

Sampling: Soup to Nuts

Continuing Challenge 2024
Prepared and Presented by EPA Emergency
Response, Region 9





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Enforcement Sampling



General Rules on Enforcement Sampling

- Conduct a thorough inventory of all containers in the location that are part of the investigation.
- The inventory should include the following: type of containers, construction of container, physical integrity of the container, contents of the container if known and info on the drum.
- Note whether it is on a hazardous waste Mark, DOT Label or some other form.
- Copy all information on the drum.



General Rules on Enforcement Sampling

- Place an inventory/sample number on the drum above the hazardous waste mark or some other visible location. Use a color that stands out from the drum.
- All the inventory information, photo logs and sample information will be tied to this number.
- Collect samples using proper protocol.
- If samples is to be field analyzed collect separate laboratory and field analytical samples.



General Rules Enforcement Sample Photography

- Photo all sides of the drum
- Photo the information on the drums up close and individually.
 - i.e. Photograph each mark, labels and other writing on the drum.
- Maintain a photo log that corresponds the drum inventory number to the photos. Included descriptions of the photos in the log when the picture is taken.
- During enforcement sampling involving law enforcement, do not take any photos of the actual sampling activities (i.e. no action photos).



General Rules Enforcement Sample Photography

- If action video is to be collected for training purposes, state so in the audio of the tape.
- Upon completion of the sampling event, take a photo of the sample on the drum or container. Try to include inventory number, marks or labels in the picture.



General Rules Enforcement Sample Photography

- Record this information in the photo log. Use the dry erase board in all of the pictures with the samples. The board should have the following info on it: Site Name, Sample Number, Date and Time Sample Collected, Sampler, Target Analytes.
- DO NOT DELETE BAD PHOTOS, LEAVE



General Rules Enforcement Sample Photography

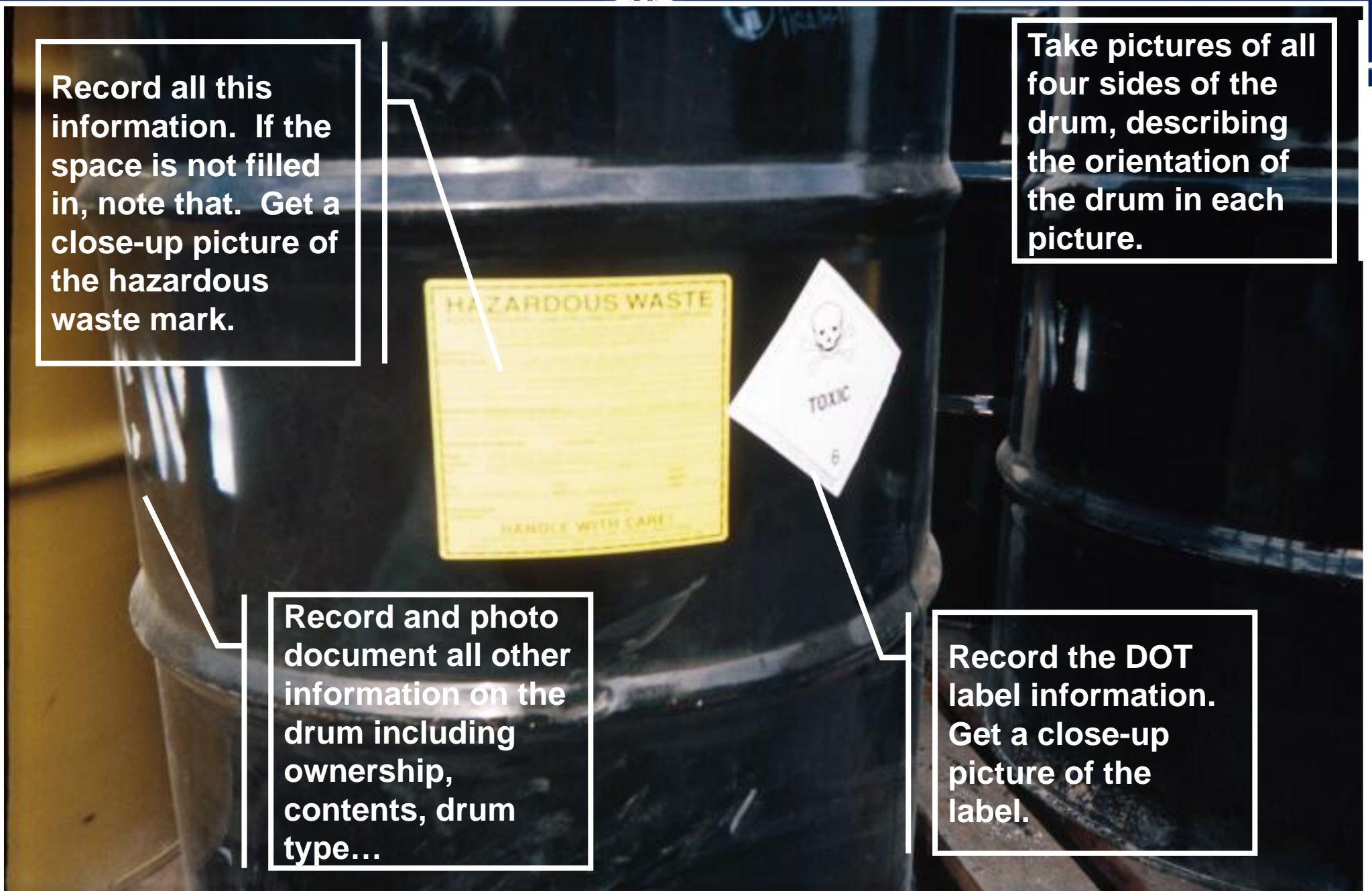
- **DO NOT USE PERSONAL CAMERAS OR PHONES TO TAKE ENFORCEMENT PICTURES!**
- **If you use your personal camera or phone you are opening everything on the device up for discovery especially in Federal court.**

Record all this information. If the space is not filled in, note that. Get a close-up picture of the hazardous waste mark.

Take pictures of all four sides of the drum, describing the orientation of the drum in each picture.

Record and photo document all other information on the drum including ownership, contents, drum type...

Record the DOT label information. Get a close-up picture of the label.





Marks vs. Labels

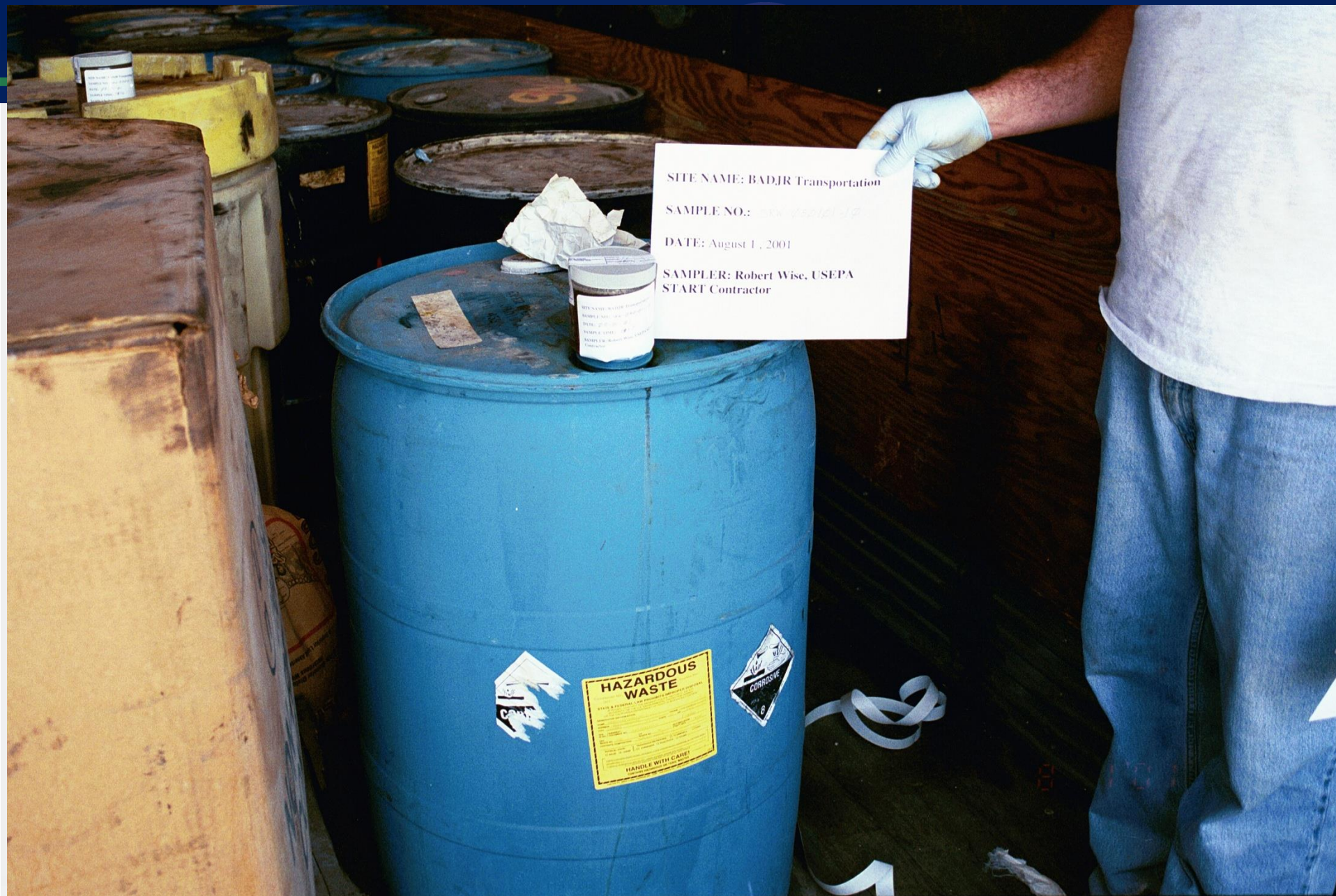
■ Marking

- Proper shipping name, ID #, instructions, manufacturers certification, cautions, weight, specification ... required on outer packages of hazardous materials.

■ Labeling

- prescribed hazard warning notice which readily identifies that a package contains a hazardous material.





Proper photo documentation of a drum with an enforcement sample.



Example: Information for Inventory

Drum Type: 55-gallon, fiber, open top drum

Condition: Poor condition with numerous holes

Information on drum: Hazardous Waste Mark (record all info on mark), DOT label, Manufacturer information, spray painted information



General Field Sampling Guidelines

ERT SOP # 2001



Sampling is the selection of a representative portion of a larger population or body (i.e. target population). The primary objective of all sampling activities is to characterize a site accurately in a way that the impact on human health and the environment can be evaluated appropriately.

Sampling Designs

- Judgmental Sampling
- Probability-based Sampling
 - Simple Random Sampling
 - Systematic Sampling
 - Stratified Sampling



Judgmental Sampling

- Based on professional judgement and technical knowledge of site (biased sampling)
- Specific samples based on background information
- Often used to target areas of known chemical spills or visible staining
- May not be representative of the full site

Examples:

- Enforcement sampling
- Sampling of off-site migration pathways
- Sampling of illegal dumping sites
- Sampling of all containers at a meth lab



Probability-Based Sampling

Simple Random

Simple Random Sampling

- Sample locations are randomly determined statistically.
- Suitable for sites where concentrations of contaminants of concern are assumed homogenous throughout the site

Probability-Based Sampling

Systematic Sampling

Systematic Grid Sampling

- Samples are collected at each node (where lines intersect) of a grid; origin point of grid is selected at random.

Systematic Random Sampling

- A random sample location is selected within each grid cell



Probability-Based Sampling

Stratified Sampling

Stratified Sampling

- A site with heterogenous conditions is separated into multiple homogenous layers.
- Each layer may be sampled using judgmental sampling, random sampling, or systematic sampling.



Sampling Techniques

Grab Sample

- Discrete sample collected at a specific location and/or time
- Investigate area(s) for the presence or absence of contamination

Composite Sample

- Non-discrete sample composed of two or more equal aliquots collected at various location and/or time.
- Represent an average concentration within the composite area



Sampling Techniques



Soil homogenization
(mixing)



In-line filter setup

- Homogenization: Mixing of soil and sediment samples to obtain a representative sample
- Filtration: In-line filters are used when collecting water samples for dissolved metals analysis.

QA/QC Samples

QA/QC Samples: Identify, measure, and control the sources of error that may be introduced throughout the sampling process.

- **Quality Assurance Samples:**

Used to determine if environmental data meet established quality criteria.

- **Quality Control Samples:**

Used to establish laboratory or analyst specific precision and bias, or to assess the performance of the measurement system.



QA/QC Sample Types

- Field Duplicates
 - Two samples collected concurrently (in the same sampling event, under the same conditions) from a single location. Used to measure variability and precision associated with the sampling process including sample heterogeneity, sampling methodology, and analytical procedures.
- Field Replicates
 - Field samples obtained from one location, divided into separate containers and treated as separate samples. Assess error associated with sample heterogeneity, sampling methodology, and analytical procedures.
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) Samples
 - Extra volume/mass is collected for MS/MSD samples. Environmental samples are spiked in the laboratory with a known concentration of target analytes to verify percent recoveries. Used to check sample matrix interferences and to monitor laboratory performance.



QA/QC Sample Types (continued)

- Equipment Blanks (Rinseate Blanks)
 - Samples obtained by running distilled/deionized water over the decontaminated sampling equipment to test for residual contamination.
- Field Blanks
 - Prepared in the field by filling the sample container with clean matrix. Evaluates contamination error associated with field operations or with shipping. May also be used to evaluated contamination error from laboratory procedures.
- Trip Blanks
 - Only required for volatile organics analysis. Consists of clean matrix, prepared prior to going into the field which is then handled, transported, and analyzed in the same manner as the other samples. Used to evaluate contamination error from sample handling, shipment, laboratory handling, and analysis.





Sampling Equipment Decontamination

ERT SOP # 2006

Describes the methods for preventing or limiting cross-contamination of samples due to inappropriate or inadequate equipment decontamination.



STANDARD OPERATING PROCEDURES

SOP: ERT-PROC-2006-20

PAGE: 1 of 17

REV: 1.1

EFFECTIVE DATE: 10/19/20

SAMPLING EQUIPMENT DECONTAMINATION

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- 2.0 METHOD SUMMARY
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- 9.0 QUALITY ASSURANCE/QUALITY CONTROL
- 10.0 DATA VALIDATION
- 11.0 HEALTH AND SAFETY

Sampling Equipment Decontamination

Basic Procedure

Basic Decontamination Steps:

- Physical removal of gross contamination (pressurized water/brushes)
- Soap and water wash
- Potable water rinse
- Distilled water rinse



Sampling Equipment Decontamination

Modified Procedure

Additional steps and reagents may be included in the decontamination process for samples containing specific analytes of interest:

Metals: Acid Rinse

- Include an acid rinse with 10% nitric acid solution prior to the final rinse.

Organics: Solvent Rinse

- For most organics, include an acetone rinse prior to the final rinse.
- If acetone is a known contaminant of concern, substitute methanol.
- For PCBs, include a hexane rinse and allow the solvent to completely evaporate prior to the final rinse.



Sample Equipment Decontamination

Cleaning Methods

Abrasive cleaning methods

- Metal or nylon brushes

Non-abrasive cleaning methods

- High- or low-pressure water
- Rinsing
- Damp Cloth


Note: Select decontamination procedures and reagents which will not damage the sampling equipment.



Sample Equipment Decontamination

Example Decontamination Procedure

Decontamination Process for Metals

- 
- **Station 1** - Place the sampling equipment into the soapy water solution and thoroughly scrub with brushes or pressure washer. When there is no visible residue remaining, transfer to Station 2.
 - **Station 2** - Rinse the equipment in the bucket/tub with potable water. Then remove from the bucket/tub and rinse with the pressure sprayer. When satisfied with the cleanliness of the sampling equipment, transfer to Station 3.
 - **Station 3** - Apply the acid solution and air dry on the plastic sheeting, behind Station 3. Once equipment has fully dried, transfer to Station 4.
 - **Station 4** - Rinse the equipment with the pressure sprayer filled with deionized water. When satisfied the rinsing process is complete, transfer to the equipment drying area. After drying, the equipment should be wrapped in aluminum foil to prevent contamination of the equipment.

Sample Documentation

Sample Labels

- **Sample Labels:** attached to all environmental samples to document their information
- Required fields:
 - Sample Number
 - Date and Time
 - Location
 - Analyses
 - Sample Volume (if an air sample)
- Generated on computer, hand-written, or pre-numbered labels are used.



Sample Documentation

Custody Seals



- **Custody Seals:** confirmation that samples have not been tampered with.
 - Person with sample custody will sign, date and affix seals to cooler/ shipping box so that it cannot be opened without breaking the seal.
 - Each sample may be sealed in some circumstances (e.g. CLP procedures).
- A simple trick to preserve Custody Seals is to put a piece of clear shipping tape over the custody seals.

Sample Documentation

Chain of Custody (COC)

- **Chain of Custody:** a legal document to track and ensure sample integrity throughout its entire path
 - Maintained from time of sample collection to sample disposal (i.e. sample shipment, sample storage, sample analysis).
 - Signed by all samplers.
 - Signed, time recorded and dated each time custody transferred.



Chain of Custody Procedures

A sample is under custody if:

- It is in a person's actual possession.
- It is in your view, after being in your possession.
- It was in your possession and is now custody sealed.
- It is stored in a controlled area.

Official custody of samples must be maintained from the time of collection to final deposition.



Chain of Custody Procedures

Chain of Custody Record

- Chain of Custody Record includes:
- Project information such as:
 - Project name/ID
 - Sampling team contact information
 - Laboratory address and contact information

[illegible]

Chain of Custody Procedures

Chain of Custody Record (Continued)

- Chain of Custody Record includes:
- Sample information such as:
 - Sample number
 - Location
 - Matrix
 - Date and time collected
 - Number of containers
 - Sample preservatives
 - Analysis requested

[illegible]

Chain of Custody Procedures

Chain of Custody Record (Continued)

- Chain of Custody Record includes:
- Sign-Off
 - Relinquished by and Received by - individuals relinquishing and receiving the samples sign their names with date and time.
 - Individual relinquishing the samples should retain a copy or scan of the COC for their records.

[illegible]



Utility Location Surveys

SERAS SOP # 2059

Documents the procedures to perform a geophysical survey to detect the presence of subsurface objects, structures, and utilities.



STANDARD OPERATING PROCEDURES

SOP: 2059
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REV: 0.0
EFFECTIVE DATE: 11/07/16

UTILITY LOCATION SURVEYS

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 - 5.3 Utility Locator
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 - 7.2 Set-Up
 - 7.3 GPR
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 - A – Subcontractor Standard Statement of Work
 - B – Utility Survey Checklist
 - C – Example Proposed Boring Location Figure and Coordinate Table

NEW SOP: SOP #2059, Rev. 0.0; 11/07/16; U.S. EPA Contract EP-W-09-031



SOP #2059 Utility Location Surveys

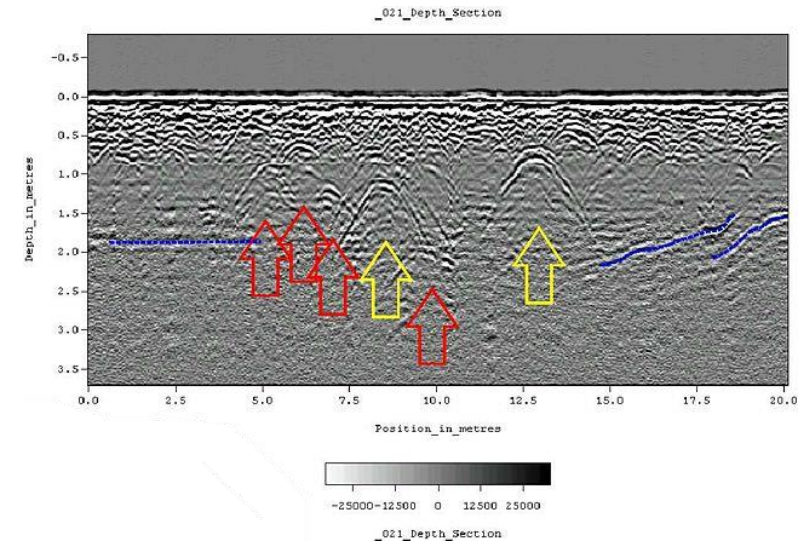
Utility location is conducted in vicinity of proposed borings, and excavations to avoid striking utilities and other subsurface objects.

- Multiple methods should be used to reduce the risk of striking an unknown utility.
- State notification system must be contacted in advance of the survey.



Ground Penetrating Radar

- Produces cross-sectional images of subsurface features using radar.
- Not generally used for large-scale surveys, but to refine resolution in areas of interest.



| Method | Types of Locatable Utilities | Sources of Interference |
|--------------------------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ground Penetrating Radar | Metallic, Plastic, Concrete | <ul style="list-style-type: none">• Reinforced concrete may mask detection.• Significant amounts of clay in soil will absorb signal.• Rule of thumb: for every foot of depth, a pipe diameter needs to be 1 additional inch. |



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Metal Detector

- High sensitivity metal detector detects metallic content.

| Method | Types of Locatable Utilities | Sources of Interference |
|----------------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Metal Detector | Metallic items or pipes with metallic reinforcement | <ul style="list-style-type: none">• Reinforced concrete will mask detection• Overhead electrical lines will negatively affect data quality. |



Source: Metal detector on the beach, Kyösti Viinamäki



Utility Locator

- **Conductive Mode:** Transmitter is connected directly to utility (metal pipe). Receiver traces the utility by following the current in the utility line.
- **Inductive Mode:** Transmitter is placed on the ground directly over the suspected utility. The signal will be introduced to utility line, and the utility can be traced using the receiver.

| Method | Types of Locatable Utilities | Sources of Interference |
|----------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Utility Locators (Metrotech/Radio Detection) | Copper - excellent Aluminum - very good Steel - good Cast Iron - poor | <ul style="list-style-type: none">• Multiple utilities located in close proximity may cause “jumping” of signal between utilities |





Utility Locator

- **Passive Mode:** Detects signals that are already in metal utilities. Can be used on electrical lines.

| Method | Types of Locatable Utilities | Sources of Interference |
|--------------------------------------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Utility Locators Electrical and Communication Lines | Live electrical and communication lines | <ul style="list-style-type: none">• If lines are not energized the locator will not be able to detect the location. |



Sampling Methods

- Drums
- Tanks
- Chip, Wipe, Sweep
- Soil
- Ground Water
- Waste Pile
- Surface Water
- Air Sampling
- Bio-Sampling
- Air Monitoring
- Radiation

Drum Sampling

ERT SOP # 2009



Objective:

Provide technical guidance on implementing safe and cost-effective response actions at hazardous waste sites containing drums with unknown contents. Container contents are sampled and characterized for disposal, bulking, recycling, segregation, and classification purposes.

Pre-Sampling Preparation

Prepare

Prepare Sample Number Scheme

- Site Name, Date, Sample Number
- i.e.: Davis-030320-001
- Use simple numbering scheme
- Drum only gets drum number, i.e.: 001
- If multiple agencies have sampled drums use an agency identifier on drums, i.e.: EPA-001

Prepare

Prepare Sample Labels

- Pre-Prepare the sample labels.
- Use a sharpie, so they do not smear.

Prepare

Prepare Sample Containers

- Prepare separate jars for field hazard characterization samples and enforcement samples.

Prepare

Write sample numbers on the lids and the outside of the jars

- Use a water proof pen or a grease pencil.
- Write numbers on drum with a paint pen or grease pencil.



Site Safety

- Monitor for Toxic gases, LEL, %O₂, Ionizing Radiation and Volatile Organic Hydrocarbons (VOCs).
- Toxic Gases may include: Hydrogen Sulfide, Hydrogen Cyanide, Carbon Monoxide, Chlorine, Ammonia...
- Ionizing Radiation: Start with Gamma Radiation if detected above 2x background then scan for Alpha and Beta radiation. Seek health physics support if gamma radiation greater than 2 mR/hr.
- Initial survey may be started in Level D, but if VOCs are detected above background but less than 5 ppm unknown then upgrade to Level C and if greater than 5 ppm then upgrade to Level B.
- If %O₂ is <19.5% or >23.5% upgrade to Level B.
- If other contaminants exceed MUC upgrade to Level B
- If drums actively smoking, fogging or emitting fumes, seek assistance in opening.



Site Safety (Continued)

- If possible, open drums in a well-ventilated area.
- Bulging drums, drums with crystals on the outside, and drums containing reactive materials should be handled with extreme caution, may have to be opened remotely.
- Open unknown drums in Level B.
- Conduct continuous air monitoring during opening and sampling operations.



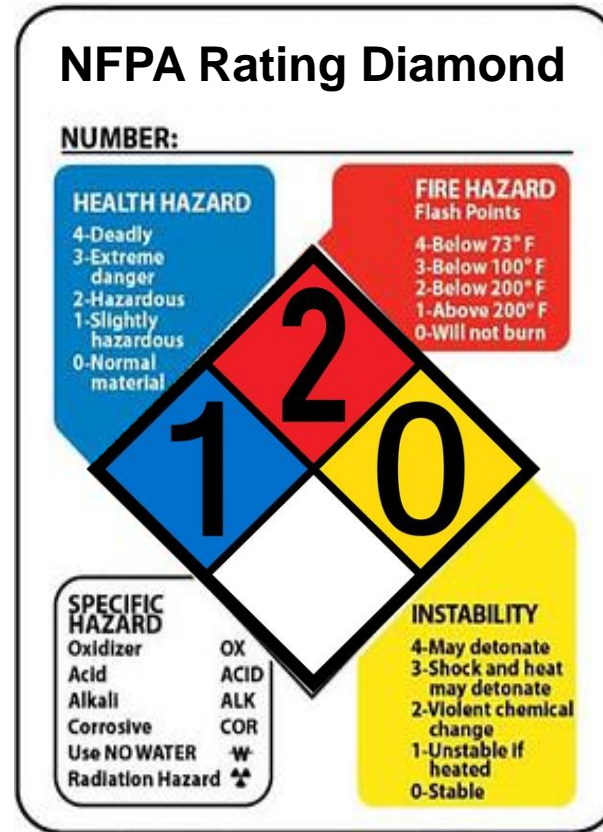
Drum Inspection/Inventory

- Do initial air monitoring to determine proper PPE.
- Count drums first to get the general number of drums.
- Number each drum.
- Assess drums for the following:
 - Drum condition including corrosion, rust, punctures, bungs, and leaking contents.
 - Drum type (open top, bung top, combo)
 - Drum size
 - Drum construction material (steel, fiber, plastic, other)
 - DOT Labels
 - Hazardous Waste Marks
 - Manufacturer Information
 - Other writing, symbols or labels on drums
 - Signs that the drum is under pressure.
 - Signs of shock sensitivity.

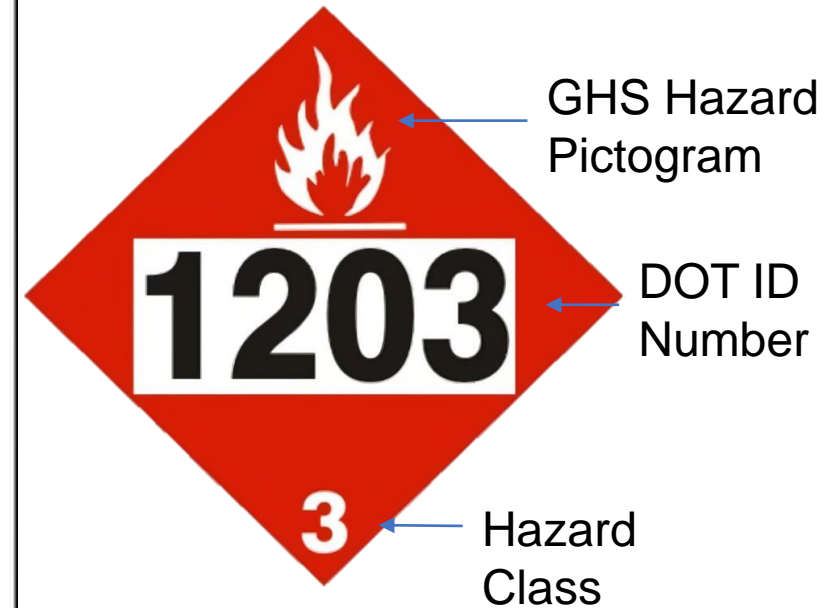


Drum Inspection/Inventory (Continued)

- Labeling
 - DOT Hazard Class
 - 1: Explosive
 - 2: Gases
 - 3: Flammable Liquids
 - 4: Flammable Solids
 - 5: Oxidizers
 - 6: Toxic Substances
 - 7: Radioactive Materials
 - 8: Corrosives
 - 9: Misc. Dangerous/Hazardous Materials
 - DOT ID Number
 - GHS Pictogram
 - NFPA Hazard Rating



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Drum Inspection/Inventory (Continued)

- Damaged or leaking drums should be placed into salvage/overpack drums.
- Multiple small containers containing similar or compatible wastes may be placed in lab packs.
 - Lab packs with liquids should contain enough compatible sorbent material to absorb any possible spill within the lab pack.
 - Field hazard categorization may be necessary to determine the hazard class of the materials.



55-gallon
drum



95-gallon
overpack drum



Lab packing in progress- small
container and sorbent material



Class Exercise 1: Drum Inspection Exercise

1. Break into 2 teams.
2. Examine the container for 5 minutes.
3. Fill out the drum evaluation form.
4. Report back to the class

Drum Staging

- Arrange drums in an easily accessible layout. Physically separate drums groupings according to inspection results.
- Drums should be arranged so all sides of the drums can be seen.
- If drums are unstable or over-pressurized, do not move.
- Drums may need to be placed in salvage drums prior to handling if leaking or not structurally sound. Record drum inspection results before placing damaged drums in salvage drums.



Drum Staging (Continued)

- If excavation is required, use heavy equipment to remove overburden soil from around drums and hand tools for close in work.
- Excavated drums may be heavily corroded and require special care or placement in salvage drums.



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Drum Opening

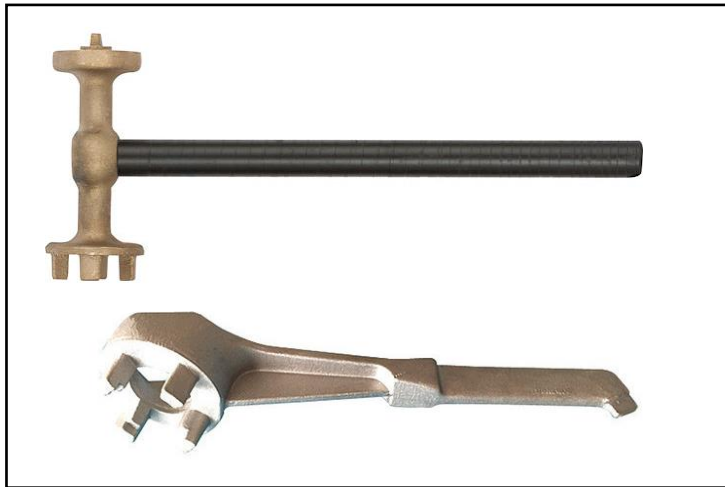
- Open unknown drums in Level B PPE.
- Use spark-proof tools
- Use remote opening technology if shock sensitive, reactive or explosive materials are suspected.
- Place labeled jars and sampling device on each drum.
 - Collect field hazard categorization samples first
 - Collect enforcement samples separately if possible
 - Change outer gloves between each sample.
- If there are many drums that must be opened, a systematic approach may be more efficient, e.g. open all drums, collect samples, and then close all drums.



Drum Opening Tools

Bung Wrench

- Commonly used to manually open drums.
- Used to remove the bung of a drum.
- May not work if the bung is rusted or otherwise in bad condition.



Drum Opening Tools

Speed Wrench

- Used to loosen bolt to remove lids from open-top drums
- If non-sparking tools are needed, use non-sparking pneumatic tool or bronze bung wrench.



Drum Opening Tools

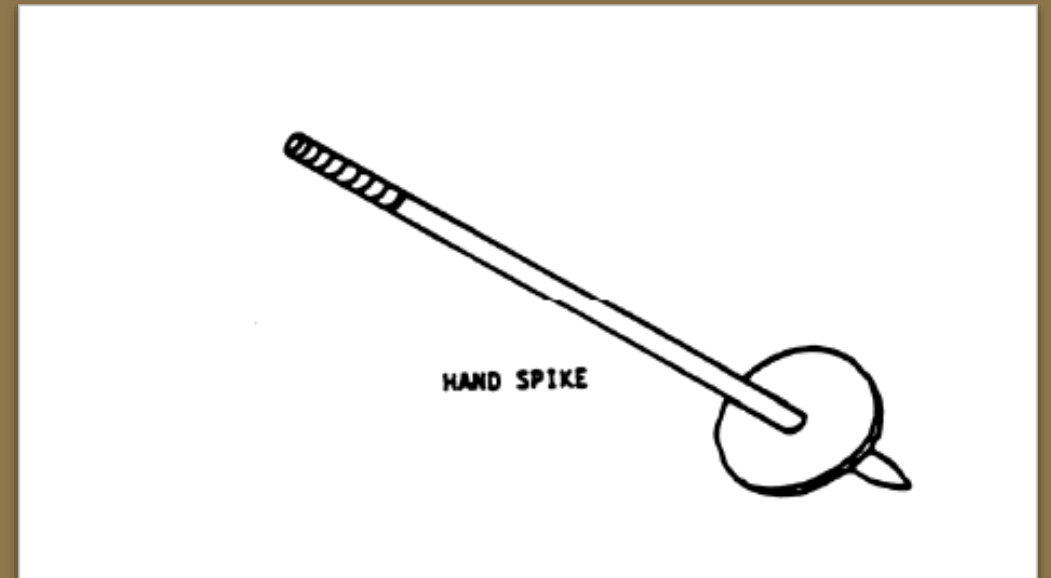
Drum Deheader

- Used to manually open drums when the bung is not able to be removed.
- Designed to cut the lid of the drum by a scissors-like cutting motion.
- Only works on closed-head drums



Drum Opening Tools

- Constructed of brass or non-sparking alloy with a sharpened point.
- Used to penetrate the drum lid or head when the tool is swung.



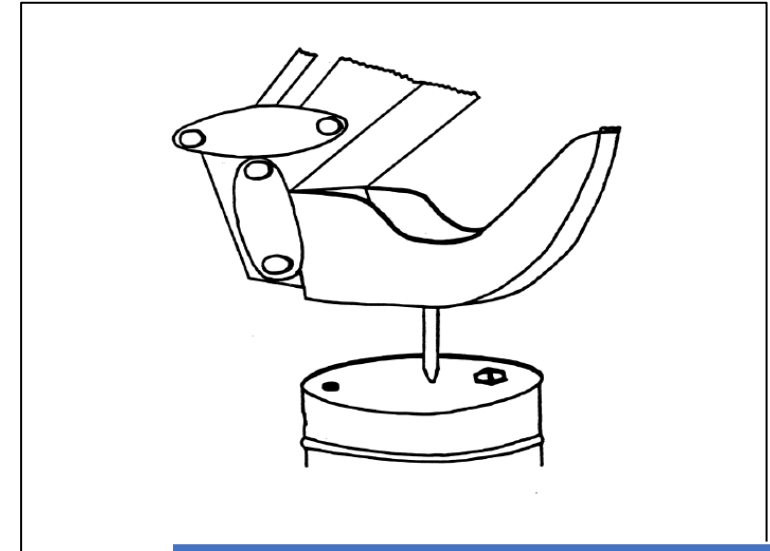
Drum Opening Tools

Remote Openers: Backhoe Spike

Remote operated drum opening tools are often slower but provide a high degree of safety compared to manual methods.

Backhoe spike

- Bronze or other metal spike attachment to backhoe bucket, used to penetrate drum. Efficient for large-scale operations.
- Equipment operator is protected from direct contact with drums or drum contents.



Backhoe Spike

Drum Opening Tools

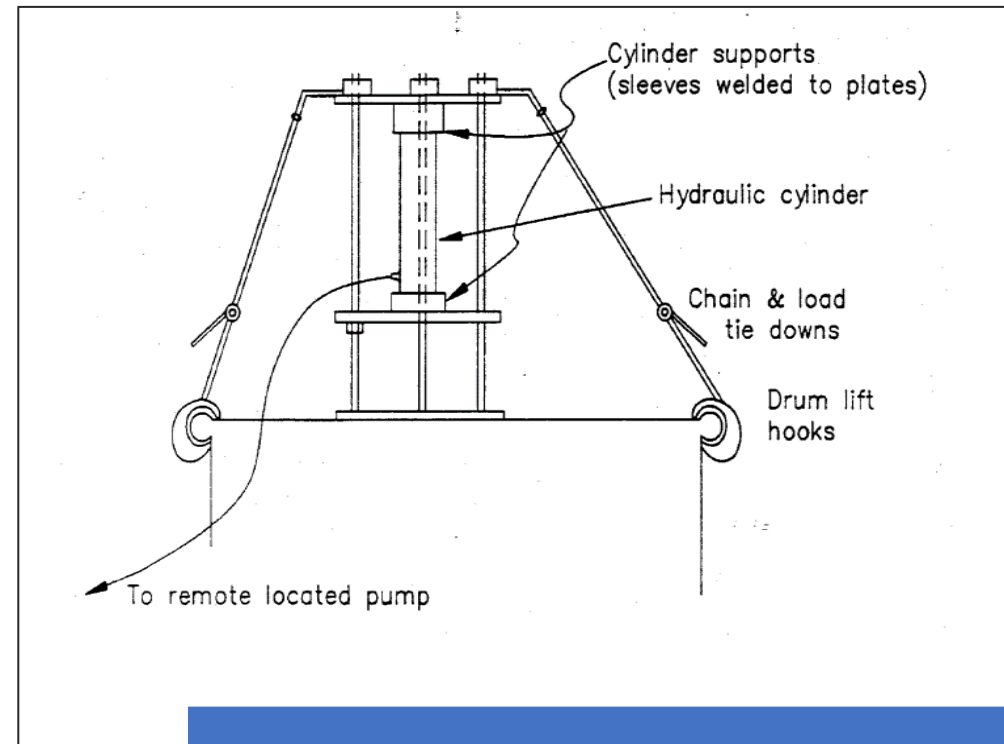
Remote Openers: Hydraulic Drum Opener

Hydraulic Drum Opener

- Uses hydraulic pressure through a hydraulic line to drive a bronze spike into drum.

Drum Penetrator (example device)

- ERT SOP 2127 establishes standard practices for operation of the Drum Penetrator, an apparatus that allows for hydraulic puncturing of a drum from a remote location (120 ft).



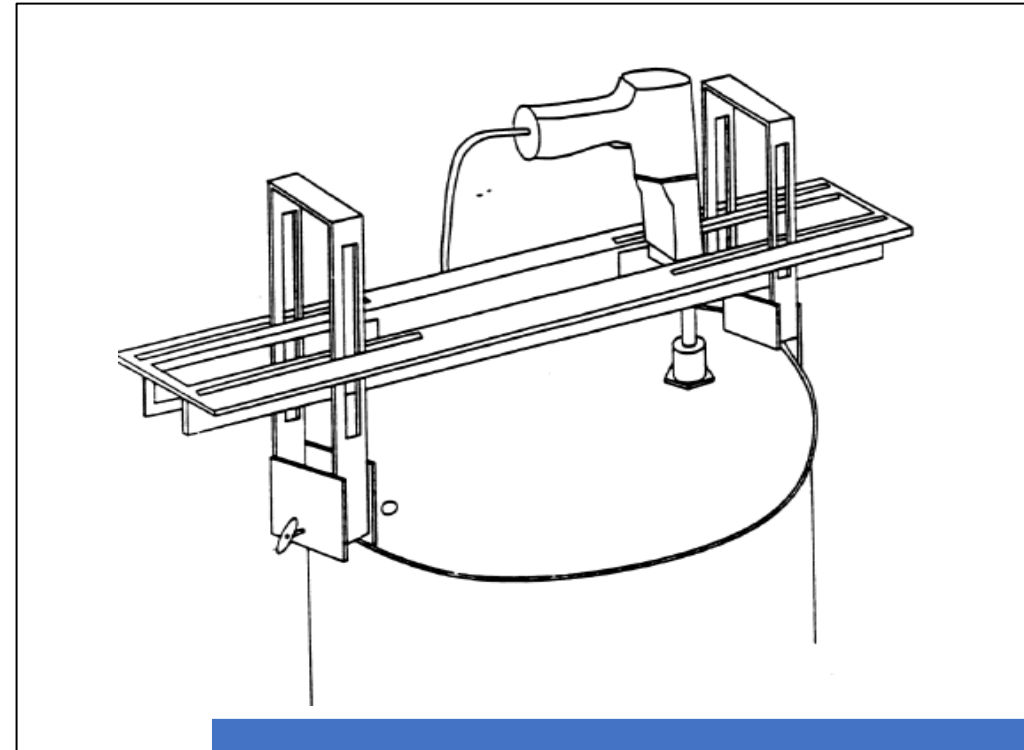
Hydraulic Drum Opener

Drum Opening Tools

Remote Openers: Pneumatic Bung Remover

Pneumatic bung remover

- High pressure line delivers compressed air to a pneumatic drill. An adjustable bracketing system aligns the drill over the bung.



Pneumatic Bung Remover

Drum Sampling

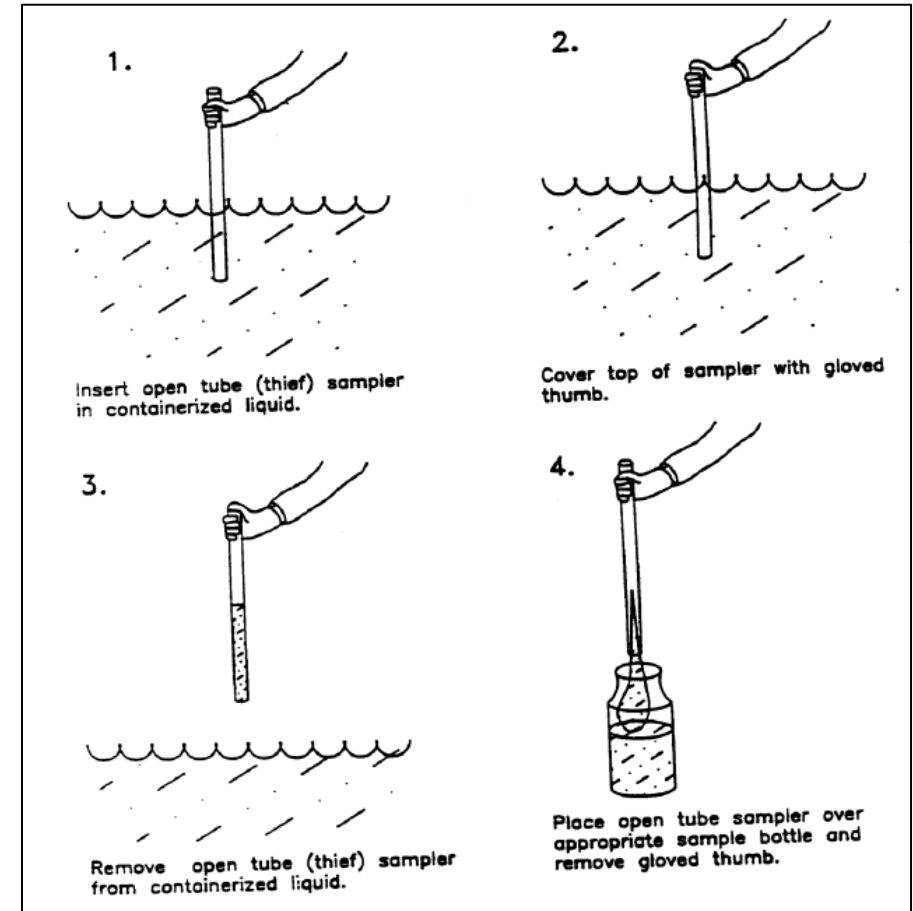
- Perform preliminary monitoring of headspace gases for oxygen/ LEL, as well as VOCs and other gases.
- Sample should represent the entire depth of the drum. Check for presence of sludge at the bottom of the drum.
- Highly viscous liquids may be difficult to sample.



Drum Sampling

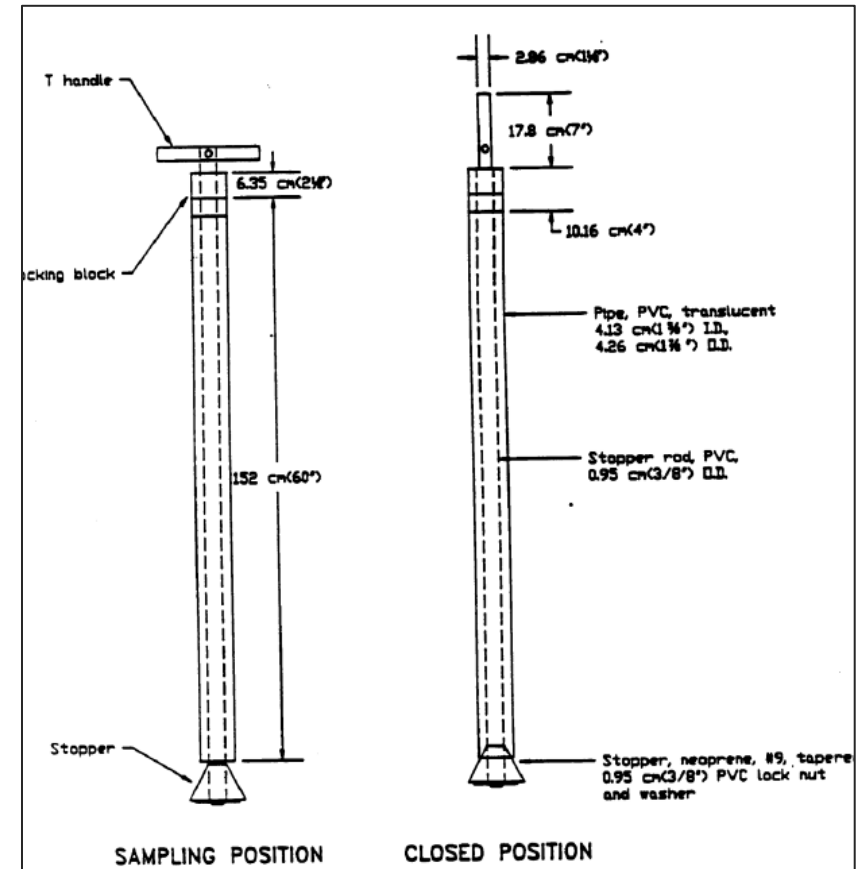
Glass Thief (Drum Thief)

- Most widely used tool for collecting liquid samples from drums.
- Consists of a single-use glass tube that is inserted into the drum, then capped. The capped tube is carefully removed from the drum, then inserted into the sample container. The cap is then released, and the liquid drains into the sample container.



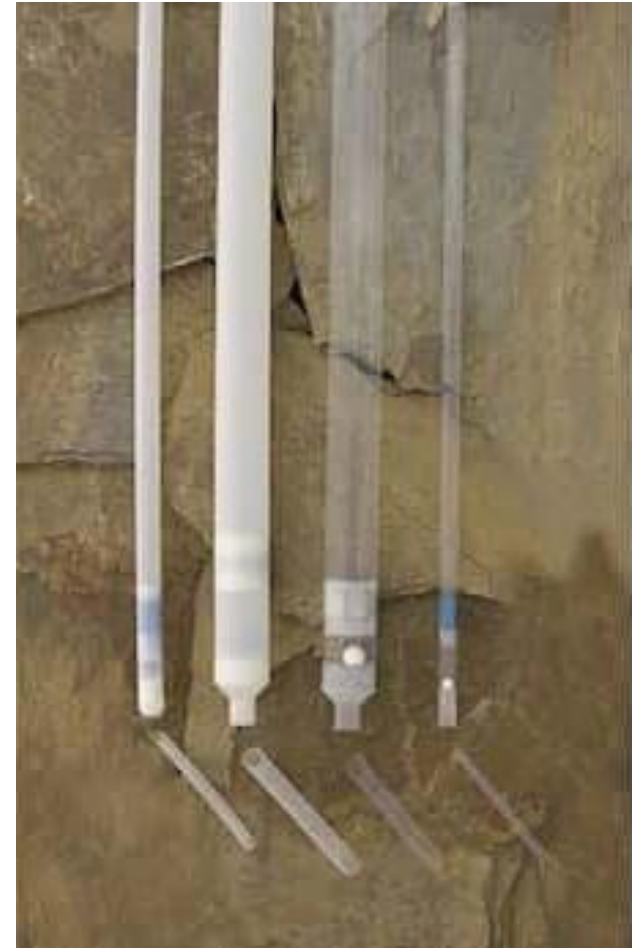
Drum Sampling COLIWASA

- Designed for sampling of multiphase wastes.
- More expensive than drum thief, and difficult to decontaminate. Use of disposable units is recommended.
- Consists of a tube with a stopper which can be closed using a handle at the top.



Drum Sampling Bailer

- Consists of a tube with a ball stopper at the bottom.
- Bailer is vertically inserted slowly into the liquid, allowing the liquid level in the bailer to equilibrate with the liquid level in the drum/container.
- Bailer is retrieved by pulling it gently upward, making sure that the ball stopper is securely seated in the bottom.





Tank Sampling

ERT SOP # 2010

Provides technical guidance
for collecting representative
samples of tanks



STANDARD OPERATING PROCEDURES

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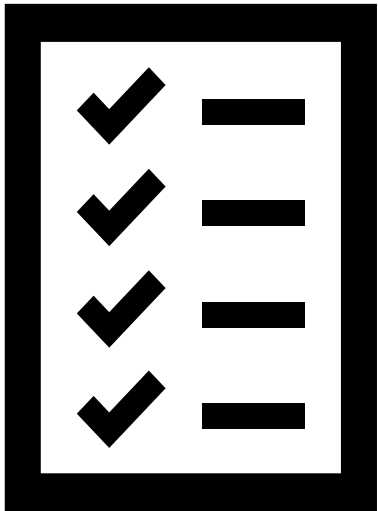
TANK SAMPLING

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Safety



- Ensure tank is structurally sound.
- OSHA fall protection requirements
 - 6-foot rule: requires fall protection when workers are working at heights of 6 feet or greater above a lower level.
 - Personal fall arrest systems
 - Guardrail system
 - Safety net system
- Air monitor for hazardous atmospheres (flammable, explosive, toxic, asphyxiating, corrosive, depending on tank contents).

Safety (Continued)

- Review proper procedures for grounding of equipment and tanks to prevent sparking.
 - Lockout Tagout of pumps or other equipment that may spark.
- Use intrinsically safe equipment and non-sparking tools.
- Sample from outside the tank if possible. If climbing into a tank is deemed necessary, follow **Permit Required Confined Space Entry Requirements.**
- Review proper procedures for evacuating a tank with forced air if necessary.



Preparation

- Assess the structural integrity of the tanks. Unstable tanks should be accessed using a mechanical lift.
- If tanks do not have their own integrated ladder with a cage, use a mechanical lift.
- Always use fall protection.
- Always use a buddy with a back-up team.
- Calculate tank volumes based on tank geometry and measurements.



Preliminary Inspection

- Inspect external structural characteristics of each tank. Evaluate sampling locations for safety, accessibility and sample quality.
- Gather any available information from facility maintenance workers. Many tanks have multi-level sampling ports. Assess sampling port condition.



Preliminary Inspection (continued)

- Measure outside tank diameter, tank length, depth of contents, etc.
- Infrared camera can be used to determine the contents based on temperature gradient.
- All sampling areas should be surveyed for air quality before sampling. If LEL >25%, leave the area. If $10\% < \text{LEL} < 25\%$, work may continue with extreme caution.



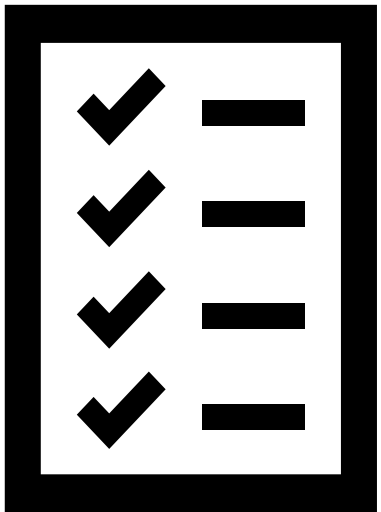
Tank Sampling

- Determine depth of all liquid, solid, or liquid/solid interfaces.
 - Sludge depths may be measured using probe line, sludge judge, or tape measure.
 - Oil/water mixtures may be assessed using an oil-water interface probe
 - Presence of water may be assessed using water paste on a weighted string.



Sump containing sludge and liquid.

Tank Sampling (continued)



- Always sample through an open hatch at the top of the tank. Valves near the bottom or under the liquid line should not be used because they may not be able to closed once open.
 - Multi-level sample ports may be used if they are inspected and determined to be in working condition.
- High volume explosion-proof blower may be used to clear tank headspace of toxic or explosive vapor concentration.

Tank Sampling (continued)

- Collect liquid samples from one foot below surface, mid-depth, and one foot above sludge layer using subsurface grab sampler or bacon bomb. Decontaminate the sampler after collecting each sample.
- Compare the three samples for visual phase difference. If phase differences appear, collect additional samples to determine the depth of the phase change.
- For liquids less than three feet in depth, use a glass thief or COLIWASA to collect a sample of the liquid column.
 - Never insert any body part into the tank to obtain a sample.
- Sludge samples may be collected with sludge judge, Ekman dredge, bacon bomb, or glass thief.
- Change outer gloves between each sample.



Sampling Devices

- Bacon Bomb

- Consists of cylindrical body with an internal plunger that acts as a valve.
- The device is lowered to the desired depth. Pull up on the plunger line to open the valve and fill the device. Release the line to seal the sampler.
- Position the sampler over the sample container and pull up on the plunger line to release the sample.



Sampling Devices

Sludge Judge

- Consists of $\frac{3}{4}$ " plastic pipe in 5 ft sections, marked at 1-foot increments.
- Measures the settleable solids (sludge) in liquid.
- Lower the device to the bottom of the tank. Float valve will open, allowing liquid to fill the pipe. Tug slightly on the device to seat the valve, then raise the column clear of the liquid.
- Touching the pin extending from the bottom of the device releases the sample.



Sampling Devices

Subsurface Grab Sampler

- Consists of aluminum or stainless steel tubing with Teflon or polypropylene sampling head that screws onto 1-liter sample container.
- Lower the device to the desired depth and pull the ring at the top, which opens the spring-loaded plunger in the sampling head.
- Release the ring, then lift the sampler.
- Unscrew the 1-liter sample container from the sampling head and cap with sample cap.





Chip, Wipe, and Sweep Sampling

ERT SOP # 2011

Outlines the methods used in collecting representative chip, wipe, and sweep samples.



STANDARD OPERATING PROCEDURES

SOP: ERT-PROC-2011-20
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CHIP, WIPE, AND SWEEP SAMPLING

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- 1.0 SCOPE AND APPLICATION
- 2.0 METHOD SUMMARY
- 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE
- 4.0 INTERFERENCES AND POTENTIAL PROBLEMS
- 5.0 EQUIPMENT/APPARATUS
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Chip, Wipe and Sweep Sampling

ERT SOP#2011



- Appropriate for surfaces contaminated with non-volatile species.
- Typical sample area is one square foot for lead and 100 square centimeters for many other analytes.
- Sample area should be selected based on potential for contamination from site processes or contaminant transport. Note the sample area associated with each sample.

Chip Sampling



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- Appropriate for porous surfaces.
- Use a hammer and chisel or electric hammer.
- The sample area is chipped both horizontally and vertically to 1/8 inch. Sample is collected into sampling container.
- Make sure that the tool used to chip the material does not contain the target analyte.



Wipe Sampling



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- Collected from smooth surfaces to measure surficial contamination.
- Sterile gauze pad or filter paper is opened, wetted, and stroked firmly and systematically over the entire sampling area
- Solvent used to wet the wipe depends on surface material and contaminant. Avoid over-wetting the wipe, as this may result in loss of sample.
- Use Rad-Wipes for removable rad contamination.
- Use a 100 cm² or 1 m² template depending on the type of sample.

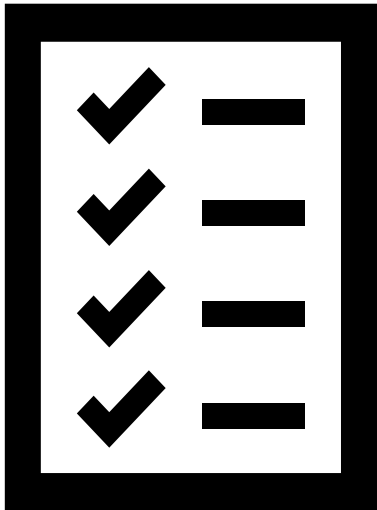
Sweep Sampling



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- Used to collect dust or residue from porous and non-porous surfaces.
- A dedicated brush is used to sweep material into dedicated dust pan.

QA/QC Samples



- QA/QC samples should be determined on a site-specific basis. (field duplicates, MS/MSDs, equipment blanks)
- Collect a field blank for each wipe sampling event.
- The field blank is treated the same as an investigative sample, except it is not used to wipe any surface before it is placed in a sample container.
- The field blank assesses any potential contamination from the solvent, the wipe itself, the sampling methods, or the sampling container.



Soil Sampling

SERAS SOP # 2012

Describes procedures for collection of representative surface soil samples



STANDARD OPERATING PROCEDURES

SOP: 2012
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SOIL SAMPLING

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- 1.0 SCOPE AND APPLICATION*
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 - 7.2.2 Sampling at Depth with Augers and Thin Wall Tube Samplers*
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*These sections affected by Revision 1.0.

SUPERCEDES: SOP #2012; Revision 0.0; 2/18/00; U.S. EPA Contract 68-C99-223.

Surface Soil Sampling

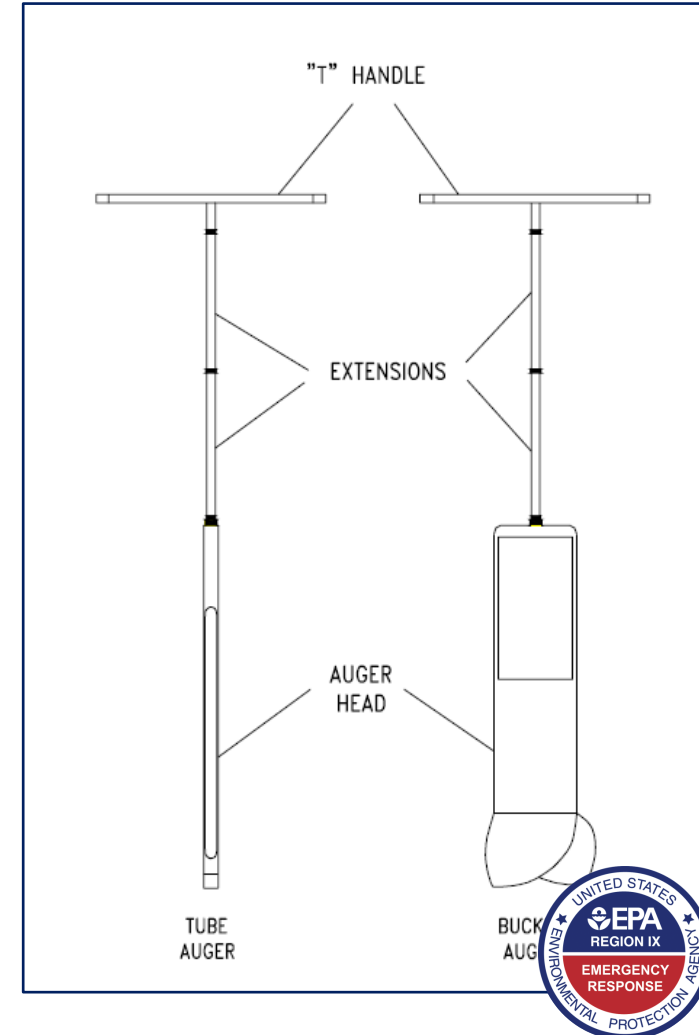
- Remove surface material and debris before sampling.
- Surface sampling tools:
 - Scoops
 - Spades
 - Trowels
- Use stainless steel or plastic tools.
- Avoid plastic tools when analyzing for semi-volatile compounds.



Subsurface Soil Sampling

Auger

- Consists of auger head, extension rods, and a T-handle.
- Auger is used to bore to desired depth. Device is removed, and soil is collected from auger head.
- Decontaminate equipment between samples.



Subsurface Soil Sampling

Trier

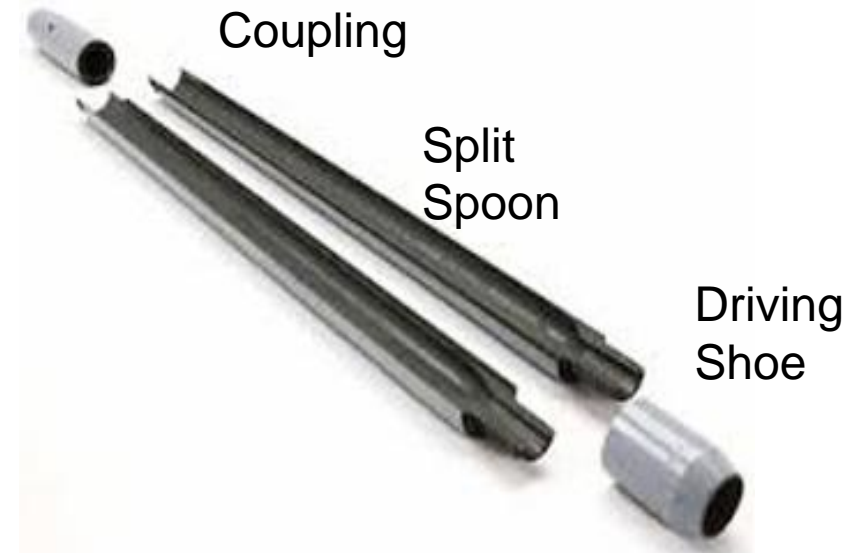
- Consists of a trier and T-handle.
- Insert into the ground at 0 to 45 degree angle from ground surface. Rotate the trier to cut a core or soil.
- Withdraw the trier, slot facing upward.



Subsurface Soil Sampling

Split Spoon (Barrel) Sampler

- Consists of a steel tube split in two halves (split spoon), a driving shoe at the tip, and a coupling.
- Used to collect 18- to 24- inch undisturbed soil cores.
- An auger may be used to reach the desired depth, after which the split spoon is driven into the soil to collect the core.



Sample Trowels

- For samples less than 12" below ground surface, solids and surface sediment.
- Change outer gloves between each sample.
- If using non-dedicated equipment, must decon between samples.
- If deconning, must collect an equipment blank at the end of the day.
- For surface samples consider sieving to remove surface debris



Subsurface Soil Sampling

Test Pit/Trench



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- A backhoe may be used to remove sections of soil to allow detailed examination of soil layers and characteristics.
- Clear for utilities before any intrusive work.
- Scrape one to two inches of soil from the excavated wall face at the sampling location before collecting soil.
- **NEVER ENTER THE HOLE TO COLLECT THE SAMPLE!**





Waste Pile Sampling

SERAS SOP # 2017

Outlines the equipment and methods used in collecting representative samples from waste piles.



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WASTE PILE SAMPLING

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 - 7.2.1 Sampling with Shovels and Scoops
 - 7.2.2 Sampling with Bucket Augers and Thin-Wall Tube Samplers
- 8.0 CALCULATIONS
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SUPERSEDES: SOP #2017; Revision 0.0; 11/16/01; U.S. EPA Contract 68-C99-223

Waste Pile Sampling

- Collect like soil samples.
- Collect surface and subsurface solid samples using scoops, augers, test pits, etc.
- Decontaminate all non-dedicated sampling equipment. Decon procedure should be developed based on the target analytes.
- Refer to the specific analytical and sampling procedures of each target analyte for sampling method, containers, preservation, volumes, and holding times.



Interferences and Potential Problems



- Waste pile materials may vary greatly within the pile (heterogeneous), presenting a challenge for representative sampling.
 - Utilize simple random sampling or stratified random sampling approach.
- May be difficult to access all parts of the waste pile. If access limits the sampling to part of the waste pile, the random sampling will only be representative of the sampled portion.
- Federal and State regulations often require a specified number of samples per volume of waste.
 - Size and shape of waste pile is used to calculate volume of waste.

Waste Pile Sampling

Simple Random Sampling

- Simple random sampling: Sample locations are selected randomly in the area of interest.
- Systematic random sampling: Variation where the simple random method is used to choose the location of the center point of a grid, and samples are collected at each node.
- Simple random sampling is the method of choice unless:
 - (1) there are known distinct strata;
 - (2) one wants to prove or disprove there are distinct strata;
 - (3) one is limited in the number of samples and wants to statistically minimize the size of a "hot spot" that could go un-sampled.
- If any of these conditions exist, stratified random sampling would be chosen.



Waste Pile Sampling

Stratified Random Sampling

- Stratified Random Sampling: The waste pile is divided into a three-dimensional grid system. Each grid cube is numbered.
- Choose the grid cubes to be sampled using a random number generator.
- The number of samples to be collected may be determined statistically based on the size of a “hot spot” that could go unsampled.



Sample Preservation, Containers, Handling, and Storage



- Change outer gloves between each sample.
- Collect VOC samples first before any other samples.
- Transfer VOC samples directly from the collection device to the specified sample container to prevent loss of VOCs. Never homogenize a VOC sample.
- If appropriate, preserve the sample, or use pre-preserved sample bottles.
- Cap the sample containers securely, place in a resealable plastic bag, and cool to less than or equal to (\leq) 4 degrees Centigrade.
- Record all pertinent data in the site logbook and/or on field data sheets.
- Complete the Chain of Custody (COC) record.
- Attach custody seals to cooler prior to shipment.
- Decontaminate all non-dedicated sampling equipment prior to the collection of additional samples.



Groundwater Well Sampling

ERT SOP # 2007

Provides general information on how to collect groundwater samples from wells for field screening and laboratory analysis.



STANDARD OPERATING PROCEDURES

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GROUNDWATER WELL SAMPLING

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- 2.2 Low-Flow Purging and Sampling
- 2.3 FLUTE Well Sampling
- 2.4 No-Purge Discrete Sampling

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

- 4.1 Effects Caused by Well Installation and Development
- 4.2 Effects Caused by Change in Sample Environment
- 4.3 Presence of Immiscible Fluids

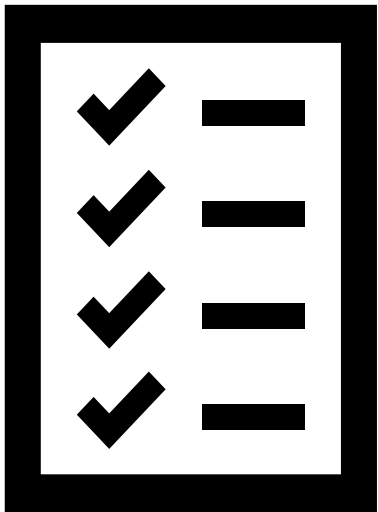
5.0 EQUIPMENT/APPARATUS

- 5.1 Bailers
- 5.2 No Purge Samplers
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- 5.5 Suction Pumps
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 - 5.7.1 General
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 - 5.7.4 FLUTE Well Sampling System
 - 5.7.5 Positive Displacement Pumps
 - 5.7.6 Inertial Pumps
 - 5.7.7 Suction Pumps

6.0 REAGENTS

Scope and Application

Purging and Sampling



- Objective: Consistent and representative sampling of the groundwater wells.
- Samples collected after purging are representative of the groundwater in the surrounding aquifer.
- Purging refers to removing water from the well such that water is pulled into the well from the surrounding aquifer.

Scope and Application

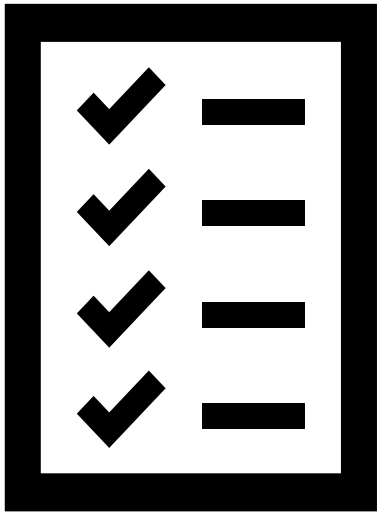
Groundwater Well Sampling

- Historically, a high-flow purging method has been used for groundwater sampling.
- In the mid-1990s, low-flow (low stress) purging, and sampling evolved using low pumping rates.
- No-purge sampling devices, which began to appear in the late 1990s and early 2000s, enabled collecting a sample without pumping or purging prior to sampling.
- The purging and sampling method should be chosen to suit the groundwater well and the target analytes.



Procedures-Preparation

Pre-Field Preparation



- Determine extent of sampling, sampling methods, and equipment required.
- Obtain necessary equipment. Decontaminate and check working order of all equipment.
- Obtain the correct well-lock keys.
- Obtain proper access to private property including water rights.

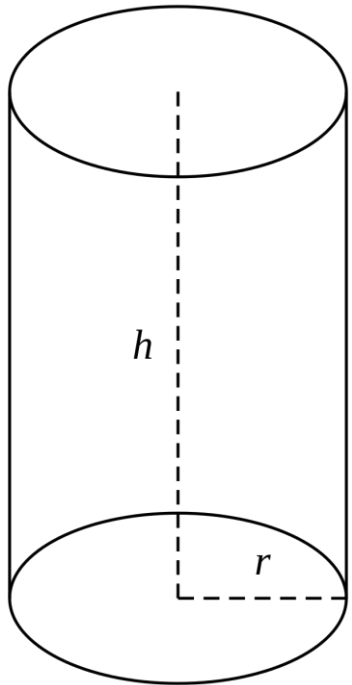
Procedures-Preparation

Field Preparation

- Mobilize from the least contaminated well to the most contaminated well.
- Lay plastic sheeting around the well to minimize contamination of sampling equipment from soil adjacent to the well.
- Unlock well cap and remove. Screen the headspace of the well for VOCs.
- Measure distance from water surface to the referenced measuring point.
- Measure the total depth of the well.
- Calculate the volume of water in the well. If conducting high-flow purging, determine the volume of water to be purged (usually three-times the well volume).
- Purge water should be stored in 55-gallon drums or buckets and disposed of as Investigation-Derived Waste.



Calculations



$$\text{Well Volume (gallons)} = \pi r^2 h k$$

where:

$$\pi = 3.14$$

r = radius of monitor well (feet)

h = height of the water column (feet). (This may be determined by subtracting the:

depth to water from the total depth of the well as measured from the same reference point).

k = conversion factor, 7.48 gallons per cubic foot (gal/ft³)

Sample Preservation, Containers, Handling and Storage

- Each analytical method specifies the sample container requirements, sample preservation, and holding time.
- Sampling container considerations:
 - Glass or plastic?
 - Clear or tinted for protection from light?
 - Is there a volume requirement for the method?



Sampling Container Examples

- Pesticides: Amber Glass, Teflon Lined Cap. 1 L.
- Metals: Plastic or Glass, pre-cleaned w/ acid wash. 250 mL.
- Total Petroleum Hydrocarbons: Amber Glass, pre-cleaned w/acid and solvent wash, Teflon Lined Cap. 1 L.

Sample Preservation, Containers, Handling and Storage (Continued)



Sample Preservation

- Samples should be placed in a cooler and maintained at ≤ 6 degrees Celsius and protected from sunlight.
- Addition of preservatives:
 - SVOCs, pesticides, herbicides, and PCBs usually do not require the addition of a preservative.
 - VOCs typically require preservation with hydrochloric acid.
 - Metals require pH adjustment with nitric acid to <2 .
 - Cyanide requires pH adjustment with sodium hydroxide to >12

Interferences and Potential Problems

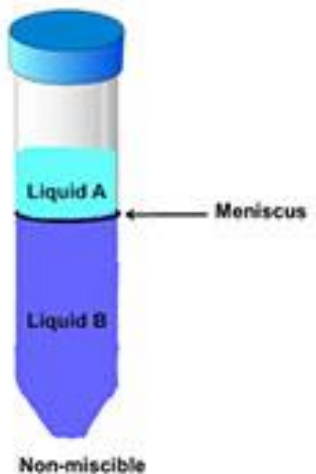
Effects Caused by Well Installation and Development:

- Definition of well development: removal of the clay and silt as well as the finer part of the aquifer directly around the well screen prior to putting the well into service.
- Samples collected from improperly developed wells, or wells with faulty filter packs or poorly grouted seals will not be representative of the groundwater aquifer.
- Newly installed wells should not be sampled for at least 24 hours after development.



Interferences and Potential Problems

Presence of Immiscible (Low-Solubility) Fluids:



- The presence of a floating or sinking organic layer in a well may require re-evaluation of the sampling design.
- Floating organic liquid may be made up of Light Non-Aqueous Phase Liquids (LNAPL). Wells containing LNAPL are generally not sampled for dissolved VOCs and SVOCs.
- Sinking organic liquid may be made up of Dense Non-Aqueous Phase Liquids (DNAPL). Wells containing DNAPL can be sampled for VOCs, SVOCs, and PCBs.

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Filtering

- Samples analyzed for dissolved metals require filtration.
 - Excludes silt and other fine particulates that would interfere with the analysis.
 - In-line filter and peristaltic pump is used to filter each collected sample into a new sample container.
 - A new filter and tube is used for each sample.



Special Considerations for VOCs

Overview

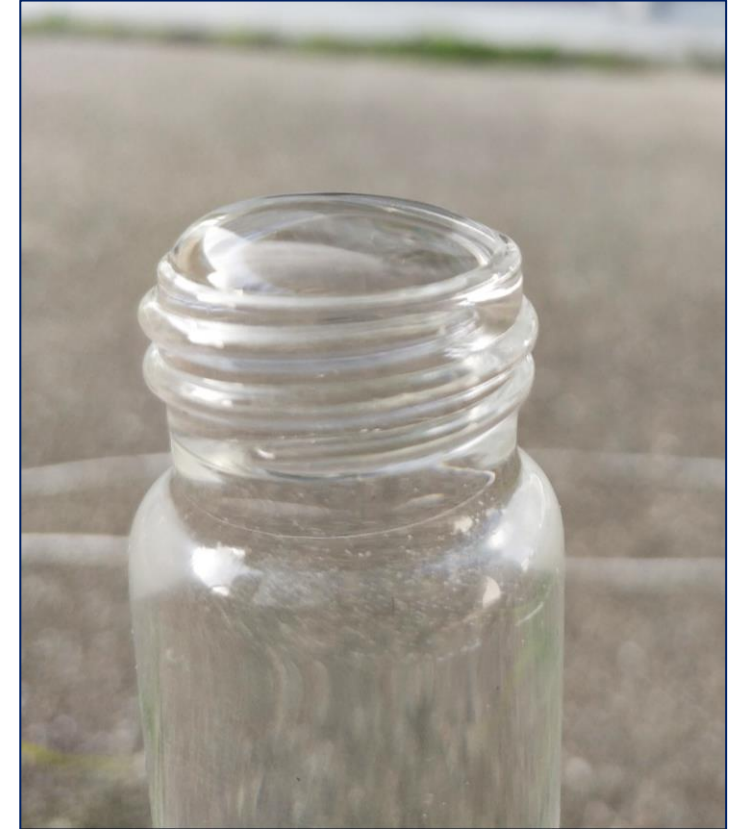
- The proper collection of a sample for VOC analysis requires minimal disturbance of the sample to limit volatilization. Sample retrieval equipment suitable for the collection of VOCs is:
 - Positive displacement bladder pumps
 - Some submersible pumps
 - No-purge samplers



Special Considerations for VOCs

Sampling Procedure

1. Open the sampling vial, set cap in a clean place, and collect the sample. When collecting duplicate samples; collect both samples at the same time.
2. Fill the vial to almost overflowing (zero head space). Do not let it excessively overflow. It needs to have a convex meniscus on the top of the vial before securing the cap.
3. Check that the cap has not been contaminated and place the cap directly over the top and screw down firmly. Do not over-tighten the cap.



Special Considerations for VOCs Sampling Procedure

4. Invert the vial and tap gently. Observe vial for at least 10 seconds. If an air bubble appears, unscrew the cap and pop the bubble or refill with more sample then re-seal. Do not collect a sample with air trapped in the vial.
5. The holding time for unpreserved samples to be analyzed for VOCs is 7 or 14 days for preserved samples.
 - Samples should be shipped or delivered to the laboratory as fast as practical in order to allow the laboratory time to analyze the samples within the holding time.
 - Ensure that the samples are stored at $\leq 4^{\circ}\text{C}$ during transport but do not allow them to freeze. The most readily available method of cooling is to use ice packed in double-sealed plastic bags (e.g. Ziploc bags).



Class Exercise 2: VOC Bottle Filling Exercise

1. Fill bottle.
2. Bottle should have no bubbles. If bubbles exist, try again.

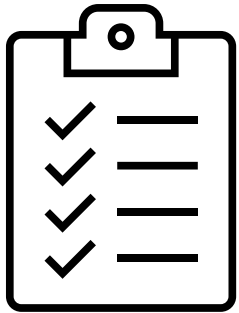


Groundwater Well Sampling Methods

Overview

Groundwater well purging and sampling methods include:

- High-Flow Purging and Sampling
- Low-Flow Purging and Sampling
- FLUTe Well Sampling
- No-Purge Discrete Sampling



Purging and Sampling

General Operating Procedures

- Positive Displacement Pumps and Suction Pumps:
 1. Assemble pump, hoses, and safety cable. Lower pump into the well, to the screened interval.
 2. Attach a flow meter to the outlet hose, or measure volume with a container of known volume.
 3. Ground the equipment, if applicable.
 4. Attach the power supply and purge until specified purge volume has been removed, or until field parameters (temperature, pH, conductivity, etc) have stabilized. Do not allow the pump to run dry. If pumping rate is higher than the well recharge rate, decrease the pumping rate.



Purging and Sampling

General Operating Procedures

- Positive Displacement Pumps and Suction Pumps (Continued):
 5. Collect the sample, securely cap and label the sample container.
 6. Dispose of the purge water.
 7. Replace the well cap and decontaminate the pump
 8. Document the collection time, sampling method, and analyses required in the site logbook.
 9. Package the samples and complete chain of custody forms.



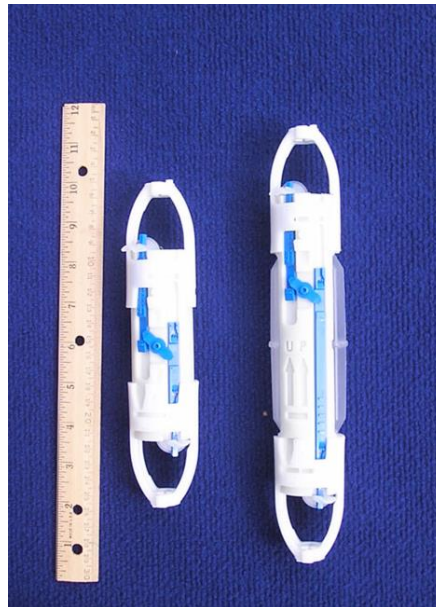
Purging and Sampling

General Operating Procedures

- No-Purge Devices:
 - Follow the manufacturer instructions for deployment and retrieval of the chosen no-purge sampling device.



HydraSleeve™



Snap Sampler



Kemmerer Sampler

Groundwater Well Sampling Methods

High-Flow Purging and Sampling

High-Flow Purging and Sampling

- Three well volumes of standing groundwater are purged at high flow prior to sampling.
- Record pumping rate, discharge volume, water level, and groundwater parameters.
- Stabilization of groundwater parameters indicates that the water is representative of the aquifer.
- May produce large volumes of purge water depending on well diameter and depth.



Groundwater Well Sampling Methods

Low-Flow Purging and Sampling

Low-Flow Purging and Sampling

- Limits the purge water volume removed. This decreases the drawdown around the well, as well as aeration and turbidity of the water.
- Flow rates generally less than one liter per minute.
- Pump intake is positioned in zone of highest contamination, or the midpoint of screened length.
- Groundwater parameters (pH, electrical conductance, temperature, turbidity, DO, ORP) are monitored for stability to indicate when sampling may commence.

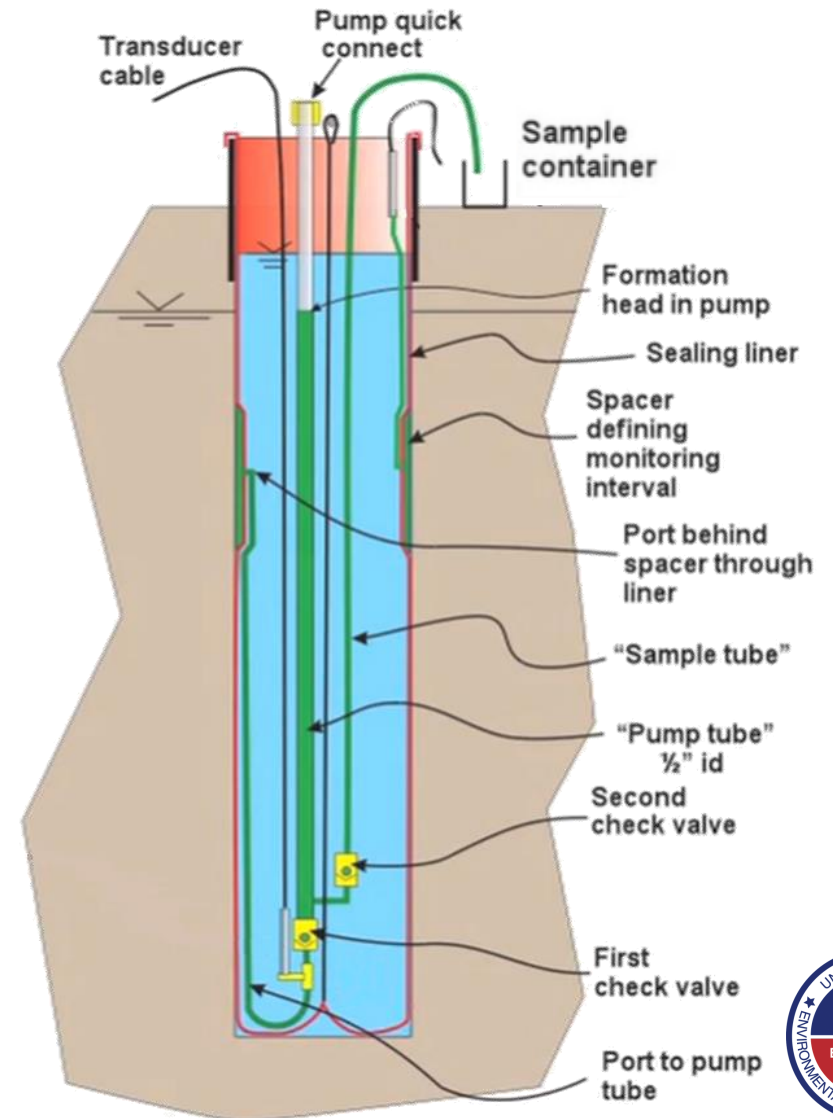


Groundwater Well Sampling Methods

FLUTe Well Sampling

FLUTe Well Sampling

- A flexible plastic liner is inserted into the well, sealing the borehole. The liner includes spacers and ports for each sampling interval.
- Each sampling interval can be purged and sampled simultaneously.



Groundwater Well Sampling Methods

FLUTe Well Sampling Equipment

FLUTe

- Sampling system consists of the liner, a manifold, valves, tubing, and a nitrogen cylinder.
- The nitrogen supply is used to pressurize a downhole air line which purges water from the sample port. After each purge, the port is allowed to recharge for 5-10 minutes. This process is repeated at least three times.
- After the final purge, wait for 10-15 minutes before sampling from the port. Move on to the next sampling port.

Advantages

- Sampled water is not subjected to pressure extremes which may change chemical makeup.
- May be able to determine if there is contaminant stratification in well.
- Multiple sampling intervals may be installed in one well.

Disadvantages

- Diameter of the well may limit the number of sampling intervals that can be sampled.
- Specialized equipment and supplies are required.



Groundwater Well Sampling Methods

No-Purge Sampling

No-Purge Sampling

- Sampling using passive samplers which make it possible to collect samples without pumping or purging.
- Sampler is lowered to desired depth and then filled.
- Some samplers are designed to be left in the well for an equilibrium period, allowing for natural conditions to be re-established following the disturbance of deploying the sampler.
- Grab Samplers vs Diffusion Samplers



Groundwater Well Sampling Methods

Grab Samplers

Grab Samplers

Sampler is lowered into the well, then activated at the target depth.

- Some of these samplers are designed to be left in the well for an equilibration period before sampling.
- Grab sampler types
 - HydraSleeve
 - Snap Sampler
 - Discrete Interval Sampler
 - Kemmerer Sampler



Snap Sampler

Groundwater Well Sampling Methods

Grab Samplers

Advantages

- No power source is needed.
- Sampled water is not subjected to pressure extremes which may change chemical makeup.
- No purge water is produced.
- May be able to determine if there is contaminant stratification in well.

Disadvantages

- Some sampler types may not produce enough water volume for all required analytical methods.
- Different sampler types may have limitations for different target analytes.



[Clu-in Link for More Information](#)



Groundwater Well Sampling Methods

Diffusion Samplers

Diffusion Samplers

- Relies on diffusion of the analytes to attain equilibrium between the sampler and the groundwater.
- Samplers are typically closed and filled with deionized water prior to deployment. Target analytes diffuse through a membrane or through the walls of the sampler over an equilibrium period of several days to a few weeks.
- As a time-saving measure, after each sampling event, a new set of samplers may be placed in the wells for retrieval in the next sampling event.



Diffusion-Equilibrium Sampler

Groundwater Well Sampling Methods

Diffusion Samplers

Advantages

- No power source is needed.
- Sampled water is not subjected to pressure extremes which may change chemical makeup.
- No purge water is produced.
- May be able to determine if there is contaminant stratification in well.

Disadvantages

- Some sampler types may not produce enough water volume for all required analytical methods.
- Different sampler types may have limitations for different target analytes.

 [Click-in Link for More Information](#)



Pumps and Bailers

- All equipment must be constructed of materials that do not introduce contaminants or alter the contaminants being investigated.



Pump Types

Positive Displacement Pumps

Positive Displacement Pumps



Centrifugal Pump

- Bladder, gear-drive, or centrifugal pumps
- Constructed from non-absorptive materials (stainless steel, Viton, Teflon) for submersion in well.

Advantages

- Small diameter pumps are portable and easily transported from well to well
- Relatively low to high pumping rates are possible
- Very reliable and priming is not required

Disadvantages

- Power or compressed air source needed
- Submersible pump might degas the sample
- Deep wells may require pumps that are heavy and cumbersome to use
- Relatively expensive
- Sediment in water may clog intake screen or impellers
- Must be decontaminated between wells
- Because pumping pulls water from the more permeable zones, contaminant contributions from lower permeability zones may be masked in the samples
- Pumping causes mixing which may destroy in-well stratification of contaminant concentrations that could exist and be vital to the investigation

Pump Types

Suction Pumps (Peristaltic)

Peristaltic Pumps

- Can be used for small diameter wells (≤ 2 inches), depth to groundwater < 25 ft.
- Only for inorganic contaminants.



Peristaltic Pump

Advantages

- Portable, inexpensive, and readily available
- Operates from either 110 VAC or 12 VDC
- Variable flow rate, easily controlled
- Dedicated or new tubing used at each well thus minimizing the chances of cross-contamination

Disadvantages

- Restricted to wells where water levels are within 25 feet of the ground surface
- Vacuum can cause loss of dissolved gasses and volatile organics
- Generally suitable for only small diameter shallow wells
- Maximum flow rate of some types (e.g. peristaltic pumps) limited to approximately 1.0-Lpm

Pump Types

Inertial Pumps

Inertial Pumps

- Simple inertial pump consists of foot pedal or hand pump connected to semi-rigid tubing.
- Appropriate for wells that are too deep to sample by hand, but too shallow or small for a submersible pump, or too deep for suction pump.
- Hand-operated down to 45 ft, motor driven for deeper wells.



Pump Types

Inertial Pumps

Advantages

- Portable, inexpensive, reliable, and readily available
- Offers a rapid method for purging relatively small diameter and shallow to intermediate depth wells
- Easily operated and decontaminated

Disadvantages

- Produces agitation that could cause turbid groundwater inside the well
- May cause VOC loss from the groundwater due to agitation
- Limited to field screening or sampling narrow-diameter temporary wells
- Restricted to depths of less than approximately 135 feet
- May be time consuming to purge wells with these pumps
- Gas-driven actuator is heavy and fuel fumes may cause sample contamination

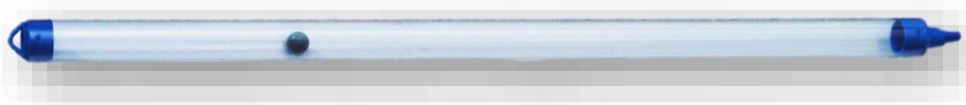


Equipment and Apparatus

Bailers

Bailers

- Consist of a rigid length of tube, with ball-check-valve at the bottom.
- Appropriate for sampling shallow or small diameter wells.
- Types: PVC, Teflon, or stainless steel. Weighted or non-weighted.



Advantages

- Portable, inexpensive, reliable, and readily available
- Easily operated
- No power source needed
- Dedicated; low chance of cross-contamination
- Sampled water is not subjected to pressure extremes which may change chemical makeup

Disadvantages

- Time-consuming for purging large volumes
- Equipment malfunctions; bottom valve often leaks
- May disturb the water column
- May result in aeration of the sample, stripping SVOCs and VOCs from the sample.

QA/QC and Data Validation

- Document all sample collection data, including purge method and time.
- If using non-dedicated equipment, collect rinsate (equipment) blanks to evaluate potential for cross-contamination.
- Duplicate samples may be collected to assess variability of analysis.
- Collect trip blanks if analyzing for VOCs.
- Check and calibrate equipment prior to purging and sampling.



Health and Safety

When working around VOCs:

- Avoid breathing volatiles venting from the well.
- Check the head-space of the well with a FID/PID before sampling.
- Based on air monitoring results, conduct sampling in appropriate PPE.



Health and Safety (Continued)

General groundwater well sampling hazards:

- Lifting injuries associated with pump and bailers retrieval; moving equipment.
- Use of pocket knives for cutting discharge hose.
- Heat/cold stress as a result of exposure to extreme temperatures in protective clothing.
- Slip, trip, fall conditions as a result of pump discharge.
- Restricted mobility due to the wearing of protective clothing.
- Electrical shock associated with use of submersible pumps. Remember to ground equipment.





Surface Water Sampling

SERAS SOP # 2013

Outlines the methods used in collecting representative surface water samples from various surface water bodies. Includes samples collected at depth, as well as samples collected from the surface.



STANDARD OPERATING PROCEDURES

SOP: 2013
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EFFECTIVE DATE: 07/31/16

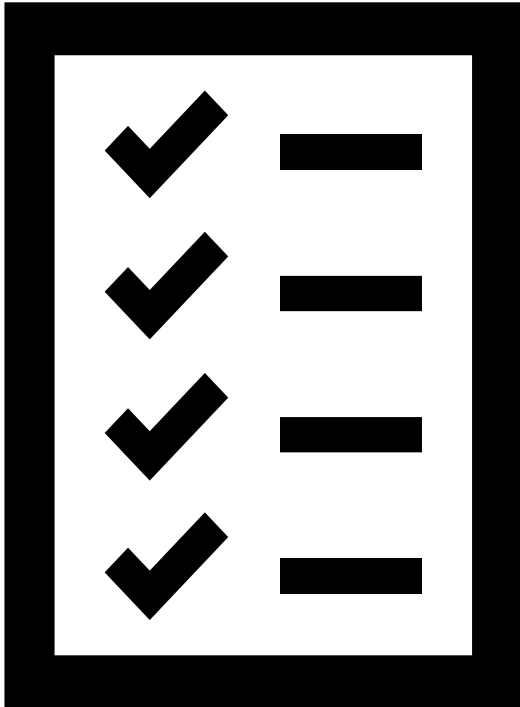
SURFACE WATER SAMPLING

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- 1.0 SCOPE AND APPLICATION
- 2.0 METHOD SUMMARY
- 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE
- 4.0 INTERFERENCES AND POTENTIAL PROBLEMS
- 5.0 EQUIPMENT/APPARATUS
- 6.0 REAGENTS
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 - 7.2 Representative Sampling Considerations
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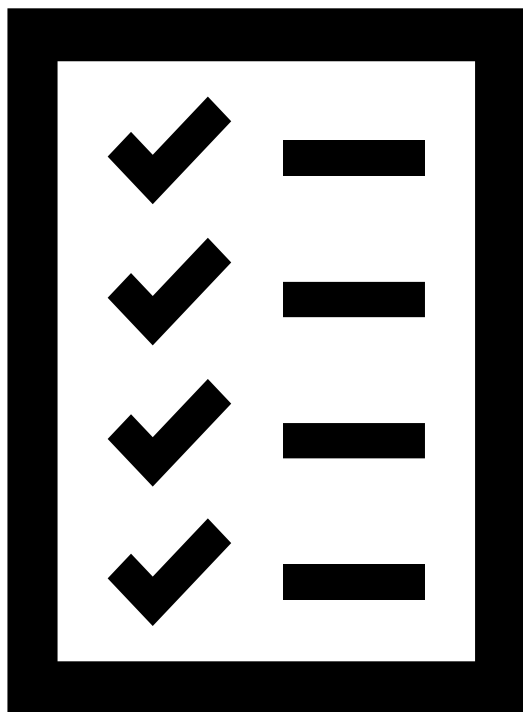
SUPERSEDES: SOP #2013; Revision 0.0; 02/15/02; U.S. EPA Contract 68-C99-223

Preparation



1. Determine the extent of the sampling effort, the sampling methods to be employed, and the type and amount of equipment and supplies needed.
2. Obtain the 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. Use stakes, flags, or buoys to identify and mark all sampling locations identified by GPS data.

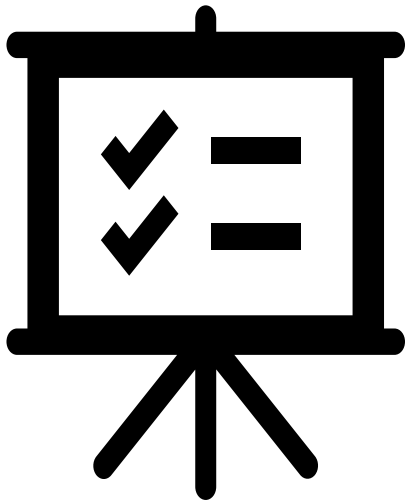
Preparation (Continued)



Field Rinsing:

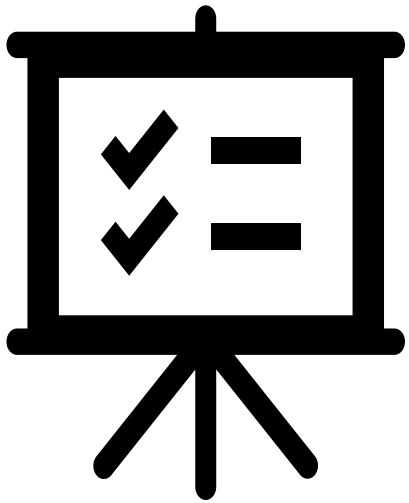
- Once field work has begun and before samples are collected, the wetted portions of most of the collection and processing equipment require a field rinse with native water.
- Field rinsing helps to condition, or equilibrate, sampling equipment to the sample environment. Rinsing also serves to ensure that all cleaning-solution residues have been removed.

Representative Sampling Considerations



- To collect representative samples, determine sampling locations and depths based on hydrology and characteristics of the surface water body.
 - Separate phases or layers may exist in ponds and lagoons, different flow patterns in rivers and streams.
 - Water quality data such as pH, conductivity, oxygen reduction potential (ORP), dissolved oxygen may be collected to determine if stratification is present.

Representative Sampling Considerations (Continued)

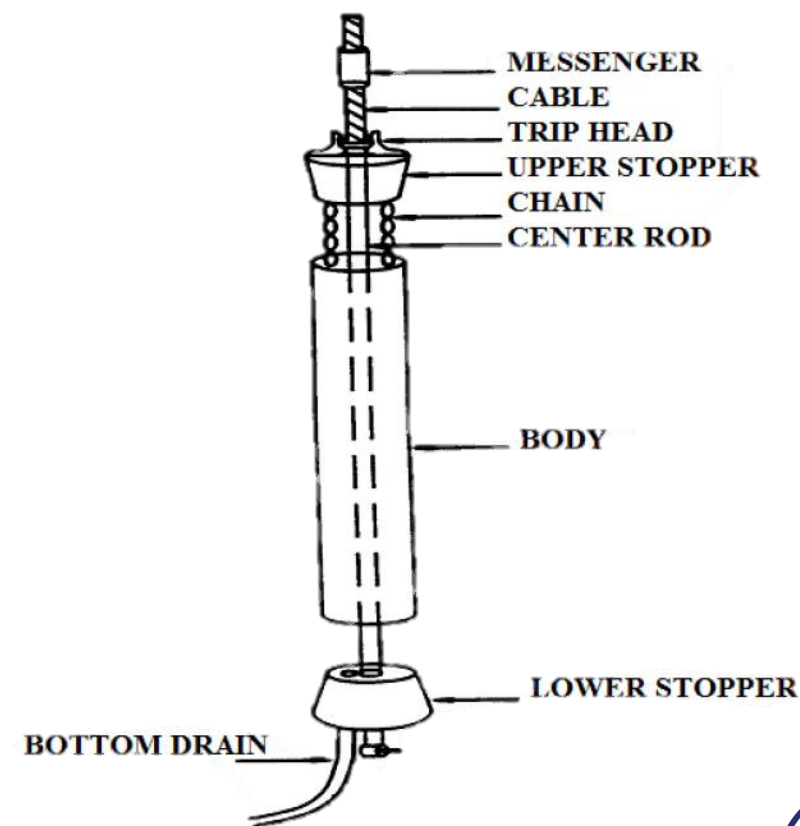


- Take care to avoid re-suspending sediment into the sample.
- In flowing water, sampler must always stand downstream of collected sample.
- Storm events may alter water quality data, dilute contaminants, or bring contaminants from upstream sources. Storm event data should be recorded in the logbook.

Sample Collection

Kemmerer Bottle

- Consists of a cylinder with an upper and lower stopper, and bottom drain. The device is attached to a cable.
- With the upper and lower stoppers open, the device is lowered to the desired depth. A weighted messenger travels down the cable to trip a mechanism to close the stoppers.



Sample Collection (Continued)

Dip sampler

- Consists of a cup or vessel with a handle. Extend the device to the sampling location, collect the sample, and retrieve the device to transfer the sample to the sampling container.



Sample Collection (Continued)



Direct method

- Using adequate PPE, access the sampling location from downstream, and collect water directly into the sampling container. Pre-preserved sample containers cannot be used.
- Filtered or unfiltered samples may also be collected directly using a peristaltic pump with tubing dedicated for each sample.

Sample Preservation, Containers, Handling, and Storage



1. Transfer the sample(s) into suitable, labeled sample containers.
2. If appropriate, preserve the sample, or use pre-preserved sample bottles. Do not overfill bottles if they are pre-preserved.
3. Cap the container securely, place in a resealable plastic bag, and cool to less than or equal to (\leq) 6 degrees Centigrade.
4. Record all pertinent data in the site logbook and/or on field data sheets.
5. Complete the Chain of Custody (COC) record.
6. Attach custody seals to cooler prior to shipment.
7. Decontaminate all non-dedicated sampling equipment prior to the collection of additional samples.



Sample Preservation, Containers, Handling, and Storage

- The following are dependent on the matrix samples and the analysis performed:
 - The amount of sample collected
 - Sample container type
 - Chemical preservation
 - Storage requirements

Interferences and Potential Problems



Potential problems

- Using contaminated or improperly decontaminated equipment
- Disturbing the substrate of the water body
- Sampling an area that has been disturbed or is otherwise not representative of the surface water body

To avoid these problems, samplers should:

- Follow proper decontamination procedures
- Minimize disturbance to the sample site
- Take care in selecting sampling locations
- Consider the effect of the timing of the sampling event when dealing with tidal influences or fast-flowing streams or rivers.

Quality Assurance/Quality Control



- Samples should be collected upstream of any activity that may disturb the sediment (i.e., wading).
- While using the direct method, the sample container should be opened below the surface to avoid the collection of floating debris.
- Water quality data (pH, specific conductivity, temperature, and DO) may be collected to detect the presence of stratified layers or other site-specific characteristics that would affect the sample.

Health and Safety

- PFD (personal floatation device) is required for surface water sampling.
- Hazardous currents are dangerous to even the strongest swimmers.
 - Dangerous currents include undertows, recirculating currents (backrollers), especially on spillways, dams.
- Consider water temperature (hypothermia), UV exposure.
- Boat Safety
 - Safe towing/transport of boat.
 - Visually inspect vessel and all necessary equipment.
 - PFDs required for all, plus an extra.
 - Throwable/rescue floatation devices.



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Sediment Sampling

SERAS SOP # 2016

Outlines the equipment and methods used in collecting representative sediment samples.



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SEDIMENT SAMPLING

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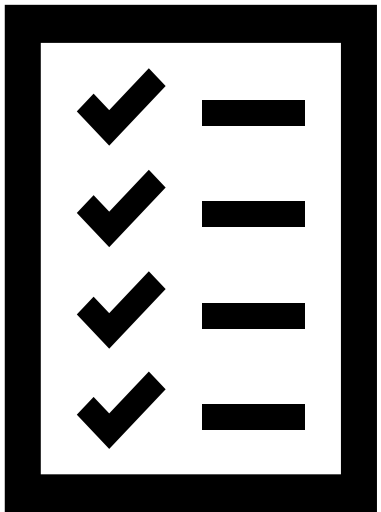
SUPERCEDES: SOP #2016, Rev. 0.0, 11/02/01, U.S. EPA Contract 68-C99-223

Scope and Application

- Sediment is defined as organic or inorganic material that is broken down by the process of weathering and erosion and is deposited/transported by water.
- This SOP is applicable to sampling of sediment located adjacent to and underneath the surface of water bodies.

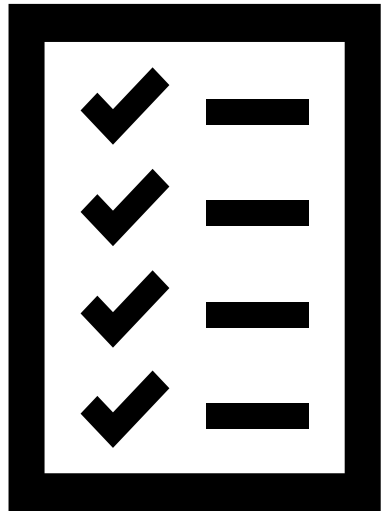


Preparation



- Determine the project objectives and extent of the sampling.
- Perform a general site survey prior to commencement of field activities, in accordance with the site-specific health and safety plan.
- Determine the type of equipment and supplies required based on the site characteristics and project objectives.
- Identify, obtain and calibrate the required air monitoring equipment (e.g. PID/FID), if required by the health and safety plan.

Preparation (Continued)



- Confirm that the sampling equipment is working and ready to use. Decontaminate all non-dedicated sampling equipment.
- Identify and mark all potential sampling locations with stakes, flags, and/or buoys, if appropriate.
- When selecting sampling locations, consider the site's specific physical characteristics including, but not limited to, water flow, topography, depth of the overlying aqueous layer, sediment type, contaminant source, and the extent and nature of contamination.

Sample Collection

The selection of a sampling device is mainly contingent upon the:

- physical characteristics of the sediment to be sampled,
- type of sample needed,
- analytical parameters to be studied,
- amount of sediment needed,
- contaminant(s) contained in the sediment,
- depth of water above the sampling location, and
- possible interferences or contamination introduced by the sampling device.



Sample Collection

- To sample from discrete depth or location, transfer directly from sampling device to the sampling container.
- For composite samples, deposit equal portions of sediment into a large container and thoroughly homogenize. Transfer to the sampling container using a scoop or spoon.
- For VOC samples, do NOT homogenize, as this may volatilize the VOCs. Transfer directly to the sampling container from the sampling device.
- Decontaminate all non-dedicated sampling devices before use and wrap in aluminum foil.



Sampling Techniques

Scoops/Trowels

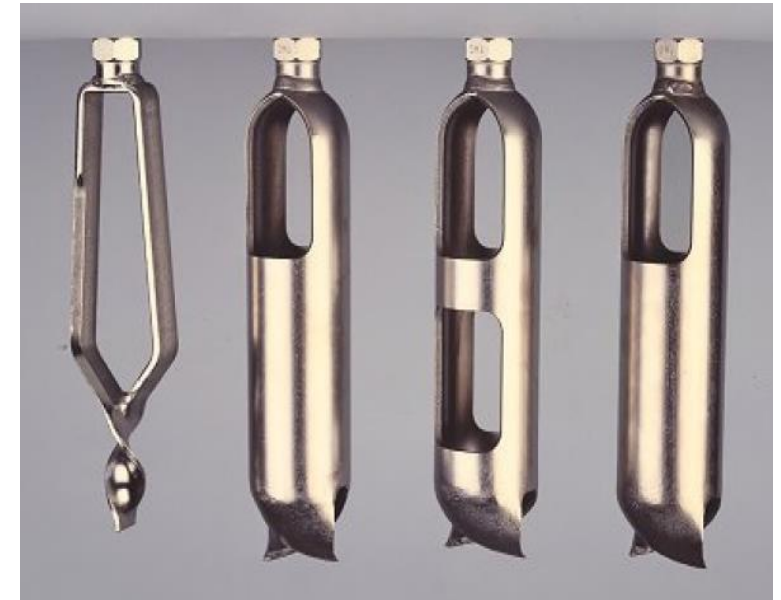
- Plastic or stainless steel
- Suitable for collecting surface samples in shallow, slow-moving waters.
- Cause the most sediment disturbance.



Sampling Techniques

Bucket/Tube Augurs

- Surface samples in shallow, slow-moving waters.
 - Retrieve auger slowly. Check to see if significant amounts of sediment is being lost in retrieval.
 - Decant water out of auger before collecting sample.
- Subsurface sampling possible in dry creek beds.
 - May have difficulty keeping auger hole open depending on sampling depth.



Sampling Techniques

Mechanical Dredge

- Devices with jaws which are lowered to the sediment and then forced closed.
- Decant excess water out of dredge before collecting sample.
- Suitable for collecting surface samples in deeper water.
- Yields large volumes of sediment.
- EkmanTM dredges are suitable for finer sediments, while PonarTM dredges work for a larger range of grain sizes.

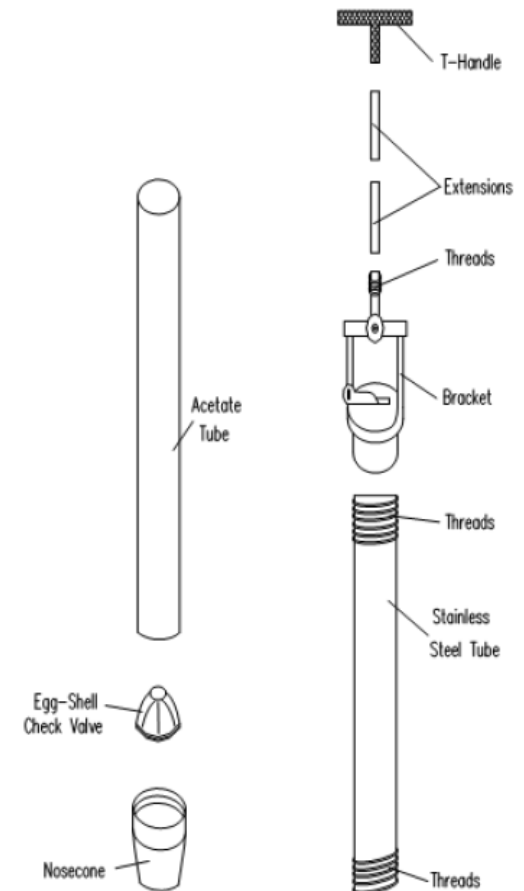


EkmanTM Dredge

Sampling Techniques

Coring Device

- Consist of elongated tubes composed of an acetate sleeve, a T-handle, core catcher, drive hammer, and cutting shoe.
- Collects an intact sediment core sample which preserves the original layers of the sediment.



Sampling Techniques

Diver-Assisted Sampling

- Suitable for collecting samples in deep water where dredges will not work, or when core samples are required.
- Depths up to 120 ft
- Performed by trained, certified divers.
- Dive team collects the samples, with support by surface team.



Sampling Techniques

Vibracore

- Suitable for deep water or when significant sample depth is required.
- Consists of a stainless steel tube, detachable nose, core catcher, and Vibracore drilling head.
- Operated by a team of two or more from a vessel or structure extending over the water surface.
- Uses vibration to penetrate into the sediment. If undisturbed cores are necessary, other methods should be used.



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Interferences and Potential Problems



- Sediments occur in a wide variety of environments, some of which can be difficult or hazardous to access.
- When working in areas deeper than wading depth, a vessel is required.
- Select the sampling container volume and material to match the target analyte (e.g., for pesticides, do not use a plastic sampling container)
- Sediments may contain very light particulate matter. Without proper sampling procedure, these light sediments may be lost during sampling due to current, agitation, or other methods.

Interferences and Potential Problems

(Continued)



- Contaminants are more likely to be concentrated in fine sediments with high organic matter. In contrast, coarse sediments with low organic matter do not typically contain concentrated contaminants.
- Fine sediments are more likely to be found in depositional zones with slower flow, and coarse sediments are more likely found in erosional zones with faster flow.
- Therefore, selection of sampling locations in a surface water body can greatly influence the analytical results.

Doeskin Road Abandoned Chemicals: A Joint EPA-DTSC Removal Action Apple Valley, San Bernardino Co., CA





Summary

A vacant home in a rural area of unincorporated areas of Apple Valley. Home had been empty for 12 years.

Discovered by the San Bernardino County Sheriff's Department during a burglary report.

The landowner owned a chemical company that went bankrupt, left-over chemicals moved to the property.

Landowner planned to move the chemicals to a mine in Colorado

- State of Colorado denied permission

Site was referred to EPA by Apple Valley Fire Department through DTSC.

EPA and DTSC conducted a joint removal action.

Multiple on-site detonations to destroy unstable chemicals by the FBI Hazardous Device Team



Assessment Activities at Doeskin



Joint inventory between EPA and DTSC.



All containers inventoried.



Six enforcement samples collected and analyzed for pH, total cyanide, California Metals, Total Petroleum Hydrocarbons and VOCs.



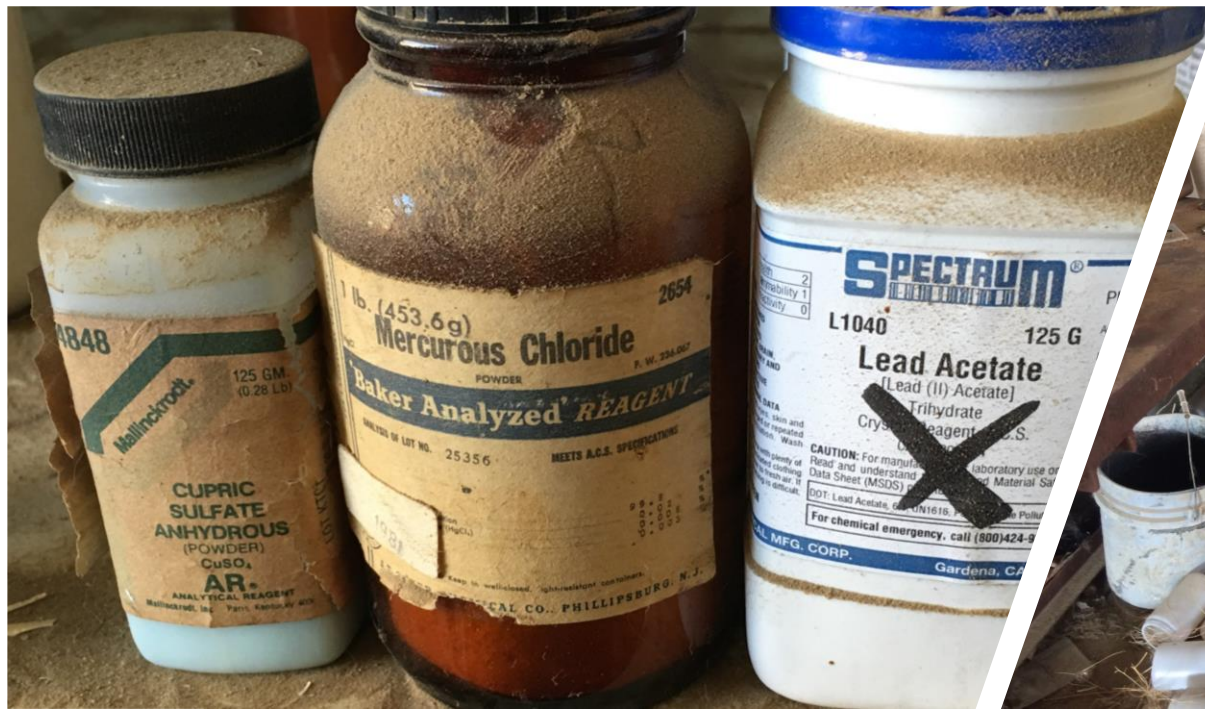
Assessment identified the presence of heavily decayed Tetrahydrofuran. Destroyed by the bomb squad.



Identified a septic tank that was full of liquid. Sampled but no hazardous substances present.

Chemical Classes Found at Doeskin

- Waste Toxic Solid, Inorganic
- Waste, Toxic Solid, Organic
- Waste Flammable Liquid
- Corrosive Solid
- Paint Related Material
- Non-RCRA Solid
- Non-RCRA Liquids
- Waste Corrosive Liquid, Basic
- Waste Corrosive Liquid, Flammable
- Waste Corrosive Solid, Acidic
- Waste Corrosive Liquids, Toxic
- Waste Chlorosulfonic acid
- Waste Phosphorus Oxychlor
- Waste Sodium Nitrate
- Waste Potassium Nitrate
- Waste Cyanides
- Waste Corrosive Solid, Basic
- Waste Sodium Sulfide
- Waste Aerosols
- Waste Carbon Disulfide
- Waste Mercury Compounds
- Waste Trimethoxysilane
- Waste Perchloric Acid





Samples Collected

| Sample ID | Container ID | Liquid/Solid | Field Characteristics | Analyses | Results |
|------------|--------------|---------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| DAC-D002 | D002 | Solid | HCN = 35 ppm | Total Cyanide (EPA 9010C/9014) | Total Cyanide = 10,000 mg/kg 40 CFR 261.23(a); meets the definition of hazardous waste for the characteristic of reactivity. |
| DAC-D004 | D004 | Liquid | pH = 11.5 | pH (SM 4500 H+B) Total Cyanide (SM 4500-CN E) CA Title 22 Metals (EPA 6010B/7470A) Mercury (EPA 7470A) | No results exceeded the 40 CFR, Part 261.20 criteria defining a hazardous waste. |
| DAC-D005 | D005 | Solid | None | Total Cyanide (EPA 9010C/9014) | Total Cyanide = 2.4 mg/kg 40 CFR 261.23(a); hazardous waste for the characteristic of reactivity. |
| DAC-DO12 | D012 | Liquid | pH = 1.0 | pH (SM 4500 H+B) Total Cyanide (SM 4500-CN E) CA Title 22 Metals (EPA 6010B/7470A) Mercury (EPA 7470A) | pH = 1.72 40 CFR 261.22; meets the definition of hazardous waste for the characteristic of corrosivity. |
| DAC-D013 | D013 | Dual Phase (solid/liquid) | VOCs = 23 ppm | TPH Motor Oil (EPA 8015B) TPH Diesel (EPA 8015B) VOCs (EPA 8260B) | No results exceeded the 40 CFR, Part 261.20 criteria defining a hazardous waste. |
| DAC-D019 | D019 | Liquid | pH = 10.0 | pH (SM 4500 H+B) Total Cyanide (SM 4500-CN E) CA Title 22 Metals (EPA 6010B/7470A) Mercury (EPA 7470A) | No results exceeded the 40 CFR, Part 261.20 criteria defining a hazardous waste. |
| DAC-SS-001 | Septic Tank | Liquid | pH = 8 | pH (SM 4500 H+B) Total Cyanide (SM 4500-CN E) Amenable Cyanide (SM 4500-CN G) TPH Gas (EPA 8015B) TPH Diesel (EPA 8015B) TPH Motor Oil (EPA 8015B) SVOCs (EPA 8270C) VOCs and Fuel Oxygenates (EPA 8260B) | No results exceeded the 40 CFR, Part 261.20 criteria defining a hazardous waste. |
| DAC-SS-002 | Septic Tank | Liquid | pH = 8 | Total Cyanide (EPA 9010C/9014) Amenable Cyanide (SM 4500-CN G) CA Title 22 Metals (EPA 6010B/7470A) | No results exceeded the 40 CFR, Part 261.20 criteria defining a hazardous waste. |







Sample Location Map



Render Safe Operations

- On January 5, 2018, EPA, START, DTSC, K-VAC, and the FBI Bomb Squad mobilized to the Site to conduct render-safe operations on the lecture bottles discovered during DTSC's December 11, 2017 Removal Action deemed unfit for transportation by K-VAC.
- The FBI Bomb Squad prepared the lecture bottles and conducted two render-safe operations destroying all the lecture bottles.
- START conducted documentation and air monitoring throughout the render-safe operations.







General Air Monitoring and Sampling Guidelines

ERT SOP # 2008

Provides guidance in developing and implementing sampling plans to assess the impact of hazardous chemicals on ambient or indoor air.



STANDARD OPERATING PROCEDURES

SOP: ERT-PROC-2008-20

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GENERAL AIR MONITORING AND SAMPLING GUIDELINES

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 - A - Portable Screening Devices and Specialized Analytical Instruments

Scope and Application



- SOP covers a standard approach to air sampling and monitoring
- Air sampling and monitoring may be used to document air impacts during specific time periods such as during cleanup operations.
- Air sampling and air monitoring procedures may be varied or changed as required by site conditions.

General Description

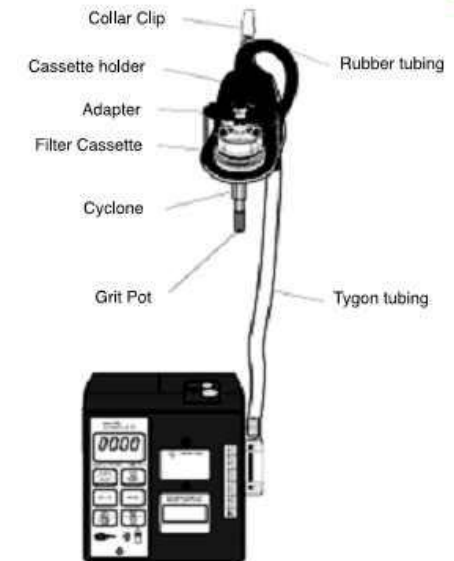
Air Monitoring

The use of direct-reading instruments to produce real-time data



Air Sampling

The use of air sampling equipment (pumps, filters, SUMMA canisters) to collect samples for laboratory analysis



Interferences and Potential Problems



- Upwind sources can contribute to sample concentrations
- Man-made sources (burning of fossil fuels, diesel emissions, smoke stacks) may contribute to contaminant level.
- Air monitoring and air sampling stations should be strategically placed to identify contributing sources.

Interferences and Potential Problems (Continued)



- Specific COCs may require special handling or preservation. Refer to each analytical method.
- Environmental factors such as humidity, temperature, and pressure can impact air sampling and air monitoring efficiency and detection limits.

Air Monitoring Design



Initial Survey

- Relatively rapid screening process to collect preliminary data, usually using hand-held devices.
- May be used to identify hotspots, determine PPE levels, establish work areas, and identify areas for more thorough analysis using air sampling.
- When warranted, intrinsically safe or explosion-proof instruments should be used.
- Typically includes an instrument capable of broad-spectrum measurement of VOCs.

Air Monitoring Design

On-Site Monitoring

- Continuous program is established to monitor ambient air as site activities and weather conditions change.

Off-Site Monitoring

- Typically, perimeter monitoring is conducted with the same instruments as on-site monitoring
- Provides useful information on pollutant migration.
- Upwind and downwind locations



Air Sampling Design

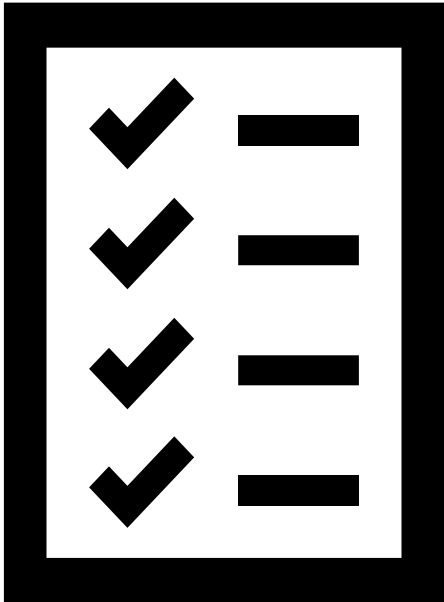
Overview



- Goal: Accurately assess impact of contaminant source(s) on ambient air quality.
- Quantify impact as average and/or maximum concentrations of contaminant during the time period of concern.
- May be affected by the transport and release of on- and off-site sources.
- It is important to establish background levels of contaminants in order to develop a reference point from which to evaluate the source data.
- Sampling strategy should be formulated based on the sampling program objectives.

Air Sampling Design

General Considerations



- Location of stationary as well as mobile sources
- Analytes of concern
- Analytical reporting limit to be achieved
- Rate of release and transport of pollutants from sources
- Availability of space and utilities for operating sampling equipment
- Meteorological monitoring data
- Meteorological conditions in which sampling is to be conducted
- Budget

Air Sampling Design

Air Sampling Objectives



- Sampling objectives should be determined before developing the sampling strategy.
 - Examples: Verify adequate PPE levels for on-site personnel; address potential off-site impacts/off-site migration

Air Sampling Design

Assumed Sampling Conditions



Sampling strategy is affected by the assumed sampling conditions.

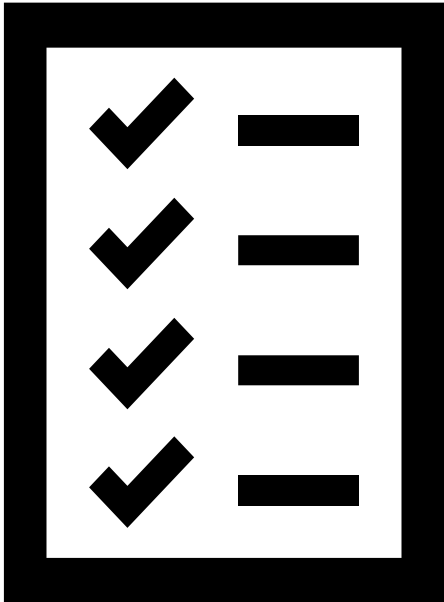
- *Typical*: Routine daily/scheduled sampling at pre-established locations.
- *Worst Case*: Sampling conducted under meteorological and/or site conditions that have the greatest potential to result in elevated concentrations.
- *One-Time*: Sample is collected at one time. May not be accurate for estimating the air impacts during the rest of the time period of interest.

Air Sampling Design

Location and Number of Sampling Points

Design considerations include:

- Location of potential on-site emission sources
- Location of potential off-site emission sources upwind of the sampling locations
- Topographic features that affect the dispersion and transport of airborne toxic constituents.
- Large water bodies, which affect atmospheric stability and the dispersion of air contaminants.
- Roadways (dirt or paved), which may generate dust that could mask site contaminants.
- Vegetation, such as trees and shrubs, which stabilizes soil and retards subsurface contaminants from becoming airborne. It also affects air flow and scrubs some contaminants from the air.



Air Sampling Design

Time, Duration, and Frequency of Sampling Events



- The duration of the response action or the number of hours of site work per day inform the time, duration, and frequency of sampling.
- Sample collection duration and flow rate dictate the sample collection volume, which in turn affects the reporting limit for the analysis. (the larger the collection volume the more sensitive the analysis)
 - “Grab” samples are collected over a brief period of time, usually less than five minutes.
 - Average or integrated samples are collected over a long period of time and provide an average concentration over that period.



Air Sampling Design

Time, Duration, and Frequency of Sampling Events (Continued)



Other design considerations:

- The effects of site activities and meteorology on emission rates
- The diurnal effect of the meteorology on downwind dispersion
- The time period(s) of concern as defined by the sampling objective
- The variability in the impact from other non-site-related sources
- Cost and other logistical considerations

Air Sampling Design

Meteorological and Chemical/Physical Considerations



- A meteorological monitoring program is an integral part of site monitoring activities.
- May be available from an existing station near the site (often at local airport) or a station may be set up on site.
- Physical/chemical characteristics of the contaminant affect its behavior, as well as the sampling method.

Air Sampling Design

Meteorological Considerations (Continued)



- Wind speed: Affects the quantity of particulate that may become airborne, the distance the particulate will travel, as well as the volatilization rate of contaminants from liquid sources.
- Wind direction: Influences the path of airborne contaminants.
- Temperature: Higher temperature increases the volatilization rate of certain compounds.
- Humidity: High humidity affects water-soluble chemicals and particulates.
- Atmospheric pressure: May affect migration of gases through landfill surfaces or upward from shallow aquifers.
- Daily variations in local meteorology affect dispersion of airborne contaminants.

Air Sampling Design

QA/QC Samples



Most commonly collected QA/QC air sample types include:

- Collocated samples (duplicates)
- Background samples
- Field blanks
- Trip blanks
- Lot blanks



Summa Canister Sampling

SERAS SOP 1704

Describes the procedure for the sampling of VOCs in ambient air using SUMMA or equivalent passivated stainless-steel canisters.



STANDARD OPERATING PROCEDURES

SOP: 1704
PAGE: 1 of 11
REV: 1.0
EFFECTIVE DATE: 11/16/15

SUMMA CANISTER SAMPLING

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- 13.0 APPENDICES

A - Typical Reporting Limits for Volatile Organic Compounds
B - Air Sampling Worksheet - SUMMA*

SUPERSEDES: SOP #1704; Revision 0.1; 07/27/95, US EPA Contract No. 68-C4-0022

Sample Preservation, Containers, Handling and Storage



- Determine holding times for target analytes before sampling.
- Store canisters in a cool dry place and protect from dents/puncture during transport.
- After sampling, identification tag is attached to the canister before transport to the laboratory.

Interferences and Potential Problems



- Canisters and other sampling equipment (flow controllers) must be cleaned before use.
- Do not overtighten valves.
- Do not sample during rainy weather- may clog the flow controller.

Equipment/Apparatus



- Sampling inlet line (optional) - Teflon tubing to connect the sampler to the environment being sampled.
- SUMMA canister - leak-free stainless steel pressure vessels of desired volume with valve and electropolished interior surfaces, certified clean by the laboratory for the analytes of interest and leak checked.
- (Optional) Particulate matter filter, 2- μ m sintered stainless steel in-line filter.
- Mass flow controller, fixed orifice, capillary or adjustable micro-metering valve for grab samples or time-integrated samples.
- Vacuum gauge, to record canister vacuum in inches of mercury.
- Flow meter to verify orifice flow rates.

Sampling Procedure

Grab Samples



1. With a 9/16" wrench, remove the brass fitting from the top of the canister.
2. Attach the vacuum gauge to the canister and open the canister valve.
3. Verify and record the "Initial" reading of the evacuated SUMMA canister.
4. Ensure that the canister valve is fully closed before removing the vacuum gauge.
5. Place the SUMMA canister in desired location. If sampling from a vapor stream, connect inert tubing to canister sampling port.
6. Open sampling valve by turning knob counter-clockwise until the knob moves easily.
7. An audible "hiss" may indicate that sampling has initiated. When the hissing stops, close valve and replace cap. Sample duration should be approximately 10 to 30 seconds.
8. Document sample collection information, including sample ID, SUMMA #, start pressure, and ending pressure.



Sampling Procedure

Time-Weighted Average Samples



1. With a 9/16" wrench, remove the brass fitting from the top of the canister.
2. Attach the vacuum gauge to the canister and open the canister valve.
3. Verify and record the "Initial" reading of the evacuated SUMMA canister.
4. Ensure that the canister valve is fully closed before removing the vacuum gauge.
5. Check the flow rate of the orifice using a certified flow meter or a rotameter that has been checked against the primary flow meter.
6. Attach the flow controller to the top of the canister. Start the fitting by hand to avoid cross threading, then tighten firmly with a wrench.
7. Open the valve on the canister counter clockwise and record the "start" time.



Sampling Procedure

Time-Weighted Average Samples (Continued)



8. Monitor sampling progress periodically.
9. At the end of the sampling period, close the valve on the canister by turning clockwise until hand tight. Record the “end” time. While the ideal reading on the can gauge should be slightly negative, the actual can pressure will be tested with a calibrated gauge at the laboratory.
10. Remove the flow controller.
11. Replace the brass fitting on top of the canister.
12. Record the final vacuum of the canister and document sample collection information, including sample ID, SUMMA #, start pressure, ending pressure, total time.

Sampling Procedure

Typical Sampling Documentation Fields

Sample ID

Location ID

SUMMA #

Orifice ID

Start Pressure &
Gauge Serial #

End Pressure &
Gauge Serial #

Flow Rate
(Start)

Flow Meter

Analysis/Method

Time (Start)

Time (Stop)

Total Time



Calculations

- Flow control device is chosen to maintain a constant flow over the desired sampling period.
- Flow rate is calculated as:

$$F = \frac{(P)(V)}{(T)(60)}$$

where:

F = flow rate (cc/min)

P = final canister pressure, atmospheres absolute (1 for atmospheric, non-pressurized sampling)

V = volume of the canister (cm³)

T = sample period (hours)





Charcoal Tube Sampling

ERT SOP # 2103

Describes the procedure for the use of charcoal tube sampling to identify specific contaminants in ambient air.



STANDARD OPERATING PROCEDURES

SOP: 2103

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REV: 1.1

EFFECTIVE DATE: 06/30/17

CHARCOAL TUBE SAMPLING IN AMBIENT AIR

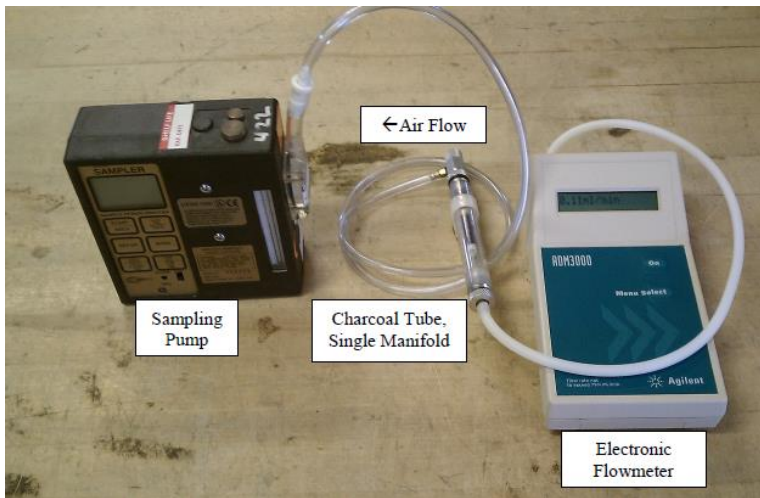
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 - A - Figures

SUPERCEDES: SOP #2103; Rev. 1.0; 04/04/16; U.S. EPA Contract EP-W-09-031

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Scope and Application



- Check the analytical method for the target analyte to see if charcoal tube sampling is applicable.
- Method applies to almost any tube sample.
- Activated charcoal is most selective toward non-polar organic solvent vapors, such as carbon tetrachloride, toluene, chlorobenzene.
- Organic compounds that are in gaseous form at room temperature, reactive, polar, or oxygenated are either not adsorbed or inefficiently desorbed.

Sample Preservation, Containers, Handling, and Storage



- Tube ends are broken off before sampling and capped after sampling.
- Place sample in re-sealable plastic bag.
- Cool sample to 6 degrees Celsius before storing or shipping to the laboratory.
- Maximum recommended holding time is 2 weeks.

Interferences and Potential Problems



- Low sampling rates, high temperature, and high humidity can decrease the adsorption capacity of the activated carbon.
- Contaminants may break through the tube or migrate through the tube over time.
- Breakthrough refers to the contaminant moving through the tube and eventually escaping from the tube as air continues to flow through the tube.

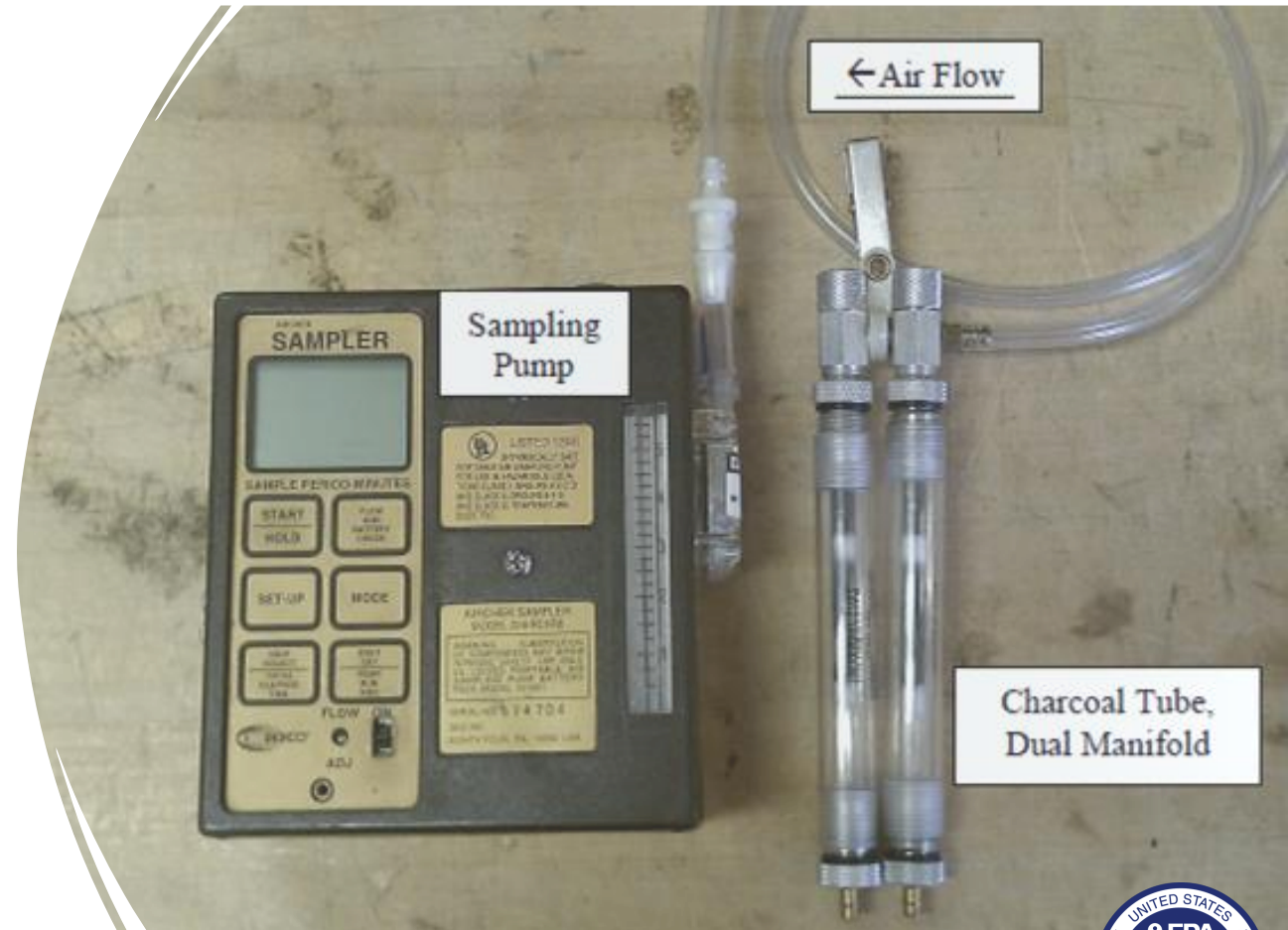
Calibration Procedures

- Sampling pumps should be calibrated to the desired flow rate using a flow meter before sampling.
- Assemble the sampling train and connect it to the sampling pump for calibration. Insert a representative charcoal tube.
- If the desired flow rate is not achieved, check the fittings, tubing, and the charcoal tube for damage, flaws, obstructions, and cracks.



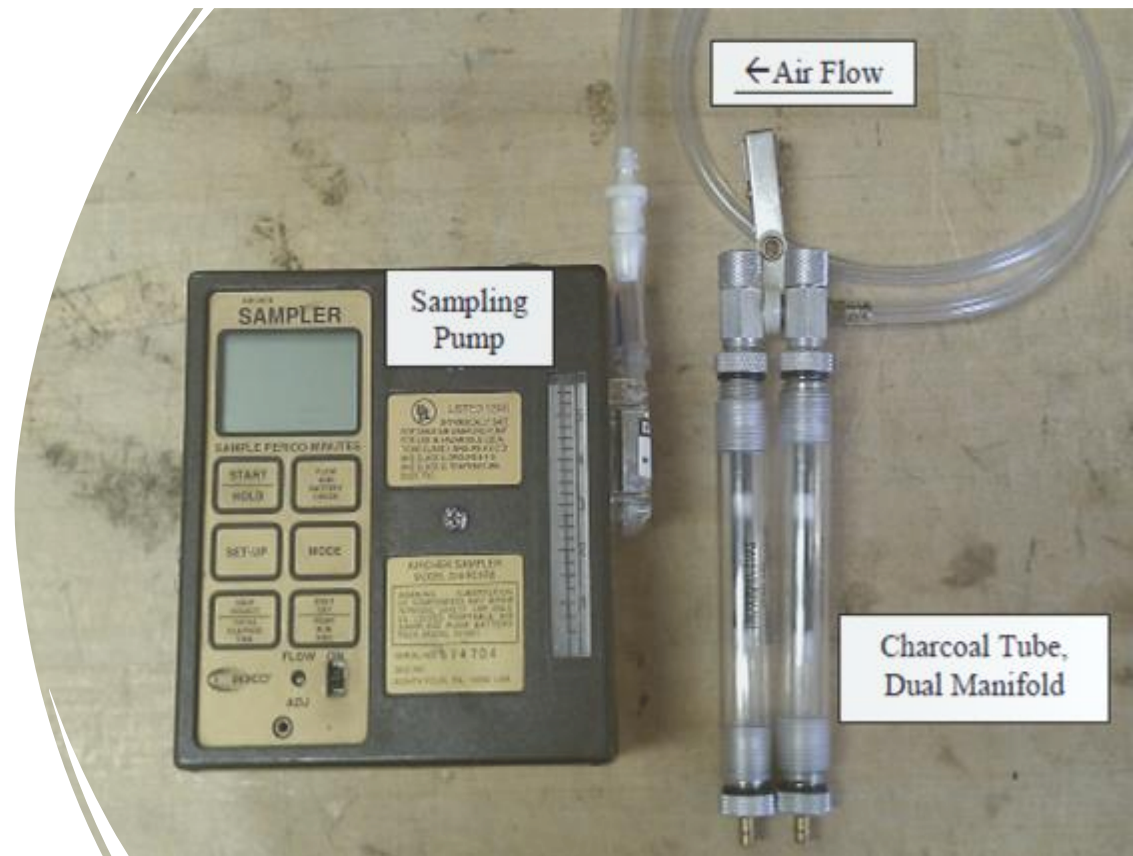
Field Operation Sampling Train

- Sampling train consists of the sampling pump connected to a charcoal tube in a protective housing via Tygon tubing.
- Charcoal tubes can be connected directly to the tube or in a manifold.
- Example of a sampling train is shown to the right.



Field Operation Procedure (Continued)

- Assemble the sampling train (the charcoal tube in protective housing, Tygon tubing, and sampling pump)
- Place the charcoal tube in the sampling position, with the sampling inlet facing downward at a 45-degree angle. This prevents intrusion of precipitation.

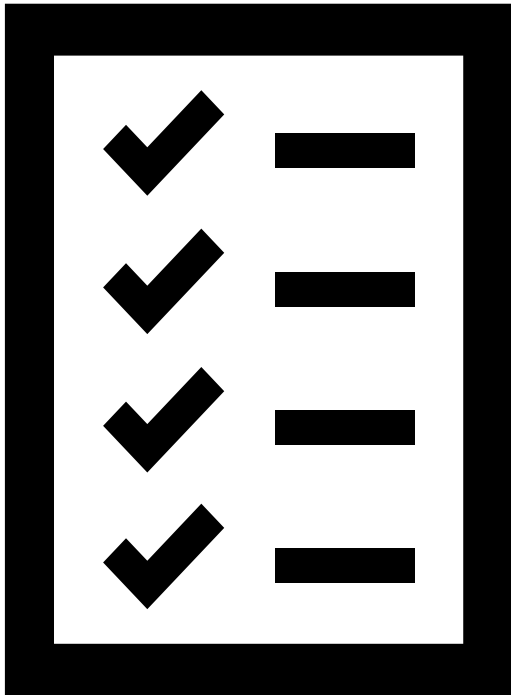


Field Operation Procedure (Continued)

- Record weather data (ambient temperature, barometric pressure, humidity, wind direction)
- Turn on the pump. After 1 minute, verify pump is running. Most faults occur during the first minute of operation.
- After sampling time has elapsed, check the pump display screen for elapsed time and any flow or battery fault messages.



Post Operation



- After sampling period is done, check the final flow rate using the rotameter or electronic flow meter.
- Note the final flow rate and any pump faults or malfunctions.
- Remove the charcoal tube from the protective housing and immediately cap with plastic caps.
- Place sample in a re-sealable sample bag and label.
- Store and transport samples on ice.

Sampling Procedure Documentation

- The following sample information should be gathered for each sample:



| | | | | |
|--------------------|----------------|-------------------|---------------|-----------------|
| Sample ID | Location ID | Pump # | Media | Analysis Method |
| Calibration Device | Time Start | Time Stop | Total Time | Pump Fault Y/N |
| Flow Rate Start | Flow Rate Stop | Flow Rate Average | Sample Volume | |

Quality Assurance/Quality Control



- Field Blanks: One per sampling event or per 20 samples. Field blank is treated the same as other samples (break, then seal in a bag and transport, do not draw air through it)
- Trip Blanks: One should be collected at the end of the sampling event. Trip blank is treated the same as other samples (break, then seal in a bag and transport, do not draw air through it)
- Collocated Samples: One per sample event or per 10 or 20 samples. Collocated samples are collected at the same location with the same flow rate and at the same time.
- Lot Blanks: Include one per manufacturer's lot of tubes. Lot blanks are taken directly from the box, without breaking the ends.



Asbestos Air Sampling

ERT SOP # 2015

Outlines procedures 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.



STANDARD OPERATING PROCEDURES

SOP: ERT-PROC-2015-20

PAGE: 1 of 25

REV: 1.1

EFFECTIVE DATE: 06/18/20

ASBESTOS AIR SAMPLING

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 - 3.2 Sample Handling, Container and Storage Procedures
- 4.0 INTERFERENCES AND POTENTIAL PROBLEMS
 - 4.1 Filter Preparation Methods
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 - 7.2.1 Calibrating a Personal Sampling Pump with a Rotameter
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 - 7.3 Meteorology

Scope and Application

Background



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- Asbestos is a carcinogenic, naturally occurring fibrous mineral.
- It has been used in building materials such as flooring tiles, paints, coatings, insulation, and roofing asphalts.
- Hazardous waste sites may contain ACM (asbestos containing material) in pipes, drums, piles, or in building materials.
- Air sampling is necessary to assess the potential for airborne exposure as part of a human health risk assessment.
- Asbestos is regulated by NESHAP and OSHA.

Scope and Application

Analytical Methods: PCM



Phase Contrast Microscopy (PCM)

► *Method Numbers: NIOSH 7400, ASTM D7201-06, ISO 8672:2014*

- Less costly than TEM
- Usually used as a screening tool
- Can be used to estimate asbestos concentrations
- Cannot distinguish between asbestos and non-asbestos fibers; all particles meeting the counting criteria are counted as total asbestos fibers.

Scope and Application

Analytical Methods: TEM



Transmission Electron Microscopy (TEM)

- More costly than PCM
- Can distinguish between asbestos and non-asbestos fibers
- Sometimes used to confirm PCM analytical results

Direct TEM Method:

- ▶ *Method Numbers: NIOSH 7402, ISO 10312,*
- Direct methods may yield an under-estimate of asbestos concentration, because other particulates may conceal some of the asbestos fibers.

Indirect TEM Method:

- ▶ *ISO 13794, ASTM D700-12*
- Indirect methods may over-estimate the asbestos concentration because some types of complex asbestos structures will disintegrate during the preparation, resulting in an increase in the number of fibers.

Sample Preservation, Containers, Handling, and Storage



- No preservation is necessary.
- Store cassettes in individual, no-static bags or manila envelopes. In low humidity conditions, plastic bags can develop a static charge that may affect the particle distribution of the filters.
- After sampling, pack the cassettes vertically in a rigid-walled container and add packing material to prevent jostling or damage (you can use the original cassette box).
- Handle cassettes carefully to avoid disturbing the dust deposited on the filters.

Interferences and Potential Problems



- Use a flow rate within the recommended range for your chosen method.
- Take care not to overload the filter with background dust.
- If more than 20-25% of the filter is covered with particles (overloaded), the measured concentration may be biased or the filter may be too overloaded to count.

Asbestos Air Sampling Overview

- Known volume of air is drawn through a mixed cellulose ester (MCE) filter, which is sent to a laboratory for analysis.
- Place sampling stations to support evaluation of the airborne asbestos concentrations through space and time.
 - Worst case: near the source
 - Area of concern: downwind
 - Background areas: upwind
 - Crosswind areas
- Monitor and record wind speed and direction.



Sampling Procedure

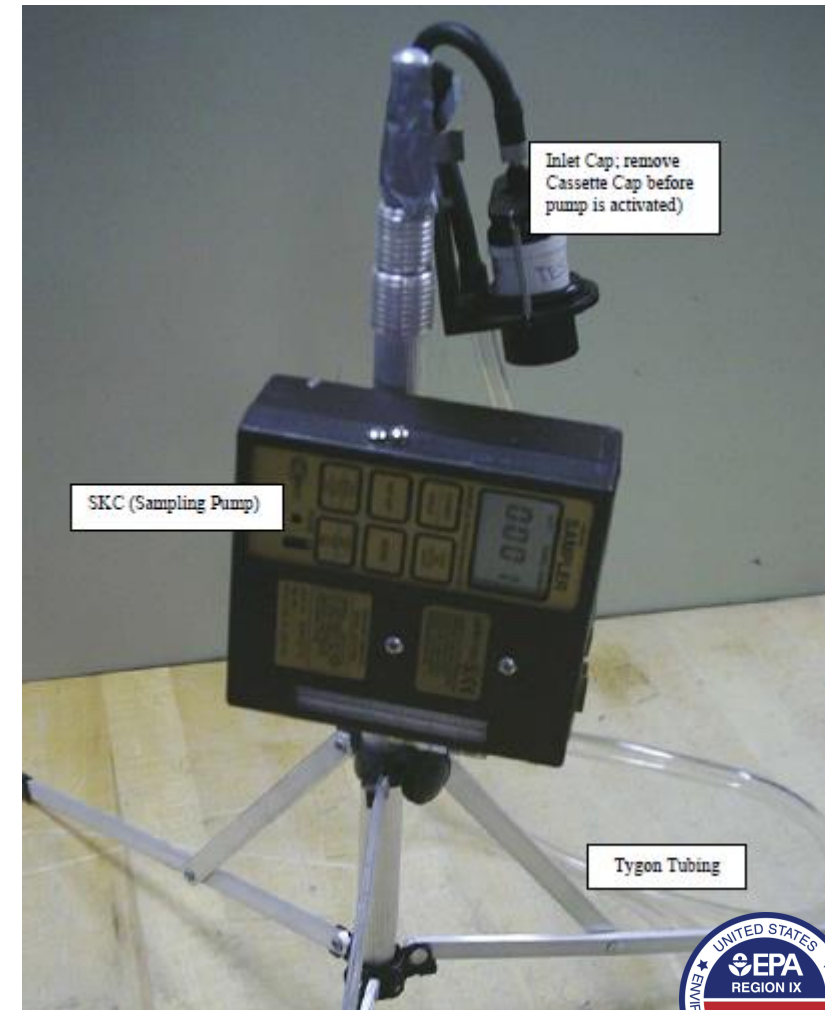
Pump Calibration

- Calibrate each sampling pump before and after sampling.
- Pre-sampling calibration
 - Calibrate the pump to the desired flow rate with a representative filter between the pump and calibrator.
- Post-sampling calibration
 - Note the flow rate of the pump through the used filter.
 - If the flow rate changes by more than 5%, the average of the pre- and post-flow rates will be used to calculate the total sample volume.



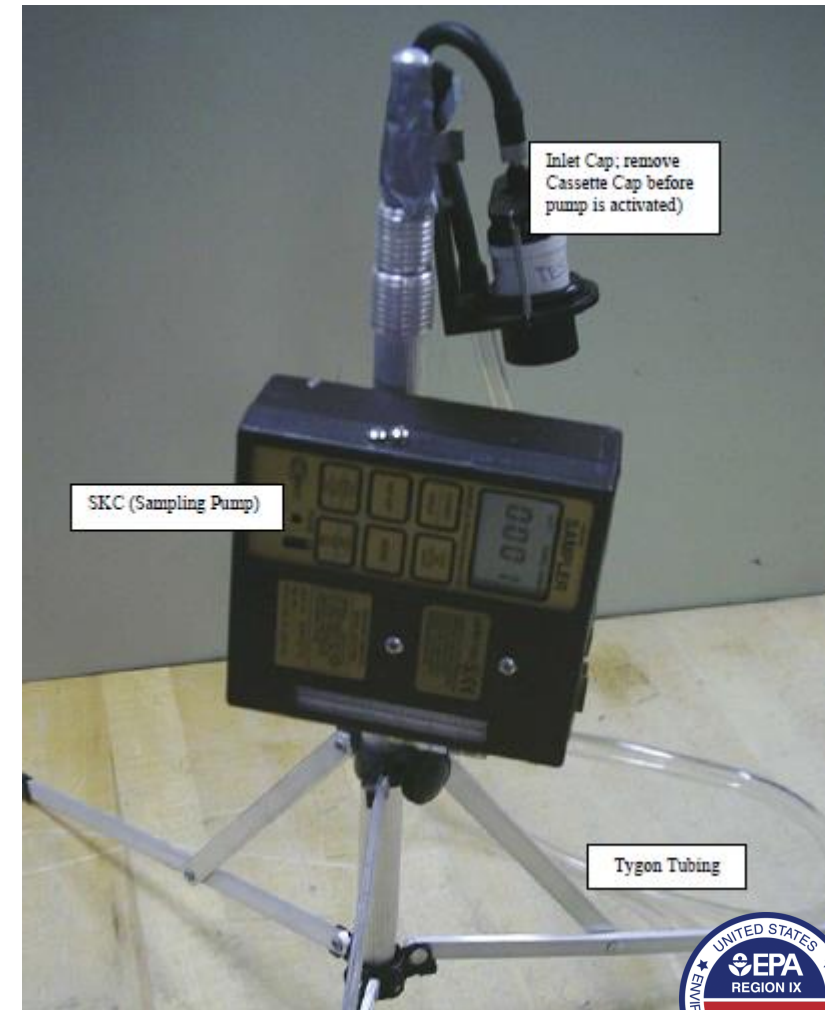
Sampling Procedure

- Determine the desired flow rate based on the analytical method, expected exposure level, and total time the sample is expected to run.
 - 1-4 L/min is appropriate for 8-hr samples in non-dusty atmospheres under the OSHA permissible exposure limit (PEL) of 0.1 fibers per cc.
 - For dusty atmospheres, lower flow rates or less time may be required.
 - For shorter period exposures, use high flow rates (7-16 L/min).
 - For relatively clean atmospheres (< 0.1 fibers per cc), collect a larger sample volume (3000-10,000 L).
- Calibrate the pump to the chosen flow rate.



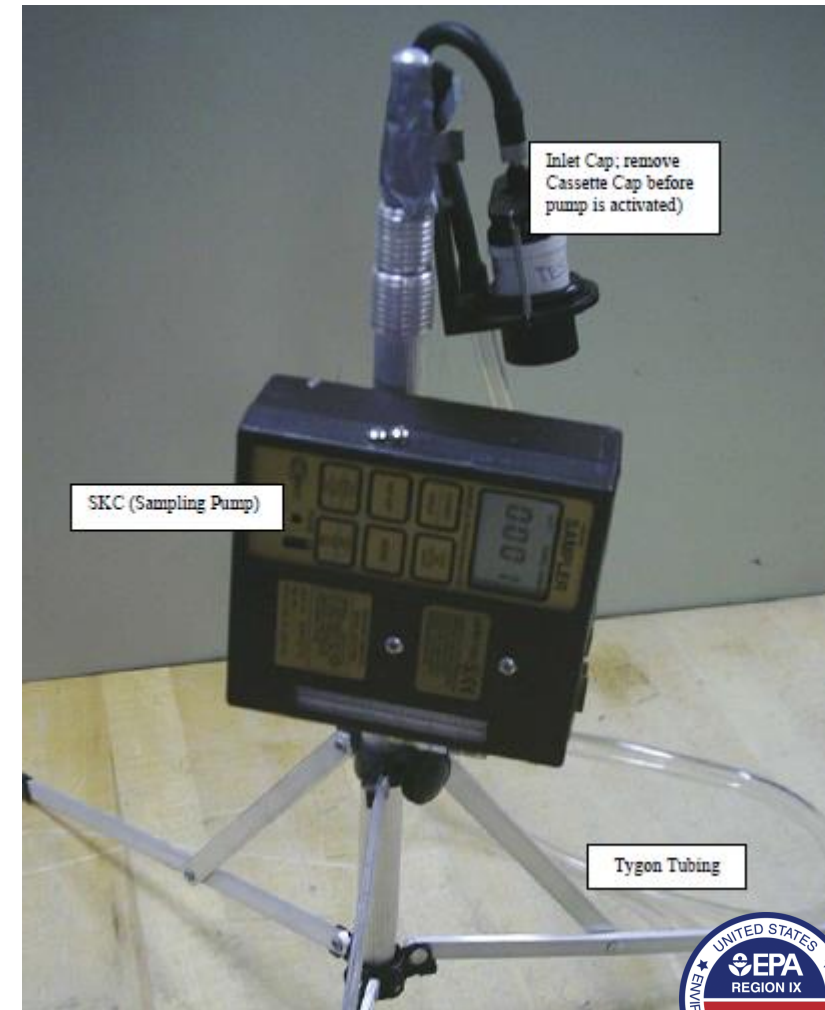
Sampling Procedure (Continued)

- Deploy the pump. Position the filter cassette to point downward or at a 45-degree angle.
- Check the sample at the mid-point if the duration is longer than 4 hours. If a filter darkens or has visible loose dust, a second sample should be started.
- At the end of the sampling period, orient the cassette up and turn off the pump. Check the final flow rate.
- Remove the tubing and replace the caps on the cassette inlet and outlet.



Aggressive Air Sampling

- Usually for indoor air sampling, for a quick characterization of a worst-case situation.
- During static/normal sampling, many fibers may settle out of the air onto the floor and other surfaces and may not be captured on the filter.
- Method utilizes forced air (leaf blower, large fan) directed towards surfaces in the room. Takes 5 minutes per 1,000 square feet.
- Then, place a 20-inch fan in the center of the room and point it toward the ceiling. Leave it on the low setting for the sampling duration.
- Collect the sample as normal.



Sampling Procedure Documentation

- The following sample information should be gathered for each sample:



| | | | | |
|--------------------|----------------|-------------------|---------------|-----------------|
| Sample ID | Location ID | Pump # | Media | Analysis Method |
| Calibration Device | Time Start | Time Stop | Total Time | Pump Fault Y/N |
| Flow Rate Start | Flow Rate Stop | Flow Rate Average | Sample Volume | |

Quality Assurance/Quality Control



- Field Blanks: Field blank is treated the same as other samples, except that no air is drawn through it.
- Lot Blanks: Include one per manufacturer's lot of tubes. Lot blanks are taken directly from the box, without removing the caps.
- Some samples can be relabeled and resubmitted under a different sample ID for recounting and comparison.
- Laboratory can analyze reference filters, which have known asbestos concentrations.



Air Sampling for Metals

ERT SOP 2119

This SOP defines the proper sample collection technique for air sampling of elemental metals



STANDARD OPERATING PROCEDURES

SOP: ERT-PROC-2119-20

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EFFECTIVE DATE: 10/19/20

AIR SAMPLING FOR METALS

[Based on NIOSH Method 7303. Elements by ICP (Hot Block/HCl/HNO₃ Digestion)]

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Scope and Application



- SOP is based on NIOSH Method 7303, which outlines the air sampling method for elemental metals.
- Sampling volumes and flow rates depend on the target analytes.
- Filter cassettes are 37-mm, 3-stage pre-banded cassettes, pre-loaded with a 0.8 μm MCE filter.
- When sampling, the inlet plug can be removed; alternatively, the entire cassette cap can be removed for more even loading.
- Remove the cassette cap when higher particulate loads are expected.

Sample Preservation, Containers, Handling, and Storage



- No preservatives or special storage conditions required.
- Pack samples upright and prevent damage to the sampling cassettes.
- Avoid impacts and vibrations that may dislodge particulates from the filters.

Interferences and Potential Problems

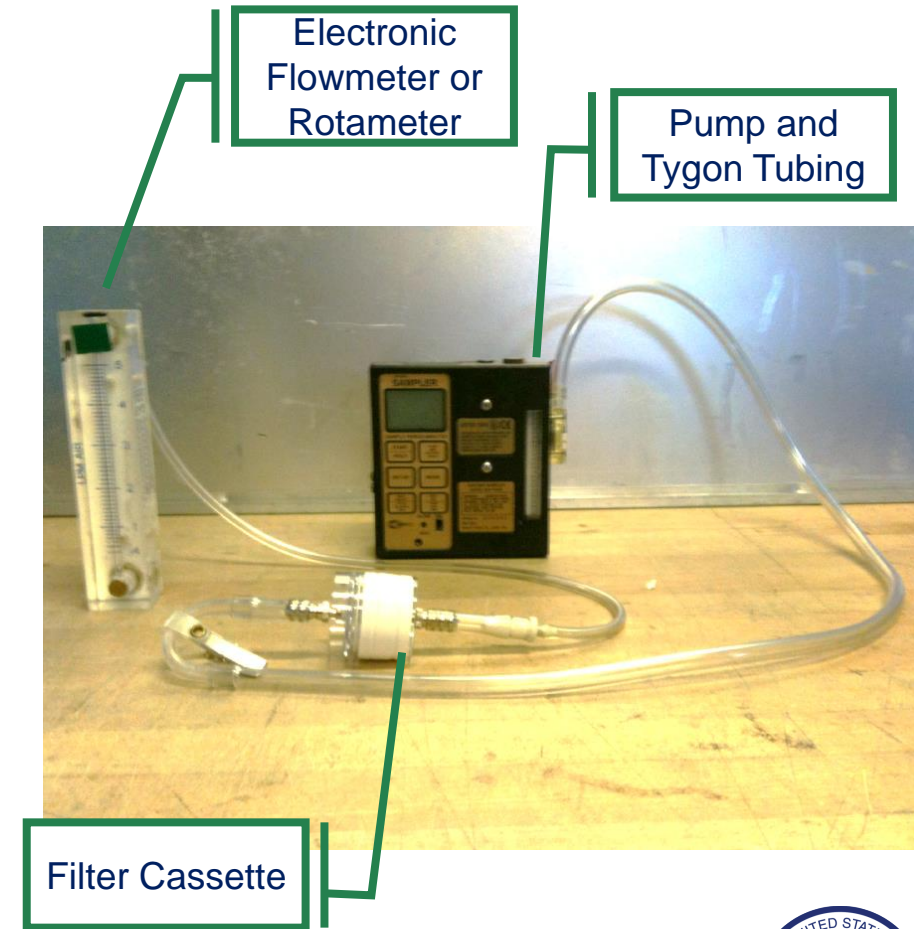


- Overloading the filter with particulate may disrupt air flow through the cartridge, producing results that are biased low.
- Check the filter periodically during sampling and change out the cassettes if necessary.
- Multiple filters can be submitted and analyzed as a single sample.

Sampling Procedure

Pre-Field Work Pump Calibration

- Determine the necessary flow rates and sample volumes.
 - Flow rates and sample volumes depend on the target analytes, expected concentrations, and analytical sensitivity. Check method for flow rates and sample volume ranges for each target analyte.
 - Calculate the sampling time using the flow rate.
- Assemble the sampling train as shown. Use a representative cassette for calibration; use a new cassette in the field.
- Calibrate each sampling pump using an electronic flow meter or calibrated rotameter.



Sampling Procedure

Field Operations

- Assemble the sampling train with a new, clean cassette.
- Verify pump calibration to the desired flow rate and note the flow rate.
- Deploy the sampling pump and commence sampling.
- Set the pump timer for the sampling period.
- Check the pump after 1 minute. Most faults occur within the first minute of operation.



Sampling Procedure

Post Sampling



- After sampling period is finished, check the final flow rate using the rotameter or electronic flow meter.
- Note the final flow rate and any pump faults or malfunctions.
- Remove the sampling cassette and replace the plugs on the sampling cassette.
- Place the sample in a Whirl-pak bag and label.

Sampling Procedure Documentation

- The following sample information should be gathered for each sample:



| | | | | |
|--------------------|----------------|-------------------|---------------|-----------------|
| Sample ID | Location ID | Pump # | Media | Analysis Method |
| Calibration Device | Time Start | Time Stop | Total Time | Pump Fault Y/N |
| Flow Rate Start | Flow Rate Stop | Flow Rate Average | Sample Volume | |

Quality Assurance/Quality Control



- Field Blanks: One per sampling event. Field blank is treated the same as other samples, except that no air is drawn through it.
- Collocated Samples: One per 20 samples. Collocated samples are collected at the same location with the same flow rate and at the same time.
- Lot Blanks: Include three per manufacturer's lot of cassettes. Lot blanks are taken directly from the box, without removing the caps. May also be used by the laboratory for blank spike/blank spike duplicate analysis.



Bio Agent Sampling

ERT SOP 2211

This SOP describes the method for Biological Agent Environmental Response Sampling following an intentional or accidental release.



STANDARD OPERATING PROCEDURES

SOP: 2211
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BIOLOGICAL AGENT ENVIRONMENTAL RESPONSE SAMPLING

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| A | Sampling Design |
| B | Recommended Equipment for Microbiological Environmental Sampling |

NEW SOP: SOP #2211, Rev. 0.0, 01/27/16, U.S. EPA Contract EP-W-09-031

Sample Preservation, Containers, Handling, and Storage



- Store and transport on ice in insulated coolers.
- Encase in triple packaging including:
 - Primary receptacle, e.g. sterile vial
 - Water-tight secondary packaging, e.g. self-sealing COC bag
 - Durable outer packaging e.g. sample cooler labeled
- Cooler requirements include:
 - Labeled “Infectious Substance”
 - Cooled with ice or ice packs. Double bag ice to prevent leaking.
 - Protects samples from damage during field activities or transit.
 - Protects samples from direct sunlight.
- Analyze ASAP, within 24-48 hours.
- Follow regulations regarding shipment of infectious materials.





Surface sample collection:

- Limited understanding of the efficiencies of sample collection, extraction, and recovery for surface sampling methods.
- Sampling results are open to interpretation- positive results may indicate a high concentration, while negative samples do not necessarily assure that the organisms are absent from the sampled area.

Decontamination



- Decontaminate using 10% bleach solution or pre-packaged bleach wipes.
- Minimum contact time should be at least 30 minutes, may be extended to 60 minutes for spore-forming microorganisms, for high contamination, cooler temperatures, and/or high organic matter.
- Wipe away any excess bleach after contact time has elapsed.
- Discard wipe material as contaminated waste.
- Equipment or materials may be autoclaved before disposal or re-use.

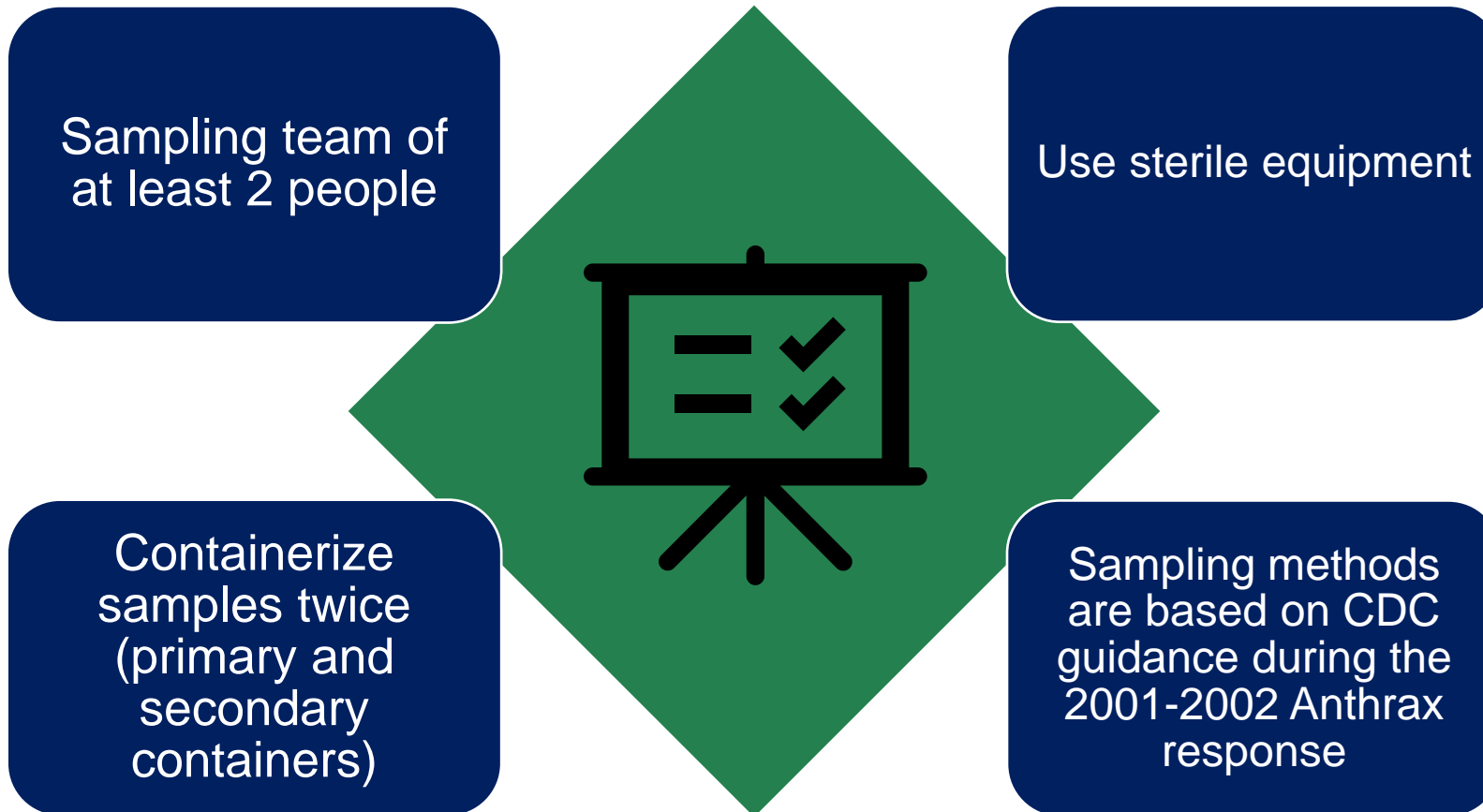
Bio-Agent Sample Collection



PPE Ensemble



Sampling Protocols



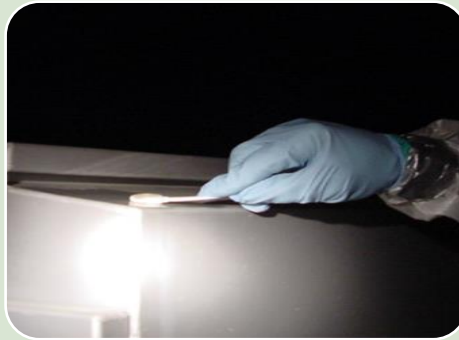
Type of Sampling



Wipe Sampling

Recommended for non-porous surfaces; glass, plastic, and metal surfaces.

Area size
100 cm² – 400 cm²



Swab Sampling

Recommended for non-porous surfaces; glass, plastic, and metal surfaces.

Area size
25 cm² – 100 cm²



Vacuum Sampling

Recommended for porous surfaces; carpet, concrete, asphalt, HVAC filters, etc.

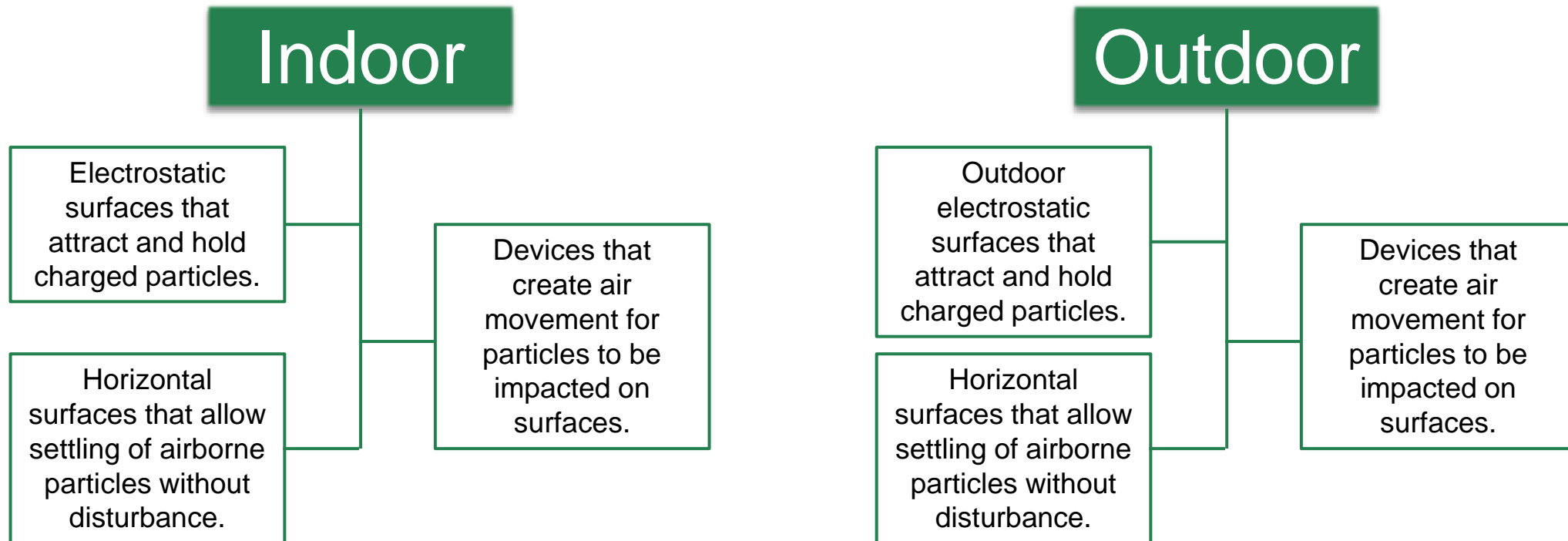
Large and small volume sampling



Air Sampling

Characterize the air concentrations of bio-agents; useful to evaluate if the bio-agent can re-aerosolize.

Sample Location Selection



Wipe Surface Sampling



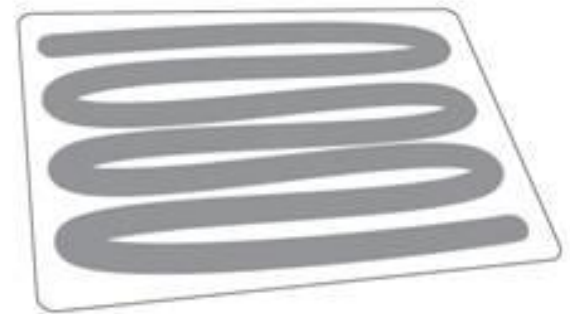
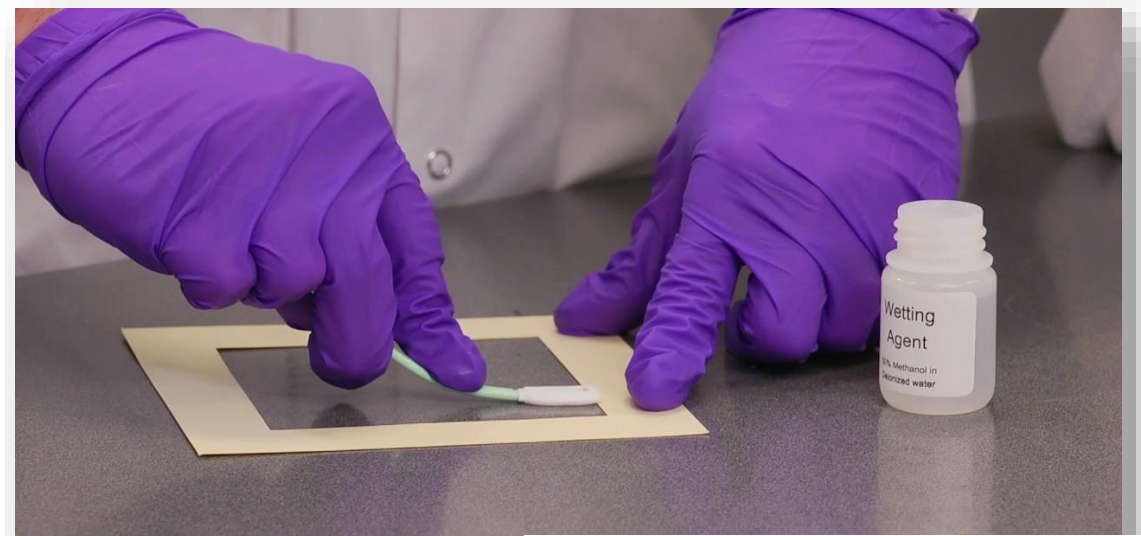
- Wipe sample area should be between 100 cm² and 400 cm².
- Remove a sterile 7.5 centimeters (cm) x 7.5 cm (3" X 3") synthetic gauze pad from package and moisten with sterile water.
- Wipe the surface thoroughly using several horizontal S-strokes, fold the exposed side of the pad, and make several vertical S-strokes over the selected surface area. Avoid letting the gauze pad dry completely but do not re-immerser or re-wet in sterile water.
- Place the sampled gauze in a sterile 50 ml conical vial and cap the vial.



Open wipe and dispose of wrapper

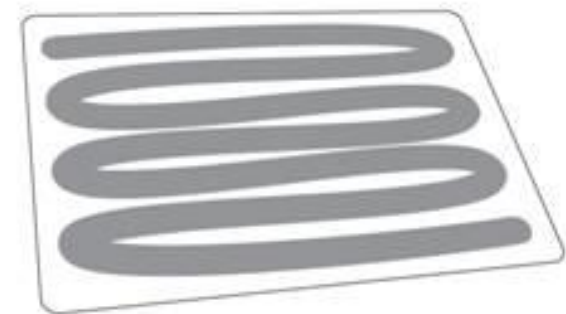
Swab Surface Sampling

- Swab sample area should be between 25 cm² and 100 cm².
- Remove a sterile swab from the package and moisten with sterile water. Swab the surface by rotating the swab to ensure that the entire surface of the swab is exposed.
- Make enough vertical S-strokes to cover the entire sample area (horizontal and vertical strokes).
- After collection, place the sampled swab in a sterile 50 milliliters (ml) conical vial and cap the vial. If the swab is too long, snap or cut off the end of the swab with sterile scissors after the sampled part of the swab is in the sterile conical vial, maintaining integrity of swab portion.



Vacuum Surface Sampling (Filter cassette)

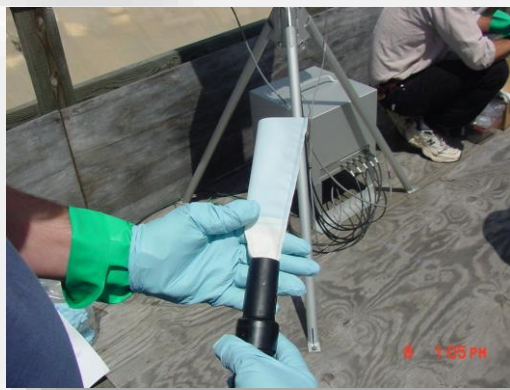
- Cut a 1" length of 1/4" Tygon® tubing, cut one end flat, and the other at a 45° angle.
- Calibrate the sampling train at 10 to 12 liters per minute (LPM).
- Determine sample area to be vacuumed. Vacuum area should be between 100 cm² and 400 cm².
- Remove the cap from the filter cassette, attach the 1" x 1/4" Tygon® tubing flat end to the filter inlet, and start the pump.
- Using the 45° angle cut end of the tubing, vacuum the surface thoroughly using horizontal and vertical S-strokes over the selected surface area.
- After the sample is collected, turn off the pump, replace the cap, and remove the filter cassette from the sampling train.



Vacuum Surface Sampling (Bag Filters)



- Inspect and calibrate the HEPA sampling train at 500 to 1,200 liters per minute (LPM).
- Determine sample area to be vacuumed. Vacuum area should be between 100 cm² and 400 cm².
- Remove the bag filter from its plastic bag, insert the closed end into the hose leaving about 2 inches outside. Open the exposed end and pull back to wrap around the hose. Be sure to securely hold the bag in place or use a rubber band to secure the bag in place around the hose.
- Turn on the vacuum, vacuum the surface thoroughly using horizontal and vertical S-strokes over the selected surface area.
- After the sample is collected, turn off the vacuum, remove the bag, reclose the open-end of the bag, and place inside the plastic bag the filter came in.



Class Exercise 3 – 5: Air and Bio Sampling

1. Set up air sampling train for carbon tube method and calibrate pump with sample train.
2. Set up air sampling train for metals and calibrate pump with sample train.
3. Using sample train for metals, convert into bio-sampling vacuum sample system and collect sample. Process sample using proper chain of custody.



Air Monitoring Equipment SOPs



Equipment SOPs

- VIPER and VIPER-Like Systems
- ERT SOP 2066 AreaRAE Pro Monitor
- ERT SOP 2139 MultiRAE Pro Monitor
- ERT SOP 2080 Operation of the Jerome J505
- ERT SOP 1729 Operation of the Lumex RA-915M Mercury Analyzer for Measuring Mercury Vapor



[Access ERT SOPs at EPA Website](#)



VIPER is a wireless network-based communication system to transmit data from field sensors to a computer or server for data management, visualization, and analysis.

LINC

- Hardware that connects to the instrument via a cable, and communicates wirelessly with a Gateway

Gateway

- Hardware that receives data from LINC's, and transmits to the survey controller software

Survey Controller

- Software that captures sensor readings and saves deployment runs

Deployment Manager

- Allows for viewing readings associated with a deployment run on the internet.



AreaRAE

- Multi-gas air monitoring equipment with removable/exchangeable sensor slots. Supported sensors include PID, LEL, Gamma Radiation, Oxygen, CO, H₂S, NO, HCN, HF, Cl₂.
- Review contaminant ionization potentials and correction factors for PID sensor.
- Remote telemetry via RAELink and ProRAE Guardian.
- Unit should be bump-tested and fresh-air calibrated each day before it is used. Instrument should be re-calibrated if it fails a bump test.



MultiRAE

- A handheld multi-gas air monitoring equipment with removable/exchangeable sensor slots. Supported sensors include PID, LEL, Gamma Radiation, Oxygen, CO, H₂S, NO, HCN, HF, Cl₂.
- Review contaminant ionization potentials and correction factors for PID sensor.
- Remote telemetry capable via RAELink.
- Unit should be bump-tested and fresh-air calibrated each day before it is used. Instrument should be re-calibrated if it fails a bump test.



Jerome J505 Mercury Vapor Analyzer

- In a 2020 report by EPA¹, Jerome 505 was found to meet the detection and sensitivity requirements to provide clearance at the ATSDR recommended level of 1 $\mu\text{g}/\text{m}^3$ for normal residential occupancy.
- Portable fluorescence spectroscopy analyzer with a detection range of 0.05 $\mu\text{g}/\text{m}^3$ to 500 $\mu\text{g}/\text{m}^3$ with a resolution of 0.01 $\mu\text{g}/\text{m}^3$.
- Three operation modes:
 - Search mode: for scanning an area to locate source of contamination
 - Quick: faster, medium resolution sampling
 - Standard: higher resolution sampling for clearance
- Data logging available on the instrument, up to 10,000 results.
- Autosamples at intervals from 1 to 120 minutes.
- Battery operation for 10 or more hours.



¹ US EPA, Office of Research and Development's Center for Environmental Solutions and Emergency Response, 2020. Portable Mercury Detector Testing and Evaluation Report, January 2020.



Lumex RA 915M Mercury Vapor Analyzer

- Real time detection of mercury vapor in air.
- Portable multifunctional atomic absorption spectrometer.
- Mercury detection limits 0.5 ng/m³ in air.
- Simple to operate, fully automated, self validating analyzer.
- Direct determination of mercury within 60 seconds. No sample preparation, no use of hazardous chemicals or bottled gases.
- Built-in performance verification test cell and auto zero function.
- 122 hours of data logging acquisition, averaging, and storage.
- Rechargeable battery for up to 12 hours



EPA Response Guides

Response guides include the following information for specific types for emergencies.

- Chemicals likely to be encountered
- Example equipment lists
- Quick-start guides for equipment
- Possible action levels for COCs
- Analytical methods for COCs
- SOPs for relevant field activities

Toxic Vapors

Electroplating

Pesticides
and Fertilizers

Oil Spill

Landfill

Mercury

Chemical Fire

Acid Spill

Tire Fire

Wildfire





Francis Street Fireworks Air Surveillance Case Study



Agencies Involved



Summary



1) An explosion in a residential neighborhood in Ontario, CA caused a secondary explosion of an outbuilding containing illegal fireworks and ammunition reloading supplies.



2) The explosions impacted the surrounding residential properties (~80 properties) and scattered unexploded and damaged fireworks over an approximate two-square-block area.



3) The Ontario Fire Department Bomb Squad performed controlled burns of the remaining scattered fireworks and explosives.



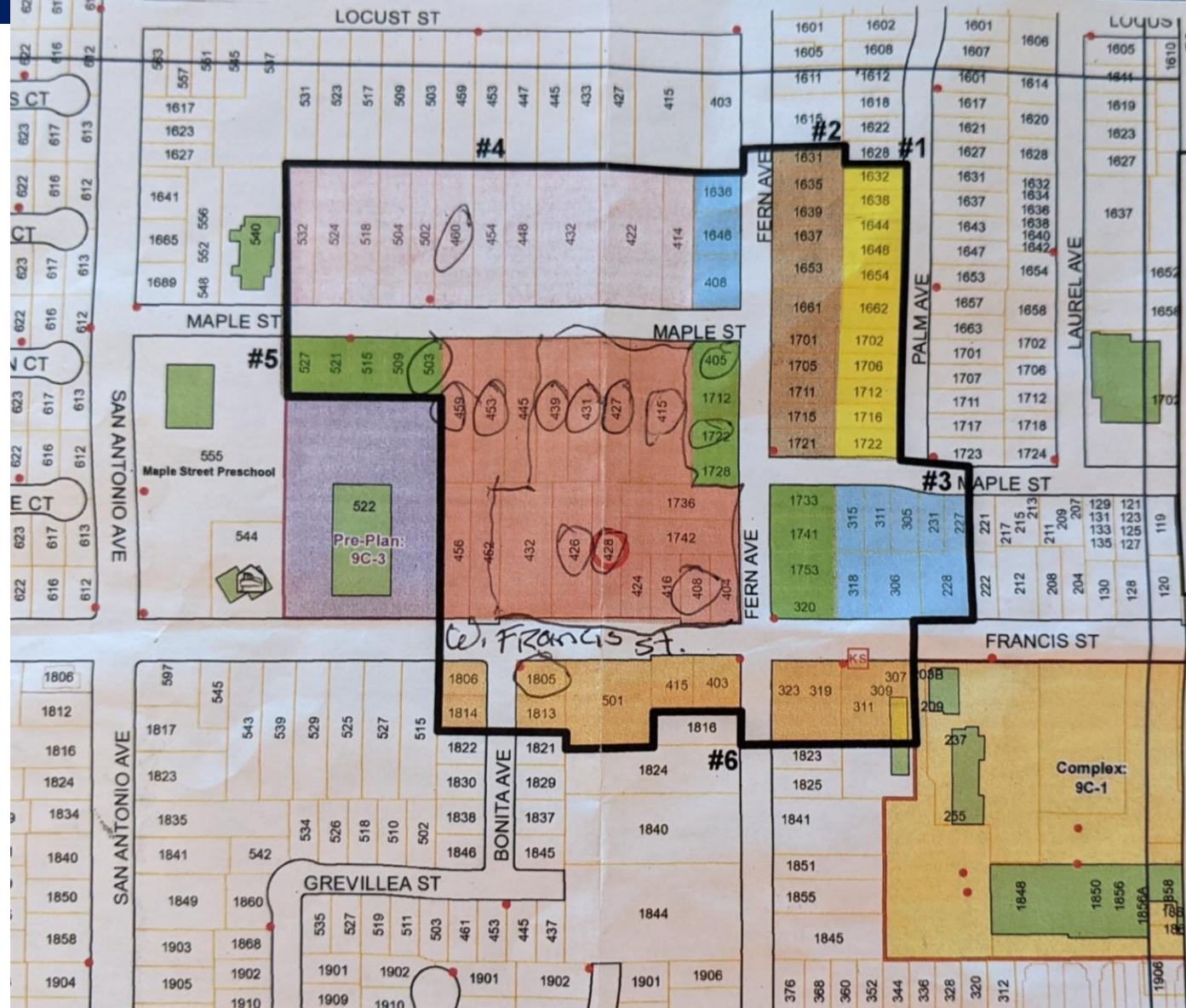
4) EPA performed pre-burn and post-burn soil sampling activities and while conducting co-located air monitoring and air sampling activities during the controlled burn activities.



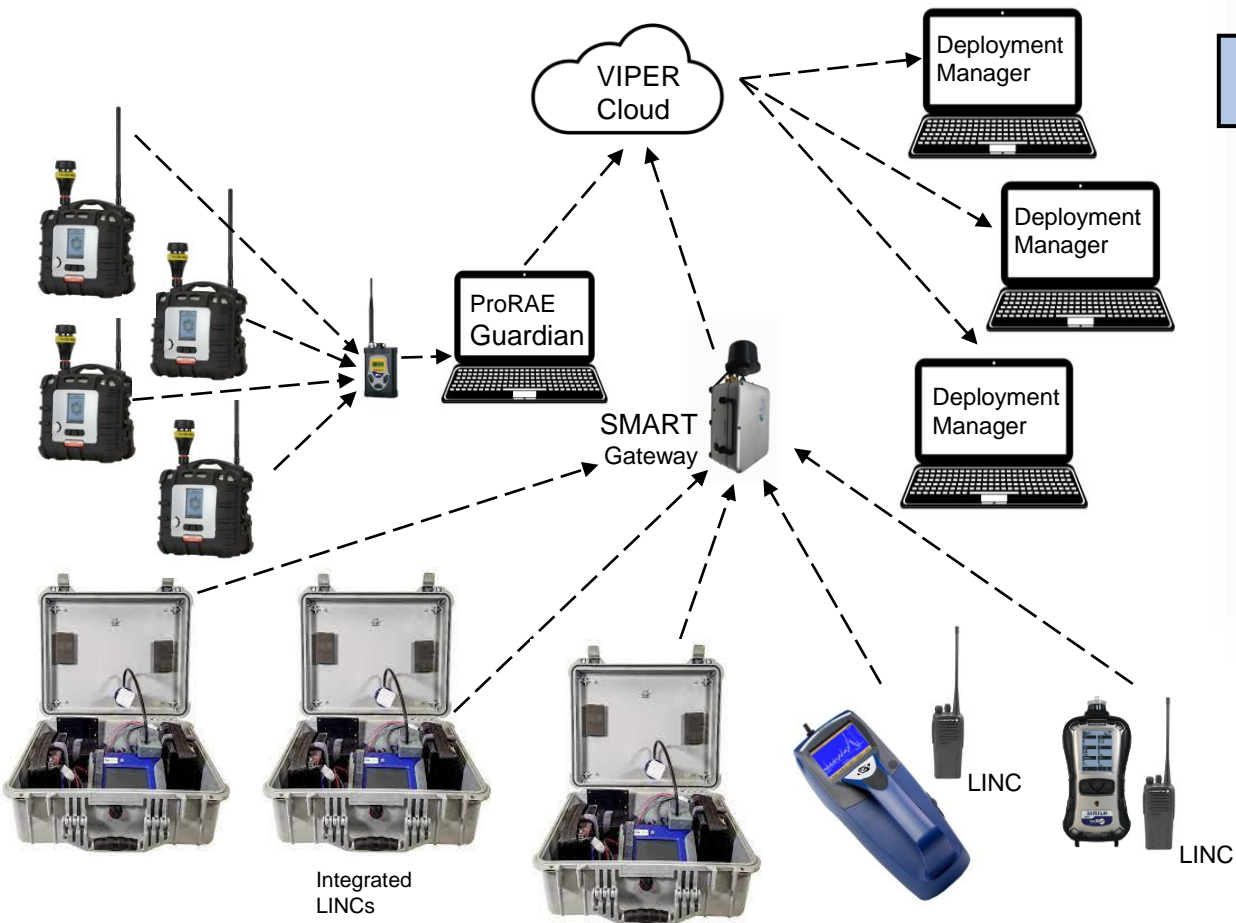
Evacuation Zone Map



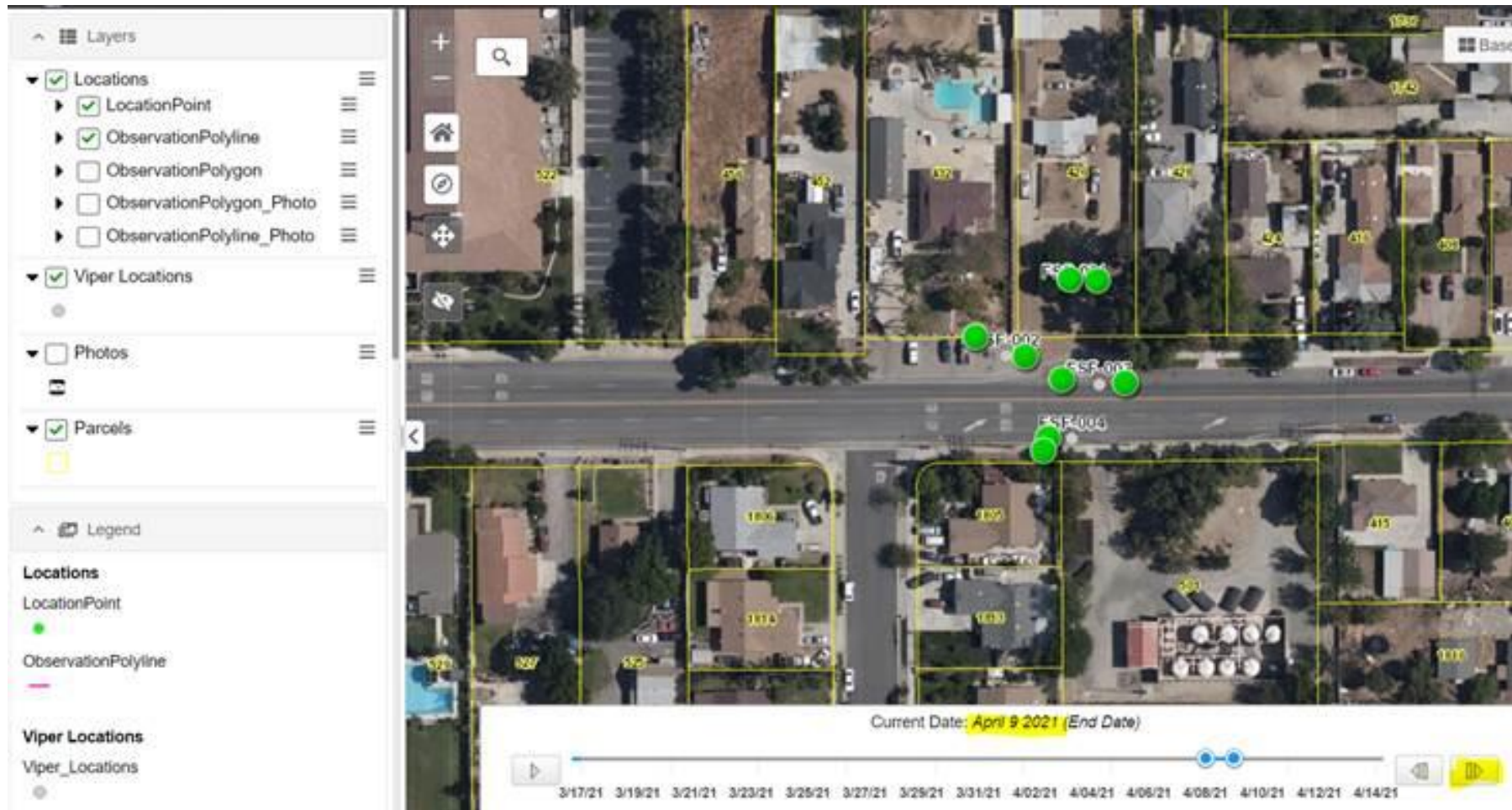
- Approximately 80 homes were evacuated for 2 days.
- The firework explosion was strong enough to cause foundation issues to nearby residential properties.
- Fireworks exploded for an approximately 7 hours.



Air Monitoring and VIPER



VIPER Live Run



Controlled burn of fireworks





VIPER Deployment and Reporting

Francis Street Fireworks Case Study and Common Obstacles

EPA Region 9
April 30, 2021

[Introduction](#)

[SSDMP](#)

[Data Set-Up](#)

[Equipment Deployed](#)

[Design and Placement](#)

[Co-Location of Sampling and Mo...](#)

[Signal Interference](#)

[Power Sources/Battery Life for...](#)

[Other Field Obstacles](#)



Building Structure Assessment



Walls

Floors

Ceilings

Roof

Structural Components

Objectives of Structural Assessment

Provide data for use to assess threats to public health, welfare and the environment

Provide data to evaluate and design demolition strategy

Provide data to determine the appropriate means of disposal for construction debris

Provide data to assess the need for an asbestos removal prior to demolition



Sampling Planning

1

Separate each matrix (i.e., floors, roof) into distinct sample populations and subpopulations

2

Use a combination of authoritative and random sampling to meet objectives

3

Assess structural safety concerns before entering building, climbing on buildings or collecting samples



Wipe Samples

- Dry Wall Surfaces
- Stucco Surfaces
- Floor Surfaces

Bulk Samples

- Dry Wall
- Floor Tiles
- Stucco
- Soil
- Insulation

Asbestos

Lead Paint

Module 8

Data Interpretation

Background Determination

- A background evaluation usually is considered when certain contaminants that pose risks and may drive an action are believed to be attributed to background.



Background Sampling Considerations

Natural variability of soil types

Operational practices

Waste type

Mobility of contaminant



When Background Samples Are Not Needed

A chemical release whose constituents are known and not expected to have been released to the environment from any source other than the site

Background levels of the constituents may not exceed risk-based cleanup goals



When Background Samples Are Needed

Constituents are expected on site and known to occur naturally or from other sources.

- Sites near agricultural land

Data gaps from historical data

- Insufficient number of samples
- Inappropriate sample locations

Reference Area

- An area where background samples will be collected for comparison with samples collected at the site
- Reference area should have the same/similar physical, chemical, geological, and biological characteristics as the site, but has not been affected by site activities



Established Background Data

- U.S. Geological Survey (USGS)
 - Soil Survey
- Soil Conservation Service (SCS)
- University studies
- Background samples results from other nearby CERCLA site investigations.



Background Comparison

- Background samples are developed for site specific screening levels for COCs that are natural occurring (i.e: arsenic, lead, NORM).
- Best supported by sampling locations representative of site conditions and lithology.
- Sufficient background samples should be collected to run valid statistical analyze.

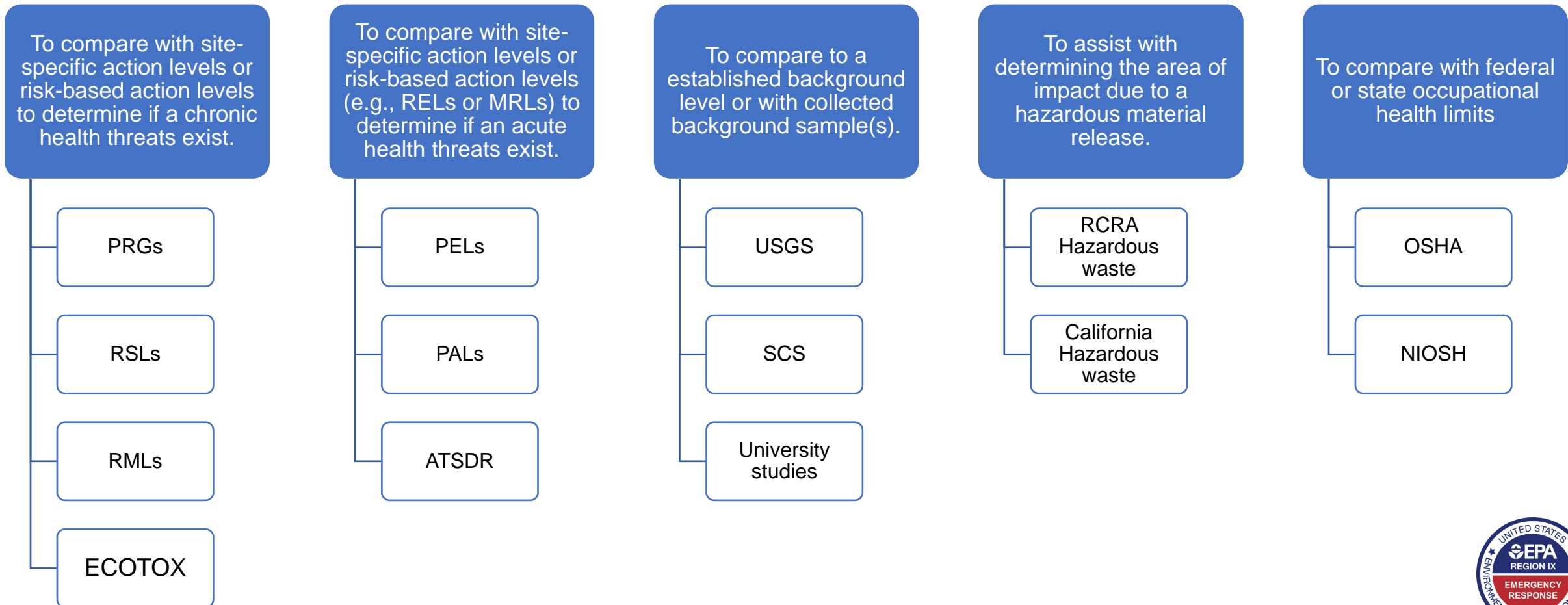


Background Comparison

- Generally, the 95% Upper Control Limit (UCL95) is calculated from background sample data.
- If the UCL95 is equal to or exceeds established screening levels (i.e. RSLs), the UCL95 will be used as the “background screening level”.
- A release is determined if the sample measurement is at least three times (3x) background.



Determining Action Level



Understanding Summary Tables

- Contaminants are layout in alphabetical order
- Removal Levels are divided by contaminated matrix and target population

Regional Removal Management Level (RML) Summary Table (TR=1E-04, HQ=3) May 2020

| | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; W = TEF applied; E = RPF applied; G = user's guide Section 5; M = mutagen; V = volatile; R = RBA applied; c = cancer; n = noncancer; * = where: n SL < 100X c SL; ** = where n SL < 10X c SL | | | | | | | | | | | | | See SLO values are based on GAF 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- Be aware of the units of measure used in the Summary Tables, more often than not the units of measure will not match the laboratories reporting units of measure. A conversion will be necessary to properly compare sample results to action levels.



Understanding Action Levels

| Contaminant | |
|-------------------------|------------|
| Analyte | CAS No. |
| Acephate | 30560-19-1 |
| Acetaldehyde | 75-07-0 |
| Acetochlor | 34256-82-1 |
| Acetone | 67-64-1 |
| Acetone Cyanohydrin | 75-86-5 |
| Acetonitrile | 75-05-8 |
| Acetophenone | 98-86-2 |
| Acetylaminofluorene, 2- | 53-96-3 |
| Acrolein | 107-02-8 |
| Acrylamide | 79-06-1 |
| Acrylic Acid | 79-10-7 |
| Acrylonitrile | 107-13-1 |
| Adiponitrile | 111-69-3 |
| Alachlor | 15972-60-8 |
| Aldicarb | 116-06-3 |
| Aldicarb Sulfone | 1646-88-4 |
| Aldicarb sulfoxide | 1646-87-3 |
| Aldrin | 309-00-2 |
| Allyl Alcohol | 107-18-6 |
| Allyl Chloride | 107-05-1 |
| Aluminum | 7429-90-5 |
| Aluminum Phosphide | 20859-73-8 |
| Ametryn | 834-12-8 |
| Aminobiphenyl, 4- | 92-67-1 |
| Aminophenol, m- | 591-27-5 |
| Aminophenol, o- | 95-55-6 |
| Aminophenol, p- | 123-30-8 |

Contaminant Column

- Analyte – Chemical name
- CAS No. – Chemical Abstract Service Number which is a unique numeric identifier that designates one substance.



Understanding Action Levels

Screening Levels

- Screening levels are divided into six (6) columns:
 - Residential Soils (mg/kg)
 - Industrial Soils (mg/kg)
 - Resident Air ($\mu\text{g}/\text{m}^3$)
 - Industrial Air ($\mu\text{g}/\text{m}^3$)
 - Tapwater ($\mu\text{g}/\text{L}$)
 - Maximum Containment Level or MCL ($\mu\text{g}/\text{L}$)

| Screening Levels | | | | | | | | | | |
|-----------------------|-----|-------------------------|-----|-----------------------------------|-----|-------------------------------------|-----|-----------------|-----|------------|
| Resident Soil (mg/kg) | key | Industrial Soil (mg/kg) | key | Resident Air (ug/m ³) | key | Industrial Air (ug/m ³) | key | Tapwater (ug/L) | key | MCL (ug/L) |
| 7.6E+01 | n | 9.8E+02 | n | | | | | 2.4E+01 | n | |
| 1.1E+01 | c** | 4.9E+01 | c** | 1.3E+00 | c** | 5.6E+00 | c** | 2.6E+00 | c** | |
| 1.3E+03 | n | 1.6E+04 | n | | | | | 3.5E+02 | n | |
| 6.1E+04 | n | 6.7E+05 | nms | 3.2E+04 | n | 1.4E+05 | n | 1.4E+04 | n | |
| 2.8E+06 | nm | 1.2E+07 | nm | 2.1E+00 | n | 8.8E+00 | n | | | |
| 8.1E+02 | n | 3.4E+03 | n | 6.3E+01 | n | 2.6E+02 | n | 1.3E+02 | n | |
| 7.8E+03 | ns | 1.2E+05 | nms | | | | | 1.9E+03 | n | |
| 1.4E-01 | c | 6.0E-01 | c | 2.2E-03 | c | 9.4E-03 | c | 1.6E-02 | c | |
| 1.4E-01 | n | 6.0E-01 | n | 2.1E-02 | n | 8.8E-02 | n | 4.2E-02 | n | |
| 2.4E-01 | c | 4.6E+00 | c | 1.0E-02 | c | 1.2E-01 | c | 5.0E-02 | c | |
| 9.9E+01 | n | 4.2E+02 | n | 1.0E+00 | n | 4.4E+00 | n | 2.1E+00 | n | |
| 2.5E-01 | c* | 1.1E+00 | c* | 4.1E-02 | c* | 1.8E-01 | c* | 5.2E-02 | c* | |
| 8.5E+06 | nm | 3.6E+07 | nm | 6.3E+00 | n | 2.6E+01 | n | | | |
| 9.7E+00 | c* | 4.1E+01 | c | | | | | 1.1E+00 | c | |
| 6.3E+01 | n | 8.2E+02 | n | | | | | 2.0E+01 | n | |
| 6.3E+01 | n | 8.2E+02 | n | | | | | 2.0E+01 | n | 2.0E+00 |
| | | | | | | | | | | 3.0E+00 |
| | | | | | | | | | | 2.0E+00 |
| | | | | | | | | | | 4.0E+00 |
| 3.9E-02 | c* | 1.8E-01 | c | 5.7E-04 | c | 2.5E-03 | c | 9.2E-04 | c | |
| 3.5E+00 | n | 1.5E+01 | n | 1.0E-01 | n | 4.4E-01 | n | 2.1E-01 | n | |
| 7.2E-01 | c** | 3.2E+00 | c** | 4.7E-01 | c** | 2.0E+00 | c** | 7.3E-01 | c** | |
| 7.7E+04 | n | 1.1E+06 | nm | 5.2E+00 | n | 2.2E+01 | n | 2.0E+04 | n | |
| 3.1E+01 | n | 4.7E+02 | n | | | | | 8.0E+00 | n | |
| 5.7E+02 | n | 7.4E+03 | n | | | | | 1.5E+02 | n | |
| 2.6E-02 | c | 1.1E-01 | c | 4.7E-04 | c | 2.0E-03 | c | 3.0E-03 | c | |
| 5.1E+03 | n | 6.6E+04 | n | | | | | 1.6E+03 | n | |
| 2.5E+02 | n | 3.3E+03 | n | | | | | 7.9E+01 | n | |
| 1.3E+03 | n | 1.6E+04 | n | | | | | 4.0E+02 | n | |



Understanding Action Levels

| Contaminant | | Removal Levels | | | | | | | | | | |
|--------------------|-----------|--------------------------|------|----------------------------|------|-------------------------|-----|---------------------------|-----|--------------------|-----|---------------|
| Analyte | CAS No. | Resident Soil (mg/kg) | key | Industrial Soil (mg/kg) | key | Resident Air (ug/m³) | key | Industrial Air (ug/m³) | key | Tapwater (ug/L) | key | MCL (ug/L) |
| Arsenic, Inorganic | 7440-38-2 | 6.80E+01 | c**R | 3.00E+02 | c**R | 4.70E-02 | n | 2.00E-01 | n | 5.20E+00 | c** | 1.00E+01 |

Action Levels for Arsenic

| | |
|-------------------|-------------------------|
| Residential Soils | 68 mg/kg |
| Industrial Soils | 300 mg/kg |
| Residential Air | 0.047 ug/m ³ |
| Industrial Air | 0.200 ug/m ³ |
| Tap Water | 5.2 ug/L |

*Note that all action levels are reported in Exponential Notation, conversion will be needed to compare action levels to sample results.



Action Level Comparison - Assessment

- Based on samples collected, determine if the results are above or below the Action Levels.
 - If results are reported above the action level, then additional sampling may be required and/or a removal is recommended.
 - If the results are below the action level, then no additional action is required.



Action Level Comparison – Removal

- From samples collected, determine if the results are above or below the Action Level.
 - If results are reported above the action level, then additional removal actions are needed.
 - If the results are below the action level, then no additional action is required.

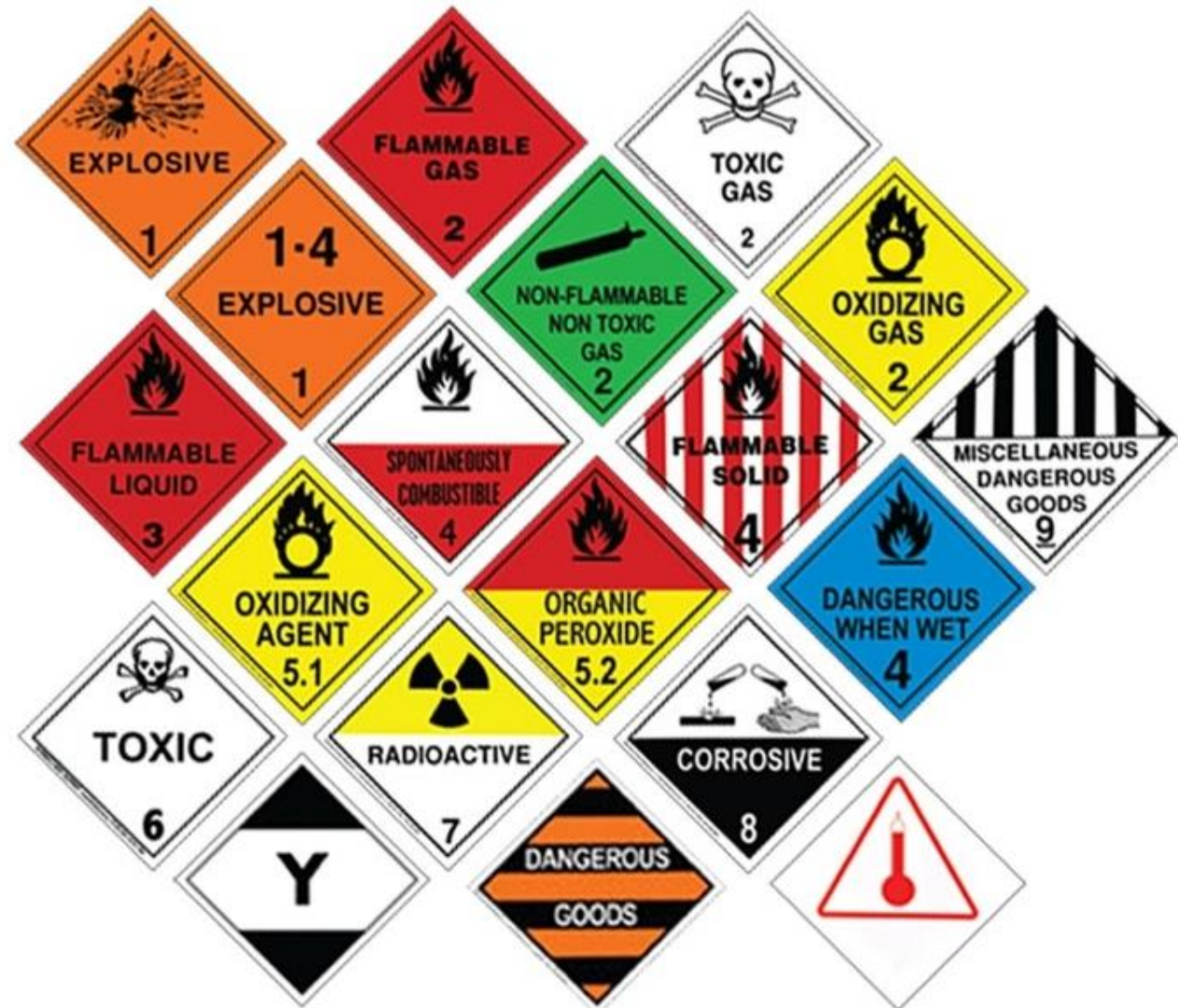


Class Exercise 6: Action Level Determination

Case Study: An illegal marijuana grow is discovered in a country recreational areas. Law enforcement removes the plants and discovers the use of Carbofuran on the plants and all over the grow areas. The drainage from the grow area drains to a local watershed which feeds a local pond used for fishing. Your agency has been task with cleaning up the Carbofuran contamination from all impacted areas. Determine the cleanup action levels.



- Dangerous Goods Shipping



Regulatory

- International Air Transport Association (IATA)
 - IATA Dangerous Goods Regulations (DGR)
- U.S. Department of Transportation (DOT)
 - 49 CFR Parts 171-180 (Hazardous Materials Regulations – HMR)



Definitions

- IATA Dangerous Goods
 - Articles or substances which are capable of posing a risk to health, safety, property or the environment and which are shown in the list of dangerous goods in the DGR or which are classified according to the DGR
- U.S. DOT Hazardous Materials
 - Substance or Material that is capable of posing an unreasonable risk to health and safety, and property when transported in commerce



Common DG items

- Many items that we take for granted in our offices or homes can be classified as Dangerous Goods

Highlighters

Batteries

Hand
Sanitizer

Laptops and
Cellphones

Fire
Extinguishers

Aerosol
sprays



Dangerous Goods Declarations

- A declaration filled out and given by the party shipping the DG to the carrier.
- It shows the list of items that are dangerous goods, states the special packaging, identification marks, and labels on them.

| SHIPPER'S DECLARATION FOR DANGEROUS GOODS | | | | | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------|
| Shipper | | | | Air Waybill No. Page 1 of 1 Pages Shipper's Reference Number (optional) | | |
| Consignee | | | | | | |
| Person Responsible for Shipment: Two completed and signed copies of this Declaration must be handed to the operator. | | | | WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. | | |
| TRANSPORT DETAILS This shipment is within the limitations prescribed for: (delete non-applicable) | | | | Airport of Departure | | |
| <input type="checkbox"/> PASSENGER AND CARGO AIRCRAFT <input type="checkbox"/> CARGO AIRCRAFT ONLY | | | | | | |
| Airport of Destination | | | | Shipment Type (delete non-applicable) <input type="checkbox"/> NON-RADIOACTIVE <input type="checkbox"/> RADIOACTIVE | | |
| NATURE AND QUANTITY OF DANGEROUS GOODS | | | | | | |
| Dangerous Goods Identification | | | | | | |
| UN or ID No. | Proper Shipping Name | Class or Division (Subsidiary Risk) | Packing Group | Quantity and Type of Packing | Packing Instructions | Authorization |
| | | | | | | |
| Additional Handling Information | | | | | | |
| Emergency Telephone Number | | | | Name/Title of Signatory | | |
| I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labelled/placarded, and are in all respects in proper condition for transport according to the applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met. (see warning above) | | | | Place and Date | | |
| | | | | Signature | | |

Created by Andy Glode at the University of New Hampshire Office of Environmental Health and Safety



Hazardous Materials/Dangerous Good Labels



Known and Potentially Hazardous Materials Sample

- If based on knowledge of site operational history and/or analytical results of samples previous collected from the site, and it is believed that the samples being shipped constitute hazardous materials, then the samples must be shipped according to IATA/DOT regulations.
- For samples containing unknown hazardous substances, DOT regulation (49 CFR 172.101(d)(11)), states that “a material for which the hazard class is uncertain and must be determined by testing...may be assigned a tentative shipping name, hazard class, and identification number, based on the shipper’s tentative determination”.



Samples for Further Testing – Flammable Liquid, Corrosive

SAMPLES FOR FURTHER TESTING — Flammable Liquid, Corrosive

Proper Shipping Name: Flammable liquid, corrosive, n.o.s., sample. The maximum net quantity per outer package may be increased, and the box requirement reduced to a "Y" strength box, by replacing the "sample" designation following the "n.o.s." name with a more accurate/specific description of the substance. Consult with your DG Shipping Advisor.

Quantity: Maximum net quantity is 0.5 liters per outer package.

Packing: This is a Packing Group I Hazard requiring U.N. Specification Packaging. Inner plastic bottles are not allowed - use only glass inner containers unless sample may contain hydrofluoric acid - consult with DG Shipping Advisor. For inner containers (bottles) containing liquids, the closures (caps/covers) must be securely held in place by secondary means such as adhesive tape. Put the sample container(s) into an IP3 metal can (inner packaging). Follow the instructions from the supplier of the U.N. Specification Packaging for Packing Instructions 350 (4G, Strength Rated – X) for package assembly, lining, absorbent material, cushioning material, etc., or consult your Shipping Advisor.

Marking: Mark the outer package with the following information:

- The corresponding UN number.
- The proper shipping name of the contents and the net quantity next to the "Flammable Liquid" Label.

Outer package

Fibreboard box (4G)



UN 2924
Flammable Liquid, Corrosive, n.o.s., Sample
Net Qty = ___ L

- The shipper's and recipient's name and address.

Labeling: Place a "Flammable Liquid" label for Class 3 and a "Corrosive" label for Class 8 number on the package. Place the package-position label (Up Arrows) on at least two opposite sides to show the proper package orientation.

Documentation: Examples of completed FedEx DG Declaration Form is shown on the following page.

Note: The samples may not be packed together with other goods.

SHIPPER'S DECLARATION FOR DANGEROUS GOODS (Provide at least three copies to FedEx)

| | | | | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|
| Your Name Here Shipper FILL IN SHIPPER'S INFORMATION | | Air Waybill No. Page 1 of 1 Pages Shipper's Reference Number (optional) | | | | |
| Consignee | | FedEx Federal Express | | | | |
| Two completed and signed copies of this Declaration must be handed to the operator. | | WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. | | | | |
| TRANSPORT DETAILS This shipment is within the limitations prescribed for: (delete non-applicable) PASSENGER AND CARGO AIRCRAFT <input checked="" type="checkbox"/> HAZARDOUS AIRCRAFT HAZARDOUS | | Airport of Departure | | | | |
| Airport of Destination: CROSS OUT THESE BOXES NON-RADIOACTIVE RADIOACTIVE | | Shipment type: (delete non-applicable) | | | | |
| NATURE AND QUANTITY OF DANGEROUS GOODS | | | | | | |
| Dangerous Goods Identification | | | | | | |
| UN or ID No. | Proper Shipping Name | Class or Division (Subsidiary Risk) | Packing Group | Quantity and Type of Packaging | Packing Inst. | Authorization |
| UN 2924 | Flammable liquid, corrosive, n.o.s., sample | 3 (8) | I | 1 Fibreboard Box x ___ L | 350 | |
| Additional Handling Information | | | | | | |
| Emergency Telephone Number 1-888-255-3924 Chem-Tel Account No. MIS0003701 | | | | | | |
| I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met. | | | | Name/Title of Signatory FILL IN SHIPPER'S NAME, TITLE (PRINT) Place and Date: FILL IN CITY, STATE, AND DATE Signature SIGN YOUR NAME (see warning above) | | |



Samples for Further Testing – Solids containing Flammable Liquid

SAMPLES FOR FURTHER TESTING — Solids Containing Flammable Liquids

Proper Shipping Name: Solids containing flammable liquids, n.o.s., Sample. This shipping name is often used for soils saturated or containing oil, gasoline, or other flammable liquids. The maximum net quantity per outer package may be increased by replacing the "sample" designation following the "n.o.s." name with a more accurate/specific description of the substance. Consult with your Shipping Advisor.

Quantity: Limited Quantity. Maximum net quantity is 5.0 kg per outer package.

Packing: Glass, plastic, metal sample containers. Maximum quantity per inner container is 0.5 kg. Each bottle must be securely packed in an intermediate package, such as a small box, a bottle, or a zip-lock bag. The intermediate package must be filled to capacity with absorbent material to prevent breakage or leakage. For inner containers (bottles) containing liquids, the closures (caps/covers) must be securely held in place by secondary means such as adhesive tape. The intermediate package must be packed in a sturdy outer package of plastic (a cooler), wood, or fibreboard. U.N. Specification packaging is not required.

Cushioning Materials: Use enough vermiculite to fill the box.

Marking: Mark the outer package with the following information:

- The corresponding UN number.
- The proper shipping name of the contents, the words "Net Quantity ="

Remove or obliterate all irrelevant markings already on the outer package.



- The name and address of the shipper and recipient.

UN 3175
Solids containing flammable liquids, n.o.s.,
Sample
Net Qty = 5.0 kg

Labeling: Place a "Flammable Solid" label for Class 4.1 and a "Limited Quantity" on the package. Place the package-position label (Up Arrows) on at least two opposite sides to show the proper package orientation.

Documentation: Examples of completed FedEx DG Declaration Form is shown on the following page.

Note: The samples may not be packed together with other goods.

SHIPPER'S DECLARATION FOR DANGEROUS GOODS (Provide at least three copies to FedEx)

| | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Your Name Here | | Air Waybill No. |
| Shipper | | Page 1 of 1 Pages |
| FILL IN SHIPPER'S INFORMATION | | Shipper's Reference Number (optional) |
| Consignee | | FedEx Federal Express |
| Two completed and signed copies of this Declaration must be handed to the operator. | | WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. |
| TRANSPORT DETAILS This shipment is within the limitations prescribed for: (delete non-applicable) PASSENGER AND CARGO AIRCRAFT <input checked="" type="checkbox"/> AIRCRAFT ONLY <input checked="" type="checkbox"/> | | Airport of Departure |
| Airport of Destination: | | Shipment type: (delete non-applicable) RADIOACTIVE <input checked="" type="checkbox"/> NON-RADIOACTIVE |

NATURE AND QUANTITY OF DANGEROUS GOODS

| Dangerous Goods Identification | | | | | | |
|--------------------------------|-----------------------------------------------------|-------------------------------------|---------------|--------------------------------|---------------|---------------|
| UN or ID No. | Proper Shipping Name | Class or Division (Subsidiary Risk) | Packing Group | Quantity and Type of Packaging | Packing Inst. | Authorization |
| UN 3175 | Solids containing flammable liquids, n.o.s., sample | 4.1 | II | 1 Plastic Box x 5 kg | Y441 | |

Additional Handling Information

Emergency Telephone Number 1-888-255-3924 Chem-Tel Account No. MIS0003701

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory
FILL IN SHIPPER'S NAME, TITLE (PRINT)
Place and Date:
FILL IN CITY, STATE, AND DATE
Signature **SIGN YOUR NAME**
(see warning above)



Samples for Further Testing – Liquids or Solids containing PCBs

SAMPLES FOR FURTHER TESTING — Liquids or Solids Containing PCBs

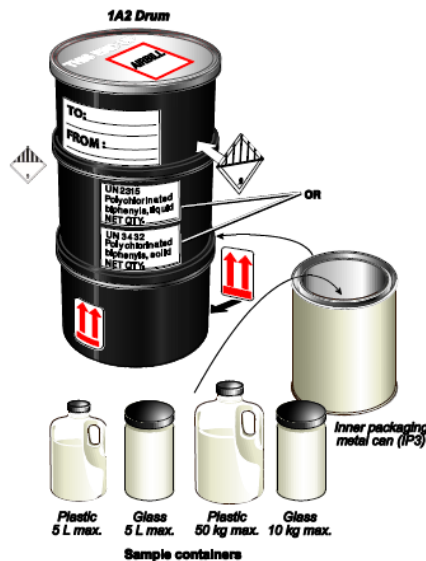
Proper Shipping Name: Polychlorinated biphenyls, liquid (if in liquid samples) OR Polychlorinated biphenyls, solid (if in solid samples)

Quantity: Maximum net quantity is 100 L (liquid) or 100 kg (solid).

Packing: This is a Packing Group II Hazard Requiring U.N. Specification Packaging. For liquid samples only, put the sample container(s) into an IP3 metal can (Inner Package). For solid samples, no inner can is required. The outer packaging must be a 1A2 Drum, normally of a 5- to 10-gallon capacity. Follow the instructions from the supplier of the U.N. Specification packaging for Packing Instructions 964 or 956 for package assembly, lining, absorbent material, cushioning material, etc., or Consult your DG Shipping Advisor. For inner containers (bottles) containing liquids, the closures (caps/covers) must be securely held in place by secondary means such as adhesive tape.

Marking: Mark the outer package with the following information:

- The corresponding UN number.
- The proper shipping name of the contents and the net quantity next to the "Miscellaneous" Label.
- The name and address of the shipper and recipient.



UN 2315 Polychlorinated biphenyls, liquid
Net Qty = ____ L

OR

UN 3432 Polychlorinated biphenyls, solid
Net Qty = ____ kg

Labeling: Place a "Miscellaneous" Class 9 label on the package. Place the package-position label (Up Arrows) on at least two opposite sides to show the proper package orientation.

Documentation: Examples of completed FedEx DG Declaration Form is shown on the following page.

Note: PCBs are not subject to the IATA/DOT Regulations when in concentrations of less than 50 mg/kg (PPM). However, PCBs are subject to Federal Express regulations at concentrations of less than or equal to 50 ppm, as well as greater than 50 ppm. If using a carrier other than Federal Express (ground couriers are ideal) for concentrations of PCBs less than 50 ppm, there should be a note in the cooler stating that they can be shipped as environmental samples.

SHIPPER'S DECLARATION FOR DANGEROUS GOODS (Provide at least three copies to FedEx)

| | | |
|-------------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Your Name Here | | Air Waybill No. |
| Shipper | | Page 1 of 1 Pages |
| FILL IN SHIPPER'S INFORMATION | | Shipper's Reference Number (optional) |
| Consignee | | FedEx Federal Express |
| Two completed and signed copies of this Declaration must be handed to the operator. | | WARNING |
| TRANSPORT DETAILS | | Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. |
| This shipment is within the limitation prescribed for: (select non-applicable) | | Shipment type: (delete non-applicable) |
| PASSENGER AND CARGO AIRCRAFT | CARGO AIRCRAFT ONLY | |
| Airport of Departure | | |
| Airport of Destination: | | CROSS OUT THESE BOXES NON-RADIOACTIVE RADIOACTIVE |

NATURE AND QUANTITY OF DANGEROUS GOODS

| Dangerous Goods Identification | | | | | | |
|--------------------------------|-----------------------------------|-------------------------------------|---------------|--------------------------------|---------------|---------------|
| UN or ID No | Proper Shipping Name | Class or Division (Subsidiary Risk) | Packing Group | Quantity and Type of Packaging | Packing Inst. | Authorization |
| UN 2315 | Polychlorinated Biphenyls, Liquid | 9 | II | 1 Steel Drum x ____ L | 964 | |
| OR | | 9 | | | | |
| UN 3432 | Polychlorinated Biphenyls, Solid | | II | 1 Steel Drum x ____ kg | 956 | |

Additional Handling Information

Emergency Telephone Number 1-888-255-3924

Chem-Tel Account No. MIS0003701

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory
FILL IN SHIPPER'S NAME, TITLE (PRINT)
Place and Date:
FILL IN CITY, STATE, AND DATE
Signature SIGN YOUR NAME
(see warning above)



Samples for Further Testing – Corrosive Liquids

SAMPLES FOR FURTHER TESTING — Corrosive Liquids

Proper Shipping Name: Corrosive liquid, n.o.s., sample. The maximum net quantity per outer package may be increased by replacing the "sample" designation following the "n.o.s." name with a more accurate/specific description of the substance. Consult with your Shipping Advisor.

Quantity: Maximum net quantity is 0.5 liters.

Packing: This is a Packing Group I Hazard requiring U.N. Specification Packaging. For inner containers (bottles) containing liquids, the closures (caps/covers) must be securely held in place by secondary means such as adhesive tape. Put the sample container(s) into an IP3 metal can (inner packaging). Follow the instructions from the supplier of the U.N. Specification Packaging for Packing Instructions 850 (4G, Strength Rated – X) for package assembly, lining, absorbent material, cushioning material, etc., or consult your Shipping Advisor.

Marking: Mark the outer package with the following information:

- The corresponding UN number.
- The proper shipping name of the contents and the net quantity (Net Qty) next to the "Corrosive" Label.
- The name and address of the shipper and recipient.



UN 1760
Corrosive Liquid, n.o.s., Sample
Net Qty = 0.5 L

Labeling: Place a "Corrosive" label for Class 8 on the package. Place the package-position label (Up Arrows) on at least two opposite sides to show the proper package orientation.

Documentation: Examples of completed FedEx DG Declaration Form is shown on the following page.

Note: The sample(s) may not be packed together with other goods.

The Net Quantity may be increased to 2.5 liters using packing instructions 854. Consult with your DG Shipping Advisor.

SHIPPER'S DECLARATION FOR DANGEROUS GOODS (Provide at least three copies to FedEx)

| | | |
|------------------------------------------------------------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Your Name Here | | Air Waybill No. |
| Shipper | | Page 1 of 1 Pages |
| FILL IN SHIPPER'S INFORMATION | | Shipper's Reference Number (optional) |
| Consignee | | FedEx® Federal Express |
| Two completed and signed copies of this Declaration must be handed to the operator. | | WARNING Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. |
| TRANSPORT DETAILS This shipment is within the limitations prescribed for: (delete non-applicable) | | Airport of Departure |
| PASSENGER AND CARGO AIRCRAFT | CARGO AIRCRAFT ONLY | Shipment type: (delete non-applicable) |
| Airport of Destination: | | CROSS OUT THESE BOXES NON-RADIOACTIVE RADIOACTIVE |

NATURE AND QUANTITY OF DANGEROUS GOODS

| Dangerous Goods Identification | | | | | | |
|--------------------------------|----------------------------------|-------------------------------------|---------------|--------------------------------|---------------|---------------|
| UN or ID No | Proper Shipping Name | Class or Division (Subsidiary Risk) | Packing Group | Quantity and Type of Packaging | Packing Inst. | Authorization |
| UN 1760 | Corrosive liquid, n.o.s., sample | 8 | I | 1 Fibreboard Box x 0.5 L | 850 | |

Additional Handling Information

Emergency Telephone Number 1-888-255-3924 Chem-Tel Account No. MIS0003701

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. I declare that all of the applicable air transport requirements have been met.

Name/Title of Signatory
FILL IN SHIPPER'S NAME, TITLE (PRINT)

Place and Date:
FILL IN CITY, STATE, AND DATE

Signature SIGN YOUR NAME
(see warning above)





Sample Packing and Shipment

ERT SOP # 2004

Summarizes the requirements for packing and shipping of environmental samples



STANDARD OPERATING PROCEDURES

SOP: ERT-PROC-2004-20

PAGE: 1 of 17

REV: 1.1

EFFECTIVE DATE: 10/19/20

SAMPLE PACKING AND SHIPPING

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5.0 APPENDICES

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General

- Samples are required to be transported in a manner that will ensure their integrity, guard them from leakage/breakage, and will protect the health and safety of the shipping and receiving personnel.
- Regulations for packing and shipping of environmental samples by all forms of transportation falls under U.S. DOT, 49 CFR: Transportation.



Sample Packing Examples

Soil and Sediment

- Shipped in durable intact insulated sample coolers

Water and Air (tube media)

- Shipped in durable intact insulated sample coolers

SUMMA Canisters

- Metal SUMMA canister box

Cassette Media

- Shipped in cardboard boxes

Tedlar Bags

- Should not be shipped, but hand delivered whenever possible

Sample Temperature Maintenance

- Wet ice is typically used to maintain appropriate sample temperatures during shipment
- Double bag wet ice with ziploc bags to prevent leakage.
- Place double bagged wet ice and samples inside a heavy-duty trash bag, minimum 13 gallons.
- Remember to place the temperature blank inside the trash bag with the samples.



Packaging – Sample Cooler

Line bottom
of cooler
with an
absorbent
pad

Place trash
bag with the
samples and
wet ice

Use tape to
seal the
trash bag.

Place the
Chain of
Custody
inside a
Ziploc bag
and on top of
the trash bag

Seal cooler
with clear
packing tape
on both ends

Place the
Custody
Seal under
the clear
packing tape
at the seam
of the cooler.