
Superfund



Compendium of ERT Soil Sampling





GENERAL FIELD SAMPLING GUIDELINES

SOP# 2001
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1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide general field sampling guidelines that will assist REAC personnel in choosing sampling strategies, location, and frequency for proper assessment of site characteristics. This SOP is applicable to all field activities that involve sampling

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Sampling is the selection of a representative portion of a larger population, universe, or body. Through examination of a sample, the characteristics of the larger body from which the sample was drawn can be inferred. In this manner, sampling can be a valuable tool for determining the presence, type, and extent of contamination by hazardous substances in the environment.

The primary objective of all sampling activities is to characterize a hazardous waste site accurately so that its impact on human health and the environment can be properly evaluated. It is only through sampling and analysis that site hazards can be measured and the job of cleanup and restoration can be accomplished effectively with minimal risk. The sampling itself must be conducted so that every sample collected retains its original physical form and chemical composition. In this way, sample integrity is insured, quality assurance standards are maintained, and the sample can accurately represent the larger body of

material under investigation.

The extent to which valid inferences can be drawn from a sample depends on the degree to which the sampling effort conforms to the project's objectives. For example, as few as one sample may produce adequate, technically valid data to address the project's objectives. Meeting the project's objectives requires thorough planning of sampling activities, and implementation of the most appropriate sampling and analytical procedures. These issues will be discussed in this procedure.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The amount of sample to be collected, and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix being sampled and the parameter(s) of interest. Sample preservation, containers, handling, and storage for air and waste samples are discussed in the specific SOPs for air and waste sampling techniques.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The nature of the object or materials being sampled may be a potential problem to the sampler. If a material is homogeneous, it will generally have a uniform composition throughout. In this case, any sample increment can be considered representative of the material. On the other hand, heterogeneous samples present problems to the sampler because of changes in the material over distance, both laterally and vertically.

Samples of hazardous materials may pose a safety threat to both field and laboratory personnel. Proper health and safety precautions should be implemented when handling this type of sample.

Environmental conditions, weather conditions, or non-target chemicals may cause problems and/or interferences when performing sampling activities or when sampling for a specific parameter. Refer to the specific SOPs for sampling techniques.

5.0 EQUIPMENT/APPARATUS

The equipment/apparatus required to collect samples must be determined on a site specific basis. Due to the wide variety of sampling equipment available, refer to the specific SOPs for sampling techniques which include lists of the equipment/apparatus required for sampling.

6.0 REAGENTS

Reagents may be utilized for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed. Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

7.0 PROCEDURE

7.1 Types of Samples

In relation to the media to be sampled, two basic types of samples can be considered: the environmental sample and the hazardous sample.

Environmental samples are those collected from streams, ponds, lakes, wells, and are off-site samples that are not expected to be contaminated with hazardous materials. They usually do not require the special handling procedures typically used for concentrated wastes. However, in certain instances, environmental samples can contain elevated concentrations of pollutants and in such cases would have to be handled as hazardous samples.

Hazardous or concentrated samples are those collected from drums, tanks, lagoons, pits, waste piles, fresh spills, or areas previously identified as contaminated, and require special handling procedures because of their potential toxicity or hazard. These samples can be further subdivided based on their degree of hazard, however, care should be taken when handling and shipping any wastes believed to be concentrated regardless of the degree.

The importance of making the distinction between environmental and hazardous samples is two-fold:

- (1) Personnel safety requirements: Any sample thought to contain enough hazardous materials to pose a safety threat should be designated as hazardous and handled in a manner which ensures the safety of both field and laboratory personnel.
- (2) Transportation requirements: Hazardous samples must be packaged, labeled, and shipped according to the International Air Transport Association (IATA) Dangerous Goods Regulations or Department of Transportation (DOT) regulations and U.S. EPA guidelines.

7.2 Sample Collection Techniques

In general, two basic types of sample collection techniques are recognized, both of which can be used for either environmental or hazardous samples:

Grab Samples

A grab sample is defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected all at once at one particular point in the sample medium. The representativeness of such samples is defined by the nature of the materials being sampled. In general, as sources vary over time and distance, the representativeness of grab samples will decrease.

Composite Samples

Composites are nondiscrete samples composed of more than one specific aliquot collected at various sampling locations and/or different points in time. Analysis of this type of sample produces an average value and can in certain instances be used as an alternative to analyzing a number of individual grab samples and calculating an average value. It should be noted, however, that compositing can mask problems by diluting isolated concentrations of some hazardous compounds below detection limits.

Compositing is often used for environmental samples and may be used for hazardous samples under certain conditions. For example, compositing of hazardous waste is often performed after compatibility tests have

been completed to determine an average value over a number of different locations (group of drums) This procedure generates data that can be useful by providing an average concentration within a number of units, can serve to keep analytical costs down, and can provide information useful to transporters and waste disposal operations

For sampling situations involving hazardous wastes, grab sampling techniques are generally preferred because grab sampling minimizes the amount of time sampling personnel must be in contact with the wastes, reduces risks associated with compositing unknowns, and eliminates chemical changes that might occur due to compositing

7.3 Types of Sampling Strategies

The number of samples that should be collected and analyzed depends on the objective of the investigation There are three basic sampling strategies random, systematic, and judgmental sampling

Random sampling involves collection of samples in a nonsystematic fashion from the entire site or a specific portion of a site Systematic sampling involves collection of samples based on a grid or a pattern which has been previously established When judgmental sampling is performed, samples are collected only from the portion(s) of the site most likely to be contaminated Often, a combination of these strategies is the best approach depending on the type of the suspected/known contamination, the uniformity and size of the site, the level/type of information desired, etc

7.4 QA Work Plans (QAWP)

A QAWP is required when it becomes evident that a field investigation is necessary It should be initiated in conjunction with, or immediately following, notification of the field investigation This plan should be clear and concise and should detail the following basic components, with regard to sampling activities

- C Objective and purpose of the investigation
- C Basis upon which data will be evaluated.
- C Information known about the site including location, type and size of the facility, and length of operations/abandonment.
- C Type and volume of contaminated material, contaminants of concern (including

concentration), and basis of the information/data

- C Technical approach including media/matrix to be sampled, sampling equipment to be used, sample equipment decontamination (if necessary), sampling design and rationale, and SOPs or description of the procedure to be implemented
- C Project management and reporting, schedule, project organization and responsibilities, manpower and cost projections, and required deliverables.
- C QA objectives and protocols including tables summarizing field sampling and QA/QC analysis and objectives

Note that this list of QAWP components is not all-inclusive and that additional elements may be added or altered depending on the specific requirements of the field investigation It should also be recognized that although a detailed QAWP is quite important, it may be impractical in some instances Emergency responses and accidental spills are prime examples of such instances where time might prohibit the development of site-specific QAWPs prior to field activities In such cases, investigators would have to rely on general guidelines and personal judgment, and the sampling or response plans might simply be a strategy based on preliminary information and finalized on site In any event, a plan of action should be developed, no matter how concise or informal, to aid investigators in maintaining a logical and consistent order to the implementation of their task

7.5 Legal Implications

The data derived from sampling activities are often introduced as critical evidence during litigation of a hazardous waste site cleanup Legal issues in which sampling data are important may include cleanup cost recovery, identification of pollution sources and responsible parties, and technical validation of remedial design methodologies Because of the potential for involvement in legal actions, strict adherence to technical and administrative SOPs is essential during both the development and implementation of sampling activities.

Technically valid sampling begins with thorough planning and continues through the sample collection and analytical procedures. Administrative requirements involve thorough, accurate

documentation of all sampling activities. Documentation requirements include maintenance of a chain of custody, as well as accurate records of field activities and analytical instructions. Failure to observe these procedures fully and consistently may result in data that are questionable, invalid and non-defensible in court, and the consequent loss of enforcement proceedings.

8.0 CALCULATIONS

Refer to the specific SOPs for any calculations which are associated with sampling techniques.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

Refer to the specific SOPs for the type and frequency of QA/QC samples to be analyzed, the acceptance criteria for the QA/QC samples, and any other QA/QC activities which are associated with sampling techniques.

10.0 DATA VALIDATION

Refer to the specific SOPs for data validation activities that are associated with sampling techniques.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U S EPA, OSHA, and corporate health and safety procedures.



SAMPLING EQUIPMENT DECONTAMINATION

SOP#: 2006
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1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide a description of the methods used for preventing, minimizing, or limiting cross-contamination of samples due to inappropriate or inadequate equipment decontamination and to provide general guidelines for developing decontamination procedures for sampling equipment to be used during hazardous waste operations as per 29 Code of Federal Regulations (CFR) 1910.120. This SOP does not address personnel decontamination.

These are standard (i.e. typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitation, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

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2.0 METHOD SUMMARY

Removing or neutralizing contaminants from equipment minimizes the likelihood of sample cross contamination, reduces or eliminates transfer of contaminants to clean areas, and prevents the mixing of incompatible substances.

Gross contamination can be removed by physical decontamination procedures. These abrasive and non-abrasive methods include the use of brushes, air and wet blasting, and high and low pressure water cleaning.

The first step, a soap and water wash, removes all visible particulate matter and residual oils and grease. This may be preceded by a steam or high pressure

water wash to facilitate residuals removal. The second step involves a tap water rinse and a distilled/deionized water rinse to remove the detergent. An acid rinse provides a low pH media for trace metals removal and is included in the decontamination process if metal samples are to be collected. It is followed by another distilled/deionized water rinse. If sample analysis does not include metals, the acid rinse step can be omitted. Next, a high purity solvent rinse is performed for trace organics removal if organics are a concern at the site. Typical solvents used for removal of organic contaminants include acetone, hexane, or water. Acetone is typically chosen because it is an excellent solvent, miscible in water, and not a target analyte on the Priority Pollutant List. If acetone is known to be a contaminant of concern at a given site or if Target Compound List analysis (which includes acetone) is to be performed, another solvent may be substituted. The solvent must be allowed to evaporate completely and then a final distilled/deionized water rinse is performed. This rinse removes any residual traces of the solvent.

The decontamination procedure described above may be summarized as follows:

- 1 Physical removal
- 2 Non-phosphate detergent wash
- 3 Tap water rinse
- 4 Distilled/deionized water rinse
- 5 10% nitric acid rinse
- 6 Distilled/deionized water rinse
- 7 Solvent rinse (pesticide grade)
- 8 Air dry
- 9 Distilled/deionized water rinse

If a particular contaminant fraction is not present at the site, the nine (9) step decontamination procedure specified above may be modified for site specificity. For example, the nitric acid rinse may be eliminated if metals are not of concern at a site. Similarly, the solvent rinse may be eliminated if organics are not of

concern at a site. Modifications to the standard procedure should be documented in the site specific work plan or subsequent report.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The amount of sample to be collected and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix being sampled and the parameter(s) of interest.

More specifically, sample collection and analysis of decontamination waste may be required before beginning proper disposal of decontamination liquids and solids generated at a site. This should be determined prior to initiation of site activities.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

- C The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided that it has been verified by laboratory analysis to be analyte free (specifically for the contaminants of concern).
- C The use of an untreated potable water supply is not an acceptable substitute for tap water. Tap water may be used from any municipal or industrial water treatment system.
- C If acids or solvents are utilized in decontamination they raise health and safety, and waste disposal concerns.
- C Damage can be incurred by acid and solvent washing of complex and sophisticated sampling equipment.

5.0 EQUIPMENT/APPARATUS

Decontamination equipment, materials, and supplies are generally selected based on availability. Other considerations include the ease of decontaminating or disposing of the equipment. Most equipment and supplies can be easily procured. For example, soft-

bristle scrub brushes or long-handled bottle brushes can be used to remove contaminants. Large galvanized wash tubs, stock tanks, or buckets can hold wash and rinse solutions. Children's wading pools can also be used. Large plastic garbage cans or other similar containers lined with plastic bags can help segregate contaminated equipment. Contaminated liquid can be stored temporarily in metal or plastic cans or drums.

The following standard materials and equipment are recommended for decontamination activities.

5.1 Decontamination Solutions

- C Non-phosphate detergent
- C Selected solvents (acetone, hexane, nitric acid, etc.)
- C Tap water
- C Distilled or deionized water

5.2 Decontamination Tools/Supplies

- C Long and short handled brushes
- C Bottle brushes
- C Drop cloth/plastic sheeting
- C Paper towels
- C Plastic or galvanized tubs or buckets
- C Pressurized sprayers (H_2O)
- C Solvent sprayers
- C Aluminum foil

5.3 Health and Safety Equipment

Appropriate personal protective equipment (i.e., safety glasses or splash shield, appropriate gloves, aprons or coveralls, respirator, emergency eye wash)

5.4 Waste Disposal

- C Trash bags
- C Trash containers
- C 55-gallon drums
- C Metal/plastic buckets/containers for storage and disposal of decontamination solutions

6.0 REAGENTS

There are no reagents used in this procedure aside from the actual decontamination solutions. Table 1 (Appendix A) lists solvent rinses which may be required for elimination of particular chemicals. In

general, the following solvents are typically utilized for decontamination purposes

- C 10% nitric acid is typically used for inorganic compounds such as metals. An acid rinse may not be required if inorganics are not a contaminant of concern
- C Acetone (pesticide grade)⁽¹⁾
- C Hexane (pesticide grade)⁽¹⁾
- C Methanol⁽¹⁾

⁽¹⁾ - Only if sample is to be analyzed for organics.

7.0 PROCEDURES

As part of the health and safety plan, a decontamination plan should be developed and reviewed. The decontamination line should be set up before any personnel or equipment enter the areas of potential exposure. The equipment decontamination plan should include:

- C The number, location, and layout of decontamination stations
- C Decontamination equipment needed
- C Appropriate decontamination methods
- C Methods for disposal of contaminated clothing, equipment, and solutions
- C Procedures can be established to minimize the potential for contamination. This may include: (1) work practices that minimize contact with potential contaminants; (2) using remote sampling techniques; (3) covering monitoring and sampling equipment with plastic, aluminum foil, or other protective material; (4) watering down dusty areas; (5) avoiding laying down equipment in areas of obvious contamination; and (6) use of disposable sampling equipment.

7.1 Decontamination Methods

All samples and equipment leaving the contaminated area of a site must be decontaminated to remove any contamination that may have adhered to equipment. Various decontamination methods will remove contaminants by (1) flushing or other physical action, or (2) chemical complexing to inactivate

contaminants by neutralization, chemical reaction, disinfection, or sterilization

Physical decontamination techniques can be grouped into two categories: abrasive methods and non-abrasive methods, as follows

7.1.1 Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The mechanical abrasive cleaning methods are most commonly used at hazardous waste sites. The following abrasive methods are available:

Mechanical

Mechanical methods of decontamination include using metal or nylon brushes. The amount and type of contaminants removed will vary with the hardness of bristles, length of time brushed, degree of brush contact, degree of contamination, nature of the surface being cleaned, and degree of contaminant adherence to the surface.

Air Blasting

Air blasting equipment uses compressed air to force abrasive material through a nozzle at high velocities. The distance between nozzle and surface cleaned, air pressure, time of application, and angle at which the abrasive strikes the surface will dictate cleaning efficiency. Disadvantages of this method are the inability to control the amount of material removed and the large amount of waste generated.

Wet Blasting

Wet blast cleaning involves use of a suspended fine abrasive. The abrasive/water mixture is delivered by compressed air to the contaminated area. By using a very fine abrasive, the amount of materials removed can be carefully controlled.

7.1.2 Non-Abrasive Cleaning Methods

Non-abrasive cleaning methods work by forcing the contaminant off a surface with pressure. In general, the equipment surface is not removed using non-abrasive methods.

Low-Pressure Water

This method consists of a container which is filled with water. The user pumps air out of the container to create a vacuum. A slender nozzle and hose allow the user to spray in hard-to-reach places.

High-Pressure Water

This method consists of a high-pressure pump, an operator controlled directional nozzle, and a high-pressure hose. Operating pressure usually ranges from 340 to 680 atmospheres (atm) and flow rates usually range from 20 to 140 liters per minute.

Ultra-High-Pressure Water

This system produces a water jet that is pressured from 1,000 to 4,000 atmospheres. This ultra-high-pressure spray can remove tightly-adhered surface films. The water velocity ranges from 500 meters/second (m/s) (1,000 atm) to 900 m/s (4,000 atm). Additives can be used to enhance the cleaning action.

Rinsing

Contaminants are removed by rinsing through dilution, physical attraction, and solubilization.

Damp Cloth Removal

In some instances, due to sensitive, non-waterproof equipment or due to the unlikelihood of equipment being contaminated, it is not necessary to conduct an extensive decontamination procedure. For example, air sampling pumps hooked on a fence, placed on a drum, or wrapped in plastic bags are not likely to become heavily contaminated. A damp cloth should be used to wipe off contaminants which may have adhered to equipment through airborne contaminants or from surfaces upon which the equipment was set.

Disinfection/Sterilization

Disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization methods are impractical for large equipment. This method of decontamination is typically performed off-site.

7.2 Field Sampling Equipment Decontamination Procedures

The decontamination line is setup so that the first station is used to clean the most contaminated item. It progresses to the last station where the least contaminated item is cleaned. The spread of contaminants is further reduced by separating each decontamination station by a minimum of three (3) feet. Ideally, the contamination should decrease as the equipment progresses from one station to another farther along in the line.

A site is typically divided up into the following boundaries: Hot Zone or Exclusion Zone (EZ), the Contamination Reduction Zone (CRZ), and the Support or Safe Zone (SZ). The decontamination line should be setup in the Contamination Reduction Corridor (CRC) which is in the CRZ. Figure 1 (Appendix B) shows a typical contaminant reduction zone layout. The CRC controls access into and out of the exclusion zone and confines decontamination activities to a limited area. The CRC boundaries should be conspicuously marked. The far end is the hotline, the boundary between the exclusion zone and the contamination reduction zone. The size of the decontamination corridor depends on the number of stations in the decontamination process, overall dimensions of the work zones, and amount of space available at the site. Whenever possible, it should be a straight line.

Anyone in the CRC should be wearing the level of protection designated for the decontamination crew. Another corridor may be required for the entry and exit of heavy equipment. Sampling and monitoring equipment and sampling supplies are all maintained outside of the CRC. Personnel don their equipment away from the CRC and enter the exclusion zone through a separate access control point at the hotline. One person (or more) dedicated to decontaminating equipment is recommended.

7.2.1 Decontamination Setup

Starting with the most contaminated station, the decontamination setup should be as follows:

Station 1. Segregate Equipment Drop

Place plastic sheeting on the ground (Figure 2, Appendix B). Size will depend on amount of

equipment to be decontaminated. Provide containers lined with plastic if equipment is to be segregated. Segregation may be required if sensitive equipment or mildly contaminated equipment is used at the same time as equipment which is likely to be heavily contaminated.

Station 2: Physical Removal With A High-Pressure Washer (Optional)

As indicated in 7.1.2, a high-pressure wash may be required for compounds which are difficult to remove by washing with brushes. The elevated temperature of the water from the high-pressure washers is excellent at removing greasy/oily compounds. High pressure washers require water and electricity.

A decontamination pad may be required for the high-pressure wash area. An example of a wash pad may consist of an approximately 1 1/2 foot-deep basin lined with plastic sheeting and sloped to a sump at one corner. A layer of sand can be placed over the plastic and the basin is filled with gravel or shell. The sump is also lined with visqueen and a barrel is placed in the hole to prevent collapse. A sump pump is used to remove the water from the sump for transfer into a drum.

Typically heavy machinery is decontaminated at the end of the day unless site sampling requires that the machinery be decontaminated frequently. A separate decontamination pad may be required for heavy equipment.

Station 3: Physical Removal With Brushes And A Wash Basin

Prior to setting up Station 3, place plastic sheeting on the ground to cover areas under Station 3 through Station 10.

Fill a wash basin, a large bucket, or child's swimming pool with non-phosphate detergent and tap water. Several bottle and bristle brushes to physically remove contamination should be dedicated to this station. Approximately 10 - 50 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

Station 4: Water Basin

Fill a wash basin, a large bucket, or child's swimming

pool with tap water. Several bottle and bristle brushes should be dedicated to this station. Approximately 10-50 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

Station 5: Low-Pressure Sprayers

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to contain the water during the rinsing process. Approximately 10-20 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

Station 6: Nitric Acid Sprayers

Fill a spray bottle with 10% nitric acid. An acid rinse may not be required if inorganics are not a contaminant of concern. The amount of acid will depend on the amount of equipment to be decontaminated. Provide a 5-gallon bucket or basin to collect acid during the rinsing process.

Station 7: Low-Pressure Sprayers

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to collect water during the rinsate process.

Station 8: Organic Solvent Sprayers

Fill a spray bottle with an organic solvent. After each solvent rinse, the equipment should be rinsed with distilled/deionized water and air dried. Amount of solvent will depend on the amount of equipment to decontaminate. Provide a 5-gallon bucket or basin to collect the solvent during the rinsing process.

Solvent rinses may not be required unless organics are a contaminant of concern, and may be eliminated from the station sequence.

Station 9: Low-Pressure Sprayers

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to collect water during the rinsate process.

Station 10: Clean Equipment Drop

Lay a clean piece of plastic sheeting over the bottom

plastic layer This will allow easy removal of the plastic in the event that it becomes dirty Provide aluminum foil, plastic, or other protective material to wrap clean equipment

7 2.2 Decontamination Procedures

Station 1 Segregate Equipment Drop

Deposit equipment used on-site (i e , tools, sampling devices and containers, monitoring instruments radios, clipboards, etc) on the plastic drop cloth/sheet or in different containers with plastic liners. Each will be contaminated to a different degree Segregation at the drop reduces the probability of cross contamination Loose leaf sampling data sheets or maps can be placed in plastic zip lock bags if contamination is evident

Station 2 Physical Removal With A High-Pressure Washer (Optional)

Use high pressure wash on grossly contaminated equipment Do not use high- pressure wash on sensitive or non-waterproof equipment

Station 3 Physical Removal With Brushes And A Wash Basin

Scrub equipment with soap and water using bottle and bristle brushes. Only sensitive equipment (i e , radios, air monitoring and sampling equipment) which is waterproof should be washed. Equipment which is not waterproof should have plastic bags removed and wiped down with a damp cloth. Acids and organic rinses may also ruin sensitive equipment. Consult the manufacturers for recommended decontamination solutions

Station 4 Equipment Rinse

Wash soap off of equipment with water by immersing the equipment in the water while brushing. Repeat as many times as necessary

Station 5 Low-Pressure Rinse

Rinse sampling equipment with distilled/deionized water with a low-pressure sprayer.

Station 6 Nitric Acid Sprayers (required only if metals are a contaminant of concern)

Using a spray bottle rinse sampling equipment with nitric acid Begin spraying (inside and outside) at one end of the equipment allowing the acid to drip to the other end into a 5-gallon bucket A rinsate blank may be required at this station Refer to Section 9

Station 7 Low-Pressure Sprayers

Rinse sampling equipment with distilled/deionized water with a low-pressure sprayer

Station 8. Organic Solvent Sprayers

Rinse sampling equipment with a solvent Begin spraying (inside and outside) at one end of the equipment allowing the solvent to drip to the other end into a 5-gallon bucket Allow the solvent to evaporate from the equipment before going to the next station A QC rinsate sample may be required at this station

Station 9 Low-Pressure Sprayers

Rinse sampling equipment with distilled/deionized water with a low-pressure washer

Station 10. Clean Equipment Drop

Lay clean equipment on plastic sheeting Once air dried, wrap sampling equipment with aluminum foil, plastic, or other protective material

7 2 3 Post Decontamination Procedures

- 1 Collect high-pressure pad and heavy equipment decontamination area liquid and waste and store in appropriate drum or container. A sump pump can aid in the collection process Refer to the Department of Transportation (DOT) requirements for appropriate containers based on the contaminant of concern
- 2 Collect high-pressure pad and heavy equipment decontamination area solid waste and store in appropriate drum or container. Refer to the DOT requirements for appropriate containers based on the contaminant of concern.
- 3 Empty soap and water liquid wastes from basins and buckets and store in appropriate

drum or container. Refer to the DOT requirements for appropriate containers based on the contaminant of concern.

- 4 Empty acid rinse waste and place in appropriate container or neutralize with a base and place in appropriate drum. pH paper or an equivalent pH test is required for neutralization. Consult DOT requirements for appropriate drum for acid rinse waste.
- 5 Empty solvent rinse sprayer and solvent waste into an appropriate container. Consult DOT requirements for appropriate drum for solvent rinse waste.
- 6 Using low-pressure sprayers, rinse basins, and brushes. Place liquid generated from this process into the wash water rinse container.
- 7 Empty low-pressure sprayer water onto the ground.
- 8 Place all solid waste materials generated from the decontamination area (i.e., gloves and plastic sheeting, etc.) in an approved DOT drum. Refer to the DOT requirements for appropriate containers based on the contaminant of concern.
- 9 Write appropriate labels for waste and make arrangements for disposal. Consult DOT regulations for the appropriate label for each drum generated from the decontamination process.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

A rinsate blank is one specific type of quality control sample associated with the field decontamination process. This sample will provide information on the effectiveness of the decontamination process employed in the field.

Rinsate blanks are samples obtained by running analyte free water over decontaminated sampling

equipment to test for residual contamination. The blank water is collected in sample containers for handling, shipment, and analysis. These samples are treated identical to samples collected that day. A rinsate blank is used to assess cross contamination brought about by improper decontamination procedures. Where dedicated sampling equipment is not utilized, collect one rinsate blank per day per type of sampling device samples to meet QA2 and QA3 objectives.

If sampling equipment requires the use of plastic tubing it should be disposed of as contaminated and replaced with clean tubing before additional sampling occurs.

10.0 DATA VALIDATION

Results of quality control samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow OSHA, U.S. EPA, corporate, and other applicable health and safety procedures.

Decontamination can pose hazards under certain circumstances. Hazardous substances may be incompatible with decontamination materials. For example, the decontamination solution may react with contaminants to produce heat, explosion, or toxic products. Also, vapors from decontamination solutions may pose a direct health hazard to workers by inhalation, contact, fire, or explosion.

The decontamination solutions must be determined to be acceptable before use. Decontamination materials may degrade protective clothing or equipment, some solvents can permeate protective clothing. If decontamination materials do pose a health hazard, measures should be taken to protect personnel or substitutions should be made to eliminate the hazard. The choice of respiratory protection based on contaminants of concern from the site may not be appropriate for solvents used in the decontamination process.

Safety considerations should be addressed when using abrasive and non-abrasive decontamination

equipment Maximum air pressure produced by abrasive equipment could cause physical injury Displaced material requires control mechanisms

Material generated from decontamination activities requires proper handling, storage, and disposal Personal Protective Equipment may be required for these activities

Material safety data sheets are required for all decontamination solvents or solutions as required by the Hazard Communication Standard (i.e., acetone, alcohol, and trisodiumphosphate).

In some jurisdictions, phosphate containing detergents (i.e., TSP) are banned

12.0 REFERENCES

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, February, 1988

A Compendium of Superfund Field Operations Methods, EPA 540/p-87/001

Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, USEPA Region IV, April 1, 1986

Guidelines for the Selection of Chemical Protective Clothing, Volume 1, Third Edition, American Conference of Governmental Industrial Hygienists, Inc., February, 1987

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/USCG/EPA, October, 1985

APPENDIX A

Table

Table 1 Soluble Contaminants and Recommended Solvent Rinse

<p style="text-align: center;">TABLE 1 Soluble Contaminants and Recommended Solvent Rinse</p>		
SOLVENT⁽¹⁾	EXAMPLES OF SOLVENTS	SOLUBLE CONTAMINANTS
Water	Deionized water Tap water	Low-chain hydrocarbons Inorganic compounds Salts Some organic acids and other polar compounds
Dilute Acids	Nitric acid Acetic acid Boric acid	Basic (caustic) compounds (e.g., amines and hydrazines)
Dilute Bases	Sodium bicarbonate (e.g., soap detergent)	Acidic compounds Phenol Thiols Some nitro and sulfonic compounds
Organic Solvents ⁽²⁾	Alcohols Ethers Ketones Aromatics Straight chain alkalines (e.g., hexane) Common petroleum products (e.g., fuel, oil, kerosene)	Nonpolar compounds (e.g., some organic compounds)
Organic Solvent ⁽²⁾	Hexane	PCBs

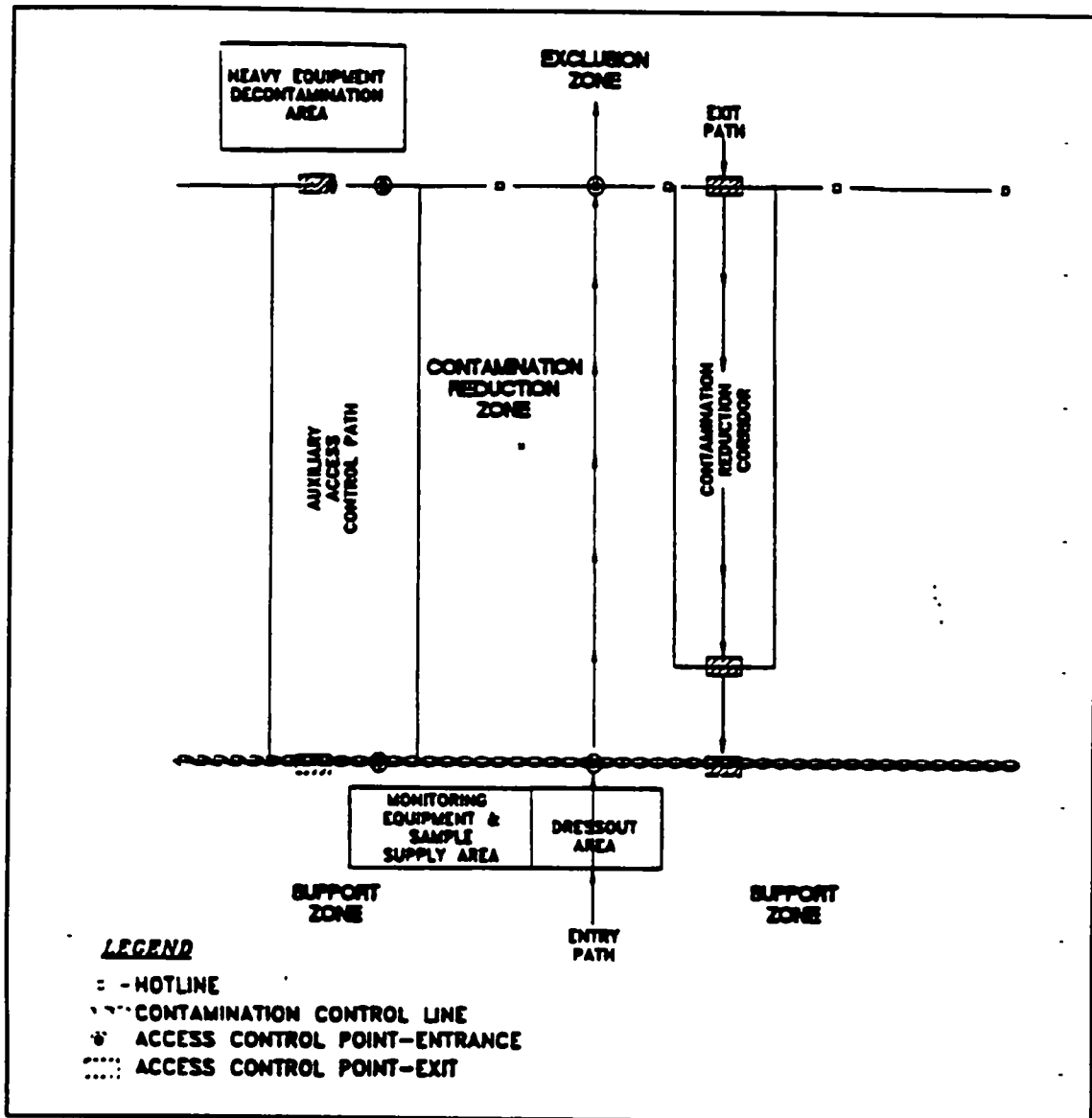
(1) - Material safety data sheets are required for all decontamination solvents or solutions as require by the Hazard Communication Standard

(2) - **WARNING** Some organic solvents can permeate and/or degrade the protective clothing

APPENDIX B

Figures

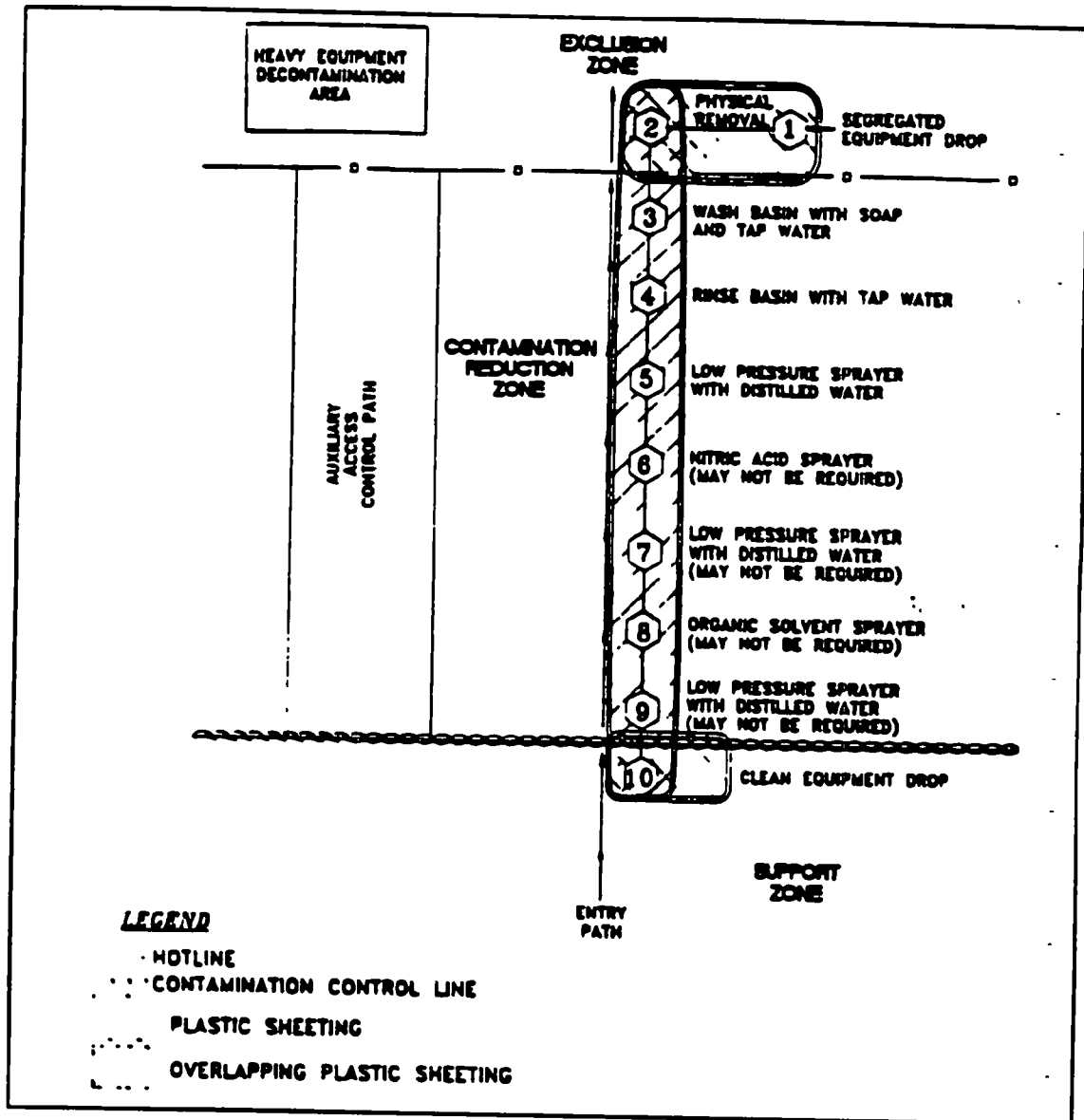
Figure 1 Contamination Reduction Zone Layout



APPENDIX B (Cont'd.)

Figures

Figure 2 Decontamination Layout





SOIL SAMPLING

SOP# 2012
DATE 11/16/94
REV # 00

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of representative soil samples. Analysis of soil samples may determine whether concentrations of specific pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health, welfare, or the environment.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Soil samples may be collected using a variety of methods and equipment. The methods and equipment used are dependent on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type. Near-surface soils may be easily sampled using a spade, trowel, and scoop. Sampling at greater depths may be performed using a hand auger, continuous flight auger, a trier, a split-spoon, or, if required, a backhoe.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is not generally recommended. Samples should, however, be cooled and protected from sunlight to minimize any potential reaction.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary interferences or potential problems associated with soil sampling. These include cross contamination of samples and improper sample collection. Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample or inadequate homogenization of the samples where required, resulting in variable, non-representative results.

5.0 EQUIPMENT/APPARATUS

Soil sampling equipment includes the following:

- C Sampling plan
- C Maps/plot plan
- C Safety equipment, as specified in the Health and Safety Plan
- C Survey equipment
- C Tape measure
- C Survey stakes or flags
- C Camera and film
- C Stainless steel, plastic, or other appropriate homogenization bucket, bowl or pan
- C Appropriate size sample containers
- C Ziplock plastic bags
- C Logbook
- C Labels
- C Chain of Custody records and seals
- C Field data sheets
- C Cooler(s)
- C Ice
- C Vermiculite
- C Decontamination supplies/equipment
- C Canvas or plastic sheet
- C Spade or shovel

- C Spatula
- C Scoop
- C Plastic or stainless steel spoons
- C Trowel
- C Continuous flight (screw) auger
- C Bucket auger
- C Post hole auger
- C Extension rods
- C T-handle
- C Sampling trier
- C Thin wall tube sampler
- C Split spoons
- C Vehimeyer soil sampler outfit
 - Tubes
 - Points
 - Drive head
 - Drop hammer
 - Puller jack and grip
- C Backhoe

6.0 REAGENTS

Reagents are not used for the preservation of soil samples. Decontamination solutions are specified in the Sampling Equipment Decontamination SOP and the site specific work plan.

7.0 PROCEDURES

7.1 Preparation

- 1 Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.
- 2 Obtain necessary sampling and monitoring equipment.
- 3 Decontaminate or pre-clean equipment, and ensure that it is in working order.
- 4 Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate
- 5 Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
- 6 Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site

factors, including extent and nature of contaminant should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations will be utility-cleared by the property owner prior to soil sampling.

7.2 Sample Collection

7.2.1 Surface Soil Samples

Collection of samples from near-surface soil can be accomplished with tools such as spades, shovels, trowels, and scoops. Surface material can be removed to the required depth with this equipment, then a stainless steel or plastic scoop can be used to collect the sample.

This method can be used in most soil types but is limited to sampling near surface areas. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. A stainless steel scoop, lab spoon, or plastic spoon will suffice in most other applications. The use of a flat, pointed mason trowel to cut a block of the desired soil can be helpful when undisturbed profiles are required. Care should be exercised to avoid use of devices plated with chrome or other materials. Plating is particularly common with garden implements such as potting trowels.

The following procedure is used to collect surface soil samples.

- 1 Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
- 2 Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
- 3 If volatile organic analysis is to be performed, transfer the sample directly into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or

other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly, or, if composite samples are to be collected, place a sample from another sampling interval or location into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

7.2.2 Sampling at Depth with Augers and Thin Wall Tube Samplers

This system consists of an auger, or a thin-wall tube sampler, a series of extensions, and a "T" handle (Figure 1, Appendix A). The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin wall tube sampler. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler.

Several types of augers are available, these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are better for direct sample recovery since they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory for use when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and cannot be used below a depth of three feet.

The following procedure will be used for collecting soil samples with the auger:

- 1 Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
- 2 Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the

drilling location.

- 3 Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
- 4 After reaching the desired depth, slowly and carefully remove the auger from boring. When sampling directly from the auger, collect the sample after the auger is removed from the boring and proceed to Step 10.
- 5 Remove auger tip from drill rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
- 6 Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into soil. Care should be taken to avoid scraping the borehole sides. Avoid hammering the drill rods to facilitate coring as the vibrations may cause the boring walls to collapse.
- 7 Remove the tube sampler, and unscrew the drill rods.
- 8 Remove the cutting tip and the core from the device.
- 9 Discard the top of the core (approximately 1 inch), as this possibly represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container. Sample homogenization is not required.
- 10 If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the

caps tightly, or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly

When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly

- 11 If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples
- 12 Abandon the hole according to applicable State regulations. Generally, shallow holes can simply be backfilled with the removed soil material

7 2 3 Sampling at Depth with a Trier

The system consists of a trier, and a "T" handle. The auger is driven into the soil to be sampled and used to extract a core sample from the appropriate depth

The following procedure will be used to collect soil samples with a sampling trier

- 1 Insert the trier (Figure 2, Appendix A) into the material to be sampled at a 0° to 45° angle from horizontal. This orientation minimizes the spillage of sample.
- 2 Rotate the trier once or twice to cut a core of material
- 3 Slowly withdraw the trier, making sure that the slot is facing upward.
- 4 If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the

caps tightly, or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly

7 2 4 Sampling at Depth with a Split Spoon (Barrel) Sampler

The procedure for split spoon sampling describes the collection and extraction of undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted.

When split spoon sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D 1586-67 (reapproved 1974)

The following procedures will be used for collecting soil samples with a split spoon

- 1 Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top
- 2 Place the sampler in a perpendicular position on the sample material
- 3 Using a well ring, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result
- 4 Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth
- 5 Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The amount of recovery and soil type should be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler

is typically available in 2 and 3 1/2 inch diameters. However, in order to obtain the required sample volume, use of a larger barrel may be required.

- 6 Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.

7.2.5 Test Pit/Trench Excavation

These relatively large excavations are used to remove sections of soil, when detailed examination of soil characteristics (horizontal, structure, color, etc.) are required. It is the least cost effective sampling method due to the relatively high cost of backhoe operation.

The following procedures will be used for collecting soil samples from test pit/trench excavations.

- 1 Prior to any excavation with a backhoe, it is important to ensure that all sampling locations are clear of utility lines, subsurface pipes and poles (subsurface as well as above surface).
- 2 Using the backhoe, a trench is dug to approximately three feet in width and approximately one foot below the cleared sampling location. Place excavated soils on plastic sheets. Trenches greater than five feet deep must be sloped or protected by a shoring system, as required by OSHA regulations.
- 3 A shovel is used to remove a one to two inch layer of soil from the vertical face of the pit where sampling is to be done.
- 4 Samples are taken using a trowel, scoop, or coring device at the desired intervals. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose fresh soil for sampling. In many instances, samples can be collected directly from the backhoe bucket.
- 5 If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a

stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly, or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

- 6 Abandon the pit or excavation according to applicable state regulations. Generally, shallow excavations can simply be backfilled with the removed soil material.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

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

- 1 All data must be documented on field data sheets or within site logbooks.
- 2 All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials,

follow U S EPA, OHSA and corporate health and safety procedures

12.0 REFERENCES

Mason, B J , Preparation of Soil Sampling Protocol Technique and Strategies 1983 EPA-600/4-83-020

Barth, D S and B J Mason, Soil Sampling Quality Assurance User's Guide 1984 EPA-600/4-84-043

U S EPA. Characterization of Hazardous Waste Sites - A Methods Manual Volume II Available Sampling Methods, Second Edition 1984 EPA-600/4-84-076

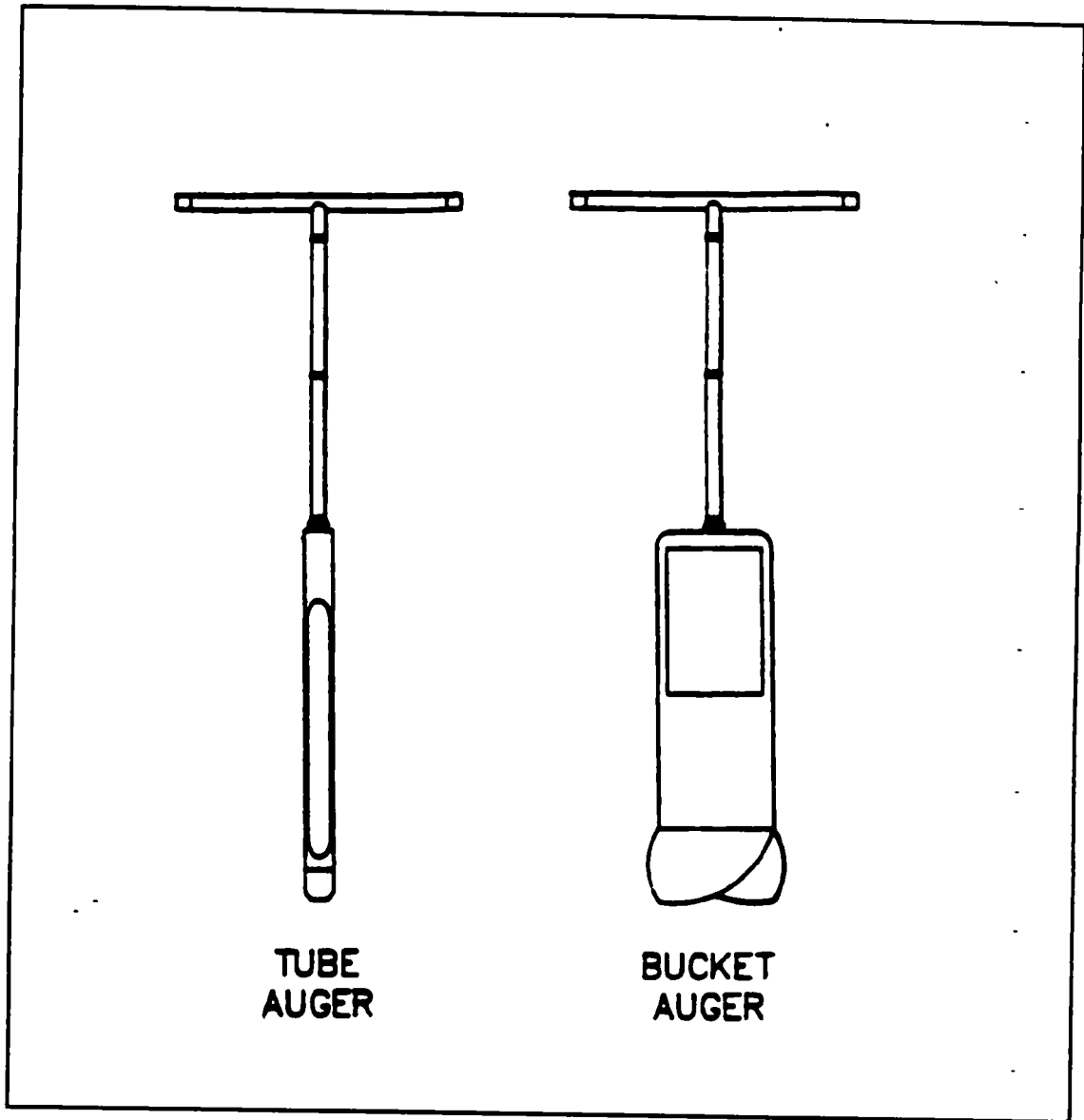
de Vera, E R , B P Simmons, R D Stephen, and D L Storm Samplers and Sampling Procedures for Hazardous Waste Streams 1980 EPA-600/2-80-018

ASTM D 1586-67 (reapproved 1974), ASTM Committee on Standards, Philadelphia, PA

APPENDIX A

Figures

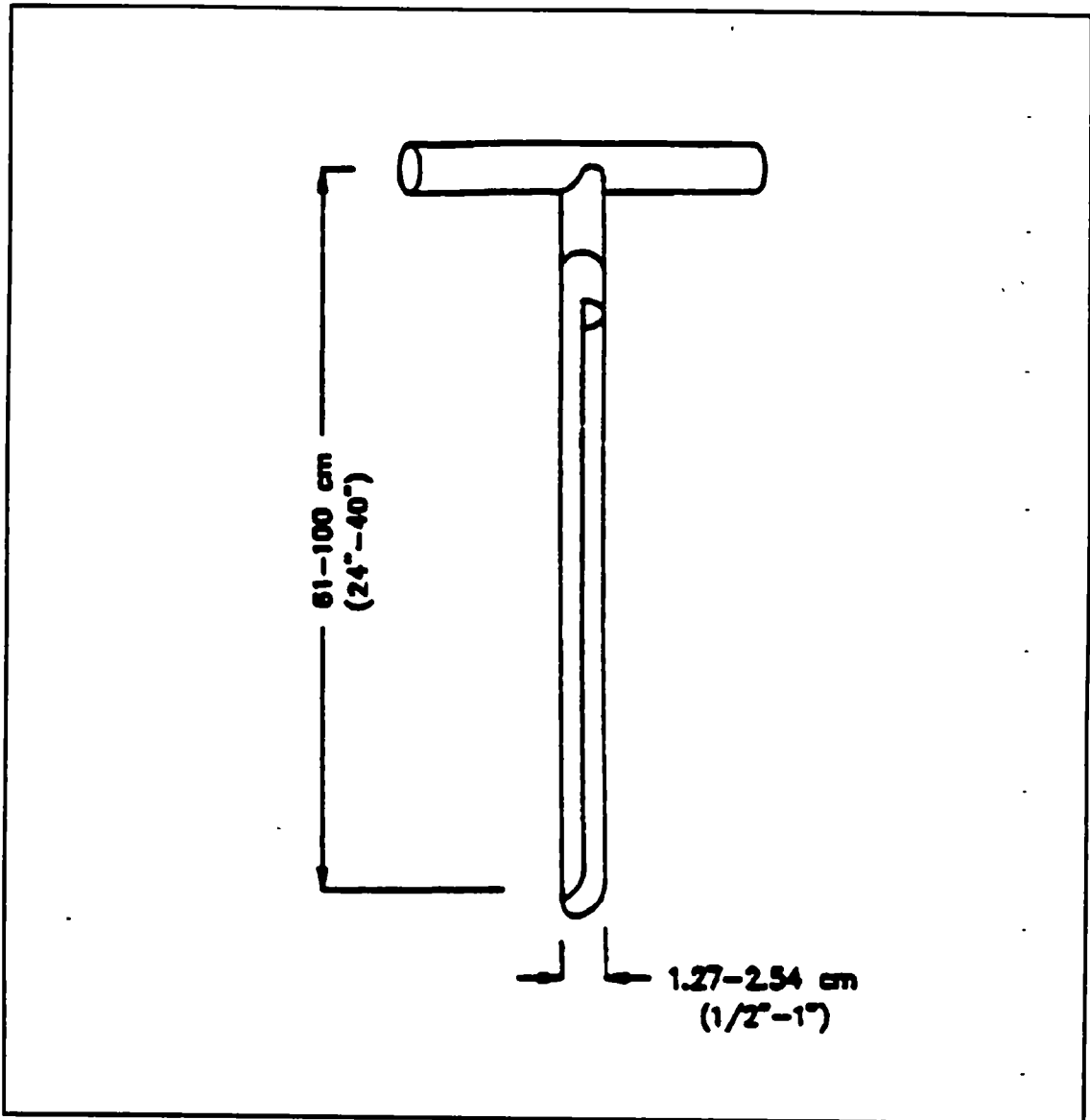
FIGURE 1 Sampling Augers



APPENDIX A (Cont'd)

Figures

FIGURE 2 Sampling Trier





SOIL GAS SAMPLING

SOP#: 2042
DATE 06/01/96
REV #: 0 0

1.0 SCOPE AND APPLICATION

Soil gas monitoring provides a quick means of waste site evaluation. Using this method, underground contamination can be identified, and the source, extent, and movement of the pollutants can be traced.

This standard operating procedure (SOP) outlines the methods used by U.S. EPA/ERT in installing soil gas wells, measuring organic vapor levels in the soil gas using a Photoionization Detector (PID), Flame Ionization Detector (FID) and/or other air monitoring devices; and sampling the soil gas using Tedlar bags, Tenax sorbent tubes, and/or Summa canisters.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

A 3/8" diameter hole is driven into the ground to a depth of four to five feet using a commercially available slam bar. Soil gas can also be sampled at other depths by the use of a longer bar or bar attachments. A 1/4" O.D. stainless steel probe is inserted into the hole. The hole is then sealed around the top of the probe using modeling clay. The gas contained in the interstitial spaces of the soil is sampled by pulling the sample through the probe using an air sampling pump. The sample may be stored in Tedlar bags, drawn through sorbent cartridges, or analyzed directly using a direct reading instrument. The air sampling pump is not used for Summa canister sampling of soil gas. Sampling is

achieved by soil gas equilibration with the evacuated Summa canister.

Other field air monitoring devices, such as the combustible gas indicator (MSA CGI/02 Meter, Model 260) and the Organic Vapor Analyzer (Foxboro OVA, Model 128), can also be used dependent on specific site conditions. Measurement of soil temperature using a temperature probe may also be desirable. Bagged samples are usually analyzed in a field laboratory using a portable Photovac GC.

Power driven sampling probes may be utilized when soil conditions make sampling by hand unfeasible (i.e., frozen ground, very dense clays, pavement, etc.). Commercially available soil gas sampling probes (hollow, 1/2" O.D. steel probes) can be driven to the desired depth using a power hammer (e.g., Bosch Demolition Hammer or Geoprobe™). Samples can be drawn through the probe itself, or through Teflon tubing inserted through the probe and attached to the probe point. Samples are collected and analyzed as described above.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

3.1 Tedlar Bags

Soil gas samples are generally contained in 10-L Tedlar bags. Bagged samples are best stored in dark plastic bags placed in coolers to protect the bags from any damage that may occur in the field or in transit. In addition, coolers insure the integrity of the samples by keeping them at a cool temperature and out of direct sunlight. Samples should be analyzed as soon as possible, preferably within 24 - 48 hours.

3.2 Tenax Tubes

Bagged samples can also be drawn onto Tenax or

other sorbent tubes to undergo lab GC/MS analysis. If Tenax tubes are to be utilized, special care must be taken to avoid contamination. Handling of the tubes should be kept to a minimum and only while wearing nylon or other lint-free gloves. After sampling, each tube should be stored in a clean, sealed culture tube; the ends packed with clean glass wool to protect the sorbent tube from breakage. The culture tubes should be kept cool and wrapped in aluminum foil to prevent any photodegradation of samples (see Section 7.4).

3.3 Summa Canisters

The Summa canisters used for soil gas sampling have a 6 liter sample capacity and are certified clean by GC/MS analysis before being utilized in the field. After sampling is completed, they are stored and shipped in travel cases.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 PID Measurements

A number of factors can affect the response of a PID (such as the HNu PI 101). High humidity can cause lamp fogging and decreased sensitivity. This can be significant when soil moisture levels are high, or when a soil gas well is actually in groundwater. High concentrations of methane can cause a downscale deflection of the meter. High and low temperature, electrical fields, FM radio transmission, and naturally occurring compounds, such as terpenes in wooded areas, will also affect instrument response.

Other field screening instruments can be affected by interferences. Consult the manufacturers manuals.

4.2 FID Measurements

A number of factors can affect the response of an FID (such as the OVA model 128). High humidity can cause the FID to flame out or not ignite at all. This can be significant when soil moisture levels are high, or when a soil gas well is actually in groundwater. The FID can only read organic based compounds (they must contain carbon in the molecular structure). The FID also responds poorly to hydrocarbons and halogenated hydrocarbons (such as gasoline, propane fuel). High and low temperature, electrical fields and FM radio transmission will also affect instrument response.

4.3 Factors Affecting Organic Concentrations in Soil Gas

Concentrations in soil gas are affected by dissolution, adsorption, and partitioning. Partitioning refers to the ratio of component found in a saturated vapor above an aqueous solution to the amount in the solution, this can, in theory, be calculated using the Henry's Law constants. Contaminants can also be adsorbed onto inorganic soil components or "dissolved" in organic components. These factors can result in a lowering of the partitioning coefficient.

Soil "tightness" or amount of void space in the soil matrix, will affect the rate of recharging of gas into the soil gas well.

Existence of a high, or perched, water table, or of an impermeable underlying layer (such as a clay lens or layer of buried slag) may interfere with sampling of the soil gas. Knowledge of site geology is useful in such situations, and can prevent inaccurate sampling.

4.4 Soil Probe Clogging

A common problem with this sampling method is soil probe clogging. A clogged probe can be identified by using an in-line vacuum gauge or by listening for the sound of the pump laboring. This problem can usually be eliminated by using a wire cable to clear probe (see Section 7.1.3).

4.5 Underground Utilities

Prior to selecting sample locations, an underground utility search is recommended. The local utility companies can be contacted and requested to mark the locations of their underground lines. Sampling plans can then be drawn up accordingly. Each sample location should also be screened with a metal detector or magnetometer to verify that no underground pipes or drums exist.

5.0 EQUIPMENT/APPARATUS

5.1 Slam Bar Method

- C Slam Bar (1 per sampling team)
- C Soil gas probes, stainless steel tubing, 1/4" O.D., 5 ft length.
- C Flexible wire or cable used for clearing the

- C tubing during insertion into the well
- C "Quick Connect" fittings to connect sampling probe tubing, monitoring instruments, and Gilian pumps to appropriate fittings on vacuum box
- C Modeling clay
- C Vacuum box for drawing a vacuum around Tedlar bag for sample collection (1 per sampling team)
- C Gilian pump Model HFS113A adjusted to approximately 3.0 L/min (1 to 2 per sample team)
- C 1/4" Teflon tubing, 2 ft to 3 ft lengths, for replacement of contaminated sample line
- C 1/4" Tygon tubing, to connect Teflon tubing to probes and quick connect fittings
- C Tedlar bags, 10 L, at least 1 bag per sample point
- C Soil Gas Sampling labels, field data sheets, logbook, etc
- C PID/FID, or other field air monitoring devices, (1 per sampling team)
- C Ice chest, for carrying equipment and for protection of samples (2 per sampling team)
- C Metal detector or magnetometer, for detecting underground utilities/pipes/drums (1 per sampling team).
- C Photovac GC, for field-lab analysis of bagged samples.
- C Summa canisters (plus their shipping cases) for sample, storage and transportation
- C Large dark plastic garbage bags

5.2 Power Hammer Method

- C Bosch demolition hammer.
- C 1/2" O.D. steel probes, extensions, and points.
- C Dedicated aluminum sampling points.
- C Teflon tubing, 1/4".
- C "Quick Connect" fittings to connect sampling probe tubing, monitoring instruments, and Gilian pumps to appropriate fittings on vacuum box.
- C Modeling clay.
- C Vacuum box for drawing a vacuum around Tedlar bag for sample collection (1 per sampling team).
- C Gilian pump Model HFS113A adjusted to approximately 3.0 L/min (1 to 2 per sample team)
- C 1/4" Teflon tubing, 2 ft to 3 ft lengths, for

- C replacement of contaminated sample line
- C 1/4" Tygon tubing, to connect Teflon tubing to probes and quick connect fittings
- C Tedlar bags, 10 L, at least 1 bag per sample point
- C Soil Gas Sampling labels, field data sheets, logbook, etc
- C HNu Model P1101, or other field air monitoring devices, (1 per sampling team)
- C Ice chest, for carrying equipment and for protection of samples (2 per sampling team)
- C Metal detector or magnetometer, for detecting underground utilities/pipes/drums (1 per sampling team)
- C Photovac GC, for field-lab analysis of bagged samples
- C Summa canisters (plus their shipping cases) for sample, storage and transportation
- C Generator w/extension cords
- C High lift jack assembly for removing probes

5.3 Geoprobe™ Method

The Geoprobe is a hydraulically-operated sampling device mounted in a customized four-wheel drive vehicle. The sampling device can be deployed from the truck and positioned over a sample location. The base of the sampling device is positioned on the ground. The weight of the vehicle is hydraulically raised on the base. As the weight of the vehicle is transferred to the probe, the probe is pushed into the ground. A built-in hammer mechanism allows the probe to be driven past some dense stratigraphic horizons. When the probe reaches the sample depth, up to 50 feet under favorable geologic situations, samples can be collected.

Soil gas can be collected from specific depths in two general ways. One method involves withdrawing a sample directly from the probe rods, after evacuating a sufficient volume of air from the probe rods. The other method involves collecting a sample through tubing attached by an adaptor to the bottom probe rod section. Correctly used, this method provides more reliable results. Manufacturer's instructions and the SOP for the Model 5400 Geoprobe™ Operation should be followed when using this method.

6.0 REAGENTS

- C PID/FID or calibration gases for field air monitoring devices (such as methane and

- C isobutylene)
- C Deionized organic-free water, for decontamination
- C Methanol, HPLC grade, for decontamination
- C Ultra-zero grade compressed air, for field blanks
- C Standard gas preparations for Photovac GC calibration and Tedlar bag spikes
- C Propane Torch (for decontamination of steel probes)

7.0 PROCEDURES

7.1 Soil Gas Well Installation

- 1 Initially a hole slightly deeper than the desired depth is made. For sampling up to 5 feet, a 5-ft single piston slam bar is used. For deeper depths, a piston slam bar with threaded 4-foot-long extensions can be used. Other techniques can be used, so long as holes are of narrow diameter and no contamination is introduced.
- 2 After the hole is made, the slam bar is carefully withdrawn to prevent collapse of the walls of the hole. The soil gas probe is then inserted.
- 3 It is necessary to prevent plugging of the probe, especially for deeper holes. A metal wire or cable, slightly longer than the probe, is placed in the probe prior to inserting into the hole. The probe is inserted to full depth, then pulled up three to six inches, then cleared by moving the cable up and down. The cable is removed before sampling.
- 4 The top of the sample hole is sealed at the surface against ambient air infiltration by using modeling clay molded around the probe at the surface of the hole.
- 5 If conditions preclude hand installation of the soil gas wells, the power driven system may be employed. The generator powered demolition hammer is used to drive the probe to the desired depth (up to 12 Ft may be attained with extensions). The probe is pulled up 1-3 inches if the retractable point is used. No clay is needed to seal the hole. After sampling, the probe is retrieved using

the high lift jack assembly

- 6 If semi-permanent soil gas wells are required, the dedicated aluminum probe points are used. These points are inserted into the bottom of the power driven probe and attached to the Teflon tubing. The probe is inserted as in step 5. When the probe is removed, the point and Teflon tube remain in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.2 Screening with Field Instruments

- 1 The well volume must be evacuated prior to sampling. Connect the Gilian pump, adjusted to 3.0 L/min, to the sample probe using a section of Teflon tubing as a connector. The pump is turned on, and a vacuum is pulled through the probe for approximately 15 seconds. Longer time is required for sample wells of greater depths.
- 2 After evacuation, the monitoring instrument(s) (i.e. HNu or OVA) is connected to the probe using a Teflon connector. When the reading is stable, or peaks, the reading is recorded on soil gas data sheets.
- 3 Of course, readings may be above or below the range set on the field instruments. The range may be reset, or the response recorded as a greater than or less than figure. Recharge rate of the well with soil gas must be considered when resampling at a different range setting.

7.3 Tedlar Bag Sampling

- 1 Follow step 7.2.1 to evacuate well volume. If air monitoring instrument screening was performed prior to sample taking, evacuation is not necessary.
- 2 Use the vacuum box and sampling train (Figure 1) to take the sample. The sampling train is designed to minimize the introduction of contaminants and losses due to adsorption. All wetted parts are either Teflon or stainless steel. The vacuum is drawn indirectly to avoid contamination from sample pumps.

- 3 The Tedlar bag is placed inside the vacuum box, and attached to the sampling port. The sample probe is attached to the sampling port via Teflon tubing and a "Quick Connect" fitting.
- 4 A vacuum is drawn around the outside of the bag, using a Gilian pump connected to the vacuum box evacuation port, via Tygon tubing and a "Quick Connect" fitting. The vacuum causes the bag to inflate, drawing the sample.
- 5 Break the vacuum by removing the Tygon line from the pump. Remove the bagged sample from the box and close valve. Record data on data sheets or in logbooks. Record the date, time, sample location ID, and the PID/FID instrument reading(s) on sample bag label.

CAUTION Labels should not be pasted directly onto the bags, nor should bags be labeled directly using a marker or pen. Inks and adhesive may diffuse through the bag material, contaminating the sample. Place labels on the edge of the bags, or tie the labels to the metal eyelets provided on the bags. Markers with inks containing volatile organics (i.e., permanent ink markers) should not be used.

Chain of Custody Sheets must accompany all samples submitted to the field laboratory for analysis.

7.4 Tenax Tube Sampling

Samples collected in Tedlar bags may be adsorbed onto Tenax tubes for further analysis by GC/MS.

7.4.1 Additional Apparatus

- A. Syringe with a luer-lock tip capable of drawing a soil gas or air sample from a Tedlar bag onto a Tenax/CMS sorbent tube. The syringe capacity is dependent upon the volume of sample being drawn onto the sorbent tube.
- B. Adapters for fitting the sorbent tube between the Tedlar bag and the sampling syringe. The adapter attaching the Tedlar bag to the sorbent tube consists of a reducing union (1/4" to 1/16" O.D. -- Swagelok cat #

SS-400-6-ILV or equivalent) with a length of 1/4" O.D. Teflon tubing replacing the nut on the 1/6" (Tedlar bag) side. A 1/4" I.D. silicone O-ring replaces the ferrules in the nut on the 1/4" (sorbent tube) side of the union.

The adapter attaching the sampling syringe to the sorbent tube consists of a reducing union (1/4" to 1/16" O.D. -- Swagelok Cat # SS-400-6-ILV or equivalent) with a 1/4" I.D. silicone O-ring replacing the ferrules in the nut on the 1/4" (sorbent tube) side and the needle of a luer-lock syringe needle inserted into the 1/16" side. (Held in place with a 1/16" ferrule.) The luer-lock end of the needle can be attached to the sampling syringe. It is useful to have a luer-lock on/off valve situated between the syringe and the needle.

- C. Two-stage glass sampling cartridge (1/4" O.D. x 1/8" I.D. x 5 1/8") contained in a flame-sealed tube (Manufacturer: Supelco Custom Tenax/Spherocarb Tubes) containing two sorbent sections retained by glass wool.

Front section 150 mg of Tenax-GC

Back section 150 mg of CMS (Carbonized Molecular Sieve)

These tubes are prepared and cleaned in accordance with EPA Method EMSL/RTP-SOP-EMD-013 by the vendor. The vendor sends ten tubes per lot made to the REAC GC/MS Laboratory and they are tested for cleanliness, precision, and reproductibility.

- D. Teflon-capped culture tubes or stainless steel tube containers for sorbent tube storage and shipping. These containers should be conditioned by baking at 120 degrees C for at least two hours. The culture tubes should contain a glass wool plug to prevent sorbent tube breakage during transport. Reconditioning of the containers should occur between uses or after extended periods of disuse (i.e., two weeks or more).
- E. Nylon gloves or lint-free cloth. (Hewlett Packard Part # 8650-0030 or equivalent.)

7 4 2 Sample Collection

Handle sorbent tubes with care, using nylon gloves (or other lint-free material) to avoid contamination

Immediately before sampling, break one end of the sealed tube and remove the Tenax cartridge

Connect the valve on the Tedlar bag to the sorbent tube adapter. Connect the sorbent tube to the sorbent tube adapter with the Tenax (white granular) side of the tube facing the Tedlar bag. Connect the sampling syringe assembly to the CMS (black) side of the sorbent tube. Fittings on the adapters should be finer-tight. Open the valve on the Tedlar bag. Open the on/off valve of the sampling syringe. Depending on work plan stipulations, at least 10% of the soil gas samples analyzed by this GC method must be submitted for confirmational GC/MS analysis (according to modified methods TO-1 [Tenax absorbent] and TO-2 [Carbon Molecular Sieve (CMS) absorbent]). Each soil gas sample must be absorbed on replicate Tenax/CMS tubes. The volume absorbed on a Tenax/CMS tube is dependent on the total concentration of the compounds measured by the photovac/GC or other applicable GC.

<u>Total Concentration (ppm)</u>	<u>Sample Volume (mL)</u>
>10	Use Serial Dilution
10	10 - 50
5	20-100
1	100-250

After sampling, remove the tube from the sampling train with gloves or a clean cloth. DO NOT LABEL OR WRITE ON THE TENAX/CMS TUBE.

Place the sorbent tube in a conditioned stainless steel tube holder or culture tube. Culture tube caps should be sealed with Teflon tape.

7 4 3 Sample Labeling

Each sample tube container (not tube) must be labeled with the site name, sample station number, date sampled, and volume sampled

Chain of custody sheets must accompany all samples to the laboratory.

7 4 4 Quality Assurance (QA)

Before field use, a QA check should be performed on each batch of sorbent tubes by analyzing a tube by thermal desorption/cryogenic trapping GC/MS

At least one blank sample must be submitted with each set of samples collected at a site. This trip blank must be treated the same as the sample tubes except no sample will be drawn through the tube.

Sample tubes should be stored out of UV light (i.e., sunlight) and kept on ice until analysis. Samples should be taken in duplicate, when possible.

7.5 Summa Canister Sampling

- 1 Follow step 7 2 1 to evacuate well volume. If PID/FID readings were taken prior to taking a sample, evacuation is not necessary.
- 2 Attach a certified clean, evacuated 6-liter Summa canister via the 1/4" Teflon tubing.
- 3 Open valve on Summa canister. The soil gas sample is drawn into the canister by pressure equilibration. The approximate sampling time for a 6 liter canister is 20 minutes.
- 4 Site name, sample location, number, and date must be recorded on a chain of custody form and on a blank tag attached to the canister.

8.0 CALCULATIONS

8.1 Field Screening Instruments

Instrument readings are usually read directly from the meter. In some cases, the background level at the soil gas station may be subtracted:

$$\text{Final Reading} = \text{Sample Reading} - \text{Background}$$

8.2 Photovac GC Analysis

Calculations used to determine concentrations of individual components by Photovac GC analysis are beyond the scope of this SOP and are covered in ERT SOP #2109, *Photovac GC Analysis for Soil Water and Air/Soil Gas*.

9.0 CALIBRATION

9.1 Field Instruments

It is recommended that the manufacturers' manuals be consulted for correct use and calibration of all instrumentation

9.2 Gilian Model HFS113A Air Sampling Pumps

Flow should be set at approximately 30 L/min, accurate flow adjustment is not necessary. Pumps should be calibrated prior to bringing into the field

10.0 QUALITY ASSURANCE/ QUALITY CONTROL

10.1 Sample Probe Contamination

Sample probe contamination is checked between each sample by drawing ambient air through the probe via a Gilian pump and checking the response of the FID/PID. If readings are higher than background, replacement or decontamination is necessary

Sample probes may be decontaminated simply by drawing ambient air through the probe until the HNu reading is at background. More persistent contamination can be washed out using methanol and water, then air drying. For persistent volatile contamination, use of a portable propane torch may be needed. Using a pair of pliers to hold the probe, run the torch up and down the length of the sample probe for approximately 1-2 minutes. Let the probe cool before handling. When using this method, make sure to wear gloves to prevent burns. Having more than one probe per sample team will reduce lag times between sample stations while probes are decontaminated.

10.2 Sample Train Contamination

The Teflon line forming the sample train from the probe to the Tedlar bag should be changed on a daily basis. If visible contamination (soil or water) is drawn into the sampling train, it should be changed immediately. When sampling in highly contaminated areas, the sampling train should be purged with ambient air, via a Gilian pump, for approximately 30 seconds between each sample. After purging, the

sampling train can be checked using an FID or PID, or other field monitoring device, to establish the cleanliness of the Teflon line

10.3 FID/PID Calibration

The FID and PIDs should be calibrated at least once a day using the appropriate calibration gases

10.4 Field Blanks

Each cooler containing samples should also contain one Tedlar bag of ultra-zero grade air, acting as a field blank. The field blank should accompany the samples in the field (while being collected) and when they are delivered for analysis. A fresh blank must be provided to be placed in the empty cooler pending additional sample collection. One new field blank per cooler of samples is required. A chain of custody sheet must accompany each cooler of samples and should include the blank that is dedicated to that group of samples

10.5 Trip Standards

Each cooler containing samples should contain a Tedlar bag of standard gas to calibrate the analytical instruments (Photovac GC, etc.). This trip standard will be used to determine any changes in concentrations of the target compounds during the course of the sampling day (e.g., migration through the sample bag, degradation, or adsorption). A fresh trip standard must be provided and placed in each cooler pending additional sample collection. A chain of custody sheet should accompany each cooler of samples and should include the trip standard that is dedicated to that group of samples

10.6 Tedlar Bag Check

Prior to use, one bag should be removed from each lot (case of 100) of Tedlar bags to be used for sampling and checked for possible contamination as follows: the test bag should be filled with ultra-zero grade air, a sample should be drawn from the bag and analyzed via Photovac GC or whatever method is to be used for sample analysis. This procedure will ensure sample container cleanliness prior to the start of the sampling effort

10.7 Summa Canister Check

From each lot of four cleaned Summa canisters, one is to be removed for a GC/MS certification check. If the canister passes certification, then it is re-evacuated and all four canisters from that lot are available for sampling.

If the chosen canister is contaminated, then the entire lot of four Summas must be recleaned, and a single canister is re-analyzed by GC/MS for certification.

10.8 Options

10.8.1 Duplicate Samples

A minimum of 5% of all samples should be collected in duplicate (i.e., if a total of 100 samples are to be collected, five samples should be duplicated). In choosing which samples to duplicate, the following criteria applies: if, after filling the first Tedlar bag, and, evacuating the well for 15 seconds, the second HN (or other field monitoring device being used) reading matches or is close to (within 50%) the first reading, a duplicate sample may be taken.

10.8.2 Spikes

A Tedlar bag spike and Tenax tube spike may be desirable in situations where high concentrations of contaminants other than the target compounds are found to exist (landfills, etc.). The additional level of QA/QC attained by this practice can be useful in determining the effects of interferences caused by these non-target compounds. Summa canisters containing samples are not spiked.

11.0 DATA VALIDATION

11.1 Blanks (Field and Tedlar Bag Check)

For each target compound, the level of concentration found in the sample must be greater than three times the level (for that compound) found in the field blank which accompanied that sample to be considered valid. The same criteria apply to target compounds detected in the Tedlar bag pre-sampling contamination check.

12.0 HEALTH AND SAFETY CONSIDERATIONS

Due to the remote nature of sampling soil gas, special considerations can be taken with regard to health and safety. Because the sample is being drawn from underground, and no contamination is introduced into the breathing zone, soil gas sampling usually occurs in Level D. Ambient air is constantly monitored using the HNu PI101 to obtain background readings during the sampling procedure. As long as the levels in ambient air do not rise above background, no upgrade of the level of protection is needed.

When conducting soil gas sampling, leather gloves should be worn, and proper slam bar techniques should be implemented (bend knees). Also, an underground utility search should be performed prior to sampling. (See Section 4.5).

13.0 REFERENCES

Gilian Instrument Corp., Instruction Manual for Hi Flow Sampler: HFS113, HFS 113 T, HFS 113U, HFS 113 UT, 1983.

HNu Systems, Inc., Instruction Manual for Model PI 101 Photoionization Analyzer, 1975.

N J D E P., Field Sampling Procedures Manual, Hazardous Waste Programs, February, 1988.

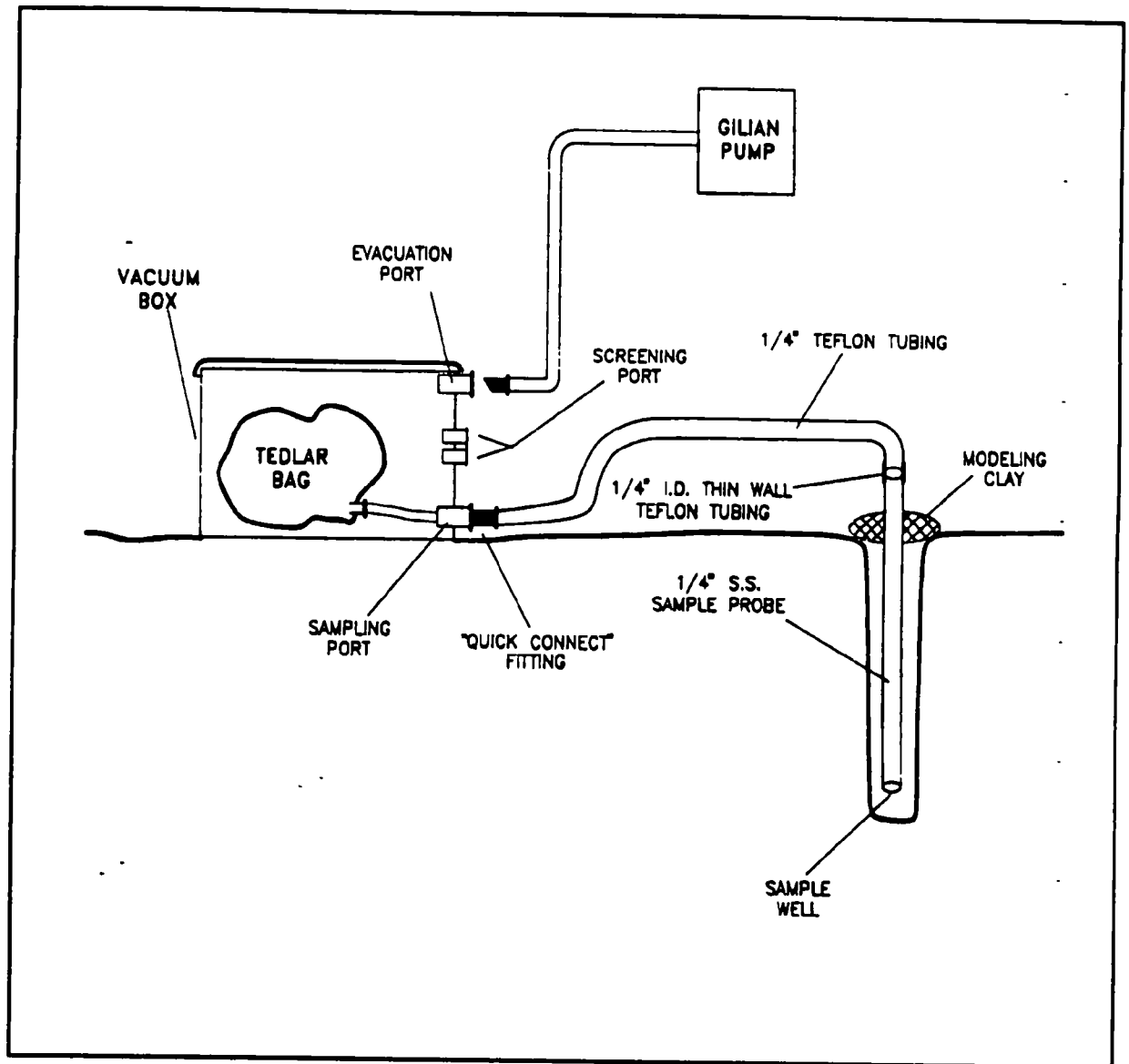
Roy F. Weston, Inc., Weston Instrumentation Manual, Volume I, 1987.

U S E P A., Characterization of Hazardous Waste Sites - A Methods Manual. Volume II, Available Sampling Methods, 2nd Edition, EPA-600/4-84-076, December, 1984.

APPENDIX A

Figure

FIGURE 1 Sampling Train Schematic



APPENDIX B

HNu Field Protocol

Field Procedure

The following sections detail the procedures that are to be followed when using the HNu in the field

Startup Procedure

- a. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug in, don't force
- b. Turn the function switch to the battery check position. The needle on the meter should read within or above the green battery area on the scale. If not, recharge the battery. If the red indicator light comes on, the battery needs recharging
- c. Turn the function switch to any range setting. Look into the end of the probe for no more than two to three seconds to see if the lamp is on. If it is on, it will give a purple glow. Do not stare into the probe any longer than three seconds. Long term exposure to UV light can damage eyes. Also, listen for the hum of the fan motor
- d. To ZERO the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed since this is an electronic zero adjustment. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 to 20 seconds to ensure that the zero reading is stable. If necessary, readjust the zero

Operational Check

- a. Follow the startup procedure
- b. With the instrument set on the 0-20 range, hold a solvent-based major market near the probe tip. If the meter deflects upscale, the instrument is working

Field Calibration Procedure

- a. Follow the startup procedure and the operational check.
- b. Set the function switch to the range setting for the concentration of the calibration gas
- c. Attach a regulator (HNu 101-351) to a disposable cylinder of isobutylene gas (HNu 101-351). Connect the regulator to the probe of the HNu with a piece of clean Tygon tubing. Turn on the valve on the regulator.
- d. After fifteen seconds, adjust the span dial until the meter reading equals the concentration of the calibration gas used. Be careful to unlock the span dial before adjusting it. If the span has to be set below 3.0, calibration internally or return to equipment maintenance for repair

- e Record in the field logbook the instrument ID no (EPA decal or serial number if the instrument is a rental), the initial and final span settings, the date and time, concentration and type of calibration has used, and the name of the person who calibrated the instrument

Operation

- a Follow the startup procedure, operational check, and calibration check
- b Set the function switch to the appropriate range If the concentration of gases or vapors is unknown, set the function switch to the 0-20 ppm range Adjust it if necessary
- c While taking care not to permit the HNu to be exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the Site Health and Safety Plan
- d When the activity is completed or at the end of the day, carefully clean the outside of the HNu with a damp disposable towel to remove any visible dirt Return the HNu to a secure area and place on charge
- e With the exception of the probe's inlet and exhaust, the HNu can be wrapped in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside in the event of precipitation.



MODEL 5400 GEOPROBE™ OPERATION

SOP# 2050
DATE 03/27/96
REV # 0.0

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to describe the collection of representative soil, soil-gas, and groundwater samples using a Model 5400 Geoprobe™ sampling device. Any deviations from these procedures should be documented in the site/field logbook and stated in project deliverables.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

The Geoprobe™ sampling device is used to collect soil, soil-gas and groundwater samples at specific depths below ground surface (BGS). The Geoprobe™ is hydraulically powered and is mounted in a customized four-wheel drive vehicle. The base of the sampling device is positioned on the ground over the sampling location and the vehicle is hydraulically raised on the base. As the weight of the vehicle is transferred to the probe, the probe is pushed into the ground. A built-in hammer mechanism allows the probe to be driven through dense materials. Maximum depth penetration under favorable circumstances is about 50 feet. Components of the Model 5400 Geoprobe™ are shown in Figures 1 through 6 (Appendix A).

Soil samples are collected with a specially-designed sample tube. The sample tube is pushed and/or vibrated to a specified depth (approximately one foot above the intended sample interval). The interior plug of the sample tube is removed by inserting small-diameter threaded rods. The sample tube is then driven an additional foot to collect the samples. The probe sections and sample tube are then withdrawn and the sample is extruded from the tube into sample jars.

Soil gas can be collected in two ways. One method

involves withdrawing a sample directly from the probe rods, after evacuating a sufficient volume of air from the probe rods. The other method involves collecting a sample through tubing attached by an adaptor to the bottom probe section. Correctly used, the latter method provides more reliable results.

Slotted lengths of probe can be used to collect groundwater samples if the probe rods can be driven to the water table. Groundwater samples are collected using either a peristaltic pump or a small bailer.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

Refer to specific ERT SOPs for procedures appropriate to the matrix, parameters and sampling objectives.

Applicable ERT SOPs include:

ERT #2012, Soil Sampling

ERT #2007, Groundwater Well Sampling

ERT #2042, Soil Gas Sampling

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

A preliminary site survey should identify areas to be avoided with the truck. All underground utilities should be located and avoided during sampling. Begin sampling activities with an adequate fuel supply.

Decontamination of sampling tubes, probe rods, adaptors, non-expendable points and other equipment that contacts the soil is necessary to prevent cross-contamination of samples. During sampling, the bottom portion and outside of the sampling tubes can be contaminated with soil from other depth intervals.

Care must be taken to prevent soil which does not represent the sampled interval from being incorporated into the sample. Excess soil should be carefully wiped from the outside surface of the sampling tube and the bottom 3 inches of the sample should be discarded before extruding the sample into a sample jar.

The amount of sample to be collected and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent upon the parameter(s) of interest. Guidelines for the containment, preservation, handling and storage of soil-gas samples are described in ERT SOP #2042, Soil-Gas Sampling.

Obtaining sufficient volume of soil for multiple analyses from one sample location may present a problem. The Geoprobe™ soil sampling system recovers a limited volume of soil and it is not possible to reenter the same hole and collect additional soil. When multiple analyses are to be performed on soil samples collected with the Geoprobe™, it is important that the relative importance of the analyses be identified. Identifying the order of importance will ensure that the limited sample volume will be used for the most crucial analyses.

5.0 EQUIPMENT/APPARATUS

Sampling with the Geoprobe™ involves use of the equipment listed below. Some of the equipment is used for all sample types, others are specific to soil (S), soil gas (SG), or groundwater (GW) as noted.

- C Geoprobe™ sampling device
- C Threaded probe rods (36", 24", and 12" lengths)
- C Drive Caps
- C Pull Caps
- C Rod Extractor
- C Expendable Point Holders
- C Expendable Drive Points
- C Solid Drive Points
- C Extension Rods
- C Extension Rod Couplers
- C Extension Rod Handle
- C Hammer Anvil
- C Hammer Latch
- C Hammer Latch Tool
- C Drill Steels
- C Carbide-Tipped Drill Bit

- C Mill-Slotted Well Point (GW)
- C Threaded Drive Point (GW)
- C Well Mini-Bailer (GW)
- C Tubing Bottom Check Valve (GW)
- C 3/8" O D Low Density Polyethylene Tubing (GW, SG)
- C Gas Sampling Adaptor and Cap (SG)
- C Teflon Tape
- C Neoprene "O" - Rings (SG)
- C Vacuum System (mounted in vehicle) (SG)
- C Piston Tip (S)
- C Piston Rod (S)
- C Piston Stop (S)
- C Sample Tube (11 5" in length) (S)
- C Vinyl Ends Caps (S)
- C Sample Extruder (S)
- C Extruder Pistons (Wooden Dowels) (S)
- C Wire Brush
- C Brush Adapters
- C Cleaning Brush (Bottle)

6.0 REAGENTS

Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

7.0 PROCEDURES

Portions of the following sections have been condensed from the Model 5400 Geoprobe™ Operations Manual(1). Refer to this manual for more detailed information concerning equipment specifications, general maintenance, tools, throttle control, clutch pump, GSK-58 Hammer, and troubleshooting. A copy of this manual will be maintained with the Geoprobe™ and on file in the Quality Assurance (QA) office.

7.1 Preparation

- 1 Determine extent of the sampling effort, sample matrices to be collected, and types and amounts of equipment and supplies required to complete the sampling effort.
- 2 Obtain and organize necessary sampling and monitoring equipment.
- 3 Decontaminate or pre-clean equipment, and ensure that it is in working order.
- 4 Perform a general site survey prior to site

- entry in accordance with the site-specific Health and Safety Plan
- 5 Use stakes or flagging to identify and mark all sampling locations. All sample locations should be cleared for utilities prior to sampling
- ## 7.2 Setup of Geoprobe™
- 1 Back carrier vehicle to probing location.
 - 2 Shift the vehicle to park and shut off ignition
 - 3 Set parking brake and place chocks under rear tires
 - 4 Attach exhaust hoses so exhaust blows downwind of the sampling location (this is particularly important during soil gas sampling).
 - 5 Start engine using the remote ignition at the Geoprobe™ operator position.
 - 6 Activate hydraulic system by turning on the Electrical Control Switch located on the Geoprobe™ electrical control panel (Figure 1, Appendix A). When positioning the probe, always use the SLOW speed. The SLOW speed switch is located on the hydraulic control panel (Figure 2, Appendix A)
- Important: Check for clearance on vehicle roof before folding Geoprobe™ out of the carrier vehicle.**
- 7 Laterally extend the Geoprobe™ from the vehicle as far as possible by pulling the EXTEND control lever toward the back of the vehicle while the Geoprobe™ is horizontal.
 - 8 Using the FOOT control, lower the Derrick Slide so it is below cylinder (A) before folding the Geoprobe™ out of the carrier vehicle (Figure 3, Appendix A). This will ensure clearance at the roof of the vehicle
 - 9 Use the FOLD, FOOT, and EXTEND controls to place Geoprobe™ to the exact probing location. Never begin probing in the fully extended position
- 10 Using the FOLD control, adjust the long axis of the probe cylinder so that it is perpendicular (visually) to the ground surface
 - 11 Using the FOOT control, put the weight of the vehicle on the probe unit. Do not raise the rear of the vehicle more than six inches
- Important: Keep rear vehicle wheels on the ground surface when transferring the weight of the vehicle to the probe unit. Otherwise, vehicle may shift when probing begins.**
- 12 When the probe axis is vertical and the weight of the vehicle is on the probe unit, probing is ready to begin
- ## 7.3 Drilling Through Surface Pavement or Concrete
- 1 Position carrier vehicle to drilling location
 - 2 Fold unit out of carrier vehicle
 - 3 Deactivate hydraulics.
 - 4 Insert carbide-tipped drill bit into hammer
 - 5 Activate HAMMER ROTATION control by turning knob counter-clockwise (Figure 4, Appendix A). This allows the drill bit to rotate when the HAMMER control is pressed.
 - 6 Press down on HAMMER control to activate counterclockwise rotation
 - 7 Both the HAMMER control and the PROBE control must be used when drilling through the surface (Figure 4, Appendix A). Fully depress the HAMMER control, and incrementally lower the bit gradually into the pavement by periodically depressing the PROBE control
 - 8 When the surface has been penetrated, turn the HAMMER Control Valve knob

clockwise to deactivate hammer rotation and remove the drill bit from the HAMMER

Important: Be sure to deactivate the rotary action before driving probe rods.

7.4 Probing

- 1 Position the carrier vehicle to the desired sampling location and set the vehicle parking brake.
- 2 Deploy Geoprobe™ Sampling Device
3. Make sure the hydraulic system is turned off
- 4 Lift up latch and insert hammer anvil into hammer - push latch back in (Figure 5, Appendix A)
- 5 Thread the drive cap onto the male end of the probe rod
6. Thread an expendable point holder onto the other end of the first probe rod
- 7 Slip an expendable drive point into point holder
- 8 Position the leading probe rod with expendable drive point in the center of the derrick foot and directly below the hammer anvil

Important: Positioning the first probe rod is critical in order to drive the probe rod vertically. Therefore, both the probe rod and the probe cylinder shaft must be in the vertical position (Figure 6, Appendix A).

- 9 To begin probing, activate the hydraulics and push the PROBE Control downward. When advancing the first probe rod, always use the SLOW speed. Many times the probe rods can be advanced using only the weight of the carrier vehicle. When this is the case, only the PROBE control is used.

Important: When advancing rods, always keep the probe rods parallel to the probe cylinder shaft (Figure 6, Appendix A).

This is done by making minor adjustments with the FOLD control. Failure to keep probe rods parallel to probe cylinder shaft may result in broken rods and increased difficulty in achieving desired sampling depth.

7.5 Probing - Percussion Hammer

The percussion hammer must be used in situations where the weight of the vehicle is not sufficient to advance the probe rods.

- 1 Make sure the Hammer Rotation Valve is closed.
- 2 Using the PROBE control to advance the rod, press down the HAMMER control to allow percussion to drive the rods (Figure 2, Appendix A)

Important: Always keep static weight on the probe rod or the rod will vibrate and chatter while you are hammering, causing rod threads to fracture and break.

- 3 Keep the hammer tight to the drive cap so the rod will not vibrate
- 4 Periodically stop hammering and check if the probe rods can be advanced by pushing only
- 5 Any time the downward progress of the probe rods is refused, the derrick foot may lift off of the ground surface. When this happens, reduce pressure on the PROBE control. Do not allow the foot to rise more than six inches off the ground or the vehicle's wheels may lift off the ground surface, causing the vehicle to shift (Figure 6, Appendix A)
- 6 As the derrick foot is raised off the ground surface, the probe cylinder may not be in a perpendicular position. If this happens, use the FOLD control to correct the probe cylinder position.

7.6 Probing - Adding Rods

- 1 Standard probe rods are three feet in length. If the desired depth is more than three feet,

another rod must be threaded onto the rod that has been driven into the ground. In order to ensure a vacuum-tight seal (soil-gas sampling), two wraps of teflon tape around the thread is recommended

- 2 Using the PROBE control, raise the probe cylinder as high as possible.

Important: Always deactivate hydraulics when adding rods.

- 3 Deactivate hydraulics.
- 4 Unthread the drive cap from the probe rod that is in the ground.
- 5 Wrap teflon tape around the threads
- 6 Thread the drive cap onto the male end of the next probe rod to be used
- 7 After threading the drive cap onto the rod to be added, thread the rod onto the probe rod that has been driven into the ground. Make sure threads have been teflon taped. Continue probing.
- 8 Continue these steps until the desired sampling depth has been reached.

7.7 Probing/Pulling Rods

- 1 Once the probe rods have been driven to depth, they can also be pulled using the Geoprobe™ Machine.
- 2 Turn off the hydraulics.
- 3 Lift up latch and take the hammer anvil out of the hammer.
- 4 Replace the drive cap from the last probe rod driven with a pull cap.
- 5 Lift up the hammer latch.
- 6 Activate the hydraulics.
- 7 Hold down on the PROBE control, and move the probe cylinder down until the latch can be closed over the pull cap

Important: If the latch will not close over the pull cap, adjust the derrick assembly by using the extend control. This will allow you to center the pull cap directly below the hammer latch.

- 8 Retract the probe rods by pulling up on the PROBE control.

Important: Do not raise the probe cylinder all the way when pulling probe rods or it will be impossible to detach a rod that has been pulled out. However, it is necessary to raise the probe cylinder far enough to allow the next probe section to be pulled.

- 9 After retracting the first probe rod, lower the probe cylinder only slightly to ease the pressure off of the hammer latch
- 10 Attach a clamping device to the base of the rods where it meets the ground to prevent rods from falling back into the hole
- 11 Raise the hammer latch
- 12 Hold the PROBE control up and raise the probe cylinder as high as possible
- 13 Unthread the pull cap from the retracted rod
- 14 Unthread the retracted rod
15. Thread the pull cap onto the next rod that is to be pulled
- 16 Continue these steps until all the rods are retracted from the hole
- 17 Decontaminate all portions of the equipment that have been in contact with the soil, soil gas and groundwater.

7.8 Soil-Gas Sampling Without Interior Tubing

- 1 Follow procedures outlined in Sections 7.1 through 7.6
- 2 Remove hammer anvil from hammer

- 3 Thread on pull cap to end of probe rod
 - 4 Retract rod approximately six inches
Retraction of the rod disengages expendable drive point and allows for soil vapor to enter rod
 - 5 Unthread pull cap and replace it with a gas sampling cap. Cap is furnished with barbed hose connector
- Important: Shut engine off before taking sample (exhaust fumes can cause faulty sample data).**
- 6 Turn vacuum pump on and allow vacuum to build in tank
 - 7 Open line control valve. For each rod used, purge 300 liters of volume. Example: Three rods used = 900 liters = 900 on gauge
 - 8 After achieving sufficient purge volume, close valve and allow sample line pressure gauge to return to zero. This returns sample train to atmospheric pressure.
 - 9 The vapor sample can now be taken
 - 1 Pinch hose near gas sampling cap to prevent any outside vapors from entering the rods
 - 2 Insert syringe needle into center of barbed hose connector and withdraw vapor sample
 - 10 To maintain suction at the sampling location, periodically drain the vacuum tank.
 - 11 To remove rods, follow procedures outlined in Section 7.7
- 7.9 Soil-Gas Sampling With Post-Run Tubing (PRT)**
- 1 Follow procedures outlined in Sections 7.1 through 7.6
 - 2 Retract rod approximately six inches
Retraction of rod disengages expendable drive point and allows for soil vapor to enter rod
 - 3 Remove pull cap from the end of the probe rod
 - 4 Position the Geoprobe™ to allow room to work
 - 5 Secure PRT Tubing Adapter with "O" - Ring to selected tubing.
 - 6 Insert the adapter end of the tubing down the inside diameter of the probe rods
 - 7 Feed the tubing down the hole until it hits bottom on the expendable point holder. Cut the tubing approximately two feet from the top probe rod.
 - 8 Grasp excess tubing and apply some downward pressure while turning it in a counter-clockwise motion to engage the adapter threads with the expendable point holder.
 - 9 Pull up lightly on the tubing to test engagement of threads
 - 10 Connect the outer end of the tubing to silicon tubing and vacuum hose (or other sampling apparatus).
 - 11 Follow the appropriate sampling procedure (ERT SOP #2042, Soil Gas Sampling) to collect a soil-gas sample.
 - 12 After collecting a sample, disconnect the tubing from the vacuum hose or sampling system
 - 13 Pull up firmly on the tubing until it releases from the adapter at the bottom of the hole
 - 14 Extract the probe rods from the ground and recover the expendable point holder with the attached adapter.

- 15 Inspect the "O"-ring at the base of the adapter to verify that proper sealing was achieved during sampling. The "O"-ring should be compressed.

Note: If the "O"-ring is not compressed, vapors from within the probe sections may have been collected rather than vapors from the intended sample interval.

7.10 Soil Sampling

- 1 Follow procedures outlined in Sections 7.1 through 7.6
- 2 Assemble soil-sampling tube.
 - 1 Thread piston rod into piston tip
 - 2 Insert piston tip into sample tube, seating piston tip into cutting edge of sample tube
 - 3 Thread drive head into threaded end of sample tube
 - 4 Thread piston stop pin into drive head. Stop pin should be tightened with wrench so that it exerts pressure against the piston rod
- 3 Attach assembled sampler onto leading probe rod
- 4 Drive the sampler with the attached probe rods to the top of the interval to be sampled
- 5 Move probe unit back from the top of the probe rods to allow work room
- 6 Remove drive cap and lower extension rods into inside diameter of probe rods using couplers to join rods together.
- 7 Attach extension rod handle to top extension rod
- 8 Rotate extension rod handle clockwise until the leading extension rod is threaded into the piston stop in downhole.
- 9 Continue to rotate extension rod handle clockwise until reverse-threaded stop-pin has disengaged from the drive head.

- 10 Remove extension rods and attached stop-pin from the probe rods
- 11 Replace drive cap onto top probe rod
- 12 Mark the top probe rod with a marker or tape at the appropriate distance above the ground surface (dependent on sample tube length)
- 13 Drive probe rods and sampler the designated distance. Be careful not to overdrive the sampler which could compact the soil sample in the tube, making it difficult to extrude.

Important: Documentation of sample location should include both surface and subsurface identifiers. Example: Correct Method - Sample Location S-6, 12.0' - 13.0'. Incorrect Method - Sample Location S-6, 12.0'.

- 14 Retract probe rods from the hole and recover the sample tube. Inspect the sample tube to confirm that a sample was recovered
- 15 Disassemble sampler. Remove all parts
- 16 Position extruder rack on the foot of the Geoprobe™ derrick
- 17 Insert sample tube into extruder rack with the cutting end up
- 18 Insert hammer anvil into hammer
- 19 Position the extruder piston (wood dowel) and push sample out of the tube using the PROBE control on the Geoprobe™. Collect the sample as it is extruded in an appropriate sample container.

Caution: use care when performing this task. Apply downward pressure gradually. Use of excessive force could result in injury to operator or damage to tools. Make sure proper diameter extruder piston is used.
- 20 To remove rods follow procedures outlined in Section 7.7

7.11 Groundwater Sampling

- 1 Follow Sections 7.1 through 7.6 with the following exception: the Mill-Slotted Well Rod with attached threaded drive point should be the first section probed into the ground. Multiple sections of mill-slotted well rods can be used to provide a greater vertical section into which groundwater can flow.
- 2 Probe to a depth at which groundwater is expected.
- 3 Remove Drive Cap and insert an electric water-level indicator to determine if water has entered the slotted sections of probe rod. Refer to ERT SOP #2043, Water Level Measurement, to determine water level.
- 4 If water is not detected in the probe rods, replace the drive cap and continue probing. Stop after each additional probe length and determine if groundwater has entered the slotted rods.
- 5 After the probe rods have been driven into the saturated zone, sufficient time should be allowed for the water level in the probe rods to stabilize.

Note: It will be difficult if not impossible to collect a groundwater sample in aquifer material small enough to pass through the slots (<0.02 inch diameter).

- 6 Groundwater samples may be collected with the 20-mL well Mini-Bailer or a pumping device. If samples are being collected for volatile organic analysis (VOA), the 20-mL Well Mini-Bailer should be used. If samples are being collected for a variety of analyses, VOA samples should be collected first using the bailer. Remaining samples can be collected by pumping water to the surface. Withdrawing water with the pump is more efficient than collecting water with the 20-mL well Mini-Bailer.

Important: Documentation of sample location should include both surface and subsurface identifiers. Example: Sample Location GW-6, 17'-21' bgs, water level in

probe rods is 17 feet bgs, and the leading section of probe rod is 21 feet bgs. The water sample is from this zone, not from 17 feet bgs or 21 feet bgs.

- 7 Remove rods following procedures outlined in Section 7.7.

8.0 CALCULATIONS

Calculating Vapor Purge Volume for Soil-Gas Sampling without Interior Tubing

Volume of Air to be Purged (Liters) = 300 x Number of Rods in the Ground

Volume in Liters/1000 = Reading on Vacuum Pump Instrument Gauge

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

The following general QA procedures apply

- 1 All data must be documented on field data sheets or within site logbooks.
- 2 All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and the REAC site specific Health and Safety Plan. The following is a list of health and safety precautions which specifically apply to Geoprobe™ operation.

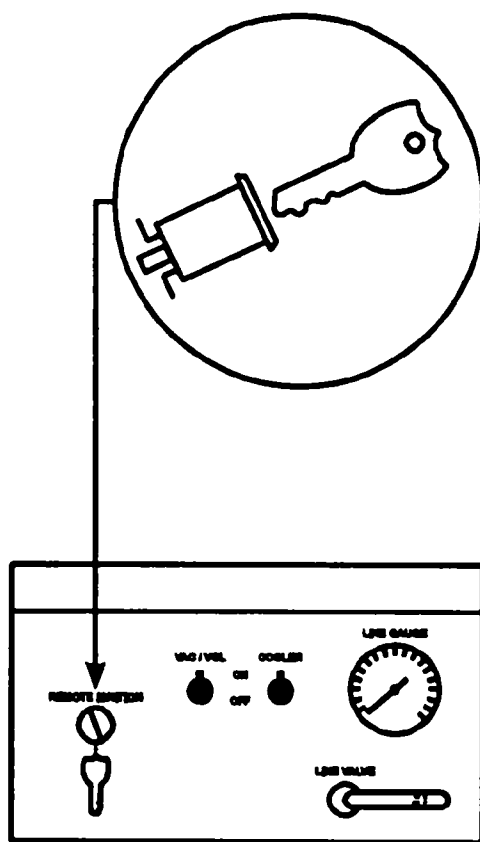
- 1 Always put vehicle in "park", set emergency brake, and place chocks under the tires, before engaging remote ignition.

- 2 If vehicle is parked on a loose or soft surface, do not fully raise rear of vehicle with probe foot, as vehicle may fall or move
 - 3 Always extend the probe unit out from the vehicle and deploy the foot to clear vehicle roof line before folding the probe unit out
 - 4 Operators should wear OSHA approved steel-toed shoes and keep feet clear of probe foot
 - 5 Operator should wear ANSI approved hard hats
 - 6 Only one person should operate the probe machine and the assemble or disassemble probe rods and accessories
 - 7 Never place hands on top of a rod while it is under the machine
 - 8 Turn off the hydraulic system while changing rods, inserting the hammer anvil, or attaching accessories
 - 9 Operator must stand on the control side of the probe machine, clear of the probe foot and mast, while operating controls
 - 10 Wear safety glasses at all times during the operation of this machine
 - 11 Never continue to exert downward pressure on the probe rods when the probe foot has risen six inches off the ground.
 - 12 Never exert enough downward pressure on a probe rod so as to lift the rear tires of the vehicle off the ground.
 - 13 Always remove the hammer anvil or other tool from the machine before folding the machine to the horizontal position
 - 14 The vehicle catalytic converter is hot and may present a fire hazard when operating over dry grass or combustibles
 - 15 Geoprobe™ operators must wear ear protection OSHA approved ear protection for sound levels exceeding 85 dba is recommended
 - 16 Locations of buried or underground utilities and services must be known before starting to drill or probe
 - 17 Shut down the hydraulic system and stop the vehicle engine before attempting to clean or service the equipment
 - 18 Exercise extreme caution when using extruder pistons (wooden dowels) to extrude soil from sample tubes Soil in the sample tube may be compacted to the point that the extruder piston will break or shatter before it will push the sample out
 - 19 A dry chemical fire extinguisher (Type ABC) should be kept with the vehicle at all times
- ## 12.0 REFERENCES
- 1 Model 5400 Geoprobe™ Operations Manual Geoprobe™ Systems, Salina, Kansas July 27, 1990
 2. Geoprobe™ Systems - 1995-96 Tools and Equipment Catalog

APPENDIX A

Figures

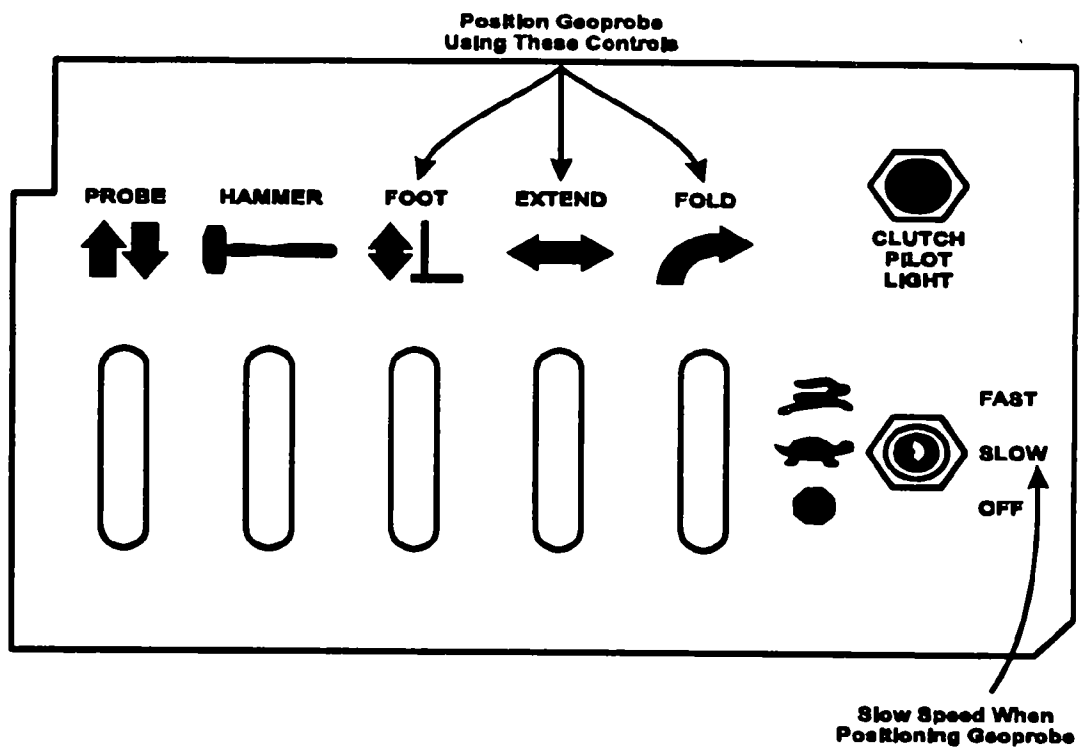
FIGURE 1 Electrical Control Panel



APPENDIX A (Cont'd)

Figures

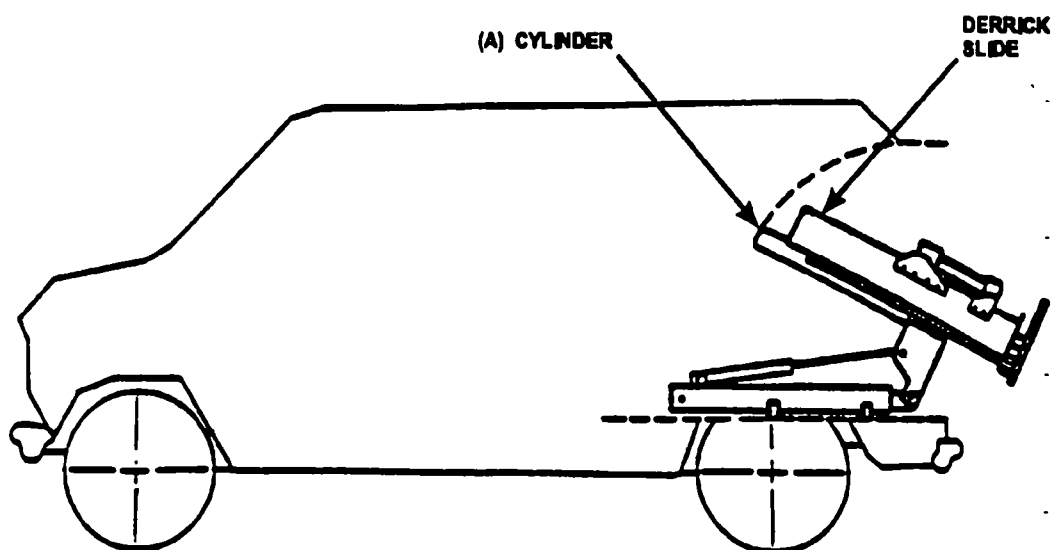
FIGURE 2 Hydraulic Control Panel



APPENDIX A (Cont'd)

Figures

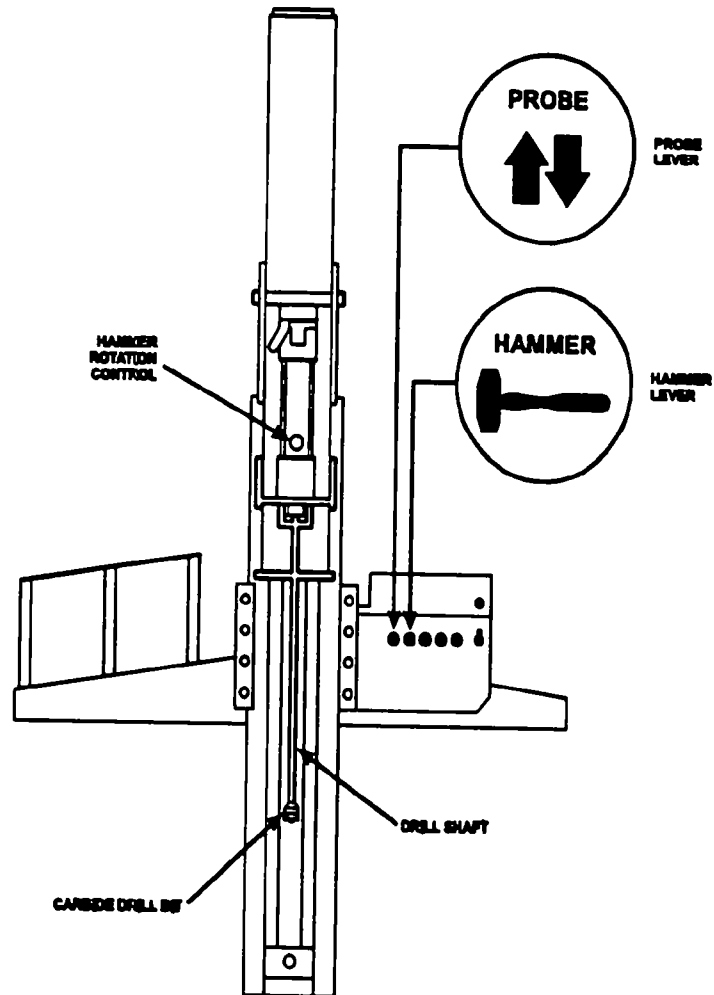
FIGURE 3 Deployment of Geoprobe™ from Sampling Vehicle



APPENDIX A (Cont'd)

Figures

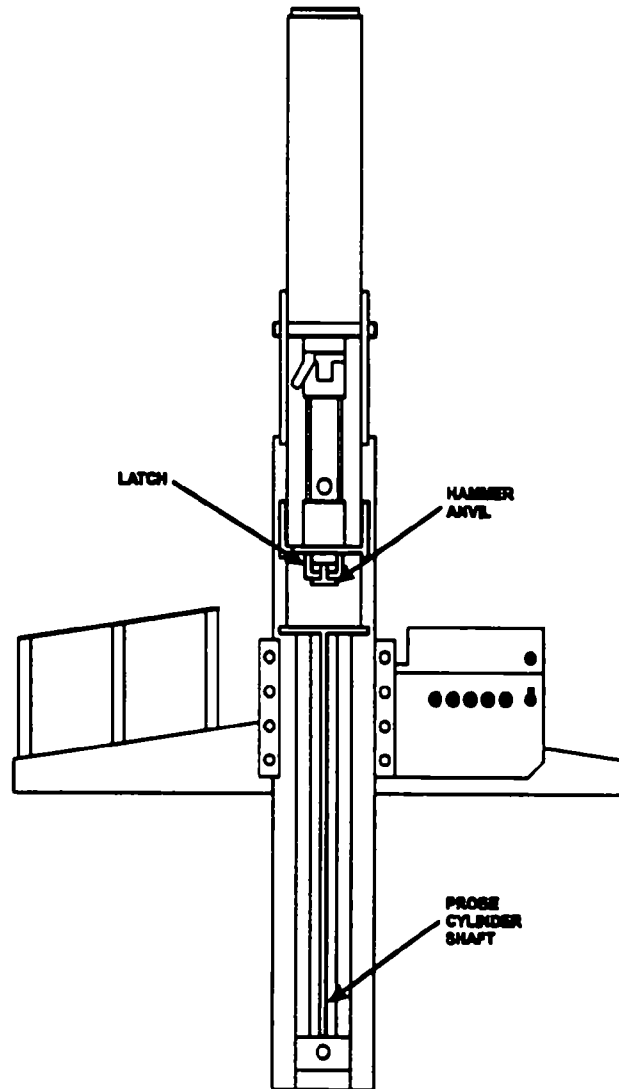
FIGURE 4 Geoprobe™ Setup for Drilling Through Concrete and Pavement



APPENDIX A (Cont'd)

Figures

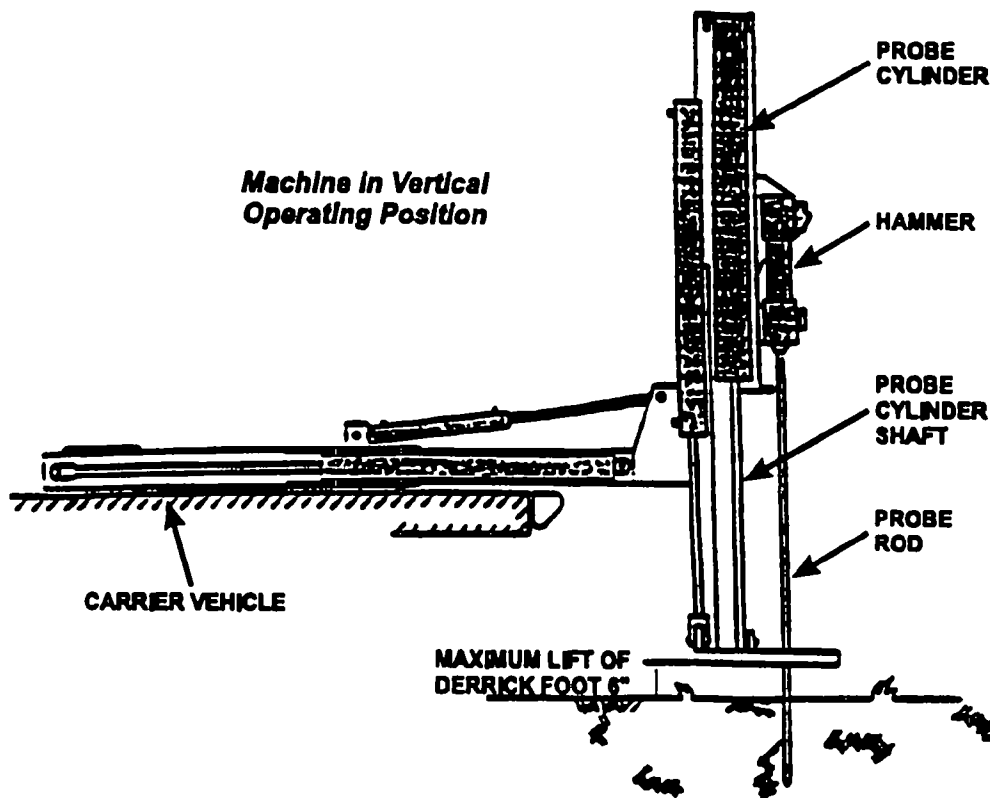
FIGURE 5 Inserting Hammer Anvil



APPENDIX A (Cont'd)

Figures

FIGURE 6 Probe Cylinder Shaft and Probe Rod - Parallel and Vertical





TEDLAR BAG SAMPLING

SOP# 2102
DATE 10/21/94
REV # 00

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to define the use of Tedlar bags in collecting gaseous grab samples. Tedlar bags are used to collect both volatile and semi-volatile organic compounds, including halogenated and non-halogenated species. The sensitivity of the method is primarily dependent on the analytical instrument and the compounds being investigated.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U S Environmental Protection Agency (U S EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

When collecting gaseous samples for analysis it is often necessary to obtain a representative grab sample of the media in question. The Tedlar bag collection system allows for this and consists of the following items:

- C the Tedlar bag complete with necessary fittings
- C a box in which the vacuum is created
- C a sampling pump to create the necessary vacuum
- C an appropriate Teflon and Tygon tubing

The Tedlar bag is placed into the vacuum box and the fitting is inserted into Teflon tubing. The Teflon tubing is the path through which the gaseous media will travel. The pump is attached to the Tygon tubing, which is part of the vacuum fitting on the vacuum

box. The pump evacuates the air in the vacuum box, creating a pressure differential causing the sample to be drawn into the bag. The sample introduced into the Tedlar bag never passes through the pump. The flow rate for the pump must be defined prior to sampling (usually 3 liters/minute [L/min] for bag sampling).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The Tedlar bags most commonly used for sampling have a 1-liter volume. When the sampling procedure is concluded, the Tedlar bags are stored in either a clean cooler or a trash bag to prevent photodegradation. It is essential that sample analysis be undertaken within 48 hours, as after that time compounds may escape or become altered.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Contamination is a major concern since many of the compounds in question will be present in the parts per billion range. In order to minimize the risk of cross contamination, the following factors should be considered:

- 1 Proximity of the bags to sources of potential contamination during transportation and storage. The further away from the source(s) the bags are, the less likely the chances of external contamination.
- 2 Bags must be attached only to clean Teflon tubing.
- 3 Once the bag has been collected, affix the sample label to the edge of the bag. Adhesives found in the label may permeate the bag if placed on the body of the bag. Fill out labels with a ballpoint pen as permanent.

markers contain volatile compounds that may contaminate the sample

- 4 Due to the chemical structure of Tedlar, highly polar compounds will adhere to the inner surface of the bag. Also, low molecular weight compounds may permeate the bag. Real-time monitors such as the organic vapor analyzer (OVA), photoionization detector (HNU), and combustible gas indicator (CGI) are used as screening devices prior to sampling. The information gathered is written on the sample label to inform the individuals performing the sample analysis.

The Tedlar bag sampling system is straightforward and easy to use. However, there are several things to be aware of when sampling.

- 1 The seal between the top half and the bottom half of the vacuum box must be air tight in order to allow the system to work.
- 2 Check the O-ring gasket to see if it is in place with the proper fit. O-rings that have been stretched out will not remain in place, thus requiring constant realignment.
- 3 Check that all the fittings associated with the vacuum joints are securely in place. The fittings can be pushed loose when inserting the valve stem into the Teflon tubing.
- 4 Occasionally, a corner of the Tedlar bag will jut out between the two halves of the vacuum box, thus impairing the seal. Since the bags will hold only a given volume, over-inflation will cause the bags to burst.

5.0 EQUIPMENT/APPARATUS

The following items must be operational to perform Tedlar bag sampling:

- C Vacuum box - must be clean, Teflon tubing replaced, and equipped with extra O-rings
- C Pump(s) - must be charged, in good working order, and set with the appropriate flow rate of 3 L/min
- C Tedlar bags - must be free of visible contamination and preferably new

- C Chain of Custody records, custody seals
- C Sample labels
- C Air Sampling Worksheets
- C Opaque trash bags

6.0 REAGENTS

This section is not applicable to this SOP.

7.0 PROCEDURES

7.1 Preparation

- 1 Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.
- 2 Obtain necessary sampling and monitoring equipment.
- 3 Decontaminate or pre-clean equipment, and ensure that it is in working order.
- 4 Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.
- 5 Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
- 6 Use stakes or flagging to identify and mark all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

7.2 Field Operation

Tedlar bags are stored in boxes of ten. The valve is in the open position when stored. Occasionally, a piece of debris will clog the valve, necessitating the closing of the valve stem to clear. The valve stem is closed by pulling the stem out. If the valve stem is difficult to pull, it helps to spin the valve stem simultaneously.

- 1 Remove the Tedlar bag from the carton.
- 2 Insert the valve stem into the Teflon tube which runs through the vacuum box (Figure 1, Appendix A).

- 3 Place the Tedlar bag in the vacuum box
Seal the vacuum box by applying pressure to the top and bottom (ensure that the O-ring is in place and unobstructed)
- 4 Connect the sampling pump to the evacuation tube
- 5 Connect the intake tube to the desired source or place the intake tube into the media of concern
- 6 Turn on the sampling pump
- 7 Allow the bag to fill (visual observation and sound of laboring pump)
- 8 Turn off the sampling pump and remove the evacuation tube from the pump
- 9 Remove bag and pull the valve stem out
10. Lock the valve stem
- 11 Label the bag using either a tag or a sticker placed on the edge of the bag Do not write on the bag itself.
- 12 Place Tedlar bag in a clean cooler or opaque trash bag to prevent photodegradation

7.3 Post-Operation

- 1 Once the samples are collected, transfer bags to the laboratory for analysis
- 2 When transferring the Tedlar bags, a chain of custody form must accompany the samples Personnel should be aware that some of the compounds of concern will degrade within a few hours of sampling.
- 3 For the time prior to analysis, samples may be stored in a clean cooler or opaque trash bag with a trip blank (a Tedlar bag filled with "zero air") and the chain of custody form.

8.0 CALCULATIONS

This section is not applicable to this SOP

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

The following general QA procedures apply

- 1 All data must be documented on field data sheets or within site logbooks
- 2 All instrumentation must be operated in accordance with operating instruction as supplied by the manufacturer, unless otherwise specified in the work plan Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented

Depending upon the Quality Assurance Work Plan (QAWP) requirements, a background sample consisting of upgradient/downgradient, beginning/ending of day or combination, may be collected It may also be desirable to change sample train tubing between sample locations

Tedlar bag standards must be filled on site to identify the contaminants' degradation from the time the sample is collected until analysis Trip blanks, Tedlar bags filled with "zero air", must accompany sample bags at a minimum rate of one per day to identify possible contamination during handling For each lot of Tedlar bags, a minimum of one bag must be filled with "zero air" and then analyzed for the parameter(s) of interest to detect contamination due to the Tedlar bag itself which may produce false positive results Duplicate Tedlar bags should be collected at a minimum rate of five percent of the total number of samples or one per sampling event.

10.0 DATA VALIDATION

Results of the quality control samples (trip and lot blanks) will be evaluated for contamination. This information will be utilized to qualify the environmental sample results according to the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U S EPA, OSHA, and corporate health and safety procedures.

12.0 REFERENCES

Gilan Instrument Corp., Instruction Manual for H1 Flow Sampler HFS113, HFS113T, HFS113U, HFS113UT, 1983

NJDEP, Field Sampling Procedures Manual, Hazardous Waste Programs, February, 1988

Roy F Weston, Inc , Weston Instrumentation Manual, Volume I, 1987

U S EPA, Characterization of Hazardous Waste Sites - A Methods Manual Volume II, Available Sampling Methods, 2nd Edition, EPA-600/ 4-84-076, December, 1984

APPENDIX A

Figure

FIGURE 1 - Tedlar Bag Sampling Apparatus

