vapors based on the principle of photoionization. Examples of PIDs include the HNu and the Microtip.

Flame Ionization Detector (FID): A direct-reading, air monitoring instrument used to measure organic vapors based on the principle of flame ionization. An example of an FID is an organic vapor analyzer (OVA).

1.4 REFERENCES

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1.5 REQUIREMENTS AND RESOURCES

Depending on container specifications and the method selected for collecting samples, the following equipment may be required to sample liquid, sludge, and slurry from containers:

- Glass tubes
- FID or PID
- Bung remover
- COLIWASA
- Rubber stopper
- Stainless-steel spatula
- Chain-of-custody forms and shipping materials
- Sample containers and labels
- Appropriate personal protective equipment (PPE)
- A permanent marker for labeling containers

2.0 PROCEDURES

Opening a closed container may potentially release toxic vapors and gases that could cause an explosive reaction. The decision to open a container to sample the contents should be made only after other potentially less dangerous site characterization methods, such as geophysical investigations or sampling of noncontainerized media, have been ruled out. In some cases, however, sampling the contents of the container may be necessary for use in legal cases or for other reasons.

Until the container contents are characterized, the sampling team should assume that materials in unlabeled containers are hazardous. Labeled containers such as 55-gallon drums are often reused and can be mislabeled. The sampling team should exercise caution when working with or around containers.

When the decision to open a container has been made, the sampling team must assess potential exposure risks. Risk factors include the number, type, and condition of containers; site conditions that could prevent a container from being safely and efficiently opened; and the anticipated contents of the container. Based

on this information and based on the scope of work for the project, the sampling team should consist of at least two persons and develop a safe procedure for opening the container and sampling its contents.

Sampling team members must wear appropriate PPE when opening and sampling containers. In some cases, particularly when the contents of the container are not positively known the sampling team should consider using a remote drum opener to open closed containers. The choice of remote drum opening methods depends on the number of drums to be opened, their contents, and their physical condition. One type of remote drum opener uses hydraulic pressure to push a non-sparking metal spike into either the side or top of the drum.

After the container is opened, headspace gases should be monitored using an intrinsically safe monitoring instrument. At a minimum, a preliminary check using appropriate air-monitoring instruments should be conducted to help determine the level of PPE required and the appropriate sampling method.

Layering or stratification of any material left undisturbed over time is likely. Agitation of the container to homogenize the material can be difficult and is undesirable if the contents of the container are not known. The sampling team must ensure that samples represent the entire contents of the container, not just the contents of a single layer.

For sampling liquid and sludge in drums or other small to medium-sized containers, the glass tube sampling method is recommended. Tubes are available that collect a sample from the full depth of a drum and retain it until placement in a sample container. This sampling method is discussed in detail in Section 2.1. The COLIWASA is widely used to sample containerized and free-flowing liquids and slurries in drums and other containers. It also is used for sampling immiscible liquid-phase waste. Use of the COLIWASA is outlined in Section 2.2.

2.1 SAMPLING USING GLASS TUBES

Glass tubes can be used to sample liquids and sludge in containers such as 55-gallon drums. Glass tubes designed for this purpose are normally 122 centimeters (4 feet) long and have an inside diameter of 0.6 to 1.6 centimeters (0.24 to 0.63 inches). Glass tubes with larger inside diameters are used for sampling

viscous liquids. When sampling is completed, the glass tubes can be broken and disposed of in the container just sampled. This eliminates the need for cleanup and disposal. However, if disposal of the tube by breaking in into the drum interferes with plans for the removal of the container contents, other disposal techniques should be evaluated.

The glass tube method is a quick, relatively inexpensive way of sampling containerized liquid and sludge. The major disadvantage of this method is that some sample loss may occur when sampling less viscous liquids. Splashing of such liquids also can expose sampling team members to potentially hazardous materials. For this reason, appropriate PPE, such as a butyl rubber apron, a face shield, safety glasses, respirators, boot covers, and gloves may be needed when using the glass tube method.

The procedures for sampling liquids and sludge using the glass tube method are given below. Following these procedures, cautionary notes are provided.

2.1.1 Sampling Containerized Liquids Using a Glass Tube

The following procedures can be used to sample containerized liquids using a glass tube:

1. Place all sampling equipment on a plastic sheet next to the container to be sampled. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Preservation, Holding Time, and Container Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Wear appropriate PPE. Use a PID or FID to monitor airborne organic vapors and gases in the breathing zone. In most cases, a PID is preferred because it is intrinsically safe, although an FID may be appropriate in some cases.
4. Record in the field logbook all exterior container markings, special conditions, and the type of opening through which the sample will be collected.
5. Using a permanent marker, make a unique identifying number on the container.
6. Locate an existing opening or bung hole in the container, if possible.
7. Using nonsparking tools, a bung remover, or a remote drum opener, carefully remove the cover or bung from the container.

8. Slowly insert a glass tube to a level slightly above the bottom of the container or until a solid layer is encountered. If layering or stratification of the liquids in the container is expected, the glass tube should be inserted at a rate that permits the liquid level inside and outside the tube to be about the same. Keep at least 30 centimeters (12 inches) of the glass tube above the top of the container.
9. Allow the liquid in the container to reach its natural level in the glass tube.
10. Cap the top of the glass tube with a safety-gloved thumb or a rubber stopper.
11. Remove the capped glass tube from the container, look for different layers, and insert the uncapped end into the labeled sample container.
12. Release the thumb or rubber stopper from the glass tube to allow the liquid to drain into the sample container.
13. Fill the sample container to approximately 90 percent of its capacity. Repeat steps 8 through 12 if more volume is needed to fill the sample container.
14. Dispose of the glass tube in an appropriate manner.
15. Ensure that a Teflon[®] liner is present in the sample container cap. Secure the cap tightly on the sample container. All containerized liquid samples should be evaluated in accordance with the "Sample Classification" section of SOP No. 019 (Packaging and Shipping Samples) to determine if they are hazardous samples; hazardous samples should be packaged and shipped in accordance with Dangerous Goods Regulations.
16. Replace the bung in the container or seal the opening in the container with plastic.
17. Complete all chain-of-custody forms and record sampling activities in the field logbook. Unless the sample will be analyzed at the site, complete all sample packaging requirements in accordance with SOP No. 019, Packaging and Shipping Samples.

2.1.2 Sampling Containerized Sludge Using a Glass Tube

The following procedures can be used to sample containerized sludge using a glass tube.

1. Follow steps 1 through 7 for sampling containerized liquids using a glass tube (see Section 2.1.1).
2. Slowly insert a glass tube to a level slightly above the top of the sludge layer. Keep at least 30 centimeters (12 inches) of the glass tube above the top of the container.
3. Allow the liquid in the container to reach its natural level in the glass tube.

4. Gently push the glass tube into the sludge layer at the bottom of the container.
5. Cap the top of the glass tube with a safety-gloved thumb or a rubber stopper.
6. Remove the capped glass tube from the container and insert the uncapped end into the labeled sample container (for example, a wide-mouthed, 8-ounce glass jar).
7. Release the thumb or rubber stopper from the glass tube to allow the material to drain into the sample container. If necessary, the sludge sample in the bottom of the tube may be dislodged using a stainless-steel spatula.
8. Fill the container to approximately 90 percent of its capacity. Repeat steps 2 through 7 if more volume is needed to fill the sample container.
9. Dispose of the glass tube in an appropriate manner.
10. Ensure that a Teflon[®] liner is present in the sample container cap. Secure the cap tightly on the sample container. All containerized sludge samples should be evaluated in accordance with the "Sample Classification" section of SOP No. 019 (Packaging and Shipping Samples) to determine if they are hazardous samples; hazardous samples should be packaged and shipped in accordance with Dangerous Goods Regulations.
11. Replace the bung in the container or seal the opening in the container with plastic.
12. Complete all chain-of-custody forms and record sampling activities in field logbook. Unless the sample will be analyzed at the site, complete all sample packaging requirements in accordance with SOP No. 019, Packaging and Shipping Samples.

2.1.3 Cautionary Notes

Because there is potential for problems, interferences, and accidents to occur during sampling of containerized liquids and sludges, the following cautionary notes are provided.

1. If you observe any reaction when the glass tube is inserted into the container (for example, violent agitation, smoke, light, or heat), leave the area immediately.
2. If the glass tube becomes cloudy or smoky after inserting it into the container, hydrofluoric acid may be present. Glass tube sampling is inappropriate in this circumstance. Instead, use a comparable length of rigid plastic tubing to collect the sample and transfer the sample to an appropriate sample container.
3. When solid material is encountered in a container (either a floating layer or bottom sludge), use the sludge sampling procedure to collect a sample of the material.

Alternatively, if the container opening is sufficiently large, the material may be sampled with a disposable scoop attached to a disposable wooden or plastic rod.

2.2 SAMPLING USING THE COLIWASA

The COLIWASA is used to collect samples of containerized or free-flowing liquid and slurry in drums and other containers. The COLIWASA is commercially available; however, it can be assembled from a variety of materials, including polyvinyl chloride (PVC), glass, or Teflon[®]. It consists of a 152-centimeter (5-foot)-long tube with an inside diameter of 4 centimeters (1.6 inches). The tube has a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the COLIWASA by raising and lowering the neoprene stopper.

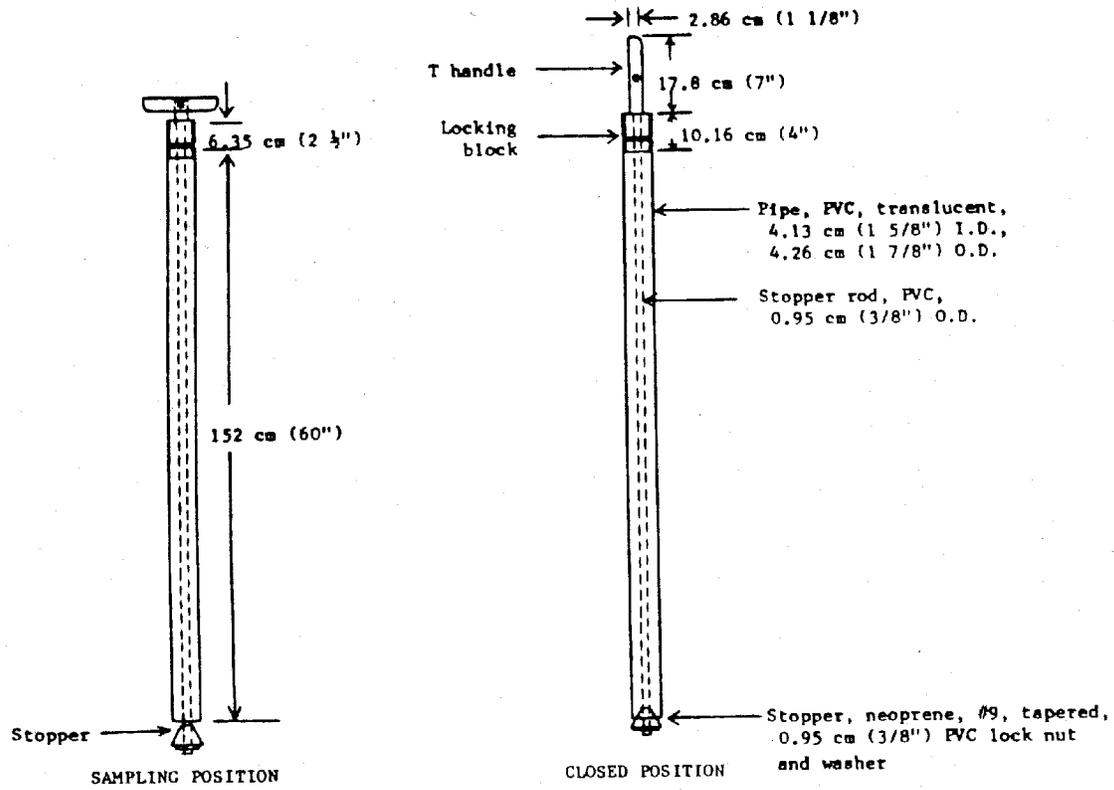
The recommended COLIWASA design is shown in Figure 1. The design may be modified to meet the needs of a sampling situation. The major drawbacks of using a COLIWASA involve decontamination and cost. The COLIWASA is difficult to decontaminate in the field and has a high cost compared to glass tubes. However, disposable COLIWASAs are available and are a viable alternative. The COLIWASA's major advantage is its ability to collect samples that accurately represent a multiphase waste.

The following procedure can be used for sampling containerized liquid or slurry using the COLIWASA:

1. If a commercial COLIWASA is unavailable, select the material to make the COLIWASA (for example, PVC, glass, or Teflon[®]). Assemble the sampler as shown in Figure 1. Check the COLIWASA to make sure it is functioning properly. Adjust the locking mechanism so that the neoprene stopper provides a tight closure.
2. If using a nondisposable COLIWASA, clean the COLIWASA according to procedures specified in SOP No. 002, General Equipment Decontamination. Place all sampling equipment on a plastic sheet next to the container to be sampled. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Preservation, Holding Time, and Container Requirements.
3. Affix a completed sample container label to the appropriate sample container.
4. Wear appropriate PPE. Use a PID or FID to monitor airborne organic vapors and gases in the breathing zone. In most cases a PID is preferred because it is intrinsically safe, although an FID may be appropriate in some cases.

5. Record in the field logbook all exterior container markings, special conditions, and the type of opening through which the sample will be collected.
6. Using a permanent marker, make a unique identifying number on the container.
7. Locate an existing opening or a bung hole in the container, if possible.
8. Using nonsparking tools, a bung remover, or a remote drum opener, carefully remove the cover or bung from the container.
9. Place the COLIWASA in the open (sampling) position. The stopper rod handle should be in the T position, and the rod should be pushed down until the handle rests against the locking block.
10. Slowly lower the COLIWASA into the liquid or slurry at a rate that permits the levels of the liquid or slurry inside and outside the COLIWASA tube to be about the same. If the liquid or slurry level in the COLIWASA tube is lower than that outside the COLIWASA tube, the sampling rate is too fast and will produce a nonrepresentative sample.
11. When the stopper reaches the bottom of the container, push the COLIWASA tube downward against the stopper to close it. Lock the COLIWASA tube in the closed position by turning the stopper rod handle from the T position until it is upright and one end rests tightly against the locking block.
12. Remove the COLIWASA tube from the container and wipe it with a disposable cloth.
13. Slowly discharge the sample into the labeled sample container. To do this, slowly pull the lower end of the stopper rod handle away from the locking block while the lower end of the COLIWASA tube is positioned in the sample container.
14. Ensure that a Teflon[®] liner is present in the sample container cap. Secure the cap tightly on the sample container. All containerized liquid and slurry samples should be evaluated in accordance with the "Sample Classification" section of SOP No. 019 (Packaging and Shipping Samples) to determine if they are hazardous samples; hazardous samples should be packaged and shipped in accordance with Dangerous Goods Regulations.
15. Replace the bung in the container or seal the opening in the container with plastic.
16. Complete all chain-of-custody forms and record sampling activities in the field logbook. Unless the sample is to be analyzed at the site, complete all sample packaging requirements in accordance with SOP No. 019, Packaging and Shipping Samples.
17. If a disposable COLIWASA was used, dispose of the device in an appropriate manner. Otherwise, unscrew the stopper rod handle of the COLIWASA tube and disengage the locking block. Decontaminate the COLIWASA tube on site or store the contaminated parts in a plastic storage tube for subsequent decontamination using the procedures in SOP No. 002, General Equipment Decontamination.

FIGURE 1
COLIWASA



SOP APPROVAL FORM

TETRA TECH, INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

RECORDING NOTES IN FIELD LOGBOOKS

SOP NO. 024

REVISION NO. 2

Last Reviewed: November 2014



Quality Assurance Approved

November 24, 2014

Date

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Title: Recording Notes in Field Logbooks	Revision No. 2, November 2014 Last Reviewed: November 2014

1.0 BACKGROUND

Complete and accurate field documentation is critical to a successful project and the field log book is an important tool to support field documentation needs. The field logbook should include detailed records of all field activities, document interviews with people, and record observations of conditions at a site. Entries should be described in a level of detail to allow personnel to reconstruct, after the fact, activities and events that occurred during their field assignments. Furthermore, entries should be limited to facts. Avoid speculation related to field events and do not record hearsay or unfounded information that may be presented by other parties during field activities. For example, do not record theories regarding the presence or absence of contamination when you are collecting field screening data or speculation regarding the reasons for a property owner's refusal to grant access for sampling.

Field logbooks are considered accountable documents in enforcement proceedings and may be subject to review. Therefore, the entries in the logbook must be accurate and detailed, but should not contain speculative information that could conflict with information presented in subsequent project deliverables and correspondence. Also be aware that the field logbooks for a site may be a primary source of information for depositions and other legal proceedings that may occur months or years after field work is complete and long after our memories have faded. The accuracy, neatness, and completeness of field logbooks are essential for recreating a meaningful account of events.

1.1 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide guidance to ensure that field logbook documentation collected during field activities meets all requirements for its later use. Among other things, field logbooks may be used for:

- Identifying, locating, labeling, and tracking samples
- Recording site activities and the whereabouts of field personnel throughout the day
- Documenting any deviations from the project approach, work plans, quality assurance project plans, health and safety plans, sampling plans, and any changes in project personnel
- Recording arrival and departure times for field personnel each morning and evening and weather conditions each day
- Describing photographs taken during the project.

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In addition, the data recorded in the field logbook may later assist in the interpretation of analytical results. A complete and accurate logbook also aids in maintaining quality control, because it can verify adherence to project scope and requirements.

1.2 SCOPE

This SOP establishes the general requirements and procedures for documenting site activities in the field logbook.

1.3 DEFINITIONS

None.

1.4 REFERENCES

Compton, R.R. 1985. *Geology in the Field*. John Wiley and Sons. New York, NY.

1.5 REQUIREMENTS AND RESOURCES

The following items are required for field notation:

- Field logbooks
- Ballpoint pens or Sharpies with permanent waterproof ink
- 6-inch ruler (optional)

Field logbooks should be bound (sewn) with water-resistant and acid-proof covers, and each page should have preprinted lines, numbered pages, and a single column. They should be approximately 7½ by 4½ inches or 8½ by 11 inches in size. Loose-leaf sheets are not acceptable for use as field notes.* If notes are written on loose paper, they must be transcribed as soon as possible into a bound field logbook by the same person who recorded the notes originally. **Note: Data collection logs and field forms used to record field measurements and data are acceptable as loose-leaf sheets maintained in a three-ring binder with numbered pages.*

Ideally, distribution of logbooks should be controlled by a designated person in each office. This person assigns a document control number to each logbook, and records the assignment of each logbook distributed (name of person, date distributed, and project number). The purpose of this procedure is to ensure the integrity of the logbook before its use in the field, and to document each logbook assigned to a

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project. In the event that more than one logbook is assigned to a project, this process will ensure that all logbooks are accounted for at project closeout.

2.0 PROCEDURES

The following subsections provide general guidelines and formatting requirements for field logbooks, and detailed procedures for completing field logbooks.

2.1 GENERAL GUIDELINES

- A separate field logbook must be maintained for each project. If a site consists of multiple subsites (or operable units), designate a separate field logbook for each subsite. Similarly, if multiple activities are occurring simultaneously requiring more than one task leader (well installation, private well sampling, or geophysical survey.), each task leader should maintain a separate field logbook to ensure that each activity is documented in sufficient detail.
- At larger sites, a general field log may be kept at the site trailer or designated field office to track site visitors, document daily safety meetings, and record overall site issues or occurrences.
- Data from multiple subsites may be entered into one logbook that contains only one type of information for special tasks, such as periodic well water-level measurements.
- All logbooks must be bound and contain consecutively numbered pages.
- No pages can be removed from the logbook for any purpose.
- All information must be entered using permanent, waterproof ink. Do not use pens with “wet ink,” because the ink may wash out if the paper gets wet. Pencils are not permissible for field notes because information can be erased. The entries should be written dark enough so that the logbook can be easily photocopied.
- Be sure that all entries are legible. Use print rather than cursive and keep the logbook pages free of dirt and moisture to the extent possible.
- Do not enter information in the logbook that is not related to the project. The language used in the logbook should be factual and objective. Avoid speculation that could conflict with information presented in subsequent project deliverables and correspondence (see Section 1.0 above).
- Use military time, unless otherwise specified by the client.
- Include site sketches, as appropriate.
- Begin a new page for each day’s notes.
- Include the date at the top of each page.
- At the end of a day, draw a single diagonal line through any unused lines on the page, and sign at the bottom of the page. Note and implement any client specific requirements (for example, some U.S. Environmental Protection Agency (EPA) programs require each logbook page to be signed).

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- Write notes on every line of the logbook. Do not skip any pages or parts of pages unless a day's activity ends in the middle of a page.
- If a line is left blank for some reason, cross out (with a single line) and initial to prevent unauthorized entries.
- Cross out (with a single line) and initial any edits to the logbook entries. Edits should only be made if the initial entry is illegible or erroneous. Do not make corrections for grammar or style.

2.2 LOGBOOK FORMAT

The layout and organization of each field logbook should be consistent and generally follow the format guidelines presented below. Some clients or contracts may have specific formatting guidelines that differ somewhat from this SOP; review client requirements at the start of the project to help ensure any client-specific guidelines are integrated.

2.2.1 Logbook Cover

Write the following information on the front cover of each logbook using a Sharpie or similar type permanent ink marker:

- Logbook document control number (assigned by issuer)
- “Book # of #” (determined by the project manager if there is more than one logbook for the project)
- Contract and task order numbers
- Name of the site and site location (city and state)
- Name of subsite (or operable unit), if applicable
- Type of activity (if logbook is for specific activity, such as well installation or indoor air sampling)
- Beginning and ending dates of activities entered into the logbook

2.2.2 Inside Cover or First Page

Spaces are usually provided on the inside front cover (or the opening page in some logbooks) for the company name, address, contact names, and telephone numbers. If preprinted spaces for this information are not provided in the logbook, write the information on the first available page. Information to be included on the inside front cover or first page includes:

- Tetra Tech project manager and site manager and phone numbers
- Tetra Tech office address

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- Client contact and phone number
- Site safety officer and phone number
- Emergency contact phone number (911, if applicable, or nearest hospital)
- Subcontractor contacts and phone numbers
- Site property owner or property manager contact information

2.3 ENTERING INFORMATION IN THE LOGBOOK

The following lists provide guidance on the type of information to be included in a typical field logbook. This guidance is general and is not intended to be all-inclusive. Certain projects or clients may specify logbook requirements that are beyond the elements presented in this SOP.

General Daily Entries:

- Document what time field personnel depart the Tetra Tech office and arrive at the hotel or site. If permitted by the client to charge travel time for site work, document what time personnel leave and arrive at the hotel each day. (This information may be needed at remote sites where hotel accommodations are not near the site.)
- Indicate when all subcontractors arrive and depart the site.
- Note weather conditions.
- Include the date at the top of each page.
- Document that a site safety meeting was held and include the basic contents of the meeting.
- List the level of protection to be used for health and safety.
- Summarize the day’s planned activities.
- Summarize which activities each field team member will be doing.

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Field Activity Entries:

- Refer to field data collection forms for details about field data collection activities (for example time, date, depth of samples, field measurements). If separate field sampling sheets are not used, see section below regarding logbook entries for sampling activities.
- Refer to well purge forms, well construction logs, and other activity-specific forms as applicable rather than including this type of information in the field logbook. These other forms allow the information to be more accessible at a later date.
- List any air monitoring instrumentation used, with readings and locations.
- Refer to instrument field logs for equipment calibration information.
- Summarize pertinent conversations with site visitors (agency representatives, property owners, client contacts, and local citizens).
- Summarize any problems or deviations from the quality assurance project plan (QAPP) or field sampling plan.
- Document the activities and whereabouts of each team member. (As indicated in Section 2.1, multiple logbooks may be required to ensure sufficient detail for contemporaneous activities).
- Indicate when utility clearances are completed, including which companies participated.
- Indicate when verbal access to a property is obtained.
- Include names, addresses, and phone numbers of any pertinent site contacts, property owners, and any other relevant personnel.
- Document when lunch breaks or other work stoppages occur.
- Include approximate scale for all diagrams. If a scale is not available, write “not to scale” on the diagram. Indicate the north direction on all maps and cross-sections, and label features on each diagram.

Sampling Activity Entries: The following information should typically be on a sample collection log and referenced in the log book. If the project does not use sample sheets as a result of project-specific requirements, this information should be included in the logbook.

- Location description
- Names of samplers
- Collection time
- Designation of sample as a grab or composite sample
- Type of sample (water, sediment, soil gas, or other medium)
- On-site measurement data (pH, temperature, and specific conductivity)

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- Field observations (odors, colors, weather)
- Preliminary sample description
- Type of preservative used.
- Instrument readings, if applicable

Closing Daily Entries:

- Describe decontamination procedures (personnel and equipment).
- Describe handling and disposition of any investigation-derived wastes.
- Summarize which planned activities were completed and which ones were not.
- Note the times that personnel depart site for the day.
- Summarize any activities conducted after departing the site (paperwork, sample packaging, etc.). This may be required to document billable time incurred after field activities were completed for the day.

Photographic Log Entries:

- For digital photographs, indicate in the text that photographs were taken and the location where the photographs can be found (for example, in the project file).
- Camera and serial #
- Photographer
- Date and time of photograph
- Sequential number of the photograph and the film roll number or disposable camera used (if applicable)
- Direction of photograph
- Description of photograph

2.4 LOGBOOK STORAGE

Custody of logbooks must be maintained at all times. During field activities, field personnel must keep the logbooks in a secure place (locked car, trailer, or field office) when the logbook is not in personal possession. When the field work is over, the logbook should be included in the project file, which should be in a secured file cabinet. The logbook may be referenced in preparing subsequent reports and may also be scanned for inclusion as an appendix to a report. However, it is advisable to obtain direction directly from the client before including the logbook as a report appendix, because its inclusion may not be appropriate in all cases.

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2.5 HEALTH AND SAFETY CONSIDERATIONS

In addition to the procedures outlined in this SOP, all field staff must be aware of and follow the health and safety practices that result from the Activity Hazard Analyses (AHAs) for a project. The AHAs include critical safety procedures, required controls, and minimum personal protective equipment (PPE) necessary to address potential hazards. The hazards specific to project tasks must be identified and controlled to the extent practicable and communicated to all project personnel via the approved, project-specific Health and Safety Plan (HASP).

ATTACHMENT 1

ERT Standard Operating Procedures

SERAS SOP 2010 1.0

SERAS SOP 2015 1.1

STANDARD OPERATING PROCEDURE APPROVAL AND CHANGE FORM

Scientific, Engineering, Response and Analytical Services
2890 Woodbridge Avenue Building 209 Annex
Edison New Jersey 08837-3679

STANDARD OPERATING PROCEDURE

Title: Tank Sampling

Approval Date: 11/07/2016

Effective Date: 11/07/2016

SERAS SOP Number: 2010, Rev 1.0

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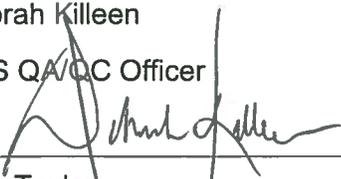
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Signature 

Date

11/7/16

The top row of this table shows the most recent changes to the controlled document. For previous revision history information, archived versions of this document are maintained by the SERAS QA/QC Officer on the SERAS local area network (LAN).

History	Effective Date
Editorial changes	11/07/2016
Added UFP QAPP preparation language to Section 1.0; training records text to Section 9.0; data verification text to Section 10.0	11/07/2016
Added text to Section 2.0 detailing unacceptable LELs and oxygen readings, TVOCs and elevated toxic gas for sampling	11/07/2016
Added text to 3.0 discussing sample preservation and its potential effects on sample characteristics; parameters considered when selecting preservatives and holding times; referencing the UFP-QAPP and SERAS SOP #2002	11/07/2016
Updated list of equipment in Section 5.0	11/07/2016
Added text to Section 7.2 for use of the MultiRAE to measure LEL/LFL, VOCs, and Toxic Gas levels.	11/07/2016
Deleted use of HNU from Section 7.2	11/07/2016
Rewrite of list item #5 in Section 7.3	11/07/2016
Added Section 7.4: Before Sampling	11/07/2016
Rewrite of list items #9 thru 12 in Section 7.5.1 Bacon Bomb Sampler	11/07/2016
Rewrite of list items #1, and #6 thru 9 in Section 7.5.2 Sludge Judge	11/07/2016
Rewrite of Section 7.5.3 Subsurface Grab Sampler	11/07/2016
Rewrite of list items #8 thru 13 in Section 7.5.4 Glass Thief (Drum Thief)	11/07/2016
Rewrite of list items #6 thru 10 in Sections 7.5.5 Bailer and 7.5.6 COLIWASA	11/07/2016
Text added to Section 11.0 discussing PPE	11/07/2016
Added references to Section 12.0	11/07/2016



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TANK SAMPLING

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SUPERCEDES: SOP #2010; Revision 0.0; 11/16/94; U.S. EPA Contract 68-C4-0022

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TANK SAMPLING

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide technical guidance to Scientific, Engineering, Response and Analytical Services (SERAS) personnel in choosing appropriate sampling techniques and equipment for the collection of representative samples from tanks. A sample of all parts of a tank may be collected to determine chemical and physical properties of its contents. Data obtained from the sample may be used to select suitable methods of treatment and disposal or confirm the contents of isolated tanks.

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

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

2.0 METHOD SUMMARY

Safe collection of a representative sample is the premier criterion for selecting sample locations. A representative sample can be collected using techniques or equipment that are designed for obtaining liquids or sludge from various depths. The structure and characteristics of storage tanks may present problems with collection of samples from more than one location; therefore, the selection of sampling devices is an important consideration.

Depending on the type of vessel and characteristics of the material to be sampled, a bacon bomb sampler, sludge judge, subsurface grab sampler, glass thief, bailer or Composite Liquid Waste Sampler (COLIWASA) may be chosen to collect the sample. A sludge judge, bacon bomb or COLIWASA can be used to determine if the tank contents are stratified. Various other custom-made samplers may be used depending on the specific application.

All sample locations should be surveyed for air quality prior to sampling. At no time should sampling continue with a lower explosive level (LEL) reading greater than 25 percent (%), oxygen readings below 19.5% or above 23.5%, problematic total volatile organic vapors (TVOCs) levels or any elevated level of toxic gas on the fourth sensor. The fourth sensor on the MultiRAE should be chosen based on the potential contents of the tank. If necessary, multiple MultiRAE or AreaRAE instruments may be used equipped with several types of sensors.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Unknown samples collected from tanks are considered waste samples and could consist of highly concentrated chemicals. As such, addition of preservatives are not required due to the potential reaction of the sample with the preservative. Samples should be cooled to less than or equal to (≤ 6) degrees Celsius (°C) with ice and protected from sunlight to minimize any potential reaction due to the potential light sensitivity of the sample. There may be times when cooling of the sample causes an alteration in the chemical and physical characteristics. Selection of preservation techniques and applicable holding times should be based on all available information, including the properties of the analytes of interest for the project, their



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anticipated concentration levels, the composition of the sample matrix itself, and the stated project-specific DQOs.

Sample bottles for collection of waste liquids, sludge, or solids are typically wide-mouth amber jars with Teflon-lined screw caps. Actual volume required for analysis should be determined in conjunction with the laboratories performing the various analyses, and according to the requirements of the UFP-QAPP.

Sample handling procedures must be as follows:

1. Label the sample jar per SERAS SOP# 2002 *Sample Documentation*.
2. Place sample container into two Ziploc plastic bags, marking the outside bag with the identification number.
3. Wrap each double bagged container securely in bubble wrap.
4. Place the bubble wrapped samples in a cooler, and fill remaining space with absorbent packing material.
5. Fill out chain of custody record for each cooler, place in plastic, and affix to inside lid of cooler.
6. Secure and custody seal the lid of cooler.
7. Arrange for the appropriate transportation mode consistent with the type of hazardous waste involved.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Sampling a storage tank requires a great deal of manual dexterity, often requiring climbing to the top of the tank going up a narrow vertical or spiral stairway or ladder while wearing protective clothing and carrying sampling equipment. All platforms or ladders must be appropriately guarded or alternative safety methods for working at heights must be employed.

Before climbing onto the vessel, a structural survey should be performed. This will ensure appropriate consideration of safety and accessibility prior to initiation of any field activities.

As in all opening of containers, extreme caution should be taken to avoid ignition or combustion of volatile contents. All tools used must be constructed of a non-sparking material and all electronic instruments to be used near the sampling points must be intrinsically safe and this includes cell phones.

All sample locations should be surveyed for air quality prior to sampling. At no time should sampling continue with a LEL reading of 25% or more.

5.0 EQUIPMENT/APPARATUS

Materials found in storage tanks may include liquids, sludge, still bottoms, and solids of various types. As previously stated, samplers commonly used for tanks include: a bacon bomb sampler, sludge judge, glass thief, bailer, COLIWASA, and subsurface grab sampler. The type of sampler chosen should be compatible with the waste. The tank sampling equipment checklist includes:

- UFP-QAPP
- Safety equipment
- Tape measure
- Weighted tape line, measuring stick or equivalent

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- Camera
- Stainless steel bucket or bowl
- Sample containers
- Ziplock plastic bags
- Logbook
- Labels
- Site Logbook
- Chain of Custody (COC) records
- COC seals
- Flashlight (explosion proof)
- Coolers
- Ice
- Decontamination supplies per SERAS SOP# 2006 – *Sampling Equipment Decontamination*
- Bacon bomb sampler, stainless steel or brass-plated, 2-1/2 inch (") outer diameter (O.D.) x 10" long and holds 500 milliliters (mL) for liquid sampling at a wide variety of sampling depths
- Sludge judge, 3/4" plastic pipe in 5 foot sections, marked at 1-foot increments with screw-type fittings for sampling settled solids
- Glass thieves, 6 millimeter (mm) to 16 mm inner diameter (I.D.) and 48 inches long for sampling drums, transformers and other liquid containers
- Bailers, manual dipping device
- COLIWASA, for sampling hazardous wastes, liquids, slurry-type sludge and semi-solids from top to bottom of tanks
- Subsurface grab sampler,
- Water/oil level indicator
- Combustible Gas Analyzer
- Hand Held MultiRAE for:
 - Oxygen,
 - LEL
 - Volatile Organic Compounds (VOCs)
 - Toxic Gas Sensor, e.g., Hydrogen Sulfide or Carbon Monoxide
- Organic vapor analyzer (OVA) (or equivalent)
- High volume intrinsically safe blower

6.0 REAGENTS

Reagents are not typically required for the preservation of waste samples. However, reagents will be utilized for decontamination of equipment. Decontamination solutions required are specified in SERAS SOP #2006, *Sampling Equipment Decontamination*.

7.0 PROCEDURE

7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.

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2. Obtain necessary sampling and monitoring equipment.
3. Decontaminate or pre-clean equipment, and ensure that it is in working order.
4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.
5. Perform a general site survey prior to site entry in accordance with the site-specific Health and Safety Plan.
6. Identify and mark all sampling locations.
7. Refer to Appendix A regarding calculations utilized in determining tank volumes.

7.2 Preliminary Inspection

1. Inspect the external structural characteristics of each tank and record in the site logbook. Potential sampling points should be evaluated for safety, accessibility and sample quality.
2. Prior to opening a tank for internal inspection, the tank sampling team will:
 - Review safety procedures and emergency contingency plans with the Health and Safety Officer (HSO).
 - Ensure that the tank is properly grounded.
 - Remove all sources of ignition from the immediate area.
3. Each tank should be accessed using appropriate means. Remove manway covers using non-sparking tools.
4. Collect air quality measurements for each potential sample location using a MultiRAE to measure LEL/LFL, oxygen, VOCs and Toxic Gas readings. An additional reading from an OVA for an organic vapor concentration may also be taken. All readings should be taken from the tank headspace, above the sampling port, and in the breathing zone.
5. Prior to commencing sampling, the tank headspace should be cleared of any toxic or explosive vapor concentration using a high volume explosion proof blower. No work will start if LEL readings exceed 25%; between 10% and 25% LEL, work can continue but with extreme caution. The SERAS HSO should be informed if the LEL reading is close to the 25% upper limit.

7.3 Sampling Procedure

1. Determine the depth of any and all liquid, solid, and liquid/solid interface, and depth of sludge using a weighted tape measure, probe line, sludge judge, or equivalent.
2. Collect liquid samples from one (1) foot below the surface, from mid-depth of liquid, and from one (1) foot above the bottom sludge layer. This can be accomplished with a subsurface grab sampler or bacon bomb. For liquids less than five (5) feet in depth, use a glass thief or COLIWASA to collect the sample.

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When sampling storage tanks, vacuum trucks, or process vessels, collect at least one sample from each compartment in the tank. Samples should always be collected through an open hatch at the top of the tank. Valves near the bottom should not be used, because of their questionable or unknown integrity. If such a valve cannot be closed once open, the entire tank contents may be lost to the ground surface. Also, individual strata cannot be sampled separately through a valve near the bottom.

3. Compare the three samples for visual phase differences. If phase differences appear, systematic iterative sampling should be performed. By halving the distance between two discrete sampling points, one can determine the depth of the phase change.
4. If another sampling port is available, sample as above to verify phase information.
5. Since it is difficult and may be dangerous to measure the inside diameter of the tank without confined space entry, measure the outside diameter of the tank only.
6. Sludge can be collected using a bacon bomb sampler, glass thief, or sludge judge.
7. Record all information on the sample data sheet or site logbook. Label the container with the appropriate sample tag.
8. Decontaminate sampling equipment as per SERAS SOP #2006, *Sampling Equipment Decontamination*.

7.4 Before Sampling

1. Using the UFP-QAPP for guidance, obtain and prepare all needed sample containers of adequate size and type (glass, amber, clear, polyethylene (PE), etc.) for sample type.
2. Establish a Scriber File for the sampling effort, accounting for all of the sampling required and prepare and print Chain of Custody Seals from Scriber.
3. If practical, pre-label the sample containers with sample number and location to save time and to ensure that the samples are properly identified and managed. However, if the sampling process carries a significant risk that the label will be impacted by the sample being collected, then do not add the permanent label until after the sample is in the jar and the jar decontaminated.
4. Be sure to bring an excess of each type of sample container to accommodate replacement samples as well as the need to add sampling locations and samples to the original sampling plan in the QAPP.

7.5 Sampling Devices

7.5.1 Bacon Bomb Sampler

The bacon bomb sampler (Figure 1, Appendix B) is designed for the collection of material from various levels within a storage tank. It consists of a cylindrical body, usually made

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of chrome-plated brass and bronze with an internal tapered plunger that acts as a valve to admit the sample. A line attached to the top of the plunger opens and closes the valve. A line is attached to the removable top cover which has a locking mechanism to keep the plunger closed after sampling. To collect a sample using the Bacon Bomb sampler, follow the steps below.

1. Attach the sample line and the plunger line to the sampler.
2. Measure and then mark the sampling line at the desired depth.
3. Gradually lower the sampler by the sample line until the desired level is reached.
4. When the desired level is reached, pull up on the plunger line and allow the sampler to fill before releasing the plunger line to seal off the sampler.
5. Retrieve the sampler by the sample line with care not to pull up on the plunger line and thereby prevent accidental opening of the bottom valve.
6. Rinse or wipe off the exterior of the sampler body.
7. Position the sampler over the sample container and release its contents by pulling up on the plunger line.
8. Cap the sample tightly and transport the sample to the decon pad for successful decontamination of the outside of the container.
9. After decontamination, dry the sample container and add the label, and if applicable, affix the COC seals to the sample bottle closure.
10. Log all samples in the site logbook or on field data sheets, enter the sample data into Scribe and check to ensure that all labels are correctly placed.
11. Package samples and complete necessary paperwork to ship.
12. After completing sampling activities at this location/port, replace the flange or manway or place plastic tightly over the tank opening.

7.5.2 Sludge Judge

A sludge judge (Figure 2, Appendix B) is used for obtaining an accurate reading of settleable solids in any liquid. The sampling depth is dependent upon the length of the sludge judge. The sampler consists of 3/4" plastic pipe in 5 foot sections, marked at 1-foot increments with screw-type fittings. To collect a sample using the sludge judge, follow the steps below.

1. Prepare Scribe, COC seals, sample containers and sample labels (if practical) for the samples to be collected.

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2. Lower the sludge judge to the bottom of the tank.
3. When the bottom has been reached, the float valve will open allowing the pipe to fill to the surface level. Tugging on the line will seat the float valve, trapping the column of material.
4. When the unit has been raised clear of the tank liquid, the amount of sludge in the sample can be read using the one foot increments marked on the pipe section.
5. By touching the pin extending from the bottom section against a hard surface, the material is released from the unit.
6. Cap the sample tightly and transport the sample to the decon pad for careful decontamination of the outside of the container.
7. After decontamination is complete, dry the container, add the label, and if applicable, affix the COC seal.
8. Log all samples in the site logbook or on field data sheets, enter the sample data into Scribe and check to ensure that all labels and COC seals are correctly placed.
9. Package samples and complete necessary paperwork to ship.
10. After completing sampling activities at this location/port, replace the flange or manway. If this is not possible, place plastic tightly over the tank opening.

7.5.3 Subsurface Grab Sampler

Subsurface grab samplers (Figure 3, Appendix B) are designed to collect samples of liquids at various depths. The sampler is usually constructed of aluminum or stainless steel tubing with a polypropylene or Teflon head that attaches to a 1 liter sample container. To collect a sample using the subsurface grab sampler, follow the steps below.

1. Prepare Scribe, COC seals, sample containers and sample labels (if practical) for the samples to be collected.
2. Screw the sample bottle onto the sampling head.
3. Gently lower the sampler to the desired depth to avoid creating turbulence or mixing.
4. Pull the ring at the top which opens the spring-loaded plunger in the head assembly.
4. After waiting sufficient time to fill the sample bottle, release the ring, lift the sampler, and remove sample bottle.
5. Cap the sample tightly and transport the sample to the decon pad for careful decontamination of the outside of the container.

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6. After decontamination, dry the sample container and add the label, and if applicable, affix the COC seal.
10. Log all samples in the site logbook on field data sheets, enter the sample data into Scribe and check to ensure that all labels and COC seals are correctly placed.
11. Package samples and complete necessary paperwork to ship.
12. After completing sampling activities at this location/port, replace the flange or manway or place plastic tightly over the tank opening.

7.5.4 Glass Thief (Drum Thief)

The most widely used implement for sampling is a glass tube commonly referred to as a glass thief or drum thief (Figure 4, Appendix B). This tool is simple, cost effective, quick, and collects a sample without having to decontaminate. Glass thieves are typically 6 mm to 16 mm I.D. and 48 inches long. This method is applicable to drums (30 to 85 gallons) and small, similarly configured tanks. To collect a sample using a glass thief, follow the steps below.

1. Remove the cover from the sample container.
2. Remove the bung or lid from the drum or small tank.
3. Insert the glass tube (thief) almost to the bottom of the tank or until a solid layer is encountered. About one foot of tube should extend above the drum.
4. Allow the waste in the tank to reach its natural level in the tube.
5. Cap the top of the sampling tube with a tapered stopper or thumb, ensuring liquid does not come into contact with stopper.
6. Carefully remove the capped tube from the tank and insert the uncapped end in the sample container. Do not spill liquid on the outside of the sample container.
7. Release stopper and allow the glass thief to drain until the container is approximately 2/3 full.
8. Remove tube from the sample container. If it is not an issue from an analytical standpoint for possible future sampling to dispose of the thief in the drum, break it (score it first) while still wearing all normal PPE and using kevlar gloves for cut protection. Alternatively, a 4" or larger PVC pipe section can be capped at one end, the used thieves inserted, then after the sample has been collected cap/seal the other end and hold for disposal.
9. Cap the sample tightly and transport the sample to the decon pad for careful decontamination of the outside of the container.

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10. After decon, dry the sample container, add the label, and if applicable, affix the COC seal.
11. Log all samples in the site logbook or on field data sheets, enter the sample data into the logbook. Scribe and check to ensure that all labels and COC seals are correctly placed.
12. Package samples and complete necessary paperwork to ship.
13. After completing sampling activities at this location/port, replace the flange or manway or place plastic tightly over the tank opening.

NOTE: In many instances a tank containing waste material will have a sludge layer on the bottom. Slow insertion of the sample tube down into this layer and then a gradual withdrawal will allow the sludge to act as a bottom plug to maintain the fluid in the tube. The plug can be gently removed and placed into the sample container by the use of a stainless steel lab spoon.

7.5.5 Bailer

The positive-displacement volatile sampling bailer (Figure 5, Appendix B) (by GPI) is perhaps the most appropriate for collection of water samples for volatile analysis. Other bailer types (messenger, bottom fill, etc.) are less desirable, but may be mandated by contract and site conditions. Generally, bailers can provide an acceptable sample, providing that the sampling personnel use extra care in the collection process. To use the bailer, follow the steps below.

1. Make sure clean plastic sheeting surrounds the tank.
2. Attach a line to the bailer.
3. Lower the bailer slowly and gently into the tank so as not to splash the bailer into the tank contents.
4. Allow the bailer to fill completely and retrieve the bailer from the tank.
5. Begin slowly pouring from the bailer.
6. Cap the sample tightly and transport the sample to the decontamination pad for careful decontamination of the outside of the container.
7. After decon, dry the sample container, add the label, and if applicable, affix the COC seal.
8. Log all samples in the site logbook or on field data sheets, enter the sample data into the logbook. Scribe and check to ensure that all labels and COC seals are correctly placed.
9. Package samples and complete necessary paperwork to ship.

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10. After completing sampling activities at this location/port, replace the flange or manway or place plastic tightly over the tank opening.

7.5.6 COLIWASA

Sampling devices are available that allow collection of a sample from the full depth of a tank and maintain its integrity in the transfer tube until delivery to the sample bottle. The sampling device is known as a COLIWASA (Figure 6, Appendix B). The COLIWASA is a sampler designed to permit representative sampling of multiphase wastes from tanks and other containerized wastes.

One configuration consists of 152 centimeter (cm) by 4 cm I.D. section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper.

Since COLIWASA samplers are expensive and difficult to decontaminate, use disposable units where this type of sampler is indicated, especially in instances where a true representation of a multiphase waste is absolutely necessary. Follow the steps outlined below for use of a COLIWASA sampler.

1. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.
2. Slowly lower the sampler into the liquid waste. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sample tube is lower than that outside the sample, the sampling rate is too fast and will result in a non-representative sample.
3. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.
4. Slowly withdraw the sample from the waste container with one hand while wiping the sampler tube with a disposable cloth or rag with the other hand.
5. Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container.
6. Cap the sample tightly and transport the sample to the decontamination pad for careful decontamination of the outside of the container.
7. After decontamination, dry the sample container, add the label, and if applicable, affix the COC seal.
8. Log all samples in the site logbook or on field data sheets, enter the sample data into

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Scribe and check to ensure that all labels and COC seals are correctly placed.

9. Package samples and complete necessary paperwork to ship.
10. After completing sampling activities at this location/port, replace the flange or manway or place plastic tightly over the tank opening.

8.0 CALCULATIONS

There are no specific calculations for these procedures. Some common volume calculations can be found in Appendix A.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

1. All data must be documented on within site logbooks and must be entered into SCRIBE.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the QAPP. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented in field data sheets or in the logbook.
3. Records will be maintained, documenting the level of personnel's competency in performing this method and handling equipment.

10.0 DATA VALIDATION

Data verification (completeness checks) must be conducted to ensure that all data inputs are present for ensuring the availability of sufficient information. This may include but is not limited to: location information, start and end times, sampling method and total volume sampled. These data are essential to providing an accurate and complete final deliverable. The SERAS Task Leader (TL) is responsible for completing the UFP-QAPP verification checklist for each project.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, Occupational Safety and Health Administration (OSHA), and corporate health and safety procedures. More specifically, the hazards associated with tank sampling may cause bodily injury, illness, or death to the worker. Failure to recognize potential hazards of waste containers is the cause of many accidents. It should be assumed that the most unfavorable conditions exist, and that the danger of explosion and poisoning is present. As a result, it is critical to purchase and wear personal protective equipment (PPE) consistent with OSHA's PPE standards, 29 CFR 1910.132 to 29 CFR 1910.138. These standards include important information on eye and face, respiratory, head, foot, hand, and electrical protection. Hazards specific to tank sampling are:

1. Hazardous atmospheres which are either flammable, toxic, asphyxiating, or corrosive.

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2. If activation of electrical or mechanical equipment would cause injury, each piece of equipment should be manually isolated using lockout/tag-out procedures to prevent inadvertent activation while workers are occupied.
3. Communication with intrinsically safe equipment is of utmost importance between the sampling worker and the standby person to prevent distress or injury going unnoticed.
4. Proper procedures to evacuate a tank with forced air and grounding of equipment and tanks should be reviewed.

12.0 REFERENCES

American Society for Testing and Materials (ASTM) D6232-08 Standard Guide for Selection of Sampling Equipment for Waste and Contaminated Media Data Collection Activities

ASTM D7831-13, Standard Practice for Sampling of Tanks by Field Personnel

EPA 1985, Guidance Document for Cleanup of Surface Tank and Drum Sites, OSWER Directive 9380.0-1

EPA 1986, Drum Handling Practices at Hazardous Waste Sites, EPA-600/S2-086-013.

OSHAPPE standards, 29 CFR 1910.132 to 29 CFR 1910.138

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APPENDIX A
Volume Calculations
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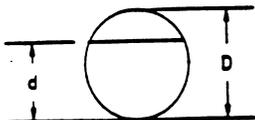
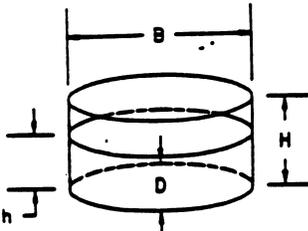
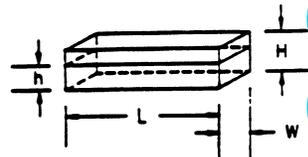
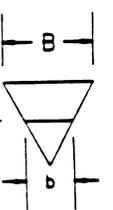
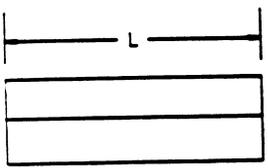
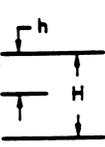
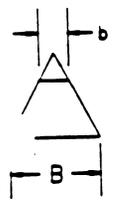
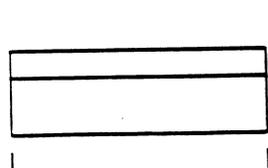
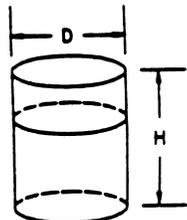


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Volume Calculations

<p style="text-align: center;"><u>SPHERE</u></p>  <p>Total Volume $V = 1/6 \pi D^3 = 0.523498 D^3$ Partial Volume $= 1/3 \pi d^2 (3/2 D - d)$</p>	<p style="text-align: center;"><u>ELLIPTICAL CONTAINER</u></p>  <p>Total Volume $V = \pi B D H$ Partial Volume $V = \pi B D h$</p>	<p style="text-align: center;"><u>ANY RECTANGULAR CONTAINER</u></p>  <p>Total Volume $V = H L W$ Partial Volume $V = h L W$</p>
<p style="text-align: center;"><u>TRIANGULAR CONTAINER</u></p> <p style="text-align: center;">Total Volume $V = 1/2 H B L$</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <p style="text-align: center; margin-top: 20px;">Case 1 Partial Volume $V = 1/2 h B L$</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> <div style="text-align: center;">  </div> </div> <p style="text-align: center; margin-top: 20px;">Case 2 Partial Volume $V = 1/2 L (H B - h B)$</p>		<p style="text-align: center;"><u>RIGHT CYLINDER</u></p>  <p>Total Volume $V = 1/4 \pi D^2 H$ Partial Volume $V = 1/4 \pi D^2 h$</p>

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Volume Calculations (cont'd)

FRUSTUM OF A CONE

Case 1

Case 2

Partial Volume

$$V = \pi/12 H(D_1^2 + D_1 D_2 + D_2^2)$$

Partial Volume

$$V = \pi/12 h(D_1^2 + D_1 d + d^2)$$

CONE

Case 1

Case 2

Total Volume

$$V = \pi/12 \cdot D^2 H$$

Partial Volume Case 1

$$V = \pi/12 \cdot d^2 h$$

Partial Volume Case 2

$$V = \pi/12 \cdot (D^2 H - d^2 h)$$

PARABOLIC CONTAINER

Total Volume

$$V = 2/3 HDL$$

Case 1

Partial Volume

$$V = 2/3 h d L$$

Case 2

Partial Volume

$$V = 2/3 (HD - hd) \cdot L$$

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APPENDIX B
Figures
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November 2016

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SOP: 2010

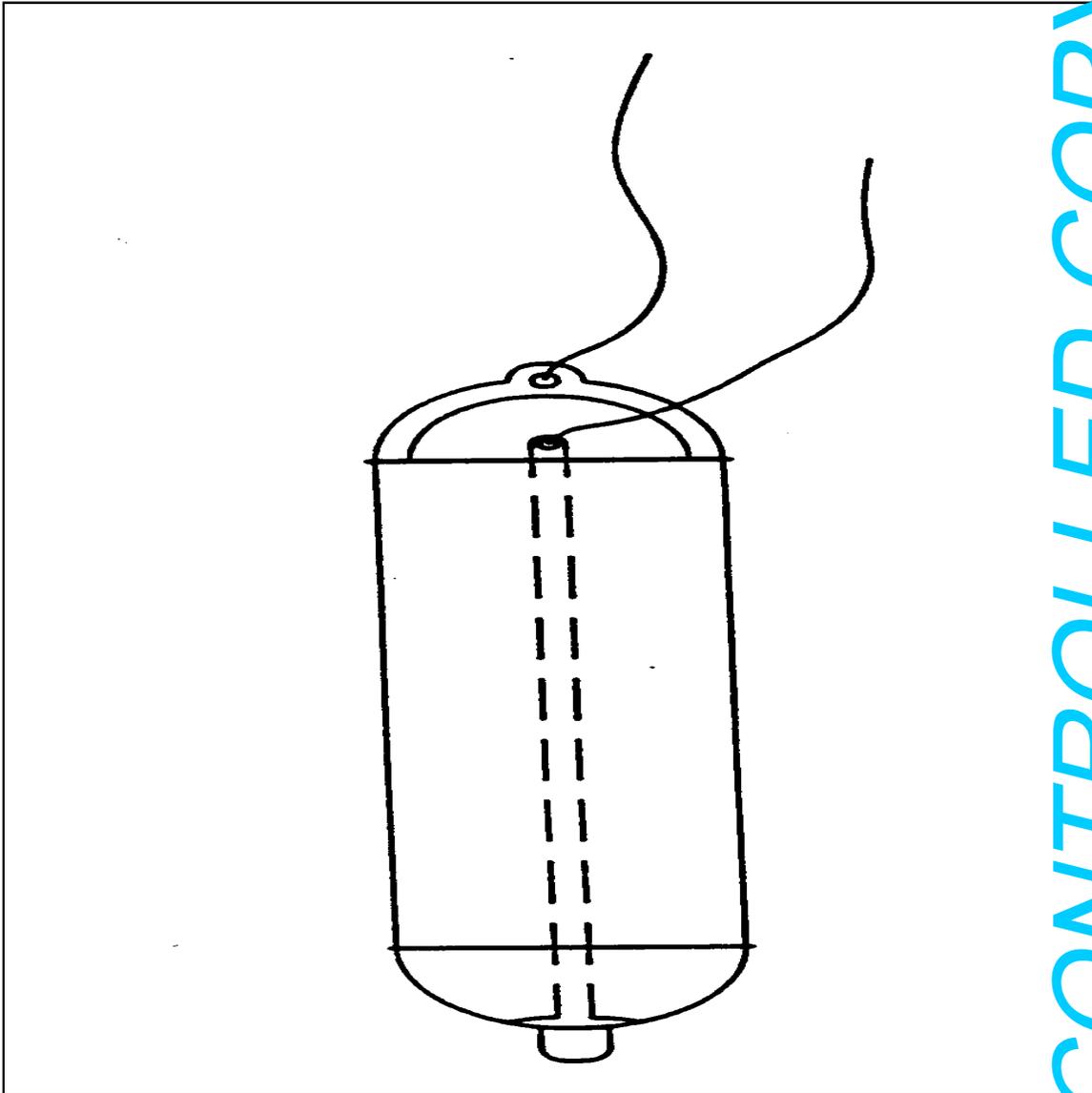
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FIGURE 1. Bacon Bomb Sampler



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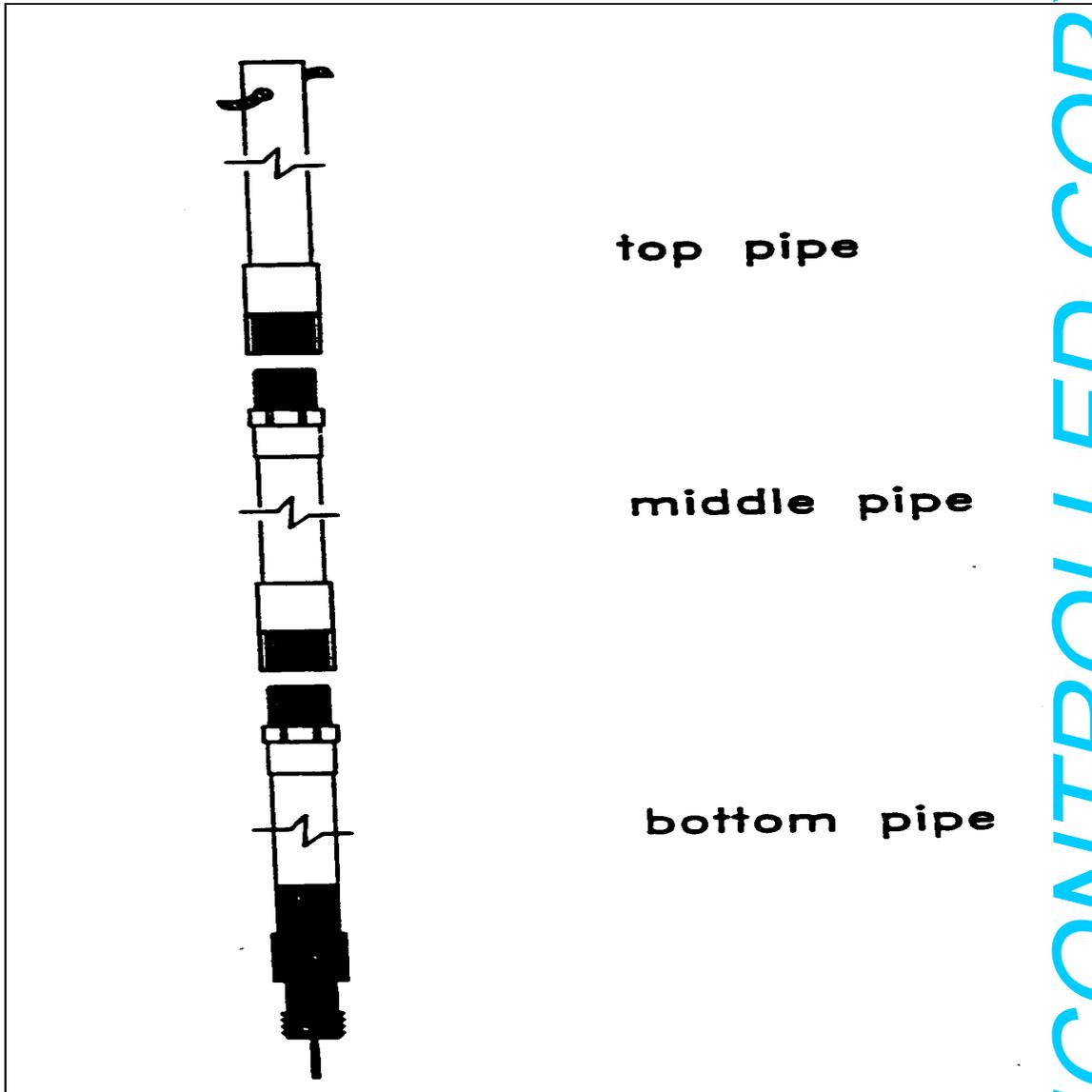
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FIGURE 2. Sludge Judge



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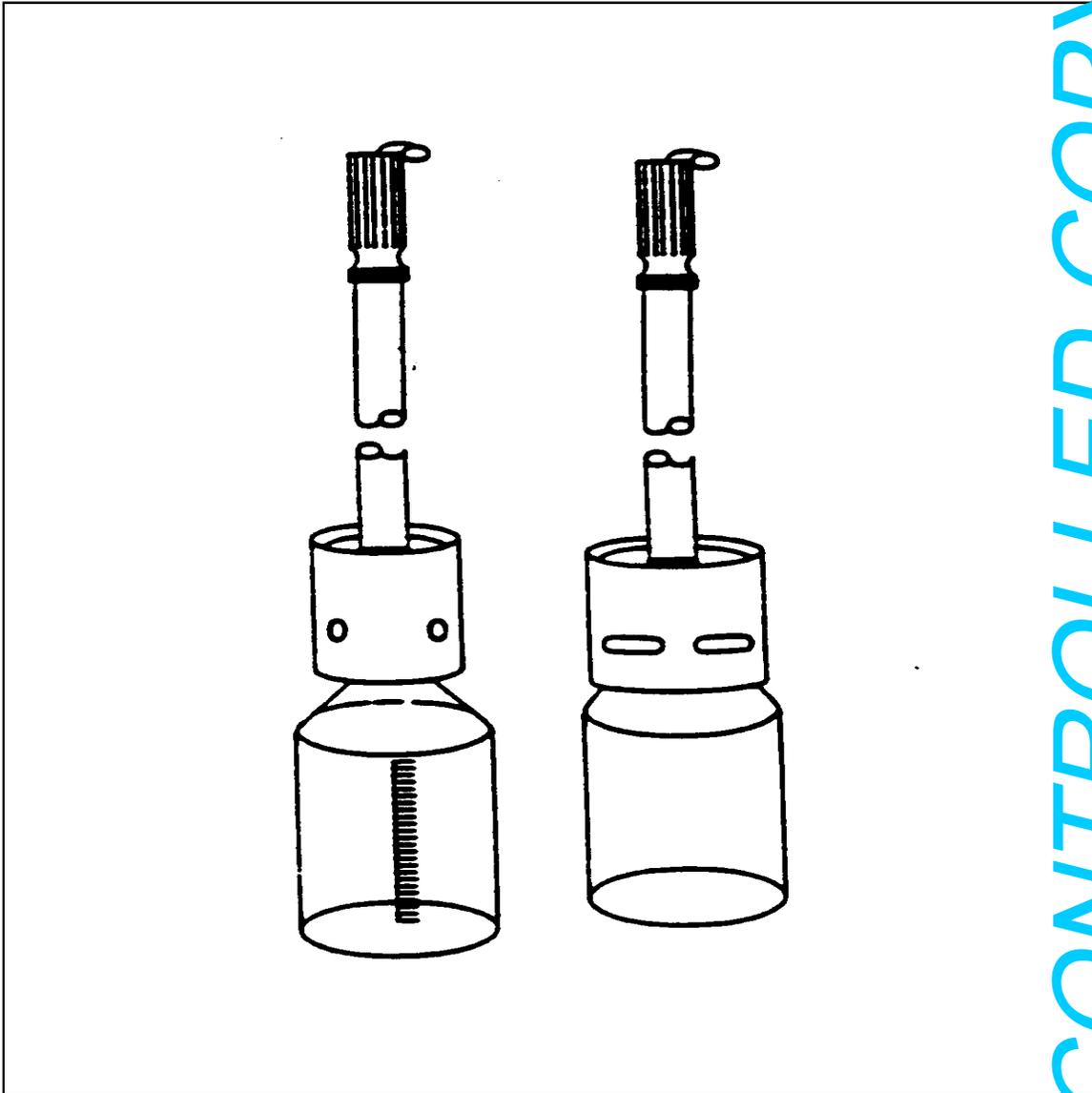
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FIGURE 3. Subsurface Grab Sampler



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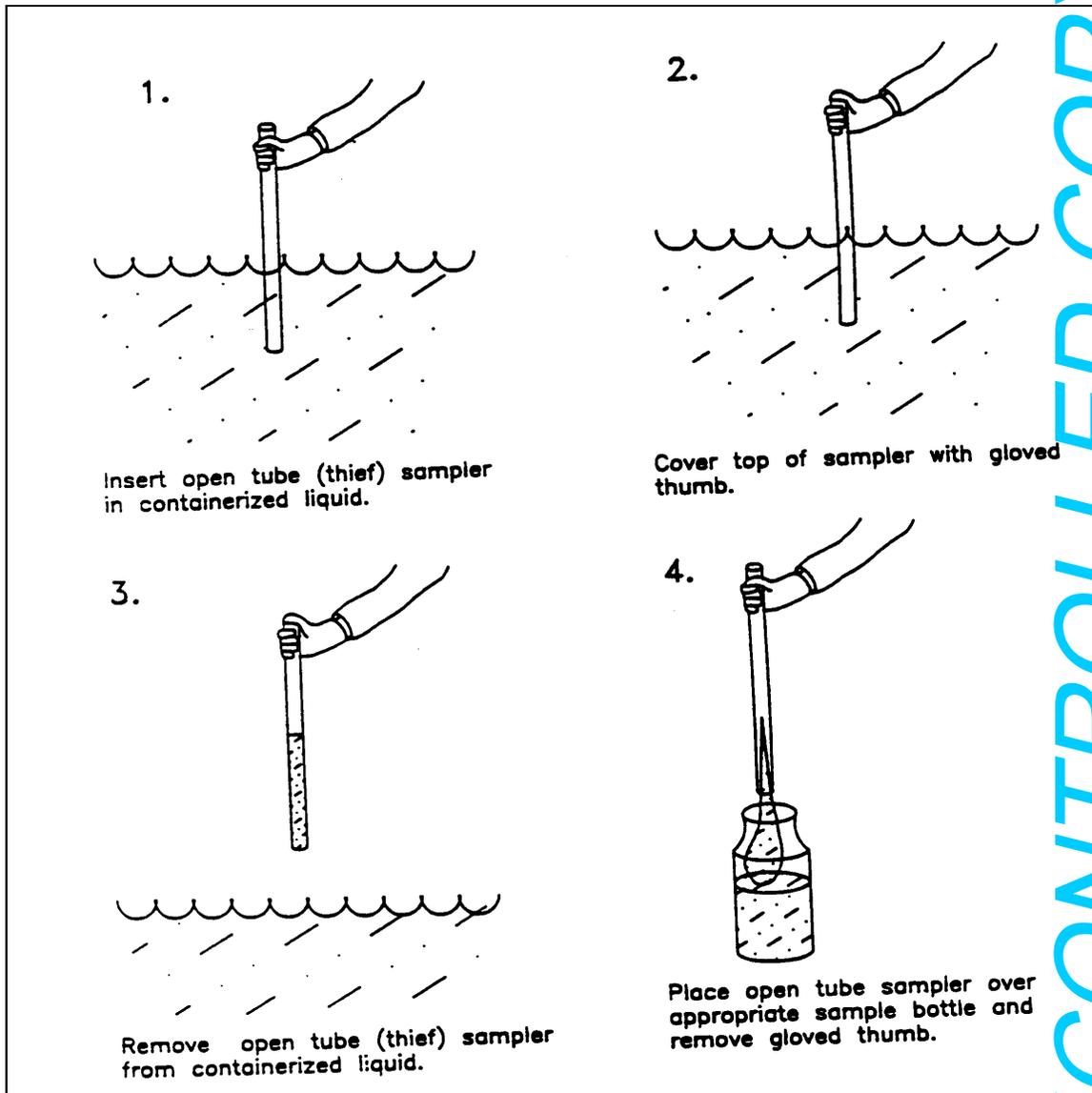


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FIGURE 4. Glass Thief



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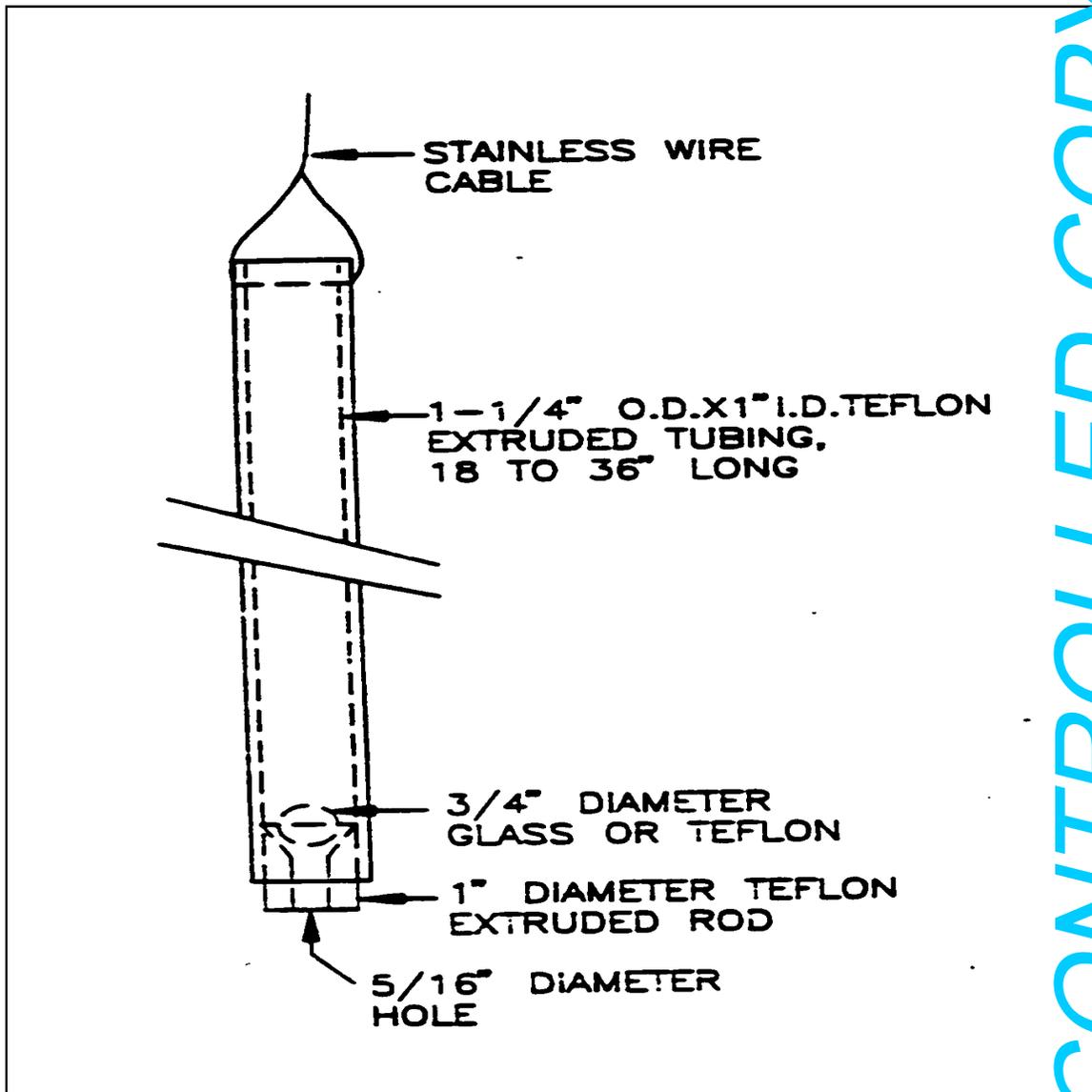


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FIGURE 5. Bailer



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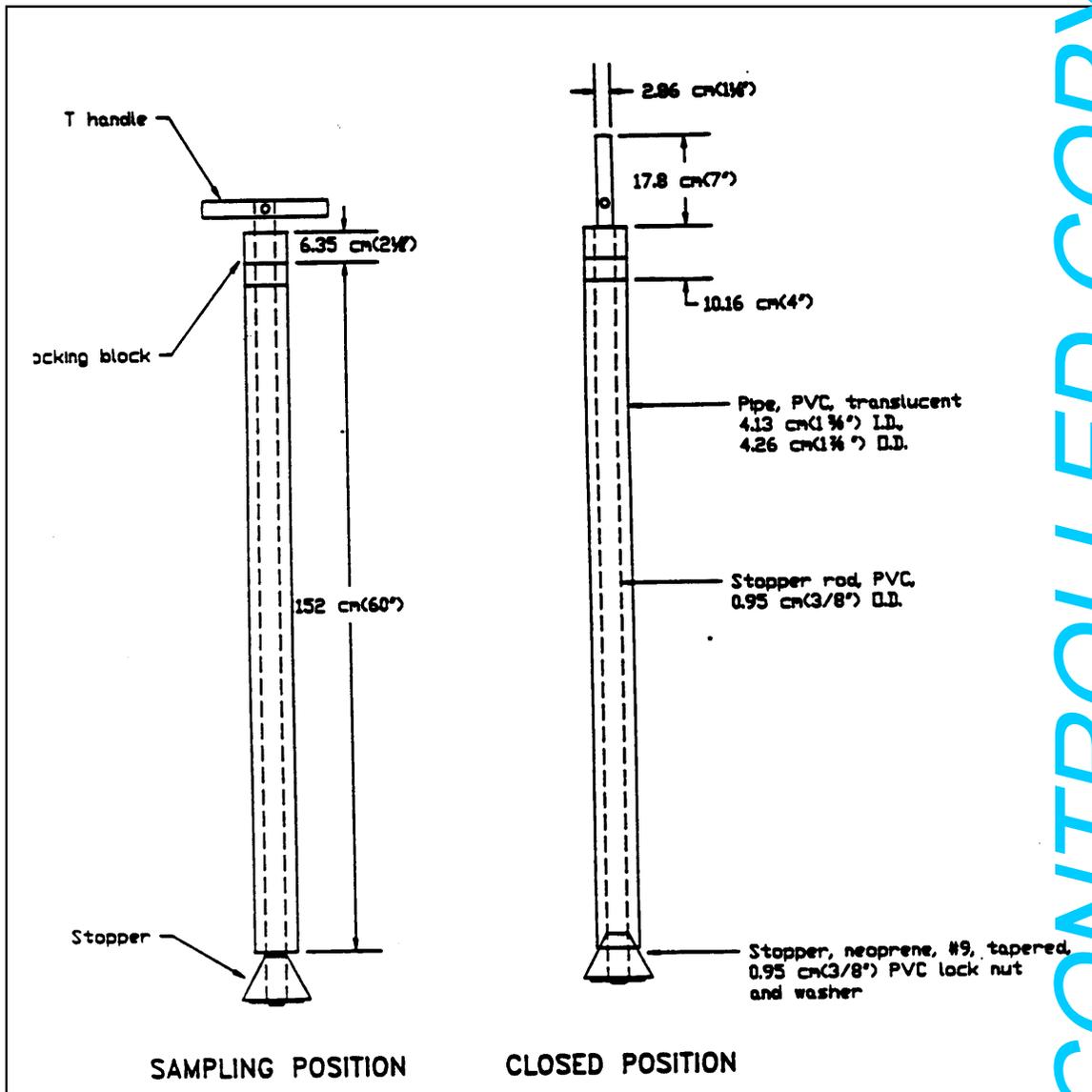


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FIGURE 6. COLIWASA



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Scientific, Engineering, Response and Analytical Services
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STANDARD OPERATING PROCEDURE

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SERAS SOP Number: 2015, Rev 1.1

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6/23/17

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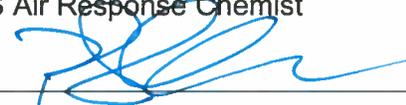
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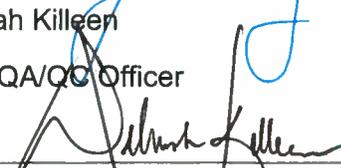
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6/23/17

The top row of this table shows the most recent changes to the controlled document. For previous revision history information, archived versions of this document are maintained by the SERAS QA/QC Officer on the SERAS local area network (LAN).

History	Effective Date
Annual Review – Minor Edits; Supercedes: SOP #2015, Rev. 1.0, 05/31/16, U.S. EPA Contract # EP-W—09-031	06/30/17
Editorial changes	05/31/16
Added UFP QAPP preparation language to Section 1.0; training records for documenting competency to Section 9.0; data verification text to Section 10.0	05/31/16
Deleted sections in 3.0 and 7.0 on U.S. EPA's Modified Yamate Method for TEM	05/31/16
Added text explaining asbestos to Section 1.0	05/31/16
Added text listing sampling and analytical protocols to Section 2.0	05/31/16
Added text for high-volume samples in Section 4.0	05/31/16
Added text regarding power sources for sampling to Section 5.0	05/31/16
Added reference to SERAS SOP #2118 to Section 7.2.1	05/31/16
Revised procedures for calibrating with a rotameter and with an electronic calibrator in Section 7.2.1 and 7.2.2	05/31/16
Revised text in Section 7.3 and added reference to SERAS SOP #2129	05/31/16
Rewrite of Section 7.4.2.	05/31/16
Added text identifying fan usage in Section 7.5.1	05/31/16
Added documentation requirements to Section 9.0	05/31/16
Deleted Appendix of tables including criteria of indoor and outdoor sampling	05/31/16



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SUPERSEDES: SOP #2015; Revision 1.0 05/31/16; U.S. EPA Contract EP-W-09-031

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ASBESTOS AIR SAMPLING

1.0 SCOPE AND APPLICATION

Asbestos are naturally occurring fibrous minerals including: chrysotile, crocidolite, amosite, tremolite, actinolite, anthophyllite, and any of these minerals that have been chemically treated and/or altered. The precise chemical formulation of each species will vary with the location from which it was mined. Asbestos has been used in many commercial products, including building materials such as flooring tiles and sheet goods, paints and coatings, insulation, and roofing asphalts. These products and others may be found at hazardous waste sites, hanging on overhead pipes, contained in drums, abandoned in piles, or as part of a structure. Another form of naturally occurring asbestos is associated with vermiculite mining and associated operations, and asbestos tailing piles from vermiculite mining operations can be a source of ambient asbestos fibers.

Asbestos is a known carcinogen, and air sampling is necessary to assess the potential for airborne exposure as part of a human health risk assessment. This standard operating procedure (SOP) provides procedure for asbestos air sampling based on drawing a known volume of air through a mixed cellulose ester (MCE) filter, which is then sent to a laboratory for analysis. One of the following three analytical methods is typically used for determining asbestos in air. These methods consist of: (1) U.S. Environmental Protection Agency (EPA) Environmental Asbestos Assessment Manual, Superfund Method for the Determination of Asbestos in Ambient Air for Transmission Electron Microscopy (TEM; direct and indirect methods); (2) National Institute for Occupational Safety and Health (NIOSH) Method 7402 (direct method only) for TEM; and (3) NIOSH Method 7400 for Phase Contrast Microscopy (PCM). Each method has specific sampling and analytical requirements (i.e. sample volume and flow rate) for determining asbestos in air.

The United States Environmental Protection Agency (U.S. EPA)/Environmental Response Team (ERT) typically follows procedures outlined in the TEM methods for determining mineralogical types of asbestos in air and for distinguishing asbestos from non-asbestos minerals. The PCM method is primarily used as a screening tool since it is less costly than TEM. TEM is used to distinguish asbestos fibers from non-asbestos fibers and characterize asbestos mineral species. The PCM method can be used to estimate asbestos concentrations, but the PCM method cannot distinguish asbestos from non-asbestos fibers. The TEM method, therefore, may be necessary to confirm analytical results. For example, if an action level for the presence of fibers has been set and PCM analysis indicates that the action level has been exceeded, TEM analysis can be used to quantify and identify asbestos structures through examination of their morphology, crystalline structures (through electron diffraction), and elemental composition (through energy dispersive X-ray analysis). In this instance, samples should be collected for both analyses in side by side sampling trains (although some laboratories are able to perform the PCM and TEM analyses from the same filter). The Superfund method is designed specifically to provide results suitable for supporting human health risk assessments at Superfund sites, and the Superfund method is applicable to a wide range of ambient air situations at hazardous waste sites. The PCM and TEM NIOSH analytical methods require lower sample volumes than the Superfund methods and are typically used indoors; however, both NIOSH methods can be adapted for ambient air sampling if the sampling volume is increased appropriately.

Regulations pertaining to asbestos have been promulgated by the U.S. EPA and Occupational Safety and Health Administration (OSHA). The U.S. EPA National Emission Standards for Hazardous Air Pollutants (NESHAP) regulates asbestos-containing waste materials. NESHAP establishes management practices and standards for the handling of asbestos and emissions from waste disposal operations under 40 Code of Federal Regulations (CFR) Part 61, Subparts A and M. Comprehensive rules for the asbestos abatement industry were promulgated under 40 CFR 763. State and local regulations regarding asbestos management and



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assessment practices vary and may be more stringent than federal requirements. The OSHA regulations in 29 CFR 1910.1001 (general industry; formerly designated 29 CFR 1926.58), 29 CFR 1926.1101 (construction industry), and 29 CFR 1915.1001 (shipbuilding industry) specify work practices and safety equipment including respiratory protection and protective clothing when handling asbestos or asbestos-containing material (ACM). The OSHA 8-hour, time-weighted average (TWA) is 0.1 fibers per cubic centimeter (f/cc) of air. This standard pertains to fibers with a length-to-width ratio of 3 to 1 with a fiber length greater than 5 microns (μm). Assessment and monitoring of airborne asbestos is required by OSHA to determine if asbestos is present in the workplace and if the work will generate airborne fibers. In addition, employers may be required to establish an employee training program, medical surveillance program, and install engineering or institutional controls in conjunction with an asbestos assessment or monitoring program.

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

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

2.0 METHOD SUMMARY

If possible and prior to sampling, the site should be characterized by identifying on-site and off-site sources of airborne asbestos. The array of proposed sampling locations and the schedule for sample collection are critical to the success of an investigation. In general, sampling strategies to characterize a single point source are fairly straightforward, while multiple point sources and/or area sources increase the complexity of the sampling strategy. Experience, objectives, and site characteristics will dictate the sampling strategy.

During a site investigation, sampling stations should be arranged to support the evaluation of spatial trends in airborne asbestos concentrations, and sampling schedules should be fashioned to establish temporal trends. The sampling strategy typically requires that the concentration of asbestos at the source (worst case), area of concern (downwind), crosswind areas, and background areas (upwind) contributions be quantified. Indoor air asbestos sampling events require a different type of sampling strategy. Consult the site-specific QAPP for all sampling activities. It is critical to establish background levels of contaminants in order to develop a reference point from which to evaluate the source data. Field blanks and lot blanks can be utilized to determine other sources.

Prior to sampling, the site sampling objectives should be identified in the site-specific QAPP to support the selection of the most appropriate analytical method. Additionally, the specific sampling requirements, required equipment and sample preparation, and quality control data quality objectives (DQOs) should be identified in the QAPP prior to sampling. Each analytical method has specific sampling requirements and produce results which may or may not be applicable to a specific sampling effort.

The following sampling and analytical protocols may be used for asbestos determination.



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- NIOSH 7400 – Determination of Asbestos and Other fibers by Phase Contrast Microscopy.
- ASTM International (ASTM) D7200-12 – Sampling and Counting Airborne Fibers, Including Asbestos Fibers, in Mines and Quarries, by Phase Contrast Microscopy and Transmission Electron Microscopy.
- ASTM D7201-06 (Reapproved 2011) – Sampling and Counting Airborne Fibers, Including Asbestos Fibers in the Workplace, by Phase Contrast Microscopy (with an Option of Transmission Electron Microscopy).
- International Organization for Standardization (ISO) 8672:2014 – Determination of the Number Concentration of Airborne Inorganic Fibres by Phase Contrast Optical Microscopy – Membrane Filter Method.
- NIOSH 7402 – Asbestos by Transmission Electron Microscopy.
- Asbestos Hazard Emergency Response Act (AHERA) – 40 CFR Part 763 Appendix A to Subpart E Interim Transmission Electron Microscopy Analytical Method.
- Modified TEM, EPA (Yamate) Level I, II, III – Methodology for the Measurement of Airborne Asbestos by Electron Microscopy. The U.S. EPA Yamate Method is a Precursor to AHERA Level II; Morphology, Selected Area Electron Diffraction (SAED), and Energy Dispersive X-Ray Analysis (EDXA) for Amphiboles.
- ISO Method 10312: Ambient Air – Determination of Asbestos Fibres – Direct Transfer Transmission Electron Microscopy Method.
- ISO Method 13794: Ambient Air – Determination of Asbestos Fibres – Indirect Transfer Transmission Electron Microscopy Method.
- California Air Resource Board (CARB) Method 427 – Determination of Asbestos Emissions from Stationary Sources.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Sample Preservation

No preservation is required for asbestos samples.

3.2 Sample Handling, Container and Storage Procedures

1. Place a sample label on the cassette that indicates a unique sampling number. Do not put sampling cassettes in shirt or coat pockets as the filter can pick up interfering fibers. The original cassette box can be used to hold the samples.
2. Upon completing the sampling, store the cassettes individually in a manila envelope. Each

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envelope should be labeled with the sample identification number, location, total sampling time, total volume and sampling date.

3. The wrapped sampling cassettes should be placed upright in a rigid container to ensure that the cassettes are oriented vertically (i.e., the caps for the top and bottom align with the top and bottom of the container). Use enough packing material to prevent jostling or damage. Do not use vermiculite as packing material for samples. If possible, hand deliver the samples to the laboratory.
4. Provide appropriate documentation with samples (i.e., chain of custody, requested analytical methodology, and other information specific to the laboratory analyzing samples).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Flow rates exceeding 15 liters/minute (L/min) that could result in filter destruction due to (a) failure of its physical support under force from the increased pressure drop; (b) leakage of air around the filter mount so that the filter is bypassed, or (c) damage to the asbestos structures due to increased impact velocities.

For high-volume samples, the filter overload should be no higher than 20 percent (%). If a high-volume sample is determined to be overloaded and a lower volume collocated sample was collected, the corresponding low-volume sample can be analyzed. For low-volume samples that are greater than 20% overloaded, the laboratory must have the capability of analyzing these samples using ISO Method 13794 (indirect method)

4.1 U.S. EPA's Superfund Method

4.1.1 Direct-Transfer TEM Specimen Preparation Methods

Direct-transfer TEM specimen preparation methods have the following significant interferences:

- The achievable detection limit (DL) is restricted by the particulate density on the filter, which in turn is controlled by the sampled air volume and the total suspended particulate concentration in the atmosphere being sampled.
- The precision of the result is dependent on the uniformity of the deposit of asbestos structures on the sample collection filter.
- Air samples should be collected to ensure that the particulate and fiber loadings are within a specified narrow range. If particulate loading on the filter is too high, it is not possible to prepare satisfactory TEM specimens by a direct-transfer method. In this case, even if satisfactory TEM specimens can be prepared, accurate fiber counting may not be possible.

4.1.2 Indirect TEM Specimen Preparation Methods

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Indirect TEM specimen preparation methods have the following interferences:

- The size distribution of asbestos structures is modified.
- There is increased opportunity for fiber loss or introduction of extraneous contamination.
- When sample collection filters are ashed, any fiber contamination in the filter medium is concentrated on the TEM specimen grid.

It can be argued that direct methods yield an under-estimate of the asbestos structure concentration because many of the asbestos fibers present are concealed by other particulate material with which they are associated. Conversely, indirect methods can be considered to yield an over-estimate of the asbestos structure concentration because some types of complex asbestos structures disintegrate during the preparation, resulting in an increase in the numbers of structures counted.

4.2 NIOSH Method for TEM

Other amphibole particles that have aspect ratios greater than 3:1 and elemental compositions similar to the asbestos minerals may interfere with the TEM analysis. Some non-amphibole minerals may give electron diffraction patterns similar to amphiboles. High concentrations of background dust interfere with fiber identification.

4.3 NIOSH Method for PCM

PCM cannot distinguish asbestos from non-asbestos fibers; therefore, all particles meeting the counting criteria are counted as total asbestos fibers. Fibers less than 0.25 μm in length will not be detected by this method. High levels of non-fibrous dust particles may obscure fibers in the field of view and increase the DL.

5.0 EQUIPMENT/MATERIALS

5.1 Sampling Pump

The constant flow or critical orifice controlled sampling pump should be capable of a flow rate and pumping time sufficient to collect the desired air sample volume.

The low flow personal sampling pumps generally provide a flow rate of 20 cubic centimeters per minute (cc/min) to 4 L/min, and these pumps are usually battery powered.

High-flow pumps are utilized when flow rates between 2 L/min to 15 L/min are required. High-flow pumps are generally used for short sampling periods. The recommended volume of 15 cubic meters (15,000 L) for the Superfund method (Phase I) requires a sample collection period of approximately 20 hours. A stand should be used to hold the filter cassette at the desired height for

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sampling and the filter cassette shall be isolated from the vibrations of the pump. Given that the proposed sampling locations may be located in remote areas or a significant distance from a stationary alternating current (AC) power source, consideration of how to provide electrical power for the pumps must be considered prior to sampling. High-flow pumps operate preferentially on AC power, but a generator or an external battery supply can be utilized as an alternative source of power. If a generator is used, the generator should be positioned downwind from the sampling stands to avoid cross contamination or interference with the samples being collected. Voltage and amperage should be closely monitored when running more than one high flow pump using the same power source.

5.2 Filter Cassette

The cassettes are purchased with the required filters in position. A shrink cellulose band or adhesive tape is usually applied to the cassette joints to prevent air leakage.

5.2.1 TEM Cassette Requirements

For NIOSH Method 7402, TEM, commercially available 25 millimeter (mm) diameter two-piece cassette with a conductive extension cowl will be used for sample collection. The cassette must be new and not previously used. The cassette will be loaded with a MCE filter with a pore size between 0.45 to 1.2 μm that was supplied from a lot number that was qualified as low background for asbestos determination. The cowls should be constructed of electrically-conducting material to minimize electrostatic effects. The filter will be backed by a 5- μm pore size MCE diffuser and support pad (Figures 1 and 2, Appendix A).

5.2.2 PCM Cassette Requirements

For NIOSH Method 7400, PCM, a 25-mm, 0.45 or 0.8- μm MCE filter cassette (typical pore sizes) with conductive extension cowl will be used for sample collection. The MCE filter will be backed by a support pad (Figures 1 and 2, Appendix A). Some labs are able to perform both the PCM and TEM analyses on the same filter; however, this should be discussed with the laboratory prior to sampling.

5.3 Other Equipment

- Sampling trains
- Manila envelopes (#6 coin size preferred) for cassettes
- Tools - small screwdrivers
- Container (to keep samples upright)
- Generator or electrical outlet (may not be required)
- Extension cords (may not be required)
- Multiple plug outlet (may not be required)
- Sample labels
- Air sampling data sheets
- Chain of custody records
- Scribe

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6.0 REAGENTS

Reagents are not required for the collection or preservation of asbestos samples.

7.0 PROCEDURES

7.1 Air Volumes and Flow Rates

Sampling volumes are determined on the basis of how many fibers need to be collected for reliable measurements. Prior to sampling, one must estimate how many airborne fibers may be in the sampling location.

Since the concentration of airborne particulate contaminants will have some effect on the sample, the following is a suggested criterion to assist in selecting a flow rate based on real-time total particulate readings in milligrams per cubic meter (mg/m^3).

	<u>Concentration</u>	<u>Flow Rate</u>
• Low particulate readings:	< $6.0 \text{ mg}/\text{m}^3$	11-15 L/min
• Medium particulate readings	> $6.0 \text{ mg}/\text{m}^3$	7.5 L/min
• High particulate readings:	> $10 \text{ mg}/\text{m}^3$	2.5 L/min

In practice, battery-operated pumps that are deployed for environmental sampling at remote locations operate under a maximum load of approximately 12 L/min when utilizing a $0.8\text{-}\mu\text{m}$ filter cassette, and a maximum load of approximately 8 L/min when utilizing a $0.45\text{-}\mu\text{m}$ filter cassette. Total sampling times will vary based on battery draw.

7.1.1 U.S. EPA's Superfund Method

The Superfund Method incorporates an indirect preparation procedure to provide flexibility in the amount of deposit that can be tolerated on the sample filter. To minimize contributions associated with background contamination from asbestos present in the plastic matrices of membrane filters and allow for sufficient quantities of asbestos to be collected, this method requires the collection of a larger volume of air per unit area of filter than has traditionally been collected for asbestos analysis. Due to the need to collect a large volume of air, higher sampling flow rates are recommended in this method than have generally been employed for asbestos sampling in the past. Alternatively, samples may be collected over longer time intervals.

The sampling rate and the period of sampling should be selected to maximize the sample volume to the extent practicable, which will minimize the influence of filter contamination. Wherever possible, a volume of 15 cubic meters (15,000 L) will be sampled for those samples intended for analysis only by the indirect TEM preparation method (Phase 1 samples). For those samples to be prepared by both the indirect and the direct specimen preparation methods (Phase 2 samples), the volumes must be adjusted in order to provide a suitably-loaded filter for the direct TEM preparation method. One option is to collect filters at several loadings to bracket the estimated optimum loading for a particular site.

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The filters can be screened in the laboratory to determine the filters that are closest to optimal loading in order to limit the number of filters analyzed by the laboratory (i.e., only those filters closest to optimal loading will be analyzed). It has been determined that the volume cannot normally exceed 5 cubic meters (5,000 L) in an urban or agricultural area, and 10 cubic meters (10,000 L) in a rural area for samples collected on a 25-mm filter and prepared by a direct-transfer technique.

The upper limit to the range of acceptable flow rates for this method is 15 L/min. At many locations, wind patterns exhibit strong diurnal variations. Intermittent sampling (sampling over a fixed time interval repeated over several days); therefore, may be necessary to accumulate 20 hours of sampling time during periods of time with consistent wind conditions. Other sampling objectives may also necessitate intermittent sampling. The objective is to design a sampling schedule that ensures samples are collected under uniform conditions throughout the sampling interval, and this method provides for such options. Air volumes collected on Phase I samples are maximized (15 L/min). Air volumes collected on Phase 2 samples are limited to provide optimum loading for filters to be prepared by a direct-transfer procedure.

7.1.2 NIOSH Method for TEM and PCM

The listed minimum recommended volume for TEM and PCM is 400 L at 0.1 f/cc. The sampling time is adjusted to obtain optimum fiber loading on the filter. A sampling rate of 1 to 4 L/min for eight hours (480 to 1920 L) is appropriate in non-dusty atmospheres containing 0.1 f/cc. Dusty atmospheres (i.e., areas with the potential for high levels of airborne asbestos) require smaller sample volumes (sometimes significantly less than 400 L) to obtain countable samples.

If a time-integrated sample is required, when collecting samples in dusty environments, collect short, consecutive samples and average the results over the total collection time.

For documenting episodic exposures, use high flow rates (7 to 15 L/min) over shorter sampling times. In relatively clean atmospheres where targeted fiber concentrations are significantly less than 0.1 f/cc, collect a larger sample volume (3,000 to 10,000 L) to achieve quantifiable loadings. Take care, however, not to overload the filter with background dust. If loading is greater than 20% of the filter surface covered with particles, the measured fiber concentration may be biased, or the filter may be too overloaded to count.

7.2 Calibration Procedures

To determine if a sampling pump is measuring the flow rate or volume of air correctly, it is necessary to calibrate the instrument. Sampling pumps are calibrated before and after each use. Preliminary calibration is conducted using a primary or secondary calibration device such as an electronic calibrator or rotameter with a representative filter cassette installed between the pump and the calibrator. The representative sampling cassette can be reused for calibrating other pumps that will be used for asbestos sampling. A cassette from the same lot used for sampling should also be used for the calibration. A sticker can be affixed to the outside of the extension cowl marked "Calibration



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Cassette." The calibration cassette cannot be used as a sampling cassette.

Constant flow calibration readings are obtained before and after sampling. If the flow rate changes by more than 5% during the sampling period, the average of the pre- and post-calibration rates will be used to calculate the total sample volume. The sampling pump used will provide a non-fluctuating air-flow through the filter, and the flow rate should be maintained within 10% of the initial volume flow rate throughout the sampling period. The value of these flow-rate measurements will be used to calculate the total air volume sampled. A constant flow or critical orifice controlled pump meets these requirements. If at any time the measurement indicates that the flow rate has decreased by more than 30%, the sampling may be terminated. It will be determined by the end user of the data if the sample should be analyzed. Flexible tubing is used to connect the filter cassette to the sampling pump. Sampling pumps can be calibrated prior to coming on-site to reduce the amount of time spent performing on-site calibration activities.

7.2.1 Calibrating a Personal Sampling Pump with a Rotameter

1. For SERAS rotameters, perform calibrations following directions established in SERAS SOP #2118, *Rotameter Calibration*.
2. Set up the calibration train as shown in (Figure 3, Appendix A) using a rotameter, sampling pump, and a representative sampling cassette.
3. To set up the calibration train, attach one end of the Tygon tubing (approximately 2 feet) to the cassette cap air inlet or cover open inlet-end of cowl with rubber cassette calibration adapter (shown in figure); attach the other end of the tubing to the air outlet (top fitting) on the rotameter. Another piece of tubing is attached from the cassette base air outlet to the inlet of the sampling pump.
4. Ensure that the rotameter is as level as possible when recording sampling flow rates.
5. Turn the sampling pump on.
6. Turn the flow adjust screw (or knob) on the personal sampling pump until the float ball on the rotameter is lined up with the pre-calibrated flow rate value. A sticker on the rotameter should indicate this value. Confirm the flow rate after approximately 10 seconds. Adjust flow rate accordingly.
7. A verification of calibration is generally performed on-site in the clean zone immediately prior to sampling.

7.2.2 Calibrating a Personal Sampling Pump with an Electronic Calibrator

1. Refer to the manufacturer's manual for operational instructions. Ensure that the unit has been calibrated within the past year.
2. Set up the calibration train as shown in (Figure 4, Appendix A) using a sampling

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pump, electronic calibrator, a representative filter cassette and Tygon tubing. A cassette from the same lot used for sampling should also be used for the calibration.

3. To set up the calibration train remove the air outlet plug of the sampling cassette and attach one end of the Tygon tubing (approximately 2 feet) to the cassette outlet; attach the other end of the tubing to the inlet of the sampling pump. Another piece of tubing is attached from the cassette inlet cap to the inlet of the electronic calibrator or cover open inlet-end of cowl with rubber cassette calibration adapter (shown in figure).
4. Turn the electronic calibrator and sampling pump on.
5. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained. Confirm the flow rate after approximately 10 seconds. Adjust flow rate accordingly.

7.3. Meteorology

It is recommended that an onsite, portable, 3-meter meteorological station be established. If possible, sample after two to three days of dry weather when wind conditions are representative for the climatology of the location based on month and time of day. Historical hourly wind speed and wind direction data should be analyzed before mobilization. Wind speed, wind direction, temperature and station pressure should be recorded and real-time data should be available for review. Suggested meteorological station specifications can be found in SERAS SOP# 2125, *Mount One Remote Meteorological Station*. Alternatively, a nearby representative meteorological station, may be used to acquire the necessary data.

7.4 Ambient Sampling Procedures

7.4.1 Pre-Site Sampling Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.
2. Obtain necessary sampling equipment and ensure it is in working order and fully charged (if necessary).
3. Perform a general site survey prior to site entry in accordance with the site-specific Health and Safety Plan.
4. Once on-site, perform calibration of the sampling equipment in the clean zone. The calibration procedures are summarized in Section 7.2.
5. After calibrating the sampling pump, mobilize to the sampling location.

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7.4.2 Site Sampling

1. Prior to sampling, assemble the sampling train as illustrated in Figures 5 (Personal Sampling Train for Asbestos) and Figure 6 (High Flow Stationary Sampling Train for Asbestos), Appendix A, by connecting one end of the Tygon tubing to the cassette cap (air inlet); connect the other end of the tubing to the inlet of the sampling pump. The cassette should be positioned downward or at a 45 degree angle.
2. If AC or direct current (DC) electricity is required, turn the power on. If used, a generator should be placed at least 10 feet downwind of the sampling pump.
3. Turn the pump on. Record the following parameters on air sampling worksheets or in a field logbook: date, time, location, sample identification number, pump number, flow rate, and cumulative time.
5. Check the pump at the sampling mid-point if the sampling duration is longer than 4 hours. If generators are used, they may need to be refueled depending on tank size. If a filter darkens in appearance or if loose dust is seen in the filter, a second sample should be started.
6. At the end of the sampling period, orient the cassette up, and turn the pump off.
7. Check the flow rate of each sampling cassette as described in Section 7.2 before removing from the pump. Note that increased dust/fiber loading may have altered the flow rate.
8. Record the post flow rate, cumulative time or pump run sample end time and date.
9. Remove the tubing from the sampling cassette. Still holding the cassette upright, replace the cassette cap and the inlet and outlet plugs.

7.4.3 Post Site Sampling

Follow handling procedures described in Section 3.2.

7.5 Indoor Sampling Procedures

PCM analysis may be used as an initial screening tool for indoor air samples. When the results of the PCM analysis indicate that the total fiber count is above the OSHA TWA of 0.1 f/cc, an additional TEM analysis may be used to characterize and identify asbestos from non-asbestos fibers.

The inlet of the sampling pump should be placed at a height four to five feet above floor level and away from obstructions that may affect air flow. For example, the pump can be placed on a table or counter. Refer to the site-specific QAPP for a summary of indoor sampling locations and rationale for selection.

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Indoor sampling may utilize high flow rates to increase sample volumes (2,000 L for PCM and 2,800 to 4,200 L for TEM) in order to obtain lower detection limits below the standard, (i.e., 0.01 f/cc or lower [PCM] and 0.005 structures/cc or lower [TEM]).

7.5.1 Aggressive Sampling Procedures

Sampling equipment at fixed locations may fail to detect the presence of asbestos fibers. Due to limited air movement, many fibers may settle out of the air onto the floor and other surfaces and may not be captured on the filter. A quick and effective way to capture asbestos fibers is to circulate the air artificially so that the fibers remain airborne during sampling. The result from this sampling option typifies a worst case condition, and this is referred to as aggressive air sampling for asbestos.

1. Before starting the sampling pumps, direct forced air (such as a leaf blower or large fan) against walls, ceilings, floors, ledges, and other surfaces in the room to initially dislodge fibers from surfaces. This should take at least 5 minutes per 1,000 square feet of floor area.
2. Place a 20-inch fan (or similar piece of equipment) in the center of the room. Place the fan on slow speed and point it toward the ceiling. Use one fan per 10,000 cubic feet of room volume.
3. Follow the procedures described in Sections 7.4.1 and 7.4.2. When sampling is completed, turn off the pump first, and turn off the fans second.
4. Follow the handling procedures described in Section 3.2.

8.0 CALCULATIONS

The sample volume is calculated by multiplying the average flow rate of the pump by the number of minutes the pump was running (**sample volume = flow rate X time in minutes**). The sample volume should be submitted to the laboratory and identified on the chain of custody for each sample. Note that a sample volume of zero will be indicated for lot and field blanks.

The concentration result is calculated using the sample volume and the numbers of asbestos structures reported after the application of the cluster and matrix counting criteria.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Specific QA/QC activities that apply to the implementation of these procedures will be listed in the QAP prepared for the applicable sampling event. The following general quality assurance (QA) procedures also apply:

1. All sample collection data, including sample number, sample location, start and end times, start and end flow rates, pump number, media used and analysis/method must be documented on site logbooks or Field Sampling Worksheets.

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2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer or instrument-specific SOPs, unless otherwise specified in the QAPP. Equipment check-out and calibration is necessary prior to sampling and must be done according to the instruction manuals supplied by the manufacturer.
3. A training record indicating the level of competency for each field employee performing the method will be documented and maintained on file.

The following quality control (QC) requirements are applicable:

9.1 TEM Requirements

1. Examine lot blanks to determine the background asbestos structure concentration.
2. Examine field blanks to determine if there is the presence of contamination associated with extraneous asbestos structures introduced during specimen preparation.
3. Examine laboratory blanks to determine if contamination was introduced during critical phases of the laboratory program.
4. To determine if the laboratory can satisfactorily analyze samples of known asbestos structure concentrations, reference filters can be examined. Reference filters can be maintained as part of the laboratory's QA program.
5. To minimize subjective effects, some specimens should be recounted by a different microscopist.
6. It is preferred that asbestos laboratories be accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).
7. At this time, performance evaluation samples for asbestos in air are not available for Removal Program Activities.

9.2 PCM Requirements

1. Examine reference slides of known concentration to determine the analyst's ability to satisfactorily count fibers. Reference slides should be maintained as part of the laboratory's quality assurance program.
2. Examine field blanks to determine if there is the presence of contamination associated with extraneous structures introduced during sample handling.
3. Some samples should be relabeled then submitted for counting by the same analyst to determine possible bias by the analyst.
4. Participation in a proficiency testing program such as the American Industrial Hygiene

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Association (AIHA)-NIOSH proficiency analytical testing (PAT) program is recommended.

10.0 DATA VALIDATION

Data verification (completeness checks) must be conducted to ensure that all data inputs are present for ensuring the availability of sufficient information. This may include but is not limited to: location information, start and end times, sampling method and total volume sampled. These data are essential to providing an accurate and complete final deliverable. The SERAS Task Leader (TL) is responsible for completing the UFP-QAPP verification checklist for each project.

Results of the QA/QC samples will be evaluated for contamination during the data validation process. This information will be utilized to qualify the environmental sample results accordingly with the data quality objectives of the project.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, Occupational Safety and Health administration (OSHA), and corporate health and safety procedures. More specifically, when entering an unknown situation involving asbestos, a powered air purifying respirator (PAPR) may be necessary in conjunction with high efficiency particulate air (HEPA) filter cartridges. Ensure field personnel have reviewed and are knowledgeable in the applicable regulations for action level, permissible exposure limits (PELs), threshold limit values (TLVs), and any other site-specific considerations. If previous sampling indicates asbestos concentrations are below personal health and safety levels, then Level D personal protection is adequate.

12.0 REFERENCES

Environmental Asbestos Assessment Manual, Superfund Method for the Determination of Asbestos in Ambient Air, Part 1: Method, EPA/540/2-90/005a, May 1990, and Part 2: Technical Background Document, EPA/540/2-90/005b, May 1990.

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13.0 APPENDICES

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APPENDIX A

Figures

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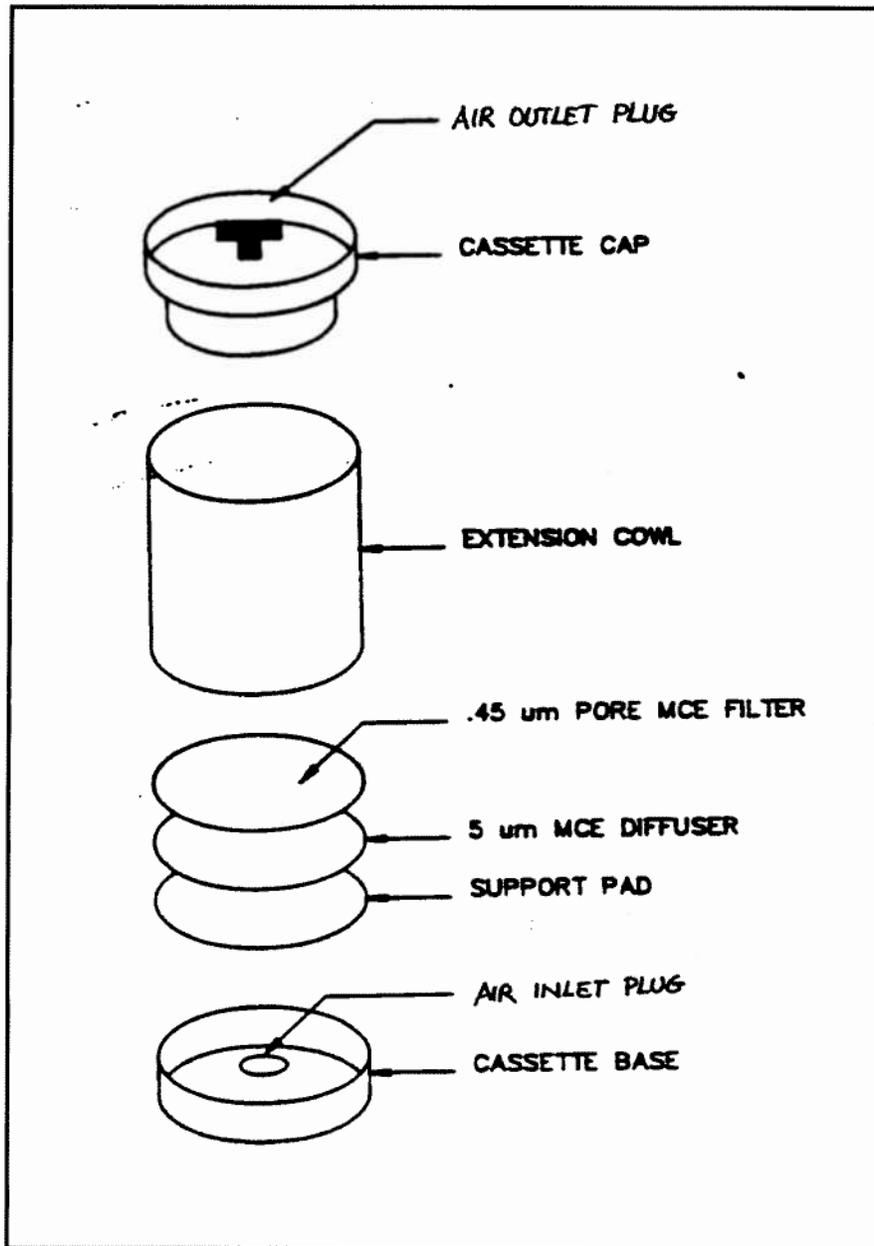


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FIGURE 1. Mixed-Cellulose Ester 0.45 micron Filter Cassette



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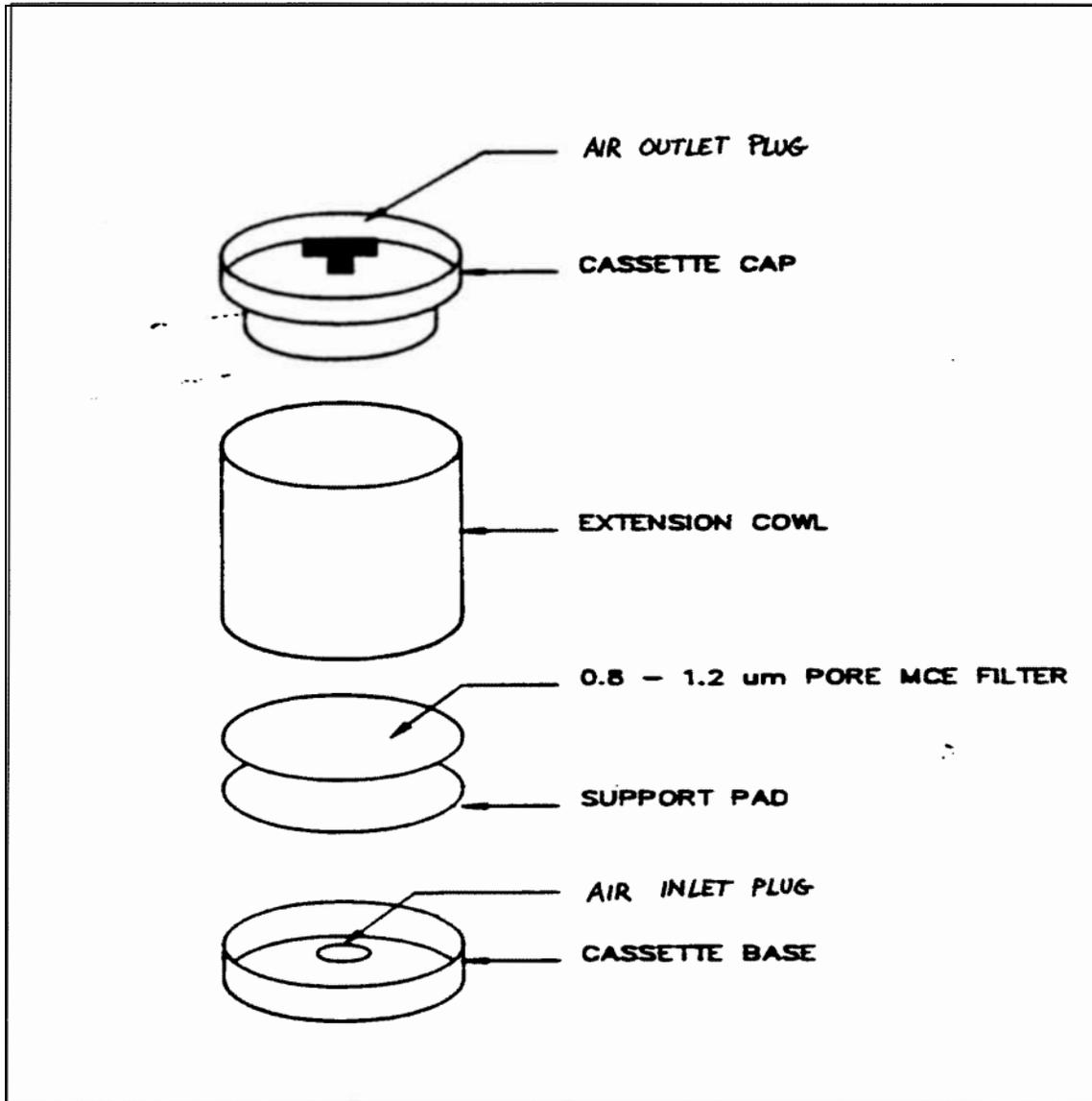
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FIGURE 2. Mixed-Cellulose Ester 0.8 micron Filter Cassette



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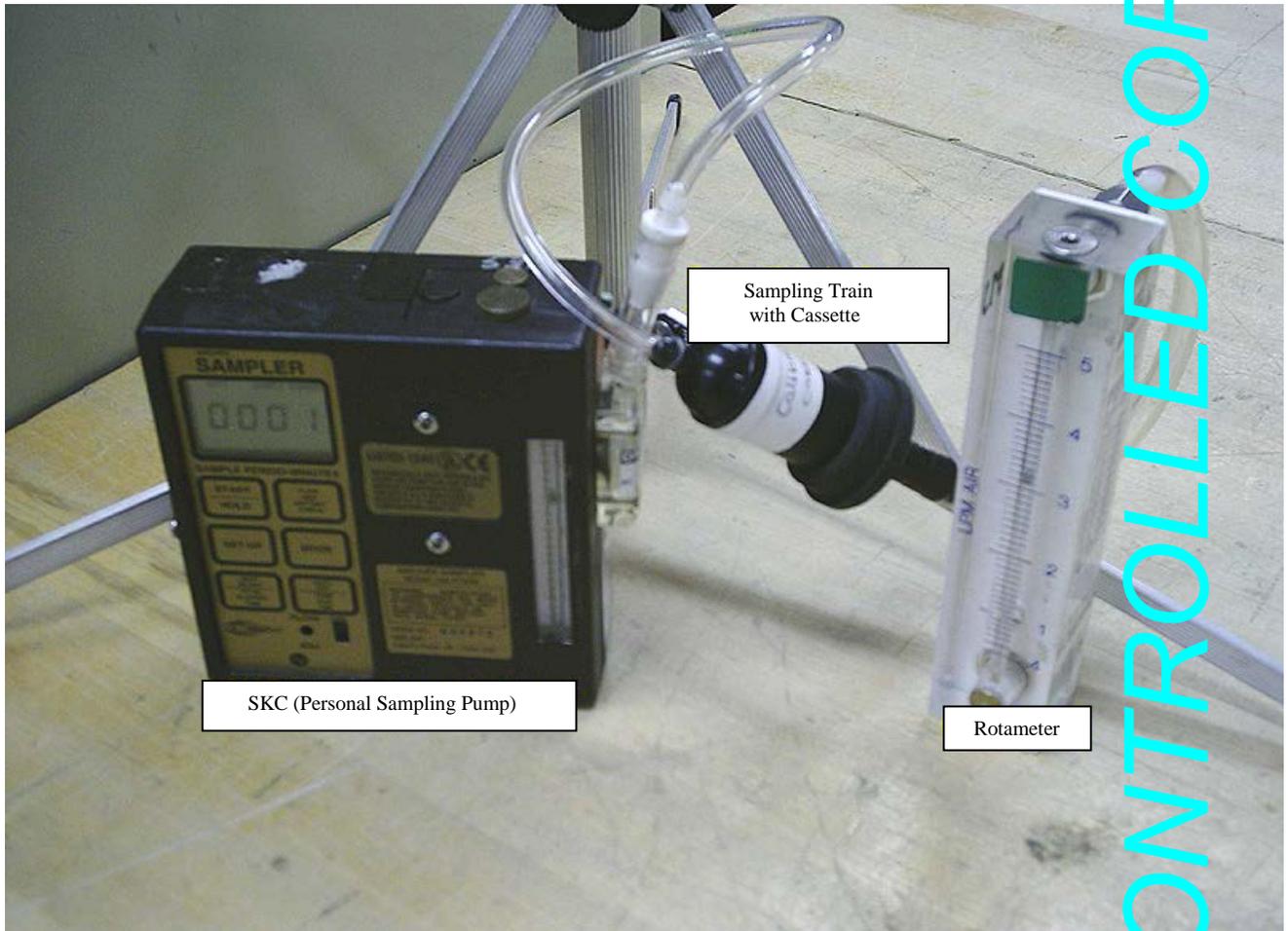
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FIGURE 3. Calibration of Personal Sampling Pump Using a Rotameter



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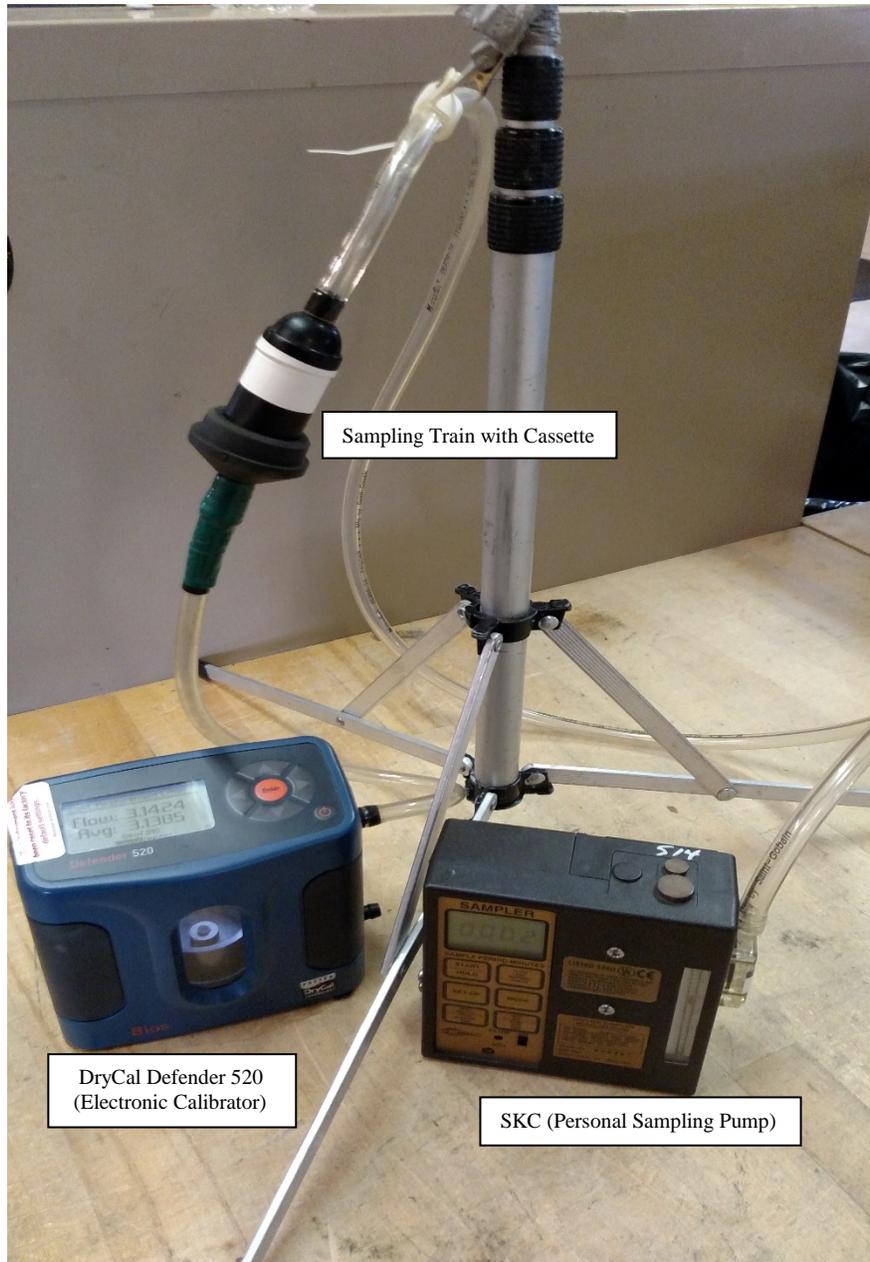
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FIGURE 4. Calibration of Personal Sampling Pump with an Electronic Calibrator (DryCal Defender 520)



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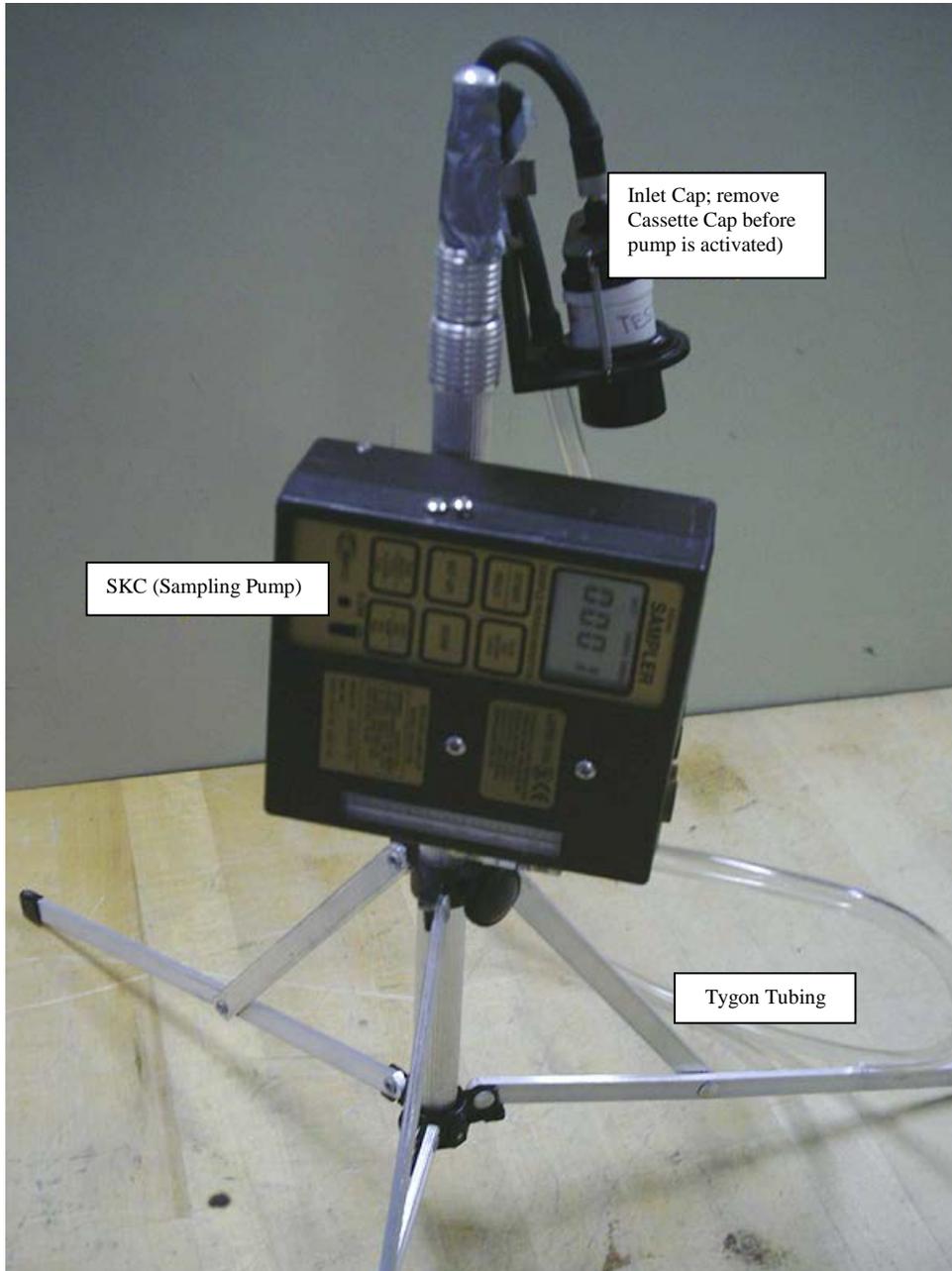
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FIGURE 5. Personal Sampling Train for Asbestos



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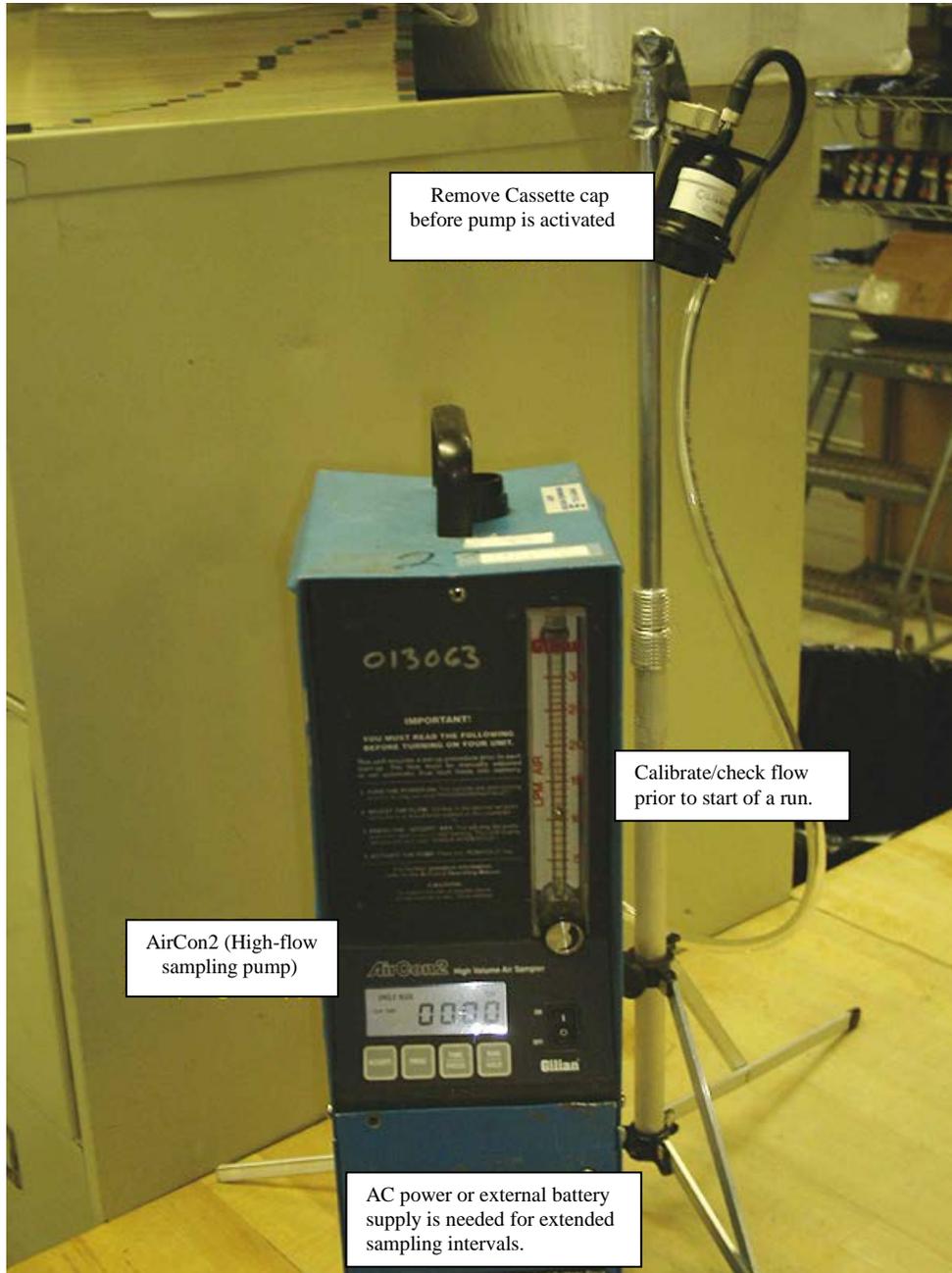


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FIGURE 6. High Flow Stationary Sampling Train for Asbestos



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