

**DRAFT**

**U.S. ARMY CENTER FOR HEALTH  
PROMOTION AND PREVENTIVE  
MEDICINE**

	<b><i>TG 251</i></b>
	<b>A Soldiers Guide to Environmental and Occupation Field Sampling for Military Deployment</b>

**August 2001**

**DRAFT**

## Acknowledgements

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## Chapter 1

### Introduction

#### 1.1 General

Deployed personnel are faced with various physical and industrial chemical threats during a deployment. Intelligence information is key to protecting the soldier. Whether the information has to do with locations of enemy troops or potential environmental threats, it is imperative that the soldier be informed of the potential risk of occupying an area and the preventive measures that should be taken to avoid loss of force strength. This includes characterizing the environment for acute and chronic risks.

Technical Guide 251 (TG-251) was developed to comply with the environmental surveillance requirements in the Department of Defense Instruction (DODI) 6490.3, *Implementation and Application of Joint Medical Surveillance for Deployments*. To be able to meet the requirements of this instruction, the sampling techniques and procedures in this TG were developed to collect samples and determine environmental exposures to deployed forces. Under this instruction, *“The Surgeons General of the Military Departments shall support unique medical surveillance activities during deployment, including early deployment teams of specialized environmental and occupational exposure and epidemiology teams to assist the Theater or Joint Task Force (JTF) Surgeon concerned in identifying and assessing threats,…”*. The instruction also states that the commander in chief Surgeon and JTF Surgeon shall, *“Deploy technically specialized units with capability and expertise in the conduct of surveillance for occupational and environmental illnesses,…”* *“These Units shall conduct health assessments of potential exposure to biological, chemical, or physical agents that threaten the health and safety of the command.”*

This TG focuses on characterizing the industrial chemical and occupational physical threats that may be encountered during a deployment. The sampling methods selected for this TG are either currently part of the preventive medicine mission or can be augmented by the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) or other specialized unit.

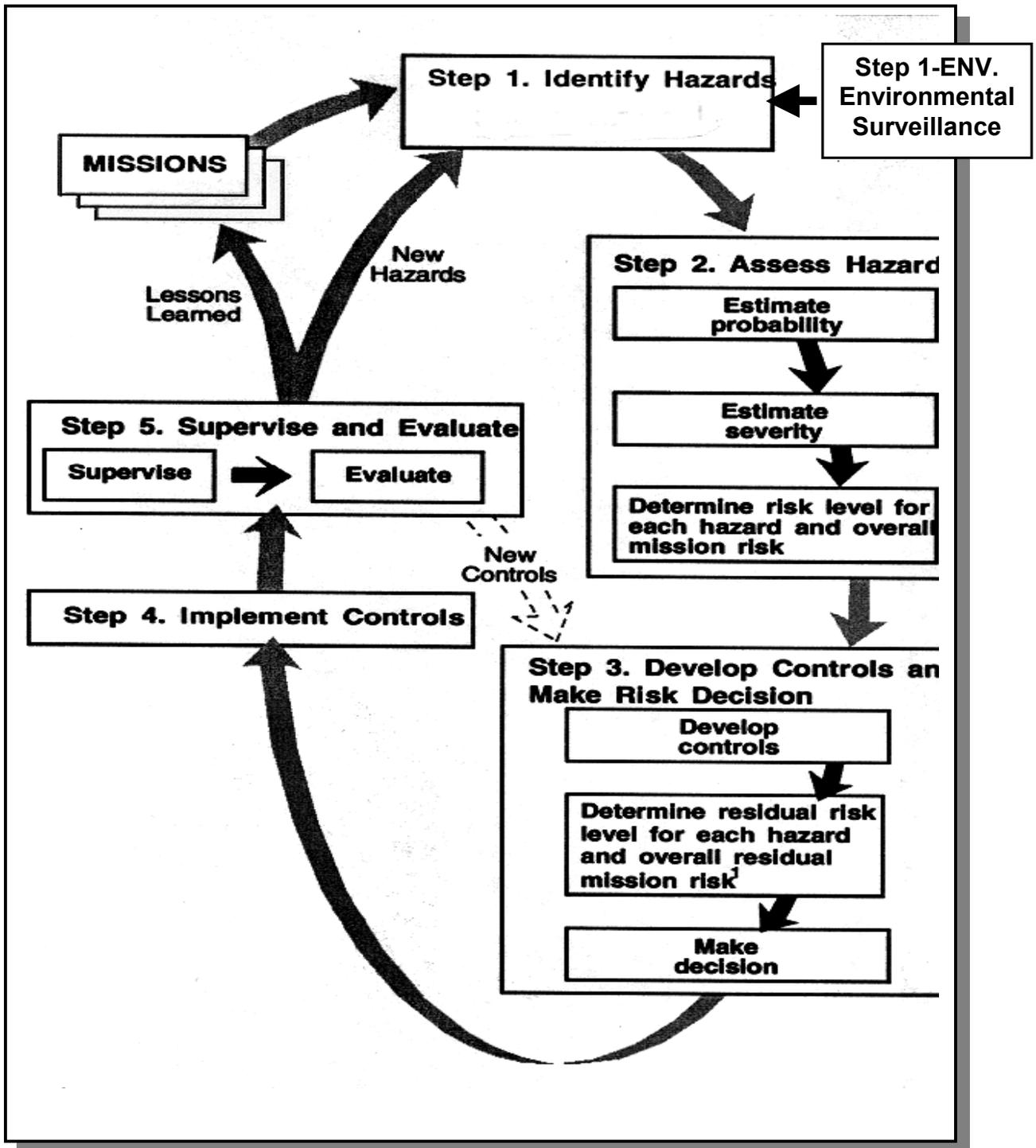
The risk management process outlined in FM 100-14, *Risk Management*, consists of five steps. The first step and the basis for the risk management decision process is the identification of the hazard. Without the ability to effectively identify potential hazards in the field, the commander is not able to make informed decisions on the protection of their forces. Figure 1-1 illustrates the risk management process used to assess hazards. The focus of this TG is to provide military personnel with the ability to identify environmental hazards (STEP 1) using sampling procedures provided.

#### 1-2. Audience

This TG is designed for use solely by military health services personnel trained in its contents. These personnel should be trained in identifying hazards using USACHPPM TG 248, *Guide for Deployed Preventive Medicine Personnel on Health Risk Management*, selecting appropriate sampling equipment, and operating the sampling equipment in this guide to gather samples in a

consistent manner to ensure that the results can be used to determine operational risk using USACHPPM TG230, *Chemical Exposure Guidelines for Deployed Military Personnel (Draft)*, and FM100-14.

Figure 1. Army Risk Management Process



\*FM 100-14

### **1-3. Purpose**

This TG establishes the standard procedures for environmental and occupational health field sampling during deployment. It is a compilation of sampling methods and techniques used to characterize the environment. It provides the necessary information for trained personnel on the selection and operation of environmental field sampling equipment to: (1) characterize hazards which pose immediate threat to personnel, (2) conduct a baseline monitoring assessment of an area to determine if a wide range of environmental contaminants are present, and (3) establish and operate a long-term environmental and occupation health monitoring assessment. The intent of the manual is to promote consistency in the manner in which environmental samples are collected for analysis. The proper collection of this information ensures that the data can be used in operational risk management decisions based on health risk and epidemiological assessments.

The field sampling data that are collected using the methods in this TG must be of adequate quality to compare against environmental and occupation health standards to ensure that deployed forces are not exposed to imminent or long-term threats. The interpretation of the analytical data must be done by a military health services personnel trained in the use of the Technical Bulletin, Medical (TB MED) 577, *Sanitary Control and Surveillance Field Water Supplies (Draft)*, USACHPPM TG 230 for chemical exposures, and USACHPPM TG 236A, *Basic Radiological Dose Estimation – Field Guide (Draft)*, for radiological hazards.

Sampling methods and procedures defined in this guide were chosen based on the quality or results from collection method, portability of the equipment, durability of equipment, and ease of operation.

### **1-4. Application**

The TG is designed as a reference to: (1) plan an environmental and occupational field sampling mission, and (2) provide instruction on operation of equipment and proper sampling techniques. It should be used in conjunction with potential industrial and environmental threat information from operational planners and the intelligence community to design a sampling plan that can be executed by deployed personnel.

The nature of the present military operations range from conventional warfighting deployment, peace keeping, police actions, to humanitarian aid missions. This guide is designed for use during any type of deployment to determine the environmental conditions and potential threats to U.S. forces from environmental exposures.

Personnel conducting environmental surveillance should be trained in the procedures in this TG to ensure that the proper sampling procedures are followed.

## **1-5. Limitations of Use**

Users of this manual should understand the difference between sampling during a military deployment and sampling for environmental regulatory compliance requirements. Many of these methods are adopted from existing regulatory field sampling methods however others were developed specifically for sampling during a deployment. Although these methods are proven to very similar, some of these methods are not approved by the U. S. regulatory community or other governing countries for compliance sampling. This document should not used to plan or conduct a sampling mission in support of regulatory compliance within the continental U.S. or outside the continental U.S. military installations or occupied territories.

## **1-6. Overview of TG**

This TG will cover planning sample missions and the procedures to be used to characterize potential environmental and occupation exposures during a deployment. Generally, the TG is divided into nine sections and organized by environmental media types (i.e., air, water, and soil). Separate sections for radiation and industrial hygiene sampling where included due to differences in the required sampling frequency—

- Section 1 discusses the purpose and application of the TG.
- Section 2 contains information for the project officer (preventive medicine officer) on the design and required contents of a sampling plan and field procedures while sampling. This section covers the general steps taken while assembling a sampling plan and refers to the environmental media sections for detailed guidance. This also includes a list of contacts that can be used by the project officer when scheduling resources or support for the sampling mission.
- Section 3 contains information on the use of direct reading industrial hygiene type equipment to determine the immediate health threat to deployed personnel during an environmental assessment.
- Sections 4 through 9 contain information on the sampling planning and procedures for conducting entomological, ambient air, soil, potable water, and radiological sampling. Appendices to these sections include detailed instructions on sampling equipment and procedures.
- Sections 2 through 9 also contain appendices, which contain information and sampling procedures for a specific piece of equipment. The appendices are designed to be removed from the TG and used in the field as a reference when conducting field sampling.

## **1-7. References**

## USACHPPM DRAFT TG 251

- a. Department of Defense Instruction (DODI) 6490.3, *Implementation and Application of Joint Medical Surveillance for Deployments*, 1997.
- b. Department of the Army (DA), *Risk Management*. FM 100-14, 23 April 1998.
- c. U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) TG 230, *Chemical Exposure Guidelines for Deployed Military Personnel (Draft)*, 2001.
- d. Technical Bulletin, Medical (TB MED) 577, *Sanitary Control and Surveillance of Field Water Supplies (Draft)*, Undated.
- e. U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) TG 236A, *Basic Radiological Dose Estimation – A Field Guide (Draft)*, June 2000.

## Chapter 2

### Environmental Surveillance Plans

#### 2-1. Purpose

Having a properly designed and effective sampling plan is essential to conducting an efficient environmental surveillance assessment. The sampling results may be meaningless without adherence to proper quality assurance (QA) procedures, selection and operation of appropriate field sampling equipment, site safety, and an efficient sampling schedule. At a minimum, the information contained in this section must be understood and integrated into the actions of the sampling team. Planning for a sampling mission consists of several steps. These steps are the same whether planning for a short- (Phase I) or long-term (Phase II) environmental surveillance mission. The differences depend on the type of sampling equipment, information used to develop the plan, and the decisions on number and type of samples collected based on the data quality objectives.

#### 2-2. Environmental Sampling Plans

There are two types of environmental surveillance assessments that will be conducted during a deployment. These consist of the Environmental-Health Short-Term Monitoring assessment (Phase I) and the Environmental Health Long-Term Monitoring Assessment (Phase II). The information required to develop a sampling plan for each of the environmental media (air, water, soil, and surface) are discussed in the respective chapters and appendices of this document. Figure 2-1 provides a series of steps used to plan for and conduct the Phase I assessment. The steps to plan for the Phase I and Phase II assessments are very similar. The only differences lie in the intelligence information used to plan the survey, sampling equipment selected for the assessment, and data quality objectives (DQOs) during sampling.

##### 2.2.1 Environmental Health Short-Term Monitoring Assessment (Phase I)

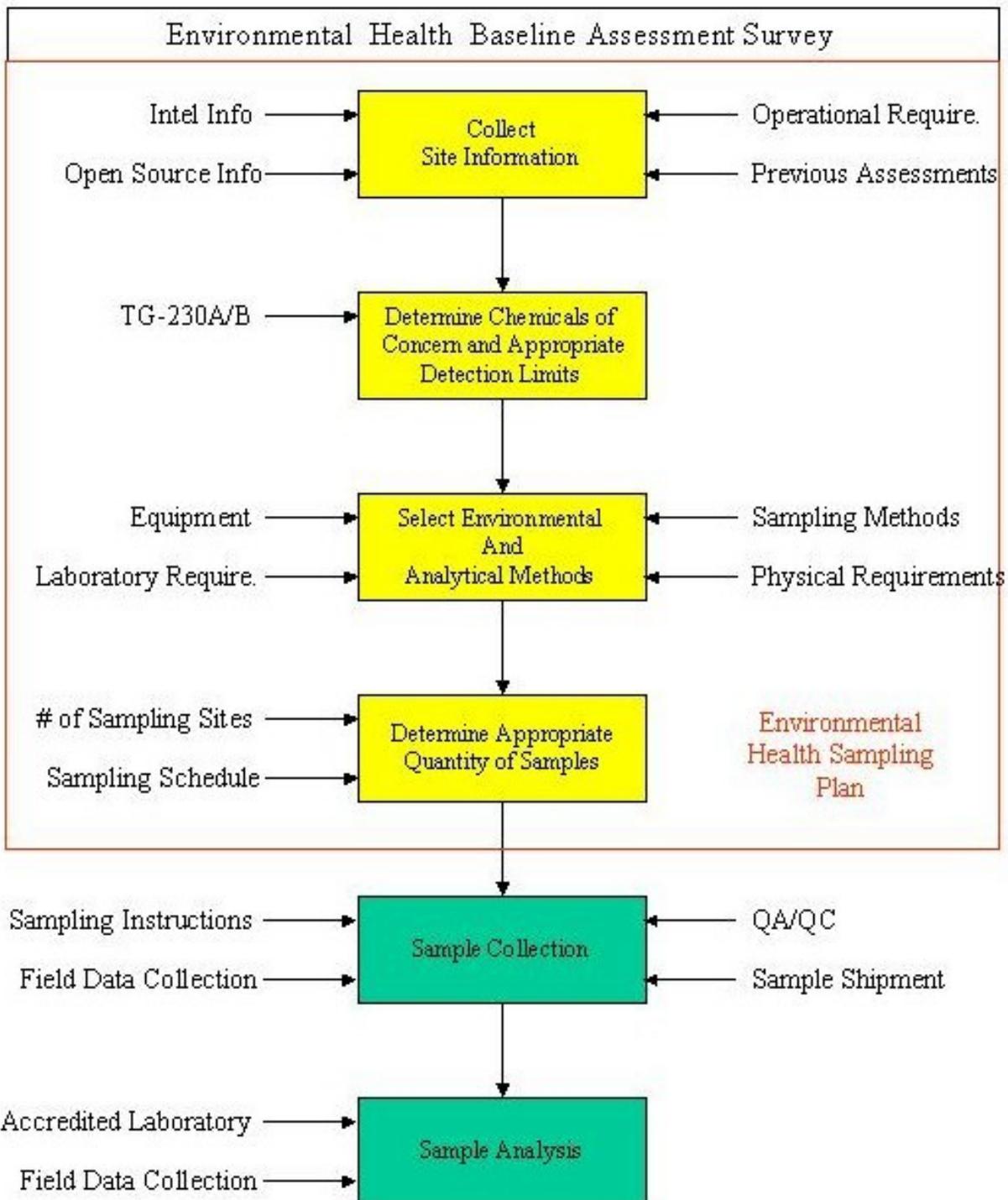
The Phase I assessment is conducted during initial entry to a site to determine the “baseline” environmental conditions at a location where U.S. forces will be or are stationed or have a tendency to visit during a deployment. Depending on the situation and proximity of the sampling team to the site, the information gathered prior to the sampling mission will vary from intelligence information to on-site reconnaissance. The prior and current use (e.g., industrial, agricultural) of the facility will influence the type and number of environmental samples collected at a location. Samples are collected from the ambient air, soil, and water for an array of environmental contaminants that can affect the readiness of the forces. The Phase I assessment is to be conducted at locations where U.S. forces occupy for more than 30 days, which includes, but is not limited to—

- a. Base camps
- b. Police stations

- c. Headquarters
- d. Checkpoints
- e. Communications points

Unless a specific environmental threat has been identified during the intelligence data collection period; samples of the air, water, soil, and surfaces should be collected to determine the presence of the common environmental contaminants listed in Appendix 2-1. Table 2-1 contains a list of the environmental media and the respective contaminants of concern (COCs) that can be assessed depending on the scope of the Phase I assessment using the sampling methods contained in this TG.

**Figure 2-1. Environmental Health Phase I and Phase II Assessment Planning Process**



**Table 2-1 Phase I Assessment Environmental Media Sampled and Respective Classes of Contaminants of Concern**

<b>Matrix</b> <b>COC Class</b>	<b>Soil<sup>1</sup></b>	<b>Water<sup>2</sup></b>	<b>Air<sup>3</sup></b>	<b>Surface Wipes<sup>4</sup></b>
Dioxins/Furans			X	
Explosives	X	X	X	
Metals	X	X	X	X
Particulate Matter			X	
Pesticides	X	X	X	X
Physical Parameters		X		
Polychlorinated Biphenyls	X	X		
Polycyclic Aromatic Hydrocarbons			X	
Radionuclides <sup>5</sup>	X	X	X	
Semi-Volatile Organic Compounds	X	X	X	
Volatile Organic Compounds		X	X	

<sup>1</sup> Soil sampling procedures provided in Chapter 8.

<sup>2</sup> Water sampling procedures provided in Chapter 5.

<sup>3</sup> Ambient air sampling procedures provided in Section 6.

<sup>4</sup> Surface wipe sampling procedures provided in Section 7.

<sup>5</sup> Radionuclides sampling procedures provided in Section 9 (Water sampling for alpha, beta, and tritium is part of the deployment water sampling kit, Section 5).

The Phase I assessment is a data gathering tool to identify immediate threats to deployed personnel and provide information to plan the Phase II assessment. The scope of the Phase I assessment can be very broad depending on the nature of the area being occupied. The types of sampling, duration of sampling, and number of samples is dependent on a number of factors, such as: size of the camp, number of sampling points (i.e., drinking water sources), and characteristics of the industrial base in the region.

The sampling equipment for the Phase I assessment is designed to be portable, rugged, and generally operate on battery power. The portability and lack of power requirements makes the Phase I assessment a practical tool for front-line deployed personnel to assess environmental and occupational threats.

### 2.2.1 Environmental Health Long-Term Monitoring Assessment (Phase II)—

The Phase II assessment is designed as a second step in the characterization of the environment at a base camp. The purpose of the Phase II assessment is to monitor the soldier’s exposures to contaminants in the environment during the length of the deployment. The data collected during

this period is used to monitor trends in the contamination of the environment and potential effects on deployed forces.

The Phase II assessment is designed from the results of Phase I and site reconnaissance information collected on the surrounding area. This information is key in reducing the scope of Phase II. COCs detected at concentrations of concern (above the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Technical Guide (TG) 230, *Chemical Exposure Guidelines for Deployed Military Personnel (Draft)* guidelines) and identified as hazardous during the site recon during Phase I should be monitored routinely. The assessment planning will define the type of samples to take, collection frequency, and sampling locations. Certain COCs should be monitored routinely even if the results of Phase I does not indicate a concern. Levels of certain COCs may change seasonally due to weather, reestablishment of industry in a region, and introduction of a source due base camp operations. For example, PM10 in air should be monitored routinely even if it is shown not to be a health hazard in Phase I. More information on the selection of COCs and frequency to monitor for in each environmental media during Phase II is contained in Chapters 5-9.

### **2-3. Environmental Intelligence Information for the Battle Field**

Both classified and unclassified intelligence information are required in conducting a comprehensive environmental health-site assessment. Through the collection, processing/analysis, and dissemination of intelligence information by the intelligence community, all of these aspects will assist preventive medicine personnel in identifying the environmental health surveillance aspects (e.g., industrial facilities, sources of contamination, potential sampling locations, target compounds, and environmental media requirements) in support of military operations and exercises. Currently, the U.S. Armed Forces Medical Intelligence Center (AFMIC) is the primary intelligence processing/analysis center to support preventive medicine intelligence production requirements for environmental health and industrial chemical threats in an area of operations/area of responsibility. The preventive medicine intelligence production requirements are identified through S2/J2/G2 assets and validated using the Community On-Line Intelligence System for End-Users and Managers (COLISEUM).

The COLISEUM is a Defense Intelligence Agency (DIA) automated production/requirements management system (world wide, web-based) and provides the mechanism for registering and validating requirements, assigning and scheduling production, and provides the capability to track and manage overall production activities across the operational and national planners and consumers. The intelligence community uses the system Intelink Central, an integrated intelligence dissemination and collaboration service, which provides uniform methods for exchanging intelligence among intelligence providers and users. Intelink Central resides on the joint world-wide intelligence communication system ((JWICS); top secret/sensitive compartmented information) and the Intelink Central-Secret resides on the global command and control system ((GCCS); secure internet protocol network, SIPRNET). Table 2-2 lists selected universal record locator (URL) for the above intelligence community assets and the following: National Imagery and Mapping Agency (NIMA), DIA, and the U.S. Army Intelligence and Security Command (INSCOM).

**Table 2-2. Selected Intelligence Community Information Assets**

Name	URL	Parent System
AFMIC	<a href="http://www.dia.ic.gov/intel/afmic/afmic.html">http://www.dia.ic.gov/intel/afmic/afmic.html</a>	JWICS
AFMIC	<a href="http://www.dia.smil.mil/intel/afmic/afmic.html">http://www.dia.smil.mil/intel/afmic/afmic.html</a>	SIPRNET
Intelink Central	<a href="http://www.ic.gov">http://www.ic.gov</a>	JWICS
Intelink Central-Secret	<a href="http://www.ismc.sgov.gov">http://www.ismc.sgov.gov</a>	SIPRNET
NIMA	<a href="http://www.nima.ic.gov">http://www.nima.ic.gov</a>	JIWCS
NIMA	<a href="http://www.nima.sgov.gov">http://www.nima.sgov.gov</a>	SIPRNET
DIA	<a href="http://www.dia.ic.gov">http://www.dia.ic.gov</a>	JWICS
DIA	<a href="http://www.dia.smil.mil">http://www.dia.smil.mil</a>	SIPRNET
INSCOM	<a href="http://www2.inscom.ic.gov">http://www2.inscom.ic.gov</a>	JWICS
INSCOM	<a href="http://www.inscom.army.smil.mil">http://www.inscom.army.smil.mil</a>	SIPRNET

In addition, USACHPPM TG 248, *Guide for Deployed Preventive Medicine Personnel on Health Risk Management*, provides guidance and additional sources of intelligence information available to the operational planners and the preventive medicine personnel. Additional information may be obtained through the S5/J5/G5 elements. The operation orders (OPORD) should include information on the type and level of environmental health threats present (or has the potential to be present) in the theater for hazards associated with—

- a. Industrial Chemicals.
- b. Nuclear/Radiological.
- c. Occupational Health.
- d. Endemic Disease.
- e. Entomology.

Information gathered during the planning phase on each of these hazards should be available to the preventive medicine unit assigned to the operation/exercise. The OPOED should be available to the preventive medicine planners through the S3/J3/G3 elements and is more than likely available on appropriate GCCS/SIPRNET resources. If this information has not been included in the OPOED, then additional sources of this information are listed in USACHPPM TG248.

### 2.3.1 Assessment of Intelligence Information

Depending on the stage of the operation, intelligence information may or may not be relevant to the unit planning on conducting environmental health surveillance/monitoring activities. The environmental health threats can change during a deployment due to a number of different parameters that may require the threats to be reevaluated such as—

- a. Reestablishment of the occupied countries industrial base/facilities.
- b. Seasonal variations in the threats (i.e. ambient particulate matter concentrations, entomological vectors, meteorological (weather) variations).
- c. Potential terrorist insurgence (sabotage of industrial chemical storage facilities).
- d. Current land use information (pesticide application).
- e. Contamination from other countries (upstream release of contaminant into river).

The intelligence community has taken measures to produce intelligence assessments focused toward environmental health threats (both actual and potential) that can impact deployed U.S. forces. The DIA published a report, Defense Intelligence Report, DIA-1816-6-99, *Medical Intelligence Assessment of Deployment Environmental Health Risks*, that provides a methodology to define and rank the potential industrial chemical and physical industrial hazards of the deployment environment. The USACHPPM uses the defined and ranked potential industrial chemical and physical industrial hazards to complete an industrial hazards assessment (IHA) of the known deployment environment. The IHA uses established defensive protection measures for potential and/or known troop encampments (Allied Command Europe (ACE) Directive 80-64, *ACE Policy for Defensive Measures Against Toxic Industrial Chemical Hazards During Military Operations*) along with emergency response planning of isolation and protection zones (U.S. Department of Transportation, *North American Emergency Response Guidebook: A Guidebook for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident*) to identify comprehensive environmental health surveillance activities for force health protection measures. Both the DIA methodology and the USACHPPM IHA support the intelligence preparation of the battlefield and the associated environmental health surveillance activities. Table 2-3 summarizes the industrial facility parameters required for the IHA.

**Table 2-3. Required Site Information for Industrial Hazard Assessment**

Site Information Parameter	Comment
Geographic Information	Latitude/Longitude; Surrounding Environmental Setting
Background	Type and History of Industrial Facility
Equipment Maintenance	Has Equipment been Maintained and at What Level
Stored and Manufactured Chemicals	Type(s) of Chemicals (e.g., chlorine); Physical Hazards; Toxicity Data
Amount/Quantity of Stored and Manufactured Chemicals	Pounds or Tons; Actual or Estimated; Toxic Release Inventory Data
Types of Weapons, Munitions	Size, Payload, Quantity, Agent Purity
Background Pollutant Levels	Overall Pollution Levels in Surrounding Environment

2.3.2 Environmental Reconnaissance

Assessment of the potential environmental health hazards in the battlefield or a base camp requires the individual be familiar with what constitutes an environmental health hazard. An environmental health hazard is defined as a known or potential environmental/industrial condition that displays toxicological, physical, or chemical properties through which exposure to deployed U.S Forces can cause detrimental human health impacts, reflected in disease non-battle injury statistics. Training on the identification of industrial chemicals and associated manufacturing processes, sources of contamination, indicators of contamination (i.e., stressed vegetation, stained soil, etc.) are required to conduct proper reconnaissance of an area. Information gathered for the OPORD and other intelligence estimates may not be complete due to the limitations and level of detail of the supporting (intelligence) information available during planning of a mission.

In order to obtain a more comprehensive environmental health hazard picture of the deployment area of operations, onsite environmental (health) reconnaissance should be conducted. Onsite environmental reconnaissance, performed by preventive medicine personnel, engineers, civil affairs, or special operations personnel will enhance the current environmental health intelligence estimate. In addition, pertinent information collected during a pre-deployment site survey (PDSS) will also provide necessary information/data. Generally, onsite environmental reconnaissance should focus on the known or potential environmental health hazards with respect to environmental media (i.e., air; water; soil) and exposure routes (e.g., inhalation; ingestion) to U.S. forces. Any onsite environmental reconnaissance should consist of collecting information from various local sources to include—

- a. Site reconnaissance by preventive medicine personnel.
- b. Base Camp Mayor.
- c. Interviews with soldiers.

- d. J2/G2/S2 elements.
- e. J5/G5/S5 elements.
- f. Interviews of local population.
- g. Prior and current site use information from local environmental agencies.
- h. Interviews with local industrial/manufacturing facility personnel.

The following paragraphs summarize the major environmental reconnaissance items for the air, water, and soil environmental media. These procedures provide guidance on the identification of known or potential environmental health hazards in the area of concern.

The procedure for onsite environmental reconnaissance of field water is contained in Technical Bulletin, Medical (TB MED) 577, *Sanitary Control and Surveillance of Field Water Supplies (Draft)*. Overall, TB MED 577 lists specific preventive medicine inspection criteria applicable to all types of water purification and distribution equipment, and to include site conditions around the water point, which all ensure production of potable water. Additional information is found in the TB MED 577 document. These should be combined with the recon procedures provided Appendix 2-1.

The procedure for onsite environmental reconnaissance of soil is contained in Section G of Appendix 2-1. Overall, this section lists specific soil/surrounding area inspection criteria applicable to tent-city and buildings living areas, maintenance areas, and outdoor recreation areas.

The procedure for onsite environmental reconnaissance of ambient air is contained in Section F of Appendix 2-1. Overall, this section lists specific ambient air inspection criteria applicable to location of nearby industrial facilities, other air emission sources, known or potential environmental noise sources, and meteorological data.

Environmental reconnaissance of potential industrial hazards can also be conducted in the field using the forms in Appendix 2-1. The information gathered from the intelligence community may not contain information on the quantity and types of chemical stored onsite. Actual site visits to these locations may be required to better characterize the potential medical health threat from these sources in the event an accidental release occurs.

#### **2-4. Integrate Environmental Health Hazards into Sampling Requirements**

The purpose of the environmental health Phase I assessment is to ‘SCREEN’ an area for common environmental health hazards. One aspect of this screening procedure involves the sampling, which consists of analyzing for a set list of target compounds that are common environmental contaminants. The preventive medicine officer planning the environmental health sampling mission should be familiar with the capabilities of the Phase I assessment equipment and understand its limitations. Typically, the familiarity of Phase I equipment is obtained in the U.S. Army Medical

Command Center and School (USAMEDDC&S) course 6AF5 and the preventive medicine specialist course, military occupational specialty (MOS) 91S. An environmental health hazard identified through intelligence information may not be addressed during Phase I. Therefore, proper planning is critical and required. Review of the intelligence information and capabilities of the Phase I sampling equipment should be conducted to determine if any augmentation of environmental sampling equipment should be made to address all the identified environmental health threats.

The selection of specific environmental health hazards to continue surveillance/monitoring efforts will be based on the results of the Phase I assessment and additional intelligence information supplied from the field. The number and frequency of environmental samples to be collected will depend upon the operational risk management level (identified through Field Manual (FM) 100-14, *Risk Management*, methods) that the deployed force structure could be subject to. The USACHPPM Deployment Environmental Surveillance Program (DESP) can provide consultative and/or onsite support in the development of Phase I and Phase II assessment monitoring plans.

## **2-5. Sampling Methods and Equipment**

Once the scope of the mission has been defined in reference to the potential COCs at the site and associated exposure guidelines determined, selecting the appropriate sampling methods is the next step in the sampling plan. Selection of the sampling methods and associated equipment is important to ensure the applicable detection limits are met to evaluate environmental health exposure against applicable guidelines. In addition, equipment selection will help define other requirements of the sampling plan, these include but are not limited to—

- a. Weight and cube of equipment for shipping purposes.
- b. Electrical requirements.
- c. Laboratory requirements.
- d. Calibration requirements.
- e. Sample shipment requirements.

Sampling equipment consists of sampling apparatus, sampling media, sample containers and all administrative support supplies.

The sampling team needs to identify the equipment requirements, ensure its operation, and that it has been maintained and calibrated properly. Chapters 4 through 9 contain specific information on the selection of sampling equipment for sampling for different types of COCs. The appendices to these sections contain detailed packing list for each method type.

### 2.5.1 Deployment Environmental Sampling Backpack

The Deployment Environmental Sampling Backpack (DESB) is a comprehensive package designed to collect environmental samples during military deployments. The DESB is modularly designed to accommodate several environmental sampling applications. The primary application is to provide a platform of supplies and tools required to conduct environmental sampling during deployments with media-specific inserts that can be customized to each sampling situation. The secondary application is to use media specific inserts to conduct discrete sampling requirements for deployments.

The DESB is designed for use during military deployments and should not be used for environmental regulatory compliance requirements. Many of the sampling methods using the DESB were adopted from existing regulatory field sampling methods; however, others were developed specifically for sampling during deployments. Although these methods are proven to be very similar, some are not approved by the U.S. regulatory community or other governing countries for compliance sampling.

Each sampling mission should prepare a backpack with consideration to the type of samples to be collected. Appendix 2-2 contains a list of the equipment in a DESB with information on the different backpack modules for the different sampling methods.

### 2.5.2 Calibration and Certification

Certain pieces of sampling equipment require routine calibration or certification which should be arranged through the unit's Test Measurement and Diagnostic Equipment (TMDE) Branch or returned to USACHPPM-DESP to have serviced. Any equipment that is defective or not operating properly should also be returned to the USACHPPM-DESP for service and replacement. Not all of the sampling methods use equipment that requires calibration or certification. Each of the appendices in Chapters 5-9 that cover the operation of the sampling equipment contains information on the frequency and type of calibration required. The person responsible for the equipment should keep a logbook and record of all calibrations performed. The logbook should contain—

- a. Date of calibration.
- b. Location calibrated.
- c. Results of calibration (pass/fail).
- d. Date of next calibration.
- e. Description of items—
  - (1) Manufacturer.
  - (2) Model Number.

- (3) Serial Number.
- (4) NSN.
- (5) Property book number (if applicable).
- f. Name of person performing calibration (organization/company).
- g. Notes (problems with calibration).

## **2-6. Environmental Health Sampling Plan (EHSP)**

An environmental health sampling plan (EHSP) does not have to be formally written to be successful as long as the elements discussed in this section have been adequately addressed during the sampling. The EHSP contains the necessary reference information required for members of the sampling team to appropriately collect samples, analytical procedures to analyze samples, quality assurance procedures, and data reporting requirements. The following sections can be used as a checklist for contents of an EHSP.

### **2.6.1 Purpose of the EHSP**

The EHSP for both Phase I and II should define target analytes, required detection limits, sampling equipment, procedures for field sampling, field analysis and laboratory analysis requirements, sample handling, and sample storage/shipping requirements. The laboratory analysis QA for the methods described in this TG have been approved through the USACHPPM method development initiative. In addition, the QA field sampling procedures and practices defined in this TG should be implemented to ensure the integrity of the samples collected. The information gathered from the EHSP will be used to assess the risk to deployed soldiers from environmental exposures such as radiation, chemical, etc. using the standards and guidelines established in USACHPPM TG 230, TB MED 577, and USACHPPM TG 238, *Radiological Sources of Potential Exposure and/or Contamination*.

### **2.6.2 Site Description**

A detailed site description should be included in the EHSP including site intelligence information available to the preventive medicine personnel. As discussed in Section 2-3, there are a number of sources which can be used to gather this information. The preventive medicine officer is responsible for compiling this information and interpreting the environmental threats that should be the targets of the EHSP. Information such as the following should be included:

- a. Maps/photos of sampling site.
- b. Prior use information of the area.
- c. Date the camp was established.

- d. Assessment of local environmental quality using site recon Appendix 2-1.
- e. Intelligence information (Section 2-3).

### 2.6.3 Impact of Past Data Collection Activities on the EHSP.

List all past collection activities conducted at the site. If the EHSP is being developed for a Phase I assessment there is a good possibility that environmental sampling information is not available for the area. Decisions for the Phase I assessment may be solely made on limited intelligence information and onsite reconnaissance. Planning for the Phase II assessment may consist of reviewing intelligence information and may depend on the results of the Phase assessment. The impact of this data may be significant by informing the planner which hazards are present at a site. This information can be used to develop a sampling strategy to select sampling locations and frequency. Hazards should be ranked according to FM 100-14 risk management methodology discussed in Section 2.4. This may save hundreds of man-hours conducting sampling which was not necessary.

### 2.6.4 Selecting Sample Parameters

A major step in the EHSP is the selection of the sampling parameters to focus the surveillance. If the purpose is to conduct a Phase I assessment, then the COCs would be the broad list of compounds to determine the presence of these compounds. If there has been an indication from previous sampling or identification of health effects from a particular COC, then list this COC as the primary target of the assessment. This will define the scope of the assessment, the necessary field sampling equipment, and the method detection limits required to define the analytical requirements.

### 2.6.5 Identify Sample Media and Sample Types

There are 4 environmental sampling medias that the team will be collecting samples. Within these mediums, samples can be collected to analyze for hundreds of COCs as listed in Table 2-1 and Appendix 2-1. The major types of environmental media samples are: ambient air, soil, and water. Selecting the types of samples to collect in each media will depend on the type of assessment being performed and the information available on the site. Section 5-9 contains information on target analytes and respective sampling equipment that should be used.

### 2.6.6 Identify Sampling Locations and Frequency

A detailed list of sampling locations should be presented in the document with justifications from site selections. This will depend on the type of assessment being conducted (Phase I or Phase II), media being sampled (e.g., air, water, soil), target compounds being sampled (VOCs, metals, etc.), physical nature of the sampling site (soil type, meteorological conditions), and sources of pollution (e.g., smokestacks, landfills). Some locations may be reconned prior to deploying troops to determine whether a site would pose a significant health risk. Information on the design of the camp should be obtained from the engineers to determine the appropriate location for sampling.

The following information should be considered when choosing a sample location for air, water, and soil:

- a. Potential exposure to deployed forces – locations should be chosen with highest probability of exposure.
- b. Size of the area to be sampled.
- c. Number of sampling sites required to characterize exposures.
- d. Sampling scheme to be used—
  - (1) Simple random sampling.
  - (2) Systematic random sampling.
  - (3) Judgment sampling.
  - (4) Combination of schemes.

Chapters 5 through 9 of this guide contain instructions on the number samples required to characterize an area. For example, to characterize the soil, simple random sampling of X number of samples composite samples, X is based on the size of the survey area, are required to meet the DQOs. On the other hand, sampling the ambient air for VOC may only require one sample location since it is assumed that contamination in the air is uniformly distributed, unless the mission is designed to determine the effects from a specific source. Air sampling may require additional duplicate samples to ensure the accuracy of the results.

The actual sample location may not be chosen until the sampling team arrives on site. Sample locations may be chosen on the basis of the criteria listed above. These decisions must be made by individuals familiar with the site reconnaissance information. The plan may only involve designing the techniques and number of samples to collect for statistical relevance. The sample locations may need to be chosen on site, depending on the amount of information provided to the sampling team prior to deployment.

#### 2.6.7 Defining the Sampling Schedule

The sample schedule for an EHSP should be developed and given to each of the personnel responsible for collecting samples. The Phase I and Phase II assessments both should have schedules developed to determine number of assets (i.e., personnel, equipment, sampling media, etc) required to fulfill the mission. Chapters 5-9 of this guide contain information on the effort required to conduct each type of sampling. This information, along with available resources and survey period, must be considered when determining the schedule. It is important that the schedule be written out so that personnel supporting the assessment have an understanding of the mission being performed. Appendix 2-3 contains an example sampling scenario and schedule used to do the

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sampling for the Phase I assessments. In addition, the example takes the results from the Phase I assessment and develops a Phase II assessment using the guidance in Chapters 5-9.

#### 2.6.8 Quality Assurance of Field Sampling Procedures

QA is one of the most important aspects of a field sampling plan. This TG details the location and number of samples taken, frequency, number of blanks to take with the samples, packing guidance, and shipping instructions. Following the procedures in this manual will help to ensure the quality of the sample is acceptable. The laboratory analysis QA procedures have been established according to the method development of each of these sample types.

#### 2.6.9 Military Grid Reference System (MGRS) Coordinates

Locations of the environmental samples must be represented geographically. Sample locations will be represented using the WGS84 datum and the MGRS coordinate system. Sample locations should use the 10 digit numeric system to represent the location within a 1-meter square. A Geographic Positioning System (GPS) “Plugger” should be used to gather these 10 digit MGRS locations for each sample collected.

A datum is the mathematical model of the Earth we use to calculate the coordinates on any map, chart, or survey system. The problem is that many countries use their own datum, mathematical model of the Earth when they make their maps and surveys. Other nations’ maps often use coordinates computed assuming the Earth is a completely different size and shape from what the Department of Defense (DOD) uses. U.S. forces use a datum called World Geodetic System 1984, or WGS84, to describe the size and shape of the earth. U.S. forces communicate locations using the MGRS coordinate system. The MGRS is an extension of the Universal Transverse Mercator (UTM) system. The MGRS coordinate for a position consists of a group of letters and numbers, which include the following elements:

- a. The Grid Zone Designation.
- b. The 100,000-meter square letter identification.
- c. The grid coordinates (also referred to as rectangular coordinates); the numerical portion of the reference expressed to a desired refinement.
- d. A reference is written as an entity without spaces, parentheses, dashes, or decimal points. The following are examples using the MGRS coordinate system:
  - (1) 18S (Locating a point within the Grid Zone Designation).
  - (2) 18SUU (Locating a point within a 100,000-meter square).
  - (3) 18SUU80 (Locating a point within a 10,000-meter square).

- (4) 18SUU8401 (Locating a point within a 1,000-meter square).
- (5) 18SUU836014 (Locating a point within a 100-meter square).
- (6) 18SUU83630143 (Locating a point within a 10-meter square).
- (7) 18SUU8363201438 (Locating a point within a 1-meter square).

2.6.10 Quality Control Samples

There are various types of QA samples collected in the field dependent upon the various sample types being collected. These samples serve to aid in determining whether the field sample was accidentally contaminated, the repeatability of the analytical results for a certain environmental media, the effectiveness of the sampling method, and to aid in determining the repeatability of identical samples taken from the same area. Chapters 5-9 and the respective appendices for each sampling method contains information on the type and number of samples that need to be collected. Table 2-4 contains information outlining the various types of quality control (QC) samples, their corresponding media, and their required frequency of collection.

**Table 2-4. Summary of Number of Quality Assurance Samples Collected During Field Sampling**

Sample Method	Split	Duplicates	Collocated	Field Blanks	Reagent Blank
<b>AIR</b>					
Particulate (PM10,PM2.5,TSP)	-	-	1 <sup>A</sup>	1 : 10	1 per reagent
TO9A	-	-		1 : 10	1 per reagent
TO10	-	-		1 : 10	1 per reagent
TO13	-	-		1 : 10	1 per reagent
TO14	-	-		1 : 10	1 per reagent
TO17	-	-	1	1 : 10	1 per reagent
<b>WATER</b>					
Deployment Water Kit	-	1	-	1	1
<b>SOIL</b>					
Deployment Soil Kit	1:10	1:10			-
VOC Soil Sample	-	1:10			-

#### 2.6.10.1 Split Samples

A split sample is a second aliquot of an individual sample that is analyzed the same way as the original sample. This analysis is to determine the consistency of results in the same sample to ensure a true representation of the entire sampling matrix.

#### 2.6.10.1 Duplicate Samples

Duplicate samples are two separate samples taken from the same sampling source. These samples would be collected in two separate containers and analyzed independently. They would be collected to examine the variability in the matrix of the sample.

#### 2.6.10.3 Collocated Samples

A collocated sample is a QC sample to test for the variability in samples taken in the same location, at the same time, and with the same media. This type of sample is used for indications of contamination during sampling methods of sample transportation. For example, MiniVol PM10 and Modified TO-1 samples collect a duplicate sample to check the variability

#### 2.6.10.4 Trip Blanks

The trip blank is prepared by the laboratory to serve as a check on sample contamination originating from sample transport, shipping, and conditions at the sampling site. It is usually an aqueous or organic solution that is as free as possible of contamination and is transported to the sample site and returned to the laboratory without being opened.

#### 2.6.10.5 Field Blanks

The field blank serves as a check on reagent and environmental contamination at the sampling site. This blank is usually an organic or aqueous solution free from contamination that is transferred from one container to another at the sampling site and preserved with the appropriate reagents. In the case of air sampling media, the field blank must always be from the same lot number as the tubes, filters or monitors used for sampling. If more than one lot number is used for sampling, a field blank is required for each different lot. Field Blanks for air samples are created just like a sample except they are only opened briefly in the field and they do not have air pumped through them.

#### 2.6.10.6 Field Reagent Blank

The field reagent blank determines if method analytes or other interferences are present in the field environment. This blank is prepared in the lab using water or another aqueous solution, and treated exactly as sample would be treated. This includes shipment to the sampling site, exposure of the blank to the sampling site conditions, storage, preservation, and all appropriate analytical procedures.

#### 2.6.10.7 Media Blanks

Media Blanks are QC samples that are often necessary in addition to field blanks when adsorbent (or sorbent) collection media is utilized. They are necessary to detect contaminants that are in the sorbent material and may be required to serve as a reference for the methods of analysis. These blanks must always be from the same lot number as the media used during sampling. The media blank is NEVER opened until it is received by the laboratory for analysis.

#### 2.6.10.8 Reagent blanks

The reagent blank is used to correct for possible contamination that may result from preparing or processing the sample. This blank is an aqueous or organic solution that is as free from contamination as possible and is the same volume as used in the processing of the samples. The blank must be carried through the complete sample processing procedure and must contain the same reagent concentrations as does the sample solution used for analysis.

### 2.7 Field Sampling Procedures

The sampling procedures for collecting environmental samples from the media of concern are obtained in the appendices to Chapters 5 through 9. These instructions are designed to be step-by-step instructions on the operation of the equipment. They are designed to discuss possible error conditions; number of field samples and blanks to collect; decontamination procedures of sampling equipment; information on completing the field datasheets; and the collection, handling, storing, and shipping of samples. Adherence to these procedures fulfills the QA objectives on proper field sampling. The procedures in these appendices should be read and understood by the individual(s) responsible for conducting the field sampling.

#### 2.7.1 Field Sample Logbook

The field logbook should document all samples collected at a camp for historical purposes. The logbook should include either copies of the datasheets used during the collection of each samples or a chronological list of entries with the following information:

- a. Country.
- b. Field sample identification.
- c. Date.
- d. Time.
- e. Camp name.
- f. Location of sample taken.

- g. MGRS.
- h. Sample Type.
- i. COC of interest.
- j. Field notes (weather conditions, deviations from sample procedures, other observation about the sample or location).
- k. Signature.

All entries into the field book should be done by the person in charge of handling recovery, packing, and shipping of the sample. That individual should be aware of the situation in which the samples were taken. All entries to the sample guide should follow the following guidelines:

- a. The first page should contain contact information for persons entering a record.
- b. Mistakes should be lined through with black or blue pen and initialed by the person making the deletion.
- c. Entries should be chronological.
- d. Copies of logbooks should sent to the USACHPPM-DESP to be archived.
- e. Deviations from the sampling plan should be documented and explained.
- f. MGRS coordinates must be to 10-digit accuracy(i.e., 34TEM3400045000).

### 2.7.2 Inventory

An equipment inventory should be generated and checked either before and after the survey or on a routine basis to ensure the proper supplies are available to conduct the sampling. The inventory should be broken into different categories for administrative and sampling supplies by the different types of sampling methods. The sampling method appendices in Chapters 5 through 9 contain detailed lists of equipment the different sampling methods. The inventory should include the following information:

- a. Sample mission.
- b. Location of equipment.
- c. Person responsible for equipment and phone number.
- d. Date of inventory.

## e. Description of items—

- (1) Manufacturer.
- (2) Model Number.
- (3) Serial Number.
- (4) National Stock Number.
- (5) Property book number (if applicable).

## f. Notes of items or consumables to be ordered and missing equipment.

### 2.7.3 Field Instrument Calibration

Certain pieces of equipment require that a field calibration be performed before sampling begins to verify the instrument is providing a valid response or sampling at a desired flow rate is achieved. Interim and post calibrations are performed to verify that the instrument maintained or deviated from the initial calibration. The appendices to Chapters 5 through 9 contain information on the frequency of the calibrations. The field datasheets provide entries for this information when recorded in the field. Field calibration procedures should be followed as described in each of the sampling appendices. Adherence to these steps will ensure all QA for the field calibration requirements are met.

Depending on the sampling method, calibration will either be performed in the field or in a laboratory. The appendices specify under what conditions the calibration should be conducted.

### 2.7.4 Sample Identification

The sample datasheets contained in each of the sampling appendices contain a field for the sample identification. For consistency, the sample identification must adhere to the following identification scheme to ensure that each sample is unique when archived in the environmental database at USACHPPM-DESP and the Defense Occupational and Environmental Health Readiness System data warehouse. The sample identification scheme also contains information of the location the sample was taken, type of sample taken, date the sample was taken, and whether the sample is a primary sample, duplicate, split, or blank sample. A list of sample method types used in this TG are summarized in Table 2-5. The following sample identification convention should be followed:

**Sample ID Format: XXX\_YYYY\_DDDD\_ZZ**

Where: XXX – Camp Abbreviation (i.e., first three letters of camp name)

YYYY – Method Type of Sample Number collected during a particular day

DDDDD – day code, the last two digits of the year followed by the three digit julian day of year (e.g. 00001 for 1-Jan-00)

ZZ – Sample Type (P–Primary sample; D–Duplicate Sample; C–Collocated Sample; FB–Field Blank; RB–Reagent Blank)

**Table 2-5. List of Method Type Abbreviations for code YYYY**

Sample Type	Abbreviation (YYYY)
Air – Volatile Organic Compounds TO17 Supelco Tubes	TO17
Air – Volatile Organic Compounds TO14 Summa Canister	TO14
Air – High Volume Total Suspended Particulate	TSP_
Air – High Volume PM10	P10H
Air – Low Volume PM10	P10L
Air – PS1 Sampling (PAHs or Dioxins/Furans)	PS1_
Water	WT(##) <sup>1</sup>
Soil	SL(##) <sup>1</sup>
Wipes	WP(##) <sup>1</sup>
Bulk	BK(##) <sup>1</sup>
<sup>1</sup> Use the last two digits in this sample number to distinguish similar type samples collected on the same day. ## will start at 1 and go up to 99.	

### 2.7.5 Sample Custody Procedures

Chain of custody is defined as the legal documentation of the procedure that provides accountability of the possession and handling of a sample from the time of collection until the final disposition. COC is applicable to all occupational and environmental health (OEH) sample(s) unless identified by the USACHPPM-DESP, project officer, or individual in charge of monitoring the sampling effort(s). A definition of chain of custody states that a sample is in an individual’s "custody" if—

- a. It is in one’s actual physical possession.
- b. It is in one’s view, after being in one’s physical possession.
- c. It is one’s physical possession and then locked up so that it can’t be tampered with.
- d. It is kept in a secured area, restricted to authorized personnel only. (This sample will include both original sample and prepared blanks or aliquot(s).)

A chain of custody procedure helps any sampling effort when litigation is necessary. This procedure is required to provide an accurate written record that can be used to trace the possession and handling of sample(s) from the moment of collection through disposal or consumption. The procedures defined represent a means to establish a reasonable probability that:

- a. This chain of custody record is supportable if the necessity arises.
- b. The sample, which is collected, is the same sample, which is analyzed.
- c. The sample is not altered, changed or otherwise compromised.

In the chain of custody process for field sample collection and sample transfer to a laboratory, the sample collector is responsible for assuring that proper chain of custody requirements are met during collection of the environmental sample(s). The USACHPPM-DESP project officer, or individual in charge of the sampling effort, has the responsibility to notify the analytical laboratory, prior to shipment, that incoming samples are being submitted under the chain of custody. All actions conducted in the field will be documented on chain of custody forms. In addition, information which is assigned to each field sample, must include the following (which is identical to the information provided in the field logbook):

- a. Source/installation where sample was collected.
- b. Date and time of collection of field sample.
- c. Field sample identification number.
- d. Analysis desired for sample.
- e. Sample collector's name.
- f. USACHPPM Project Number (if applicable).
- g. Total number of containers per sample.
- h. Date of shipment of sample to laboratory.
- i. Method of shipment (e.g., UPS, Federal Express).

When transferring the "possession" of the container or sample set to the next party (i.e., laboratory personnel, or shipping company), the sample custodian will sign and record the date/time of transfer on the chain of custody form included with each group of sample(s) for each transportation container. The sample collector must then print the name of the transport company in the "received by" block to verify transfer of the samples on a specific date to a specific company. The tracking system for that particular carrier will then serve as the chain of custody record until receipt in the laboratory. The original chain of custody forms must be placed in a sealed plastic bag or

comparable package to prevent wetting and secured inside the respective sample's shipping container. Transportation containers will then be sealed with tamper proof shipping tape and forwarded to the laboratory for subsequent analysis. An example of the USACHPPM Chain-of-Custody Form is attached as Appendix 2-5.

Unless hand carried, transportation containers must be shipped to the laboratory via common carrier (e.g., UPS, Federal Express, etc.). Common carriers should abide by Department of Transportation regulations governing shipment of chain of custody sample(s). Upon receipt of containers from a common carrier or from the customer, chain of custody should be relinquished to the USACHPPM analytical laboratory (i.e., Laboratory Information and Sample Management Division) or staff duty personnel during non-duty hours. An inspection of transportation containers by personnel of the analytical laboratory should be completed to note any evidence of tampering (e.g., breakage of seal) during shipment by common carrier and must be documented upon receipt during duty hours or by staff duty personnel during non-duty hours. Staff duty personnel shall follow guidelines of the non-duty sample receipt policy. As soon as sample(s) are transferred to analytical laboratory personnel, custody must be formally relinquished to them. If for any reason the chain is broken between transfer of sample(s) from field to staff duty personnel or during transfer of sample(s) from staff duty personnel to laboratory, [e.g. if sample(s) does not/do not arrive with chain of custody form(s)], a contingency plan will be implemented to determine the cause of breakage of the chain and corrective action to reconstruct chain will be performed, if possible. This contingency plan includes contacting the project officer and documenting all actions and observations concerning the non-compliance on a Chain of Custody Affidavit. This affidavit and any associated paperwork are kept in the Laboratory Project Folder. If the provisions are not followed, the analytical laboratory may not be able to accept field sample(s) as chain of custody and appropriate notification of USACHPPM-DESP or the project officer must take place.

#### 2.7.6 Laboratory Chain-of-Custody Requirements.

Original field chain-of-custody forms together with the sample(s) are received and maintained at the analytical laboratory. The laboratory will create internal chain-of-custody forms for the transfer of the samples internal to the laboratory. These forms will be transferred with the sample(s) to respective laboratories and signed and date/time stamped to show transfer of the samples. The chain of custody will be maintained through the labs until the final disposition of the sample(s). Access to the laboratory area containing custody sample(s) is controlled at all times. After sample analysis and report generation, copies of the internal chain-of-custody forms will be returned with the data report to the project officer. The laboratory retains the original chain-of-custody form(s) together with the sample(s) until the sample(s) is/are disposed or consumed. Upon disposal of the sample, the Department/Division sample custodian will mark the disposition of the samples on the original internal COC form and return this original to the respective analytical laboratory. The analytical laboratory maintains project files containing chain-of-custody form(s) and forwards copies of field and internal laboratory COC form to the project officer or USACHPPM-DESP.

#### 2.8 Sample Packing Procedures

Specific packing and preservation instructions for each type of sample discussed in this sampling

guide are provided in the appendices to Chapters 5 through 9. The following information provides a checklist for the personnel responsible for packing all of the survey samples for shipment back to the laboratory. These general instructions apply too all of the samples collected during a sampling assessment. The user of this information should ensure that he or she has also adhered to the steps in the sampling appendices—

a. Know which samples require special handling, packing, or shipment. Radiochemistry tests, in particular, often require special handling. See sampling appendices in Chapters 5 through 9.

b. Verify that all sample container caps and lids are tight and not leaking.

c. Mark the level of liquid in sample containers with indelible ink. If a sample leaks during shipment, the USACHPPM Directorate of Laboratory Sciences (DLS) will contact the project officer and a decision will be made as to whether the sample needs to be recollected.

d. Set the sample containers in an upright position in the shipping container (which must be leak-proof). Acceptable containers and coolers can be obtained from DLS upon request.

e. Place an absorbent in the shipping container. This is absolutely necessary if any samples contain, or are suspected of containing, hazardous material. Be sure to include enough material to absorb all of the liquid in the shipment if sample leakage occurs.

f. Use suitable packing materials (bubble wrap is preferred) to prevent breakage of samples—

(1) Wrap each glass container with enough suitable packing material to prevent contact with other containers or the outer box.

(2) Seal small vessels containing liquids in plastic bags or aluminum foil depending on the analysis requested. For example, biological samples for pesticide analyses require aluminum foil, while biological samples for metals require plastic bags. This practice ensures sample integrity and prevents contamination of an entire shipment if a sample leaks.

b. Use a cooler and refrigerants to maintain the samples at the temperature prescribed by the sampling and analysis procedure. Refer to Table 2-6 to determine the amount of refrigerant sufficient to achieve 3.5 - 5.5 degrees Celsius (°C).

(1) Pre-cool shipping coolers to below 4 °C before shipping.

(2) Use pre-frozen gel blocks whenever possible. Do not allow blocks to become in direct contact with the samples.

(3) Use dry ice only when special sample requirements require its use. Verify shipping regulations before shipping samples.

(4) Use ice as a refrigerant only when gel blocks are not available. When used, ice must be sealed in heavy double-layered plastic bags to prevent leakage as it melts. Zip-lock type freezer bags are recommended because of their extra thickness.

**TABLE 2-6. REFRIGERANT REQUIREMENTS**

Sample Volume	Pounds of Prefrozen Gel Blocks	Hours Maintained Between 3.5 – 5.5°C
Small [½ pint (pt)]	3.5	111
Medium (1 pt)	7.5	116
Large [1 quart (qt)]	18.0	122
Extra Large [1 gallon (gal)]	21.0	120

2-9. Shipment Requirements and Specifics.

All samples should be shipped to the respective USACHPPM-laboratory for the area of operation via military or commercial carriers. See points of contact in Section 2.11. Pick-up of samples with limited holding times should be coordinated with the respective USACHPPM laboratory. Samples can be shipped directly to the USACHPPM-Main laboratory if commercial carriers are available and reliable.

**TABLE 2-7. SHIPMENT REQUIREMENTS AND SPECIFICS**

<b>ALL SAMPLES</b>	<ul style="list-style-type: none"> <li>☒ List the contents as “Laboratory Samples (Generic).”</li> <li>☒ Label the shipment as “Property of the U.S. Government.”</li> </ul>
<b>STANDARD ANALYSIS SAMPLES</b>	<p><b>CAN BE SENT BY:</b></p> <ul style="list-style-type: none"> <li>☒ Military carrier</li> <li>☒ Priority First Class mail</li> <li>☒ Certified U.S. Mail</li> <li>☒ Commercial carriers, such as <b>FedEx</b> or <b>UPS</b></li> </ul> <p><b>Ø Do Not Send Hazardous Materials by U.S. Mail.</b>  <b>Ø Do Not Use Registered Mail</b></p> 
<b>PRIORITY SAMPLE OR SHIPMENTS CONTAINING SAMPLES:</b>	<b>MUST BE:</b>
<ul style="list-style-type: none"> <li>☒ With short-holding times</li> <li>☒ That must be kept refrigerated or frozen</li> </ul>	<ul style="list-style-type: none"> <li>☒ Shipped by overnight express (<b>FedEx</b> or <b>UPS</b>)</li> </ul>
<b>FedEx SPECIFICS</b>	<ul style="list-style-type: none"> <li>☒ Packages shipped overnight arrive by 1200 the next day</li> <li>☒ Samples cannot be picked up on Sunday</li> <li>☒ Samples sent on Friday will be delivered Monday, unless the shipment is clearly marked “Saturday Delivery”</li> </ul>
<b>SHIPMENTS ARRIVING OUTSIDE OF NORMAL SERVICE HOURS (0800 – 1630)</b>	<b>Require advance arrangements with DLS before the samples are shipped</b>

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<b>SHIPMENTS MUST COMPLY WITH ALL APPLICABLE REGULATIONS</b>			<ul style="list-style-type: none"> <li>☒ Department of Transportation (DOT)</li> <li>☒ State and Local Governments</li> <li>☒ Hazardous Waste</li> <li>☒ Radiochemical</li> <li>☒ Biohazard</li> </ul>		
<b>°Method</b>	<b>Sample Media Preparation-&gt;Analysis</b>	<b>Holding Time Sampling-&gt;Extraction</b>	<b>Holding Time Extraction -&gt; Analysis</b>	<b>Ideal Temperature</b>	<b>Other Shipping Instructions</b>
<b>AIR</b>					
Detector Tubes	NA	NA		NA	NA
Particulate Samplers	Indefinite	Indefinite		No limits	Packed in a sealed envelope in a manner to prevent loss of particulate
TO9A	30 days	7 days	40 days	Store at 2 – 6° C after sampling, until receipt by laboratory	Avoid contamination from other media Packed to prevent breaking
TO10A	30 days	7 days	40 days	Store at 2 – 6° C after sampling, until receipt by laboratory	Avoid contamination from other media Packed to prevent breaking
TO13A	30 days	7 days	40 days	Store at 2 – 6° C after sampling, until receipt by laboratory	Avoid contamination from other media Packed to prevent breaking Minimize exposure to fluorescent light
TO14A	30 days	Analyze within 30 days following sample collection		No limits	
NIOSH Methods	See method	See method		See method	See method
TO17A	30 days	Analyze within 30 days following sample collection		Store at 2 – 6° C after sampling, until receipt by laboratory	Avoid contamination from other media
<b>WATER</b>					
Deployment Water Kit	60 days	Different for type of analysis		Store at 2 – 6° C after sampling	Avoid contamination from other media
<b>SOIL</b>					
Metals	6 months	6 months		Ship at 2-6° C	Package all containers in original

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					deployment kit foam inserts.
SVOCS	14 Days	40 Days		Ship at 2-6° C	
Acid Herbs	14 Days	40 Days		Ship at 2-6° C	
Pesticides/PCBs	14 Days	40 Days		Ship at 2-6° C	
Explosives	14 Days	40 Days		Ship at 2-6° C degrees Celsius	
VOC	48 HOURS	14 Days		Ship at 2-6° C	<b>ENCORE SAMPLER</b>
<b>°Method</b>	<b>Sample Media Preparation-&gt;Analysis</b>	<b>Holding Time Sampling-&gt;Extraction</b>	<b>Holding Time Extraction-&gt;Analysis</b>	<b>Ideal Temperature</b>	<b>Other Shipping Instructions</b>
<b>SURFACE WIPES</b>					
Pesticides	Indefinite	30-days		Store at 2-6° C after sampling	Avoid contamination from other media

2.9.1 Water Samples

While packing the water kit for shipment to the laboratory, the following steps should be taken to ensure a complete and accurate sample is being packaged and shipped:

- a. Ensure that all containers are labeled completely and accurately.
- b. Ensure that the caps are place securely on each of the sample containers, but not over-tightened.
- c. Place containers in the shipping assembly in which they arrived.
- d. Place the shipping assembly into large zip-lock bag included with the sampling kit.
- e. Place bagged shipping assembly into the sampling pack and/or coolers.
- f. Fold original “Potable Water Field Data Sheet “ and “Chain of Custody Document” and place in smaller plastic zip-lock bag and place in the sampling pack and/or cooler.
- g. Place sampling pitcher/cup in cooler.
- h. Place ice packs in cooler, (do not use dry ice for sample packaging)
- i. Seal and secure cooler with the tape provided in the sample kit.

2.9.2 Soil Samples

After verifying the container labels are correct and the lids are fastened securely, the samples should be placed in a cooler, if available. The samples should be maintained at a temperature of 2-6°C. The purpose of cooling the samples is to retard the loss of organic contamination as much as possible and to slow down any chemical reactions between the sample and the contaminants. Place ice packs or wet ice in the cooler with the samples when shipping to the laboratories. The cooling material should not come in direct contact with the sample containers. Placing the wet ice or ice packs in plastic bags will help to prevent getting the samples wet and creating a barrier between the cooling material and the glass containers. The samples should be cushioned to prevent breakage. Surround the sample containers with packing material (crumpled up newspaper is adequate) to keep them immobile in the coolers, helping to prevent breakage. A copy of the USACHPPM Soil Importation Permit, a copy of the USACHPPM Soil Importation Compliance Agreement, a copy of a Toxic Substances Control Act (TSCA) Declaration signed by the person packing the samples, and a Plant Protection and Quarantine Form 550 (Soil Samples Restricted Entry) should be placed in the cooler. This documentation will help to prevent the samples from being held by U.S. Customs. Copies of these forms are provided in Appendix 8-2. After securing the chain-of-custody document in the cooler, seal and secure the shipment.

### 2.9.2 Air Samples

There are various packing methods for the different air sampling media. Some specific packing instructions follow for media that requires special handling.

For all media, ensure the information on the sample labels match the information on the chain of custody documents prior to packaging for shipment.

#### 2.9.3.1 Particulate Filters

Follow the following guidelines to prepare the particulate filters for shipment to the laboratory:

- a. Filters should be replaced in their respective petri dishes and sealed (i.e. with rubber bands) to prevent the filters from falling out of the petri dishes. Place the petri slide containing the filter in a 4" x 4" plastic bag for shipment.
- b. Include datasheets, in a plastic bag, with respective filters in packing box for shipment.
- c. Include enough packing material in shipping box to ensure that filters do not move in shipping container. Filters that move in shipment may lose sample collected on the filter.

#### 2.9.3.2 VOCs TO-17

When handling the sampling tubes, only hold the middle of the tube. Touching the ends of the sampling tube could result in oils from your hands being adsorbed into the sampling tube causing contamination problems. The sampling tubes should be refrigerated before and after sampling. Do not allow tubes to get wet! Each metal sampling tube is contained in a Teflon shipping container.

The tube number (e.g. C1025) is usually indicated on the tube's shipping container from the laboratory. Ensure the appropriate container is labeled with the appropriate sample information on the tube label. If information contained on the shipping container is incorrect the sample will be considered invalid and the sampling site must be re-sampled.

Ensure the tubes are sealed in zip lock bags with the appropriate data sheet and chain of custody documents to prevent water contamination. The tubes should be placed in a cooler with ice/ice packs to maintain the 2-6°C temperature range. The cooler must then be sealed in preparation for shipment.

### 2.9.3.3 VOCS TO-14

In preparation for shipment, the canisters must be secured in a shipping container (cardboard box) to ensure the samplers do not move. There is no need for cooling preservation with this sampling media.

## 2.10 Sample Shipping Procedures

Samples should be shipped by either military or commercial carriers to the USACHPPM point of contact in the area of operation. All samples should be transported from the field by a major carrier (e.g., Federal Express), or the sampling personnel must make arrangements to ship cooler(s) back to USACHPPM as soon as possible, by whatever means available. The USACHPPM frequently uses Federal Express to ship samples from the field to the laboratory. Federal Express forms pre-printed with the USACHPPM account number are provided with each sampling kit.

Since Federal Express will not pick up samples on Sunday, samples sent on Saturday will be delivered on Monday. If the samples are to be sent on Friday, the USACHPPM-DESP or Water Supply Management Program must be notified in advance to ensure that a staff member will be present to receive the samples on Saturday. The sample shipment must be clearly marked for Saturday delivery or Federal Express will default to a next business day delivery schedule.

The address for the USACHPPM DLS-Main for Federal Express, UPS or other commercial carriers is—

CDR, USACHPPM  
ATTN: MCHB-TS-LID (Sample Mgt Lab)  
Bldg E2100  
APG, MD 21010-5403

## 2.11 Points of Contact

The following points of contact are provided for personnel to arrange support of any sampling mission with respect to equipment requirements and analytical support:

**Table 2-8. USACHPPM Points of Contact**

Organization	Address / Web Page	Phone / Fax
USACHPPM-DESP	CDR, USACHPPM 5158 Blackhawk Road ATTN: MCHB-TS-EES Aberdeen Proving Ground, MD 21010-5403 <a href="http://chppm-www.apgea.army.mil/desp/">http://chppm-www.apgea.army.mil/desp/</a>	COM 410.436.6708 FAX 410.436.2407 DSN 584.XXXX
USACHPPM-DLS	CDR, USACHPPM ATTN: MCHB-TS-LID Bldg E 2100 Aberdeen Proving Ground, MD 21010-5403 <a href="http://chppm-www.apgea.army.mil/dls/">http://chppm-www.apgea.army.mil/dls/</a>	COM 410-436-2208 FAX 410.436.4108 DSN 584.XXXX
USACHPPM-Europe	CDR, USACHPPM-EUR CMR 204, APO-AE 09180 <a href="http://www.chppmeur.amedd.army.mil/default.htm">http://www.chppmeur.amedd.army.mil/default.htm</a>	COM 06371-486-7040 FAX 06371-486-8954 DSN 486.XXXX
USACHPPM-Pacific	Unit 45006 APO AP 96346-5006 <a href="http://chppm-www.apgea.army.mil/pac/">http://chppm-www.apgea.army.mil/pac/</a>	COM 0462-51-1788 FAX 0462-51-8579 DSN 263-XXXX

2.12 References

- a. U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) TG 230, *Chemical Exposure Guidelines for Deployed Military Personnel (Draft)*, 2001.
- b. U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) TG 248, *Guide for Deployed Preventive Medicine Personnel on Health Risk Management*, August 2001.
- c. Defense Intelligence Agency, Defense Intelligence Report, DI-1816-6-99, *Medical Intelligence Assessment of Deployment Environmental Health Risks*, January 1999.
- d. Allied Command Europe (ACE) Directive Number 80-64, *ACE Policy for Defensive Measures Against Toxic Industrial Chemical Hazards During Military Operations*, 20 December 1996.

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- e. U.S. Department of Transportation, *North American Emergency Response Guidebook: A Guidebook for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Incident*, January 2000.
- f. USACHPPM Directorate of Laboratory Services, Chain of Custody Standard Operating Procedures, (SOP #5), February 2000.
- g. U.S. Environmental Protection Agency, *Manual for the Certification of Laboratories Analyzing Drinking Water*, EPA/570/9-90/008, April 1990. USEPA, Washington, D.C. 20460.
- h. National Institute for Occupational Safety and Health, *Industrial Hygiene Laboratory Quality Control # 587*, July. 1983. NIOSH, Cincinnati, Ohio.
- i. Code of Federal Regulations, Title 49, Parts 171 to 177, Transportation.
- j. U.S. Environmental Protection Agency, *The User's Guide to the Contract Laboratory Program*, Office of Emergency and Remedial Response, Dec 1986.

APPENDIX 2-1

**ENVIRONMENTAL RECONNAISSANCE**

**SECTION A. POINTS OF CONTACT**

Person	Name	Phone Number
1. Camp Mayor		
2. Air Station/PM		
3. Support Platoon/Unit		
4. Contract Camp Manager		
5. Army Contracting Office		
6. Theater PM Detachment		
7. Medical Brigade PM Personnel		
8. Brigade/Task Force S2		
9. Brigade/Task Force S3		
10. Brigade/Task Force S5		

**SECTION B. CAMP DEMOGRAPHICS**

11. Date Of Survey:	
12. Camp Layout:	

**SECTION B. CAMP DEMOGRAPHICS**

13. Former Uses of Occupied Buildings or Land (e.g. residential, quarry, etc)

14. Description of Nearby Industrial Operations (e.g. power plant, factories, etc)

15. Description of Corps Grown in Area (e.g. corn, wheat, etc):

16. Camp Fixed Population:

17. Rotation Schedule:

18. Number of U.S. Troops, if not U.S. Camp:

19. Units and Detachments/Teams/Elements Present:


SECTION C. WATER							
Type	ID	Geo Location (MGRS)	Source	Type of Use	History of Use	Camps Supplied	

Type Bottled, well, municipal, ROWPU, Surface  
 Source: lake, well, river  
 Type of Use: drinking, hygiene, wash rack, etc.

**SECTION D. WATER RECON**

**Bottled Water**

ID	Brand	Bottle Size	Notes

**Municipal Water**

ID	Municipal Name	Treatment Methods	Distribution Point Description

**Well Water**

ID	Well Construction	Pump Specifications	Potential Sources of Contamination

**Surface Water**

ID	River or Lake Name	Treatment Method	Potential Sources of Contamination

**ROWPU/UV Water**

ID	Water Source Name	Size	Operating Unit or Contractor

**SECTION E. SOLID WASTE DISPOSAL**

General Description of Camp Solid Waste Disposal Practices

**Landfills / Burn Pits**

ID				
Location				
GEO Location				
Material Disposed				
Disposal Volume/Day				
Operating Contractor				
Daily Cover (yes/no)				
Description				

**Incinerators**

ID				
Location				
GEO Location (MGRS)				
Materials Disposed				
Disposal Rate/Day				
Operating Contractor				
Manufacture of Unit				
Hours of Operation/Day				
Supplemental Fuel				

**SECTION F. AIR RECON**

Description of Soldier Complaints (if any)

Description of Historical Air Studies (if any)

Description of Camp Foundation (sand, gravel, hardstand, etc)

General Description of Ambient Air Conditions

Meteorological Information

Day				
Ave Wind Speed				
Predominate Wind Direction				
High Temp				
Low Temp				
Ave Barometric Pressure				
Ave Relative Humidity				
Conditions (rain, snow, sun, etc.				

**SECTION F. AIR RECON (Continued)**

**Nearby Sources of Air Pollution**

ID	MGRS	Name	Type (circle one)	Operation	Description
			<b>Point Area Volume</b>		
			<i>Point Area Volume</i>		
			<i>Point Area Volume</i>		
			<i>Point Area Volume</i>		
			<i>Point Area Volume</i>		
			<i>Point Area Volume</i>		

**Nearby Industrial Facilities**

ID	MGRS	Name	Type of Industry	Active	Description
				<i>Yes / No</i>	
				<i>Yes / No</i>	
				<i>Yes / No</i>	
				<i>Yes / No</i>	
				<i>Yes / No</i>	
				<i>Yes / No</i>	

<b>SECTION G. SOIL RECON</b>					
Road Aggregate type					
Source of Aggregate					
<b>Living Area – Tents</b>					
ID	MGRS	# Personnel	Soil Description	Area Prior Use	Potential Contaminants
<b>Living Area - Buildings</b>					
ID	MGRS	# Personnel	Soil Description	Area Prior Use	Potential Contaminants
<b>Maintenance Areas</b>					
ID	MGRS	# Personnel	Soil Description	Area Prior Use	Potential Contaminants
<b>Outdoor Recreation Areas</b>					
ID	MGRS	# Personnel	Soil Description	Area Prior Use	Potential Contaminants

<b>SECTION H. ENVIRONMENTAL NOISE</b>			
<b>Sensitive Use Areas</b>			
ID	MGRS	Name	Type (circle one)
			<i>Hospital / Church / Office / Sleeping quarters</i>
			<i>Hospital / Church / Office / Sleeping quarters</i>
			<i>Hospital / Church / Office / Sleeping quarters</i>
			<i>Hospital / Church / Office / Sleeping quarters</i>
<b>Electrical Generator Locations</b>			
ID	MGRS	Name	Generator Details (Capacity / NSN / Manufacturer)
<b>Runway Locations and Aircraft</b>			
ID	MGRS	Name	Type(s) Aircraft using Runway
<b>Motorpool Locations</b>			
ID	MGRS	Name	Type(s) of Vehicles Serviced
<b>Helipad Locations and Helicopters</b>			
ID	MGRS	Name	Type(s) of Helicopters Using Helipad

<b>Section - I -PERIMETER RECONNAISSANCE</b>		
Description Site Characteristics Not Consistent with Aerial Photographs or Maps (such as disappearance of depressions, disturbed area, changes in vegetation, construction buildings, etc.).		
Describe any Labels, Markings, Placards, or Containers Identified from Perimeter.		
Describe Deterioration or Damage to Containers.		
Describe any Biological Indicators (dead animals, fish, plants).		
Describe Unusual Environmental Conditions (clouds, mists, discolored liquids, oil slicks, vapors, etc.)		
28. Describe Unusual Odors, or Human Indicators (burning eyes, chest, etc.).		
<b>INFORMATION FROM DOWNWIND PERIMETER AIR MONITORING</b>		
Hazard	Level Measured	Estimated Risk
Combustible Gas Levels		
Inorganic Gases/Vapors		

Organic Gases/Vapors		
Specific Hazards Identified		

**LIST OF IDLH OR HAZARDOUS CONDITIONS IDENTIFIED  
(SEE TABLE 3-1).**


**SECTION H. ONSITE CHARACTERIZATION**

**PERSONNEL PROTECTIVE EQUIPMENT REQUIREMENTS**

29. Describe Respiratory Protection Intended for Escape Purposes.  
(Make/Model/Filter/Cartridge)

--

30. Describe Respiratory Protection Intended for Other Than Escape Purposes.

--

31. Describe Skin Protection if Required (Mopp/Coveralls, Gloves).

--

32. Describe Additional Protection Required (Eye, Splash, Boots, Helmets, Hearing, etc.)

--

**INFORMATION FROM ONSITE AIR MONITORING**

Location	Hazard Description	Level Measured	Estimated Risk

<b>ADDITIONAL ONSITE IH CONCERNS</b>	
<b>Potential Hazards</b>	<b>Description</b>
1. Containers/Impoundments/Storage Systems.	
2. Condition of Items Listed Above.	
3. Peculiar Physical Condition of Materials.	
4. Natural Wind Barriers.	
5. Potential Pathways for Dispersion.	
6. Indications of Exposure to Hazardous Substances.	
7. Any Additional Safety Concerns.	
<b>SECTION I. ONGOING MONITORING</b>	
<b>SEE USACHPPM TG 231</b>	

<b>SECTION J - IHA FACILITY INFORMATION DATASHEET</b>		
<b>Facility Name</b>		
<b>Location (Town Name)</b>	<b>Point of Contact</b>	
<b>SIC CODE</b>	<b>POC PH#</b>	
<b>Facility Use</b>	MGRS 34T	
<b>Year Built</b>	<u>Latitude (Decimal Degrees)</u>	
<u>Facility Product</u>	<u>Longitude (Decimal Degrees)</u>	
<u>Facility Size (sq meters)</u>	<u>Elevation (meters AMSL)</u>	
<b>Description and Sketch of Facility</b>		
<b>Signage marking chemicals, safety, and transport requirements</b>		
<b>Camps Within 5km of Facility</b>		
<b>Camp Name</b>	<b>Direction to Camp</b>	<b>Distance to Camp (KM)</b>

**SECTION K - IHA CHEMICAL STORAGE DATA**

Facility Name:

<b>CAS</b>	<b>Container Type</b>	<b>Circle all that Apply</b> Corrosive / Ignitable / Toxic / Reactive Vented / Flammable Cabinets / Stored with other Chemicals
<u>UNCODE</u>	<u>Container Material</u>	
<u>Chemical Name</u>	<u>Container Size (Units)</u>	
<b>Manufacturer Name</b>	<u>Container Thickness (mm)</u>	

<b>CAS</b>	<b>Container Type</b>	<b>Circle all that Apply</b> Corrosive / Ignitable / Toxic / Reactive Vented / Flammable Cabinets / Stored with other Chemicals
<u>UNCODE</u>	<u>Container Material</u>	
<u>Chemical Name</u>	<u>Container Size (Units)</u>	
<b>Manufacturer Name</b>	<u>Container Thickness (mm)</u>	

<b>CAS</b>	<b>Container Type</b>	<b>Circle all that Apply</b> Corrosive / Ignitable / Toxic / Reactive Vented / Flammable Cabinets / Stored with other Chemicals
<u>UNCODE</u>	<u>Container Material</u>	
<u>Chemical Name</u>	<u>Container Size (Units)</u>	
<b>Manufacturer Name</b>	<u>Container Thickness (mm)</u>	

<b>CAS</b>	<b>Container Type</b>	<b>Circle all that Apply</b> Corrosive / Ignitable / Toxic / Reactive Vented / Flammable Cabinets / Stored with other Chemicals
<u>UNCODE</u>	<u>Container Material</u>	
<u>Chemical Name</u>	<u>Container Size (Units)</u>	
<b>Manufacturer Name</b>	<u>Container Thickness (mm)</u>	

<b>CAS</b>	<b>Container Type</b>	<b>Circle all that Apply</b> Corrosive / Ignitable / Toxic / Reactive Vented / Flammable Cabinets / Stored with other Chemicals
<u>UNCODE</u>	<u>Container Material</u>	
<u>Chemical Name</u>	<u>Container Size (Units)</u>	
<b>Manufacturer Name</b>	<u>Container Thickness (mm)</u>	

<b>List Chemicals Stored Together:</b>	<u>Notes on the Chemical Transportation Procedures:</u>
--	---

<b>SECTION K - IHA PROCESS INFORMATION DATASHEET</b>			
<b><u>Facility Name:</u></b>			
<u>Process Name:</u>	<u>Product:</u>		
<u>MGRS:</u> 34T	<u>Quantity Produced Daily (units):</u>		
<u>Description of Process:</u>			
<b>Equipment Information</b>			
<b>Manufacturer</b>	<b>Model</b>	<b>Year Built</b>	<b><u>Condition (Circle One)</u></b>
			poor / fair / good / excellent
			poor / fair / good / excellent
			poor / fair / good / excellent
			poor / fair / good / excellent
<b>Chemical Usage</b>			
<b>Chemical Name</b>	<b>CAS</b>	<b>Phase</b>	<b>Quantity Used Daily</b>
		liquid / gas / solid	
		liquid / gas / solid	
		liquid / gas / solid	
		liquid / gas / solid	
<b>Wastes Generated</b>			
<b>Description</b>	<b>Phase</b>	<b>Daily Quantity</b>	<b>Quantity Stored Onsite</b>
	liquid / gas / solid		
	liquid / gas / solid		
	liquid / gas / solid		
	liquid / gas / solid		
<b>Exhaust Stacks</b>			
<b>MGRS</b>	<b>Height</b>	<b>Diameter</b>	<b>Fan Rating (m3/min)</b>
34T			

**APPENDIX 2-2**

**DEPLOYMENT ENVIRONMENTAL  
SURVEILLANCE BACKPACK**

**2-2.1 Introduction**

The Deployment Environmental Sampling Backpack (DESB) is a comprehensive package designed to collect environmental samples during military deployments. The DESB was developed by the U.S. Army Center for Health Promotion and Preventive Medicine primarily for use by Preventive Medicine personnel; however, it can be used by any military personnel to collect environmental samples.

**2-2.2 Application**

The DESB is modularly designed to accommodate several environmental sampling applications. The primary application is to provide a platform of supplies and tools required to conduct environmental sampling during deployments with media specific inserts that can be customized to each sampling situation. The secondary application is to use media specific inserts to conduct discrete sampling requirements for deployments.

**2-2.3 Limitations of Use**

The DESB is designed for use during military deployments and should not be used for environmental regulatory compliance requirements. Many of the sampling methods used the backpack were adopted from existing regulatory field sampling methods, however others were developed specifically for sampling during deployments. Although these methods are proven to very similar, some are not approved by the regulatory community in the United States or other governing countries for compliance sampling.

**2-2.4 Backpack Layout**

The DESB was designed in sections; each section is outlined in Table 1 and described in detail in the associated paragraphs.

Table 2-2-1

Section	Backpack Location	Use
Administrative Pocket	Front	Administrative
Administrative Pouch	Front	Administrative
Soil Pouch	Front	Soil
Water Pouch	Front	Water
Equipment Section	Compartment 1 - Side A	Air
Document Section	Compartment 1 - Side B	Administrative
Administrative Section	Compartment 2 - Side A	Administrative
Air Insert Pack	Compartment 2 - Side B	Air
Soil Insert Pack	Compartment 2 - Side B	Soil
Water Insert Pack	Compartment 2 - Side B	Water

**2-2.5 Backpack Front**

The front of the backpack contains an administrative pouch and pocket, soil pouch and water pouch. Figure 1 and Photo 1 outlines the layout of the backpack front and Table 2 outlines the contents.

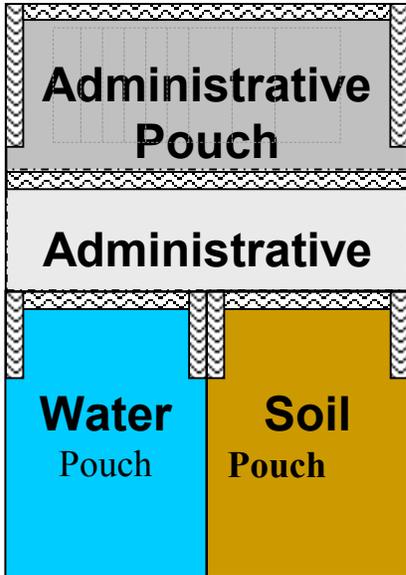


Figure 1

Table 2-2-2

Section	Item	Unit	Qty	Consumable
Administrative Pocket	Re-closable plastic bag (9" x 12")	ea	5	Yes
Administrative Pocket	Wipes	ea	4	Yes
Administrative Pouch	6" Ruler	ea	1	No
Administrative Pouch	Clipboard	ea	1	No
Administrative Pouch	Permanent marker (Black)	ea	1	Yes
Administrative Pouch	Permanent marker (Blue)	ea	1	Yes
Administrative Pouch	Permanent marker (Green)	ea	1	Yes
Administrative Pouch	Permanent marker (Red)	ea	1	Yes
Administrative Pouch	Soil sampling stainless steel bowl (1-1/2 quart)	ea	1	No
Administrative Pouch	Thermometer	ea	1	No
Soil Pouch	Brush	ea	1	No
Soil Pouch	Container of detergent for cleaning bowl	ea	1	Yes
Soil Pouch	Magnifying glass	ea	1	No
Soil Pouch	Small squirt bottle	ea	1	No
Soil Pouch	Stainless steel scoop	ea	1	No
Soil Pouch	Wipes	ea	2	Yes
Water Pouch	Chlorine paper package	ea	1	Yes
Water Pouch	Emergency eye wash	ea	1	Yes
Water Pouch	PH paper package	ea	1	Yes
Water Pouch	Pitcher (100 ml)	ea	1	Yes
Water Pouch	Wipes	ea	2	Yes

**2-2.6 Equipment Section (Compartment 1 – Side A)**

The equipment section contains equipment primarily used in ambient air sampling. However, can be used in other sampling applications.



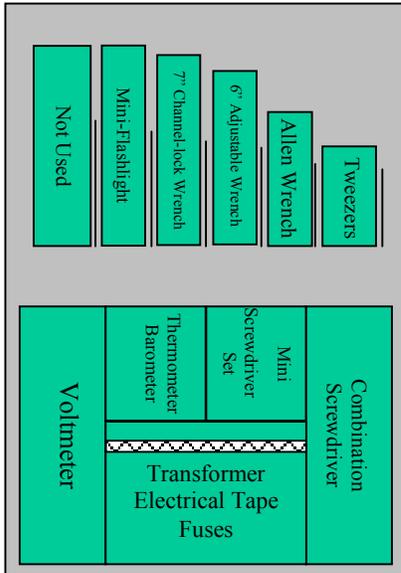


Table 2-2-3

Section	Item	Unit	Qty	Consumable
Equipment	6" Adjustable Wrench	ea	1	No
Equipment	7" Channel-lock wrench	ea	1	No
Equipment	Allen wrench	set	1	No
Equipment	Combination screwdriver	ea	1	No
Equipment	Electrical Tape	roll	1	Yes
Equipment	Fuses: ¼ Amp (1.25"x0.25" AGC)	ea	2	Yes
Equipment	Fuses: 1 Amp (1.25"x0.25" AGC)	ea	2	Yes
Equipment	Fuses: 1 Amp (2x20mm GMA)	ea	2	Yes
Equipment	Fuses: 2 Amp (1.25"x0.25" AGC)	ea	2	Yes
Equipment	Mini flash light	ea	1	No
Equipment	Mini Screwdriver set	set	1	No
Equipment	Thermometer / Barometer	ea	1	No
Equipment	Transformer (50W)	ea	1	No
Equipment	Tweezers	ea	1	No
Equipment	Voltmeter	ea	1	No

**2-2.7 Document Section (Compartment 1 – Side B)**

The document section contains two slip pockets to store papers. The lower slip pocket contains the operating instructions for several items contained in the equipment section. The upper slip pocket contains the backpack inventory and sampling instructions.

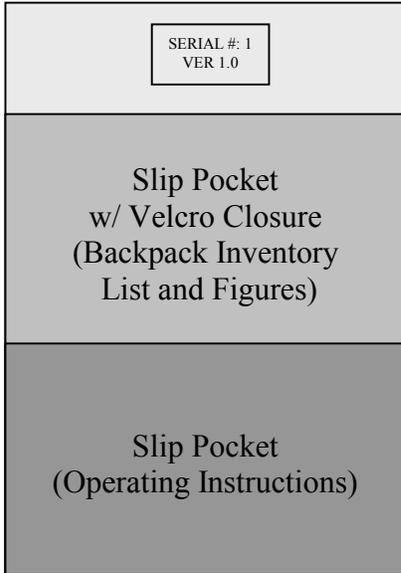


Table 2-2-4

Section	Item	Unit	Qty	Consumable
Documents	Backpack Inventory List	ea	1	No
Documents	Backpack Layout Figures	ea	1	No
Documents	Voltmeter Operating Instructions	set	1	No
Documents	Thermometer/Barometer Operating Instructions	ea	1	No
Documents	Transformer (50W) Operating Instructions	ea	1	No

**2-2.8 Administrative Section (Compartment 2 – Side A)**

The administrative section contains supplies that will be utilized in the collection, packaging and shipping of environmental samples. All the items with the exception of the compass, scissors and box cutter are consumable and must be re-supplied.

Rubber bands	Nitrile Gloves
Disposable Camera	Teflon Tape Marking Tape Compass
Plastic Bags (4" x 4") (5" x 10")	Scissors Box Cutter
Colored Dots	Batteries (AA, 9-Volt, Therm/Barom Lithium)



Table 2-2-5

Section	Item	Unit	Qty	Consumable
Interior Administrative	Rubber Bands	pack	3	Yes
Interior Administrative	Disposable Camera	ea	1	Yes
Interior Administrative	Re-closable plastic Bag (4" x 4")	ea	10	Yes
Interior Administrative	Re-closable plastic Bag (5" x 10")	ea	10	Yes
Interior Administrative	Colored dots	pack	1	Yes
Interior Administrative	Nitrile gloves	pair	3	Yes
Interior Administrative	Teflon Tape (0.5" x 520")	roll	1	Yes
Interior Administrative	Marking tape	roll	1	Yes
Interior Administrative	Compass	ea	1	No
Interior Administrative	Scissors	ea	1	No
Interior Administrative	Box Cutter	ea	1	No
Interior Administrative	9-volt Battery	ea	2	Yes
Interior Administrative	AA – Battery	ea	4	Yes
Interior Administrative	Thermometer/Barometer Lithium Battery	ea	2	Yes

**2-2.9 Media Inserts**

Media inserts provide the appropriate sampling media and supplies for each specific sampling type. The three primary inserts are Air, Water and Soil and can be detached from the sampling backpack.

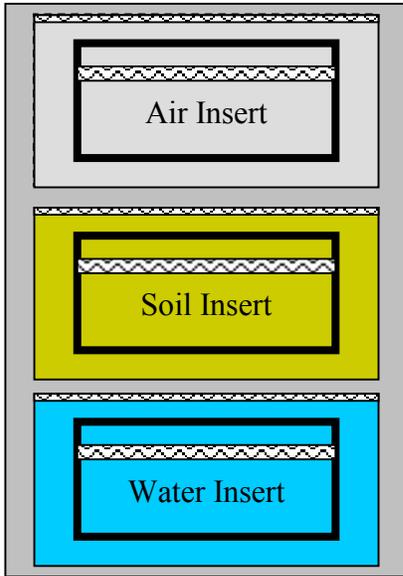


Table 2-2-6

Section	Item	Unit	Qty	Consumable
Media Insert	Air Sampling Bag (Gray)	ea	1	No
Media Insert	Soil Sampling Bag (Tan)	ea	1	No
Media Insert	Water Sampling Bag (Blue)	ea	1	No

**APPENDIX 2-3**  
**ANALYTICAL METHODS**

**USACHPPM DRAFT TG 251**

WATER<sup>1</sup>

<b>Analyzed Contaminants</b>	<b>Sampling Container</b>	<b>Laboratory Analytical Method</b>
Alkalinity	Alkalinity, pH, color, cond., TDS, chloride, sulfate	EPA 310.1 or SM 2320
Chloride, Fluoride, Sulfate	Alkalinity, pH, color, cond., TDS, chloride, sulfate	EPA 300.0
Color	Alkalinity, pH, color, cond., TDS, chloride, sulfate	EPA110.2
Conductivity	Alkalinity, pH, color, cond., TDS, chloride, sulfate	EPA 120.1
Cyanide	Cyanide	EPA 335.2 or SM 4500B,C,E
Foaming Agents/MBAS	MBAS	EPA 425.1
Hardness	Metals	EPA 130.2
Nitrite/Nitrate	Nitrite/Nitrate	EPA 353.2
Ph	Alkalinity, pH, color, cond., TDS, chloride, sulfate	EPA 150.1 or SM 4500 H&B
Phosphate	Total Phosphate	EPA 365.2
Total Dissolved Solids (TDS)	Alkalinity, pH, color, cond., TDS, chloride, sulfate	EPA 160.1
Total Organic Carbon (TOC)	TOC	EPA 415.1
Turbidity	Metals	EPA 180.1
Metals	Metals	EPA 200.8 – ICP/MS
Semi – Volatile Organic Compounds (SVOC)	SVOC	EPA 525.2
Volatile Organic Compounds (VOC)	VOC	EPA 524.2
Carbamates	Glyphosate/Carbamates	EPA 531.1
Diquat	Diquat/Paraquat	EPA 549.1
Endothall	Endothall	EPA 548.1
Glyphosate	Glyphosate/Carbamates	EPA 547
Pesticides/Herbicides (neutral)	Pesticides	EPA 507/508
EDB/DBCP, Organochlorine pesticides	EDB/DBCP	EPA 504.0
Herbicides (acidic)	Herbicides	EPA 515.1
Gross alpha/beta	Gross alpha/beta	STD AB001

<sup>1</sup> Contaminants and respective analytical methods presented in this table are for the field sampling procedures provided in *Appendix 5-2*.

AIR<sup>1</sup>

Compounds	Sampling Method	Laboratory Analytical Method
Various organics/inorganics	Detector Tubes	NA
Metals	Mini-Volume Particulate Sampler ( <i>Appendix 6-1</i> )	EPA 200 Series
Particulate	Mini-Volume Particulate Sampler ( <i>Appendix 6-1</i> )	Gravimetric
VOCs	TO14A ( <i>Appendix 6-4</i> ) and TO17 ( <i>Appendix 6-3</i> )	TO14A (gas chromatography (GC)) TO17
Polynuclear aromatic compounds (PAHs) Explosives/Energetics	TO13A ( <i>Appendix 6-5</i> ) (if power is available)	TO13A (GC/high performance liquid chromatography (HPLC))
Dioxins/Furans	TO9A ( <i>Appendix 6-5</i> ) (if power is available)	TO9A (High Resolution (HR)GC/HR mass spectrometry (MS))
Pesticides	TO10 ( <i>Appendix 6-5</i> )	TO10 (GC/Electron Capture Detector (ECD))
Various tubes (Porapak, silica gel, charcoal, coconut shell charcoal) with personal sampling pumps	NIOSH Methods	Various

<sup>1</sup> Sampling method instructions contained in Chapter 6

SOIL<sup>1</sup>

Compounds	Laboratory Analytical Method
Metals	EPA 6101A, 7040, 7090, 7061A, 7130, 7190, 7420, 7441A, 7470A
VOCs	EPA 8260
SVOCs	EPA 8270
Explosives	EPA 8330
Explosives/Energetics	TO13A (GC/high performance liquid chromatography (HPLC))
Acidic Herbicides	EPA Method 8151A.
Specific OC/OP Pesticides/PCBs/Neutral Herbicides	CAD Method 38.1
Specific OC Pesticides and PCBs in	in EPA Methods 3550B/8081A & 8082
Specific OP Pesticides	in EPA Method 3540/3620B/8141A
Specific Neutral Organonitrogen Herbicides	EPA Method 8141 Detector (ECD))

<sup>1</sup> Sampling method for soil is the same for all constituents – *Appendix 8-3*

## CHAPTER 3.

### INDUSTRIAL HYGIENE SITE CHARACTERIZATION

#### 3.1. Purpose

The information contained in this section is intended to guide preventive medicine personnel in conducting thorough site characterizations during a Phase I assessment prior to environmental sampling or site occupation. A thorough site characterization identifies site hazards that pose immediate health threats to reconnaissance or survey personnel and provides the information needed to determine appropriate protective measures.

#### 3.2. General

Sites may contain three types of occupational and environmental health (OEH) hazards that pose an immediate health threat to deployed personnel at dangerous concentrations/levels: chemical hazards, physical hazards, and endemic disease. These hazards may be present as contamination from previous site use or battle damage, they may be stored on-site from previous and/or for future use, or they may arise from the site's current or nearby commercial or residential operations.

Chemical hazards include any chemical element or compound that presents adverse health effects when inhaled, ingested, or absorbed through the skin. Examples of chemical hazards that environmental surveillance team members may discover during initial entry site assessments include industrial chemicals (e.g., trichloroethylene, benzene, and other organic solvents), hazardous gases (e.g., chlorine, ammonia, and carbon monoxide), and other commonly used yet toxic chemicals (such as pesticides, gasoline, and propane).

Physical hazards include injury associated with entering poorly maintained structures, confined spaces, stacked materials or drums, excessive levels of ionizing and non-ionizing radiation, noise, temperature and pressure extremes, and vibration that present adverse health effects upon exposure. Examples of physical hazards that team members may face during initial entry site assessments include loud noise from industrial operations and extreme heat or cold from the environment and/or personal protective equipment (PPE).

Biological hazards include any living organism or its properties that present adverse health effects upon exposure. Examples of biological hazards that team members may face during initial entry site assessments include pathogenic organisms resulting in endemic diseases (e.g., tuberculosis and malaria) while interfacing with the local population and exposed to the local environment. Other biological hazards include molds and fungi from poorly maintained or ventilated buildings, as well as venomous plants and animals (e.g., poison ivy and brown recluse spiders) that are indigenous to the area.

While reconnaissance or survey personnel should be aware of all of these hazards and take them into consideration during the site characterization, the methods described below pertain primarily to identifying and assessing acutely hazardous chemical environments. Professional judgment should be used during the characterization to determine if additional resources or equipment are necessary to assess acutely hazardous physical and biological hazards.

3.2.1. Responsibilities

The team leader or senior preventive medicine team member is primarily responsible for the site characterization and safety of the reconnaissance or survey personnel. In addition, outside experts, such as chemists, health physicists, industrial hygienists, and toxicologists may be needed to accurately and fully interpret all the available information on site conditions. A broad array of expertise is available by contacting USACHPPM as specified in section 2.12.

3.2.2. Three Phases of Site Characterization

Site characterization is conducted in three phases. The first phase is offsite characterization, where the site is researched and reconnoitered from photographs or the site perimeter. The second phase is the onsite survey, where the team gathers air-monitoring data and visually inspects the site to determine the extent of the site hazards. The final phase, if the site is determined safe for occupation or additional sampling, is ongoing monitoring to provide continuous information about the site conditions. Figure 3-1 provides the decision process used during the site characterization.

3.3. Offsite Characterization

Conducting thorough research onsite is vital to determining site hazards and providing for the safety of the reconnaissance or survey personnel. Initial information gathering should focus on identifying all potential or suspected conditions that may pose inhalation hazards that are immediately dangerous to life or health (IDLH) or other conditions that may cause serious harm or death (see Table 3-1 below). Information gathered in the Offsite Characterization phase will be used to determine the extent of PPE required by the reconnaissance or survey team as well. The two primary sources of Offsite information are interview/records research and perimeter reconnaissance.

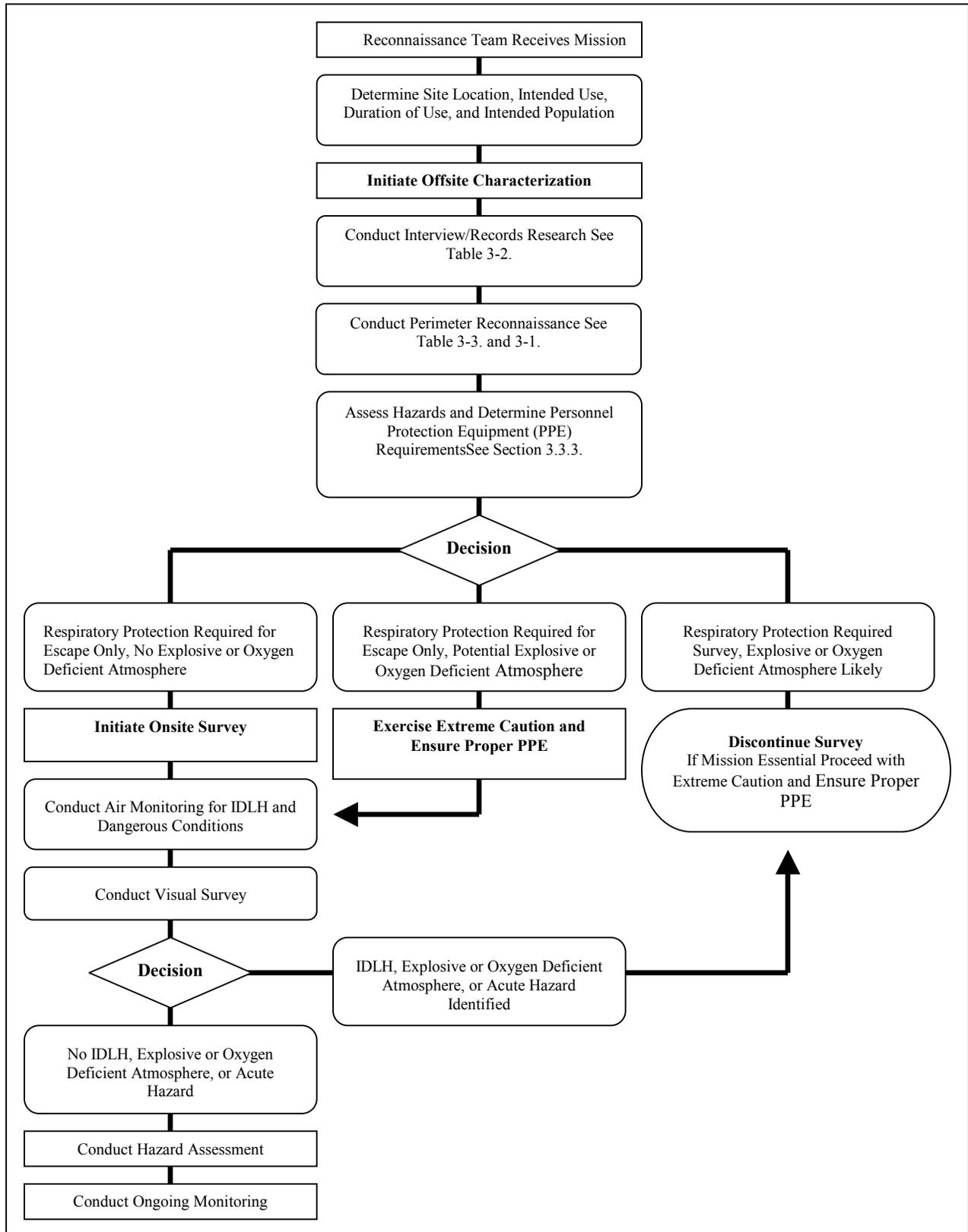
**Table 3-1. Visible Indicators of Potential IDLH and Other Dangerous Conditions**

<ul style="list-style-type: none"> <li>• Large containers or tanks that must be entered.</li> </ul>
<ul style="list-style-type: none"> <li>• Enclosed spaces such as buildings or trenches that must be entered.</li> </ul>
<ul style="list-style-type: none"> <li>• Potentially explosive or flammable situations (indicated by bulging drums, effervescence, gas generation, or instrument readings).</li> </ul>
<ul style="list-style-type: none"> <li>• Extremely hazardous materials (e.g., cyanides, phosgene, or radiation sources) that pose an inhalation or dermal hazard.</li> </ul>
<ul style="list-style-type: none"> <li>• Visible vapor clouds.</li> </ul>
<ul style="list-style-type: none"> <li>• Areas where biological indicators (such as dead animals or vegetation) are located.</li> </ul>

3.3.1. Interview/Records Research

The maximum amount of research possible should be conducted before any personnel actually go to the site. The information sources listed in paragraph 2-3, Environmental Intelligence Information for the Battle Field, should be utilized when available. In addition, the Environmental Reconnaissance sheet provided in Appendix 2-1 provides a valuable template for gathering Offsite information. Primary attention should be focused on identifying the information listed in Table 3-2. Though much of the information can be provided by support agencies, like those listed in paragraph 2-3, and foreign governmental agencies, excellent information can be gained by conducting interviews with local personnel that live or work near the site of concern. Personal interviews with the local population should be conducted to gain or verify information whenever possible and security permits.

Figure 3-1. Phase I Industrial Hygiene Decision Tree



**Table 3-2. Offsite Information of Primary Concern**

<ul style="list-style-type: none"> <li>• Exact location of the site.</li> </ul>
<ul style="list-style-type: none"> <li>• Detailed description of the activities that occurred at the site and duration of the activities.</li> </ul>
<ul style="list-style-type: none"> <li>• Meteorological data (current weather and forecast, prevailing wind direction, precipitation levels, temperature profiles, etc).</li> </ul>
<ul style="list-style-type: none"> <li>• Terrain (historical and current site maps, site photographs, aerial photographs, land use maps, land cover maps, etc).</li> </ul>
<ul style="list-style-type: none"> <li>• Geologic and hydrologic data.</li> </ul>
<ul style="list-style-type: none"> <li>• Habitation, to include population centers and population at risk.</li> </ul>
<ul style="list-style-type: none"> <li>• Pathways of dispersion.</li> </ul>
<ul style="list-style-type: none"> <li>• Hazardous substances involved and their chemical and physical properties (information sources include company records, local government regulative agencies, local fire fighters, waste storage or shipment inventories, interviews with personnel, families, nearby residents, media reports, etc).</li> </ul>
<ul style="list-style-type: none"> <li>• Previous surveying, sampling, and monitoring data.</li> </ul>
<ul style="list-style-type: none"> <li>• Medical Threat Information (Armed Forces Medical Intelligence Center (AFMIC))</li> </ul>
<ul style="list-style-type: none"> <li>• Medical support assets and capabilities (for use if emergency medical support is required).</li> </ul>

3.3.2. Perimeter Reconnaissance

If the primary hazards of the site are unknown, and if time permits, visual observations, perimeter monitoring for airborne pollutants, and sampling near the site should be conducted. While these steps do not provide definitive hazard information, they can assist in determining preliminary information on site conditions. Perimeter reconnaissance should be conducted according to Table 3-3.

<p><b>Table 3-3. Perimeter Reconnaissance</b></p>
<ul style="list-style-type: none"> <li>• Develop preliminary site map, including locations of buildings, impoundments, ponds, tanks, and pits.</li> </ul>
<ul style="list-style-type: none"> <li>• Review current and historical aerial photographs to identify disappearance of depressions, quarries and pits (could indicate buried materials or waste), deforestation or disturbed areas, mounding or modification in grade, changes in vegetation around buildings or traffic patterns at the site (could provide information on past activities).</li> </ul>
<ul style="list-style-type: none"> <li>• Note labels, markings, or placards on containers, vehicles, or buildings.</li> </ul>
<ul style="list-style-type: none"> <li>• Note deterioration or damage of containers or vehicles.</li> </ul>
<ul style="list-style-type: none"> <li>• Note any biological indicators, such as dead animals or plants, or areas devoid of vegetation.</li> </ul>
<ul style="list-style-type: none"> <li>• Note unusual environmental conditions, such as clouds, discolored liquids, oil slicks, vapors, etc.</li> </ul>
<ul style="list-style-type: none"> <li>• Monitor the ambient air downwind of the site perimeter (using equipment and techniques discussed in 3.4.3.), including toxic substances, combustible and flammable gases and vapors, oxygen deficiency, and specific materials, if known.</li> </ul>
<ul style="list-style-type: none"> <li>• Note unusual odors, eye, or respiratory irritants.</li> </ul>

3.4. Onsite Survey

The purpose of an onsite survey is to verify and supplement information from the offsite characterization. Prior to conducting the onsite survey, the information gained from the offsite characterization should be used to address the work to be accomplished, the protective equipment for the team, and the procedures to protect the health and safety of the reconnaissance team. Priorities should be established for hazard assessment and site activities after evaluation of the site conditions.

The size and composition of the reconnaissance team depends on the site characteristics. In situations where significant hazards are anticipated, a minimum of 4 personnel should be on the team, and fifty percent of the team should remain outside the site perimeter and in radio contact with the reconnaissance team in case emergency response is necessary.

#### 3.4.1. Protection of Reconnaissance Personnel

The information gained from researching the site, interviews, and perimeter reconnaissance is used to determine the recommended personnel protection measures for reconnaissance and survey team members. It is critical to include the scope of the reconnaissance, survey, and site use into this recommendation. For instance, if reconnaissance members are going to a site, but will not enter enclosed buildings/spaces or sample containers, the level of concern and protection may be less stringent than if they were to enter enclosed buildings, or sample open containers or visibly contaminated soil and water.

Based on the commander's guidance and the team leader's assessment of potential site hazards, team members should be equipped with PPE adequate to meet all reasonably perceived contingencies. Onsite surveys should be restricted, whenever possible, to locations with minor hazards that require the minimum level of PPE. This equipment should primarily be used to protect team members while departing a newly discovered unsafe area. In other words, team members should only be concerned with identifying the boundaries of "healthy" areas, and they should not attempt to enter these areas once "unhealthy" concentrations/levels are detected. The minimum level of protection requires that respiratory protection be carried, not worn, and minimal skin protection, such as eye splash protection, boots (preferably all leather and water resistant), and gloves. A military protective mask should be carried as a precautionary measure rather than as a method of primary protection from industrial chemicals. In most scenarios, if the offsite characterization identifies sufficient hazards to warrant higher personnel protective gear, sufficient evidence exists to eliminate the site from consideration for use.

In rare instances, it may be necessary to conduct an onsite survey where sufficient hazards exist to warrant more stringent protective measures. In such instances it is crucial to identify the proper personal protective equipment for the reconnaissance team. If time and resources permit, it is preferable to research and procure commercially manufactured protective gear ideally suited to the site hazards, such as air purifying respirators and chemical protective over garments. A second alternative is military protective gear, such as the M40 protective mask, butyl rubber gloves, and chemical protective over garments (mission-oriented protective posture (MOPP) gear). Appendix 1 details the chemical protective capabilities of the M40 protective mask's filter. The military protective mask will not provide adequate protection against all industrial chemicals, and should never be used in a potentially oxygen deficient environment. Operational risks are present when using the military protective mask in this capacity. If the military protective mask is used, duration

of exposure should be as short as possible and the chemical filter should be exchanged after each use.

#### 3.4.2. Initial Steps for Onsite Survey

Upon entering the site, personnel should monitor the air for conditions that pose an IDLH, such as combustible or explosive atmospheres, oxygen deficiency, or toxic substances, and visually observe for signs of actual or potential IDLH conditions (see Table 3.1). The National Institute for Occupational Safety and Health (NIOSH), *Pocket Guide to Chemical Hazards*, defines IDLH concentrations as the “maximum level from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects.”

#### 3.4.3. Air Monitoring

Identification and quantification of contaminants through air monitoring is essential to evaluating site safety. Data gained through air monitoring is valuable for determining PPE, determining off-limits areas, assessing potential health effects of exposure, and determining the need for follow-on monitoring.

##### 3.4.3.1. Air Monitoring Equipment

The reconnaissance team may be equipped with a variety of environmental monitoring equipment and supplies. These items are fielded as part of the units’ Medical Equipment Set-Industrial Hygiene (MES-IH), or augmented by USACHPPM. If MES-IH equipment is unavailable or if additional equipment is needed, contact USACHPPM as specified in section 2.12. for information on equipment selection and operation recommendations.

Two principal approaches for identifying and/or quantifying airborne contaminants exist. The onsite use of direct-reading equipment is the first and preferred method. If direct reading equipment is not available, laboratory analysis of air samples obtained by gas sampling bag, filter, sorbent, or wet-contamination collection is also possible by coordinating with supporting laboratory agencies.

Each MES-IH contains the same “classes” of direct-reading instruments (e.g., PID’s, multi-gas monitors, and gas detector tubes). However, the instruments and supplies are often procured from a variety of manufacturers. The operation, maintenance, and limitations of these items are frequently manufacturer-specific; therefore, this chapter cannot provide specific operating and maintenance instructions for each instrument contained in the instrument classes. It is imperative that the team members are adequately trained on the maintenance, calibration, and operation of all direct air monitoring equipment used, as well as equipment limitations. Therefore, all team members must thoroughly read and practice the equipment operating and maintenance procedures provided in each item operator’s manual.

Appendix 3-2 lists several direct reading instruments common to medical equipment sets and the conditions and substances they measure.

##### 3.4.3.2. Site Monitoring for IDLH and Other Dangerous Conditions

Depending on site conditions and project goals, four categories of site monitoring, as well as personnel monitoring, may be necessary: monitoring for IDLH and other dangerous conditions, general onsite monitoring, perimeter monitoring, and periodic monitoring. Because general onsite monitoring, perimeter monitoring, and periodic monitoring will be accomplished once initial site safety is determined, the primary focus of this section is to protect the reconnaissance team by

monitoring for IDLH and other dangerous conditions, such as flammable or explosive environments, and highly toxic levels of airborne contaminants. Direct-reading instruments normally used for this purpose include combustible gas indicators, oxygen meters, colorimetric tubes, and organic vapor monitors.

Personnel conducting the reconnaissance must understand that conditions may suddenly change from nonhazardous to hazardous. Acutely hazardous concentrations of chemicals may persist in confined and low-lying spaces for long periods of time. Any natural or artificial barriers, such as hills, tall buildings, or tanks, behind which air might be still and allow concentrations to build up, can indicate potentially hazardous environments. Avoid and place off limits any confined spaces such as cargo holds, silos, storage tanks, box cars, buildings, bulk tanks, and sumps where chemical exposures capable of causing acute health effects are likely to accumulate. If it is necessary to monitor the confined spaces, use extreme caution and follow established confined space protocol to the greatest degree possible. Table 3-4 provides guidelines for some atmospheric hazards assessed with direct-reading equipment.

**Table 3-4. Guidelines for Some Atmospheric Hazards**

Hazard	Monitoring Equipment	Measured Level	Action
Explosive atmosphere	Combustible gas indicator	<10% Lower Explosive Limit (LEL)	Continue Investigation.
		10%-25% LEL	Continue with Extreme Caution.
		>25% LEL	Explosive Hazard—Withdraw Immediately.
Oxygen	Oxygen concentration meter	<19.5%	Oxygen Deficient—Withdraw Immediately. Note: Combustible gas readings are not valid in atmosphere <19.5% Oxygen.
		19.5%-25%	Continue with caution. Deviation from normal level may be due to the presence of other substances.
		>25%	Fire hazard potential—Withdraw Immediately.
Inorganic and organic gases and vapors	Colorimetric tubes or chemical-specific instruments	Depends on chemical	Consult standard reference manuals for air concentrations/toxicity data. Action levels depend on MAGs*, PEL*, REL*, or TLV®*.
Organic gases and vapors	Portable photoionizer	Depends on chemical	Consult standard reference manuals for air concentrations/toxicity data. Action levels depend on MAG's, PEL, REL, or TLV.

- \*MAGs: Military Air Guidelines
- \*PEL: Permissible Exposure Limit
- \*REL: Recommended Exposure Limit
- \*TLV: Threshold Limit Value

TLV® is a registered trademark of the American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

After considering whether the suspected contaminants are lighter or heavier than air, consider sampling on hilltops, under any cover or canopy where soldiers might congregate or work, and in trenches and low-lying areas. Acutely

hazardous conditions are not likely to persist in open spaces for extended periods of time unless there is a very large and readily identifiable source. Open spaces are, therefore, generally given a lower monitoring priority.

Environmental variables that affect air monitoring should also be taken into consideration. Examples of common variables are provided in Table 3.4.

**Table 3-4. Variables That Affect Air Sampling**

<ul style="list-style-type: none"> <li>• Temperature. An increase in temperature increases the vapor pressure of most chemicals.</li> </ul>
<ul style="list-style-type: none"> <li>• Wind speed. An increase in wind speed can affect vapor concentrations near a freestanding liquid surface. Dusts and particulate-bound contaminants are also affected.</li> </ul>
<ul style="list-style-type: none"> <li>• Rainfall. Water from rainfall can essentially cap or plug vapor emission routes from open or closed containers, saturated soil, or lagoons, thereby reducing airborne emissions of certain substances.</li> </ul>
<ul style="list-style-type: none"> <li>• Moisture. Dusts, including finely divided hazardous solids, are highly sensitive to moisture content. This moisture content can vary significantly with respect to location and time and can also affect the accuracy of many sampling results.</li> </ul>
<ul style="list-style-type: none"> <li>• Vapor emissions. The physical displacement of saturated vapors can produce short-term, relatively high vapor concentrations. Continuing evaporation and/or diffusion may produce long-term low vapor concentrations and may involve large areas.</li> </ul>
<ul style="list-style-type: none"> <li>• Work activities. Work activities often require the mechanical disturbance of contaminated materials, which may change the concentration and composition of airborne contaminants.</li> </ul>

3.4.4. Additional Onsite Concerns

If air monitoring reveals no IDLH hazards or other dangerous conditions, continue the survey. Visual inspection and spot sampling of concern areas listed in Table 3-5 and use of additional equipment available in the MES-IH to assess noise, heat, and radiological hazards is recommended.

**Table 3-5. Additional Onsite Survey Concerns**

<ul style="list-style-type: none"> <li>Note the types of containers, impoundments or storage systems (paper or wood packages, drums or barrels, underground or aboveground tanks, compressed gas cylinders, pits, ponds, lagoons, etc.).</li> </ul>
<ul style="list-style-type: none"> <li>Note the condition of waste containers and storage systems (undamaged, rusty or corroded, leaking, bulging, types and quantities of material contained, labels indicating corrosive, explosive, flammable, radioactive, or toxic materials, etc.).</li> </ul>
<ul style="list-style-type: none"> <li>Note the physical condition of the materials (gas, liquid, or solid, color, turbidity, behavior such as corroding, foaming, or vaporizing, and conditions conducive to splash or contact).</li> </ul>
<ul style="list-style-type: none"> <li>Identify natural wind barriers such as buildings, hills, tanks, or other structures.</li> </ul>
<ul style="list-style-type: none"> <li>Determine potential pathways of dispersion (air, biological routes such as animals, insects and food chains, ground water, land surface, or surface water).</li> </ul>
<ul style="list-style-type: none"> <li>Note any indication of exposure to hazardous substances (dead fish, animals, or vegetation, dust or spray in the air, fissures or cracks in solid surfaces that expose deep waste layers, pools of liquid, foams or oils on liquid surfaces, gas generation, deteriorating containers, cleared land and possible land fill areas).</li> </ul>
<ul style="list-style-type: none"> <li>Note any safety hazards (condition of site structures, obstacles to entry and exit, terrain stability, stability of stacked materials, etc).</li> </ul>

The sound level meter available in MES-IHs can be used to assess hazardous noise levels. Although commanders may not be as concerned with hazardous noise levels as they are with hazardous chemical contaminants, high noise levels may still present a significant health hazard to environmental surveillance team members (especially at levels greater than 100 decibels. Situations that may present a noise hazard to team members include the initial entry site assessment of an operating industrial facility (e.g., a large factory, power generating facility, or other processing plant). However, in most cases noise surveys are conducted as part of a comprehensive OEH exposure assessment of an existing base camp since the base campsite is normally dormant during the initial entry site assessment. When necessary, the survey team should operate the sound level meter utilizing the outer perimeter survey technique (described earlier in this section) to establish noise level contours within the survey site. This technique should be employed for both outdoor and indoor environments with special emphasis given to large, noisy equipment and work processes, as well as noise-reverberating environments.

The heat stress monitor is another component of the MES-IH that may be used by team members during initial-entry site assessments. Although heat stress may not seem to be an immediate hazard to survey team members, certain environments (e.g., operational boiler rooms and hot, humid outdoor environments) in combination with the team members' personal protection level may present a significant health hazard to the team. Team members should add 10 degrees Fahrenheit (°F) to the current heat stress index reading while wearing MOPP gear and/or body armor, and they should take the appropriate heat injury prevention measures (e.g., work/rest cycles and water intake levels) described in FM 21-10-1, *Unit Field Sanitation Team*, depending on the revised index level. The monitor is designed to be a general area monitor rather than a personal monitor, however, is not portable and it does not measure (or even estimate) body core temperatures (which is a true measure

of heat stress). Also, if the monitor is moved from one location to another (especially from an outdoor environment to an indoor environment), the instrument’s thermometers must stabilize for a minimum of 10 minutes before recording any measurements.

Use of equipment such as the AN/PDR-77 or AN/VDR-2 to detect suspected radiological contamination is recommended. For additional information on radiological surveillance see Chapter 9.

3.4.5. Documentation

Documentation of survey procedures and information collected is vital for ensuring data quality and enabling accurate assessment and communication of site hazards. Thorough documentation can include use of logbooks, field data records, graphs, photographs, and sample labels, as well as any other records used or created in the offsite characterization or onsite survey. Regardless what types of records are maintained, the importance of maintaining thorough records can’t be emphasized enough. At a minimum, the information shown in Table 3-6 should be included:

**Table 3-6. Recommended Documentation**

• Date and time of entry.
• Purpose of sampling.
• Name and affiliation of personnel performing sampling.
• Visual descriptions.
• Chemical components and concentrations.
• Number and times of samples.
• Description and location of sampling points.
• Difficulties encountered.
• Visual references (maps, photographs, etc.).
• Weather conditions.

Photographs are also a valuable source of documentation when possible. For each photograph taken, ensure the following information is recorded: date, time, name of site and photographer, location of the subject within the site, general compass orientation of the photograph, subject description, and the sequential number of the photograph.

**3.5. Hazard Assessment**

If any presence or concentrations of specific chemicals, classes of chemicals, or safety concerns are identified, the associated hazards must be assessed. Hazard assessment is conducted by referring to standard reference sources for data and guidelines on permissible levels of exposure, flammability, etc. Some key references include TG 230, *Chemical Exposure Guidelines for Deployed Military Personnel (Draft)*, TG 231, *Soldier Occupational Exposure Assessment (Draft)*, the American Conference of Governmental Industrial Hygienists (ACGIH), *Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents, and Biological Exposure Indices (BEIs)*, NIOSH, *Pocket Guide to Chemical Hazards*. Additional information can be obtained by contacting outside experts, such as chemists, health physicists, industrial hygienists, and toxicologists. A broad array of expertise is available by contacting USACHPPM as specified in section 2.12.

Once all potential or actual health hazards are identified and all information is gathered the team should assign risk assessment codes to each hazard using the process outlined in FM 100-14, *Risk Management*, and USACHPPM TG 230. All risks identified in the off site and on site surveys should be compiled with hazards identified in thorough environmental surveillance and provided to the commander for determination of site use.

### 3.6. Long-Term Monitoring

Long-term air monitoring should be conducted to account for changing site activities and weather conditions once the offsite characterization and onsite survey have determined the site is safe for operations. The long-term monitoring should involve use of ambient air, water and soil sampling, as well as periodic area monitoring using direct reading instruments and personnel monitoring devices. Periodic monitoring and use of personnel monitoring devices should focus on hazards assessed during the offsite characterization and onsite survey. For additional guidelines on conducting ongoing monitoring of site and occupational hazards reference TG 231.

### 3.7. References

- a. National Institute for Occupational Safety and Health. *Pocket Guide to Chemical Hazards*. U.S. Department of Health and Human Services (DHHS) (NIOSH) Publication No. 97-140. Cincinnati, OH: NIOSH, June 1997.
- b. U.S. Army Center for Health Promotion and Preventive Medicine TG 230, *Chemical Exposure Guidelines for Deployed Military Personnel (Draft)*, 2001.
- c. 29 Code of Federal Regulations Part 1910.1000, *Air Contaminants*. July 1999. Washington, DC: U.S. Government Printing Office.
- d. National Institute for Occupational Safety and Health. *Recommendations for Occupational Safety and Health – Compendium of Policy Documents and Statements*. Cincinnati, OH: NIOSH, 1992.
- e. American Conference of Governmental Industrial Hygienists. *Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents, and Biological Exposure Indices (BEIs)*. Cincinnati, OH: ACGIH, 2001.
- f. Occupational Safety and Health Administration (OSHA). NIOSH/OSHA/USCG/EPA, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, October 1985.
- g. Department of the Army (DA), *Unit Field Sanitation Team*. FM 21-10-1.
- h. Department of the Army (DA), *Risk Management*. FM 100-14, 23 April 1998.
- i. U.S. Army Center for Health Promotion and Preventive Medicine TG 231, *Soldier Occupational Exposure Assessment (Draft)*, 2001.
- j. Maslansky, Carole J. and Steven P., *Air Monitoring Instrumentation: A Manual for Emergency, Investigatory, and Remedial Responders*, John Wiley and Sons, Inc., New York, 1993.

## CHAPTER 4 –

## MILITARY ENTOMOLOGICAL SAMPLING METHODS

**4.1 General.**

Traditional medical entomology is primarily concerned with the vector-borne diseases that have posed significant threats to military forces throughout history and have been a consistent focus of military preventive medicine. Military entomology encompasses not only these vector-borne disease but also medical pests and pesticide exposure. Medical pests include: nuisance arthropods (e.g., fire ants, spiders, scorpions), animals (e.g., rodents, birds, bats, snakes) and poisonous plants e.g., poison ivy/oak/sumac). Medical pests can be important in any geographical area and should not be ignored. Biting and stinging arthropods in areas relatively free of vector-borne diseases have caused many casualties from secondary infections, allergic reactions, and even death from their venom. This chapter will provide guidelines for sampling military entomological hazards ranging from traditional vectors of disease through the medical pests found within any deployment area.

**4.2 Hazard Identification.**

Pre-deployment planning for military entomological hazards must encompass endemic diseases, pesticide exposure, and medical pests. Endemic diseases are those normally found in a given area. Common examples of arthropod-borne endemic diseases include plague, yellow fever and malaria. To identify the total entomological hazard, planners must not only determine what potential and actual vector-borne diseases exist in the proposed deployment area, but they must also consider the other military entomological hazards described above. For example: if malaria is a problem in a deployment area, how prevalent is the disease? Is there a competent vector (i.e., *Anopheles* spp.) in the area to transmit this disease? Poisonous snakes, spiders, scorpions, and fish may also be a hazard to deployed soldiers and should be identified at this time.

**4.2.1 Disease History.**

To determine the potential risk a vector-borne disease may present to a deployed force, planners must first consider the probability of the disease and vector being present at the same time and location, and planners must also consider the probability of troop contact with the vector. Historical data relevant to the disease presence may provide great insight into the trends of the vector and disease in the deployment area. Planners should use this data to help determine if the same problems will occur over the timeframe of the entire deployment. There are a number of sources of good historical data that encompass many aspects of the military entomological hazard. Some of them are:

- The Medical Environmental Disease Intelligence Countermeasures (MEDIC) CD, which is updated semiannually. It is produced by the Armed Forces Medical Intelligence Center (AFMIC), Fort Detrick, Frederick, MD 21701 (301) 619-7574, DSN 343-7574. The MEDIC CD is also available through the USACHPPM web page.

- Disease Vector Ecology Profiles (DVEPS) that contain much the same information and are available through the Armed Forces Pest Management Board (AFPMB) web page at <http://www.afpmb.org/pubs/dveps/dveps.htm>.

- The Navy Preventive Medicine Information System maintains up-to-date Disease Risk Assessment Profiles (DISRAPs) and Disease Vector Risk Assessment Profiles (VECTRAPs) on most countries of the world. DISRAPs and VECTRAPs can be obtained by contacting the Navy Occupational and Environmental Health Center, (804) 444-7575, extension 456 or DSN 564-7575, ext 456.

#### 4.2.2 Presence of Infected Vectors.

If it has been determined that a disease, or group of diseases and a competent vector are present, then sampling must be conducted. This sampling will be used to determine if the vector is in the deployment area and if it is infected with the disease(s) of concern. Table 4-1 includes the vectors of most vector-borne diseases a deployed force may encounter and their associated disease pathogens. It is presented by vector in order to demonstrate to the reader how important each of these small, irritating creatures are to our fighting force.

Table 4-1. Diseases with Associated Vector

DISEASE	PATHOGEN	VECTOR	SPECIFIC VECTOR(S)
Anthrax	<i>Bacillus anthracis</i>	<b>DEER FLIES</b> Family Tabanidae	
Babesiosis	<i>Babesia microti</i>	<b>HARD TICKS</b> Family Ixodidae	
Bartonellosis (only occurs in Western Andes)	<i>Bartonella bacilliformis</i>	<b>SAND FLIES</b> Family Psychodidae	<i>Phlebotomus verrucarum</i>
Bed Bugs	Parasitism	<b>BED BUGS</b> Family Cimicidae	<i>Cimex lectularius</i> <i>Cimex hemipterus</i>
Body Lice	Parasitism	<b>SUCKING LICE</b> Family Pediculidae	<i>Pediculus humanus humanus</i>
Boutonneuse Fever	<i>Rickettsia conori</i>	<b>HARD TICKS</b> Family Ixodidae	
California Encephalitis	Bunyaviridae, Bunyavirus	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> mosquitoes
Chikungunya	Togoviridae, <i>Alphavirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> and <i>Culex</i> spp.
Colorado Tick Fever	Reoviridae, Orbivirus	<b>HARD TICKS</b> Family Ixodidae	
Crimean-Congo Hemorrhagic Fever	Bunyaviridae, <i>Nairovirus</i>	<b>HARD TICKS</b> Family Ixodidae	<i>Hyalomma</i> spp.
Dengue	Flaviviridae, <i>Flavivirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes aegypti</i> , <i>Aedes</i> spp. in tropics
Eastern Equine Encephalitis	Togoviridae, <i>Alphavirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> and <i>Culex</i> spp.
Ehrlichiosis, Human Granulocytic	<i>Ehrlichia phagocytophila?</i>	<b>HARD TICKS</b> Family Ixodidae	<i>Ixodes scapularis</i>
Ehrlichiosis, Human Monocytic	<i>Ehrlichia chaffeensis</i>	<b>HARD TICKS</b> Family Ixodidae	<i>Amblyomma americanum</i>
Epidemic Relapsing Fever	<i>Borrelia recurrentis</i>	<b>SUCKING LICE</b> Family Pediculidae	<i>Pediculus humanus humanus</i>
		<b>SOFT TICKS</b> Family Argasidae	<i>Ornithodoros</i> spp.
Filariasis	<i>Wuchereria bancrofti</i>	<b>MOSQUITOES</b>	<i>Culex fatigans</i>

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<b>DISEASE</b>	<b>PATHOGEN</b>	<b>VECTOR</b>	<b>SPECIFIC VECTOR(S)</b>
	<i>Brugia malayi</i>	Family Culicidae	<i>Anopheles gambiae</i> <i>Anopheles sinensis</i>  <i>Mansonia uniformis</i> <i>Mansonia longipalpa</i> <i>Anopheles sinensis</i>
Hantaviral Disease	Bunyaviridae	<b>RODENTS</b>	
Head Lice	Parasitism	<b>SUCKING LICE</b> Family Pediculidae	<i>Pediculus humanus capitis</i>
Japanese Encephalitis	Flaviviridae, <i>Flavivirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> and <i>Culex</i> spp.
Leishmaniasis	<i>Leishmania</i> spp.	<b>SAND FLIES</b> Family Psychodidae	<i>Phlebotomus</i> spp. <i>Lutzomyia</i> spp.
Leptospirosis	<i>Leptospira interrogans</i>	<b>RODENTS</b>	
Loiasis (tropical West and Central Africa only)	<i>Loa loa</i>	<b>DEER FLIES</b> Family Tabanidae	<i>Chrysops silacea</i> <i>Chrysops dimidiata</i>  <i>Chrysops distinctipennis</i>
Louse-borne (epidemic) Typhus	<i>Rickettsia prowazekii</i>	<b>SUCKING LICE</b> Family Pediculidae	<i>Pediculus humanus humanus</i>
Lyme Disease	<i>Borrelia burgdorferi</i>	<b>HARD TICKS</b> Family Ixodidae	<i>Ixodes</i> spp.
Malaria	<i>Plasmodium falciparum</i> <i>Plasmodium vivax</i> <i>Plasmodium ovale</i> <i>Plasmodium malariae</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Anopheles</i> spp.
Mansonellosis	<i>Mansonella ozzardi</i>	<b>BLACK FLIES</b> Family Simuliidae	<i>Simulium rugglesi</i> <i>Simulium anatinum</i>
Murine (endemic) Typhus	<i>Rickettsia typhi</i> (= <i>Rickettsia mooseri</i> )	<b>FLEAS</b> Family Pulicidae	<i>Xenopsylla cheopis</i> <i>Leptopsylla segnis</i> <i>Polyplax spinulosa</i>
Murray Valley Encephalitis	Flaviviridae, <i>Flavivirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> and <i>Culex</i> spp.
Nairobi Sheep Disease	Bunyaviridae, <i>Nairovirus</i>	<b>TSETSE FLIES</b> Family Glossinidae Genus Glossina	<i>Culicoides tororensis</i>

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<b>DISEASE</b>	<b>PATHOGEN</b>	<b>VECTOR</b>	<b>SPECIFIC VECTOR(S)</b>
Onchocerciasis	<i>Onchocerca volvulus</i>	<b>BLACK FLIES</b> Family Simuliidae	<u>Tropical African</u> <i>Simulium damnosum</i>  <i>Simulium naevi</i> <u>Central &amp; South Amer.</u> <i>Simulium ochraceum</i>
O'nyong-nyong		<b>MOSQUITOES</b> Family Culicidae	<i>Anopheles gambiae</i> only
Pinkeye	<i>Streptococcus pyogenes</i>	<b>HIPPILATES FLIES</b>	
Plague	<i>Yersinia pestis</i>	<b>FLEAS</b> Family Pulicidae	<i>Xenopsylla cheopis</i>
Queensland Tick Typhus	<i>Rickettsia australis</i>	<b>HARD TICKS</b> Family Ixodidae	<i>Ixodes holocyclus</i>
Query "Q" Fever	<i>Coxiella burnetii</i>	<b>HARD TICKS</b> Family Ixodidae	
		<b>SOFT TICKS</b> Family Argasidae	
		<b>MITES</b>	<i>Trombicula?</i> spp.
		<b>RODENTS</b>	
Rickettsial Pox	<i>Rickettsia akari</i>	<b>MITES</b>	
Rift Valley Fever	Bunyaviridae, <i>Phlebovirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> spp.
Rift Valley Fever	Bunyaviridae, <i>Phlebovirus</i>	<b>TSETSE FLIES</b> Family Glossinidae	<i>Glossina</i> spp.
Rocky Mountain Spotted Fever	<i>Rickettsia rickettsii</i>	<b>HARD TICKS</b> Family Ixodidae	<i>Dermacentor</i> spp.
Ross River Fever	Togoviridae, <i>Alphavirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> and <i>Culex</i> spp.
Salmonellosis	<i>Salmonella</i> spp.	<b>RODENTS</b>	
Sand Fly Fever	Bunyaviridae, <i>Phlebovirus</i>	<b>SAND FLIES</b>	<i>Phlebotomus</i> spp.
		Family Psychodidae	<i>Lutzomyia</i> spp.
Scabies	Parasitism	<b>MITES</b>	<i>Sarcoptes scabiei</i>
Schistosomiasis	<i>Schistosoma mansoni</i> <i>Schistosoma haematobium</i> <i>Schistosoma mekongi</i> <i>Schistosoma japonicum</i>	<b>TREMATODES</b>	

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<b>DISEASE</b>	<b>PATHOGEN</b>	<b>VECTOR</b>	<b>SPECIFIC VECTOR(S)</b>
	<i>Schistosoma intercalatum</i>		
Scrub Typhus	<i>Rickettsia tsutsugamushi</i>	<b>MITES</b>	<i>Leptotrombidium (=Trombicula) spp.</i>
		<b>SOFT TICKS</b> Family Argasidae	
Siberian Tick Typhus	<i>Rickettsia sibirica</i>	<b>HARD TICKS</b> Family Ixodidae	
Sindbis Virus	Togoviridae, <i>Alphavirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> and <i>Culex</i> spp.
St. Louis Encephalitis	Flaviviridae, <i>Flavivirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> and <i>Culex</i> spp.
Tickborne Encephalitis Kyasanur Forest Encephalitis Louping-ill Disease Omsk Hemorrhagic Fever Powassan Encephalitis Russian Spring-Summer Encephalitis	Flaviviridae, <i>Flavivirus</i>	<b>HARD TICKS</b> Family Ixodidae	
Tickborne Relapsing Fever	<i>Borrelia duttoni</i> (Africa) <i>Borrelia</i> sp. (Middle East) <i>Borrelia hermsi</i> (US) <i>Borrelia turicatae</i> (US) <i>Borrelia parkeri</i> (US)	<b>SOFT TICKS</b> Family Argasidae	
Trench Fever	<i>Rochalimaea quintana</i>	<b>SUCKING LICE</b> Family Pediculidae	<i>Pediculus humanus humanus</i>
Trypanosomiasis, African	<i>Trypanomoma brucei gambiense</i>	<b>TSETSE FLIES</b> Family Glossinidae	<u>West Africa</u> <i>Glossina palpalis</i> <i>Glossina tachinoides</i>
	<i>Trypanomoma brucei rhodesiense</i>		<u>East Africa</u> <i>Glossina morsitans</i> <i>Glossina swynnertoni</i>
Trypanosomiasis, American, Chagas Disease	<i>Trypanosoma cruzi</i>	<b>KISSING BUGS</b> Family Reduviidae	<i>Rhodnius prolixus</i> <i>Triatoma infestans</i> <i>Panstrongulus megitus</i>

DISEASE	PATHOGEN	VECTOR	SPECIFIC VECTOR(S)
Tularemia	<i>Francisella tularensis</i>	<b>HARD TICKS</b> Family Ixodidae	
		<b>DEER FLIES</b> Family Tabanidae	
Tungiasis		<b>FLEAS</b> Family Pulicidae	<i>Tunga penetrans</i>
Venezuelan Equine Encephalitis	Togoviridae, <i>Alphavirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> and <i>Culex</i> spp.
Western Equine Encephalitis	Togoviridae, <i>Alphavirus</i>	<b>MOSQUITOES</b> Family Culicidae	<i>Aedes</i> and <i>Culex</i> spp.
West Nile Virus	Flaviviridae, <i>Flavivirus</i>	<u>MOSQUITOES</u> Family Culicidae	<i>Aedes</i> and <i>Culex</i> spp.
Yellow Fever	Flaviviridae, <i>Flavivirus</i>	<b>MOSQUITOES</b> Family Culicidae	<u>Urban</u> <i>Aedes aegypti</i> <u>Sylvatic</u> <i>Aedes simpsoni</i> <i>Aedes africanus</i> <i>Haemogogus</i> spp. <i>Sabethes</i> spp.

#### 4.2.3 Habitat, Seasonality, and Hosts.

Most deployment areas will not have a homogenous habitat for these creatures. There could be ocean or lake shorelines, deserts, coniferous forests, deciduous forests, open areas, urban areas, and the list could continue. Each of the vectors presented in Table 4-1 may or may not be present in all or some of these habitat areas. Each of these habitat areas may have different vectors of the same disease and may support different numbers of vectors during different seasons of the year. Many of these vectors feed on many different small mammals, birds, and reptiles. The diseases that are associated with each vector, may be greatly affected by the presence or absence, or the population numbers of each of these types of animal. All of these factors must be considered to prepare a sampling plan for any given disease, vector, and regional association.

#### 4.2.4 Expert Knowledge.

Each deployed force will have an associated preventive medicine activity to rely on. However, specific expert knowledge is required to analyze the interaction of all of these mobile, seasonal biological organisms acting together to present a hazard. The historical sources listed in Paragraph 6.2.1 are a good start, but analysis of the dynamics of these vectors and their associated diseases and how they may affect a deployed force, requires the attention of an expert familiar with these interactions. USACHPPM has these experts located worldwide in the Entomological Sciences Program offices. They can be reached at the following addresses and telephone numbers:

**USACHPPM DRAFT TG 251**

USACHPPM  
ATTN: MCHB-TS-OEN  
5158 Blackhawk Road  
Aberdeen Proving Ground, MD 21010-5403

Commercial (410) 436-3613  
DSN 584-3613  
FAX (410) 436-2037

USACHPPM North  
ATTN: MCHB-AN-ES  
Fort George G Meade, Maryland  
20755-5225

Commercial (301) 677-6502  
DSN 923-6502  
FAX (301) 677-7132  
DSN 923-7132

USACHPPM South  
ATTN: MCHB-AS-ES  
1312 Cobb Street, SW  
Fort McPherson, GA 30330-1075

Commercial (404) 464-2564  
  
DSN 367-2564  
FAX DSN 367-2126

USACHPPM West  
ATTN: MCHB-AW-ES  
Box 339500, MS 115  
Fort Lewis, WA 98433-9500

Commercial (253) 966-0073  
DSN 347-0073  
FAX DSN 347-0163

USACHPPM Europe  
ATTN: MCHB-AE-EN  
Landstuhl, Germany CMR 402  
APO, AE 09180

DSN 486-8540  
FAX 011-49-6371-86-7198

USACHPPM Pacific  
ATTN: MCHB-AJ-TOE  
Camp Zama, Japan  
APO, AP 96343-5006

DSN 263-4478  
FAX 011-81-3117-63-8597

### **4.3 Military Entomological Constants.**

Table 4-1 presents an extensive list, but the probability of all of these diseases and the associated vectors being present on any given deployment is extremely low. Any geographic area will have its associated vector-borne diseases, but only a few of these vectors will be encountered. Table 4-2 details the methods that will be used for sampling each different type of pest that will be encountered. Only a few creatures of military entomological concern will be a problem in virtually every deployment that can occur. In order of importance they are mosquitoes, filth flies, and rodents. During virtually every deployment, these pests will be present and will degrade or cause damage to the deployed fighting force, unless their presence is identified and the necessary control and protective measures are taken.

**Table 4-2 Pest and Sampling Techniques**

PEST SAMPLED	PHYSICAL LOCATION(S)	TYPE OF SAMPLING	SAMPLE SIZE	SAMPLING DOCUMENT (REFERENCE)	
<b>BED BUGS</b> Family Cimicidae	<b>INSIDE HUMAN DWELLINGS IN CRACKS AND CREVICES</b>	Observation of fecal spotting on walls, headboard of bed, and furniture. "Sweet Sickly" Odor.			
<b>BIRDS AND BATS</b>	<b>ABANDONED STRUCTURES AND LIVING QUARTERS</b>	<b>Direct Observation.</b>			
<b>BLACK FLIES, HORSE FLIES, DEER FLIES AND OTHER BITING FLIES</b> <b>ADULT COLLECTIONS.</b> Biting Midges (Ceratopogonidae), and Stable Flies and Horn Flies (Muscidae)	<b>AREAS NEAR AQUATIC AND SEMI-AQUATIC LARVAL BREEDING HABITATS.</b>	<b>Visual Landing Rate Counts.</b> Use aspirator to collect flies as they land.	Usually in intervals from 5 minutes to 1 hour.	TB MED 561 DA FORM 8020-R	
<b>BLACK FLIES, HORSE FLIES, DEER FLIES AND OTHER BITING FLIES</b> <b>ADULT COLLECTIONS.</b> Biting Midges (Ceratopogonidae), and Stable Flies and Horn Flies (Muscidae)	<b>AREA OCCUPIED BY PERSONNEL</b>	<b>Light Trap</b> (CDC, SSAM) NOT very useful for Black Flies, Muscids and Tabanids.	Minimum of 3 light traps. Operate light traps between 2 and 7 nights a week from dawn to dusk, depending on mosquito populations and risk of mosquito-borne diseases.	TB MED 561	
	<b>VICINITY OF BREEDING AREAS, IN INSECT SWARMS, IN VEGETATION, OR FLIES ATTEMPTING TO BLOOD FEED.</b>	<b>Sweep Net</b> – Used for qualitative sampling.			
	<b>SHADED AREAS NEAR AQUATIC AND SEMI-AQUATIC LARVAL BREEDING HABITATS.</b>		<b>Malaise Trap.</b> Works well for collecting Tabanids. Use of CO <sub>2</sub> will increase trap efficiency.	Minimum of 3 days trapping per site selected.	
			<b>Landing Rate Counts.</b> Use aspirator to collect flies as they land.	Usually in intervals from 5 minutes to 1 hour.	
			<b>Animal Baited Traps.</b> Usually used for pathogen transmission studies. Not recommended in operational settings.		
			<b>Sticky Traps.</b> Place trap 12-18 inches above the ground in the immediate breeding area.	Use 2-6 traps in at least 3 different locations.	
<b>OVER A BODY OF WATER TO BE SAMPLED.</b>		<b>Adult Emergence Traps.</b> May be used to sample aquatic insects emerging from the larval habitat.	Minimum of 1 trap at 3 different locations.		

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<b>PEST SAMPLED</b>	<b>PHYSICAL LOCATION(S)</b>	<b>TYPE OF SAMPLING</b>	<b>SAMPLE SIZE</b>	<b>SAMPLING DOCUMENT (REFERENCE)</b>
	<b>BREEDING SITE.</b>	<b>Flotation with Salts.</b> Use concentrated solution of MgSO <sub>4</sub> to “float” larvae to the surface of a container where they can be removed.	Minimum of 10 samples from 3 different locations.	
<b>CHEWING LICE</b> Mallophaga	<b>USUALLY HOST SPECIFIC</b>	<b>Visual Inspection of Host.</b> Look for irritation and itching in the host.	Minimum of 10 host animals from 3 different locations.	
<b>FILTH FLIES – ADULT COLLECTIONS</b> House flies (Muscidae), Eye gnats (Chloropidae)	<b>LANDFILLS, STABLES, KENNELS, REFUSE COLLECTION POINTS, LATRINES, ETC.</b>	<b>Visual Counting Flies on Resting Sites.</b> Conduct weekly surveys throughout the fly breeding season. Use Fly Grill technique or Fly Bait technique (if indoors).	Minimum of 3 separate count periods used at 3 different locations.	TB MED 561 DA FORM 8015-R
		<b>Light Trap</b> (CDC, SSAM) Use with ultraviolet (UV) lamp. May be used with CO <sub>2</sub> or other attractants (i.e., octenol)	Minimum of 3 light traps. Operate light traps between 2 and 7 nights a week from dawn to dusk, depending on mosquito populations and risk of mosquito-borne diseases.	
		<b>Sticky Traps.</b> Conduct weekly surveys throughout the fly breeding season.	Exposure sticky traps to flies for a period of 24 hours. Minimum of 1 sticky trap at 3 different locations.	TB MED 561 DA FORM 8015-R
<b>FILTH FLIES – ADULT COLLECTIONS</b> House flies (Muscidae), Eye gnats (Chloropidae)		<b>Live Traps.</b> Recommended only when live specimens are required for identification or resistance testing.	Exposure live traps to flies for a period of 24 hours. Minimum of 1 live trap at 3 different locations.	TB MED 561 DA FORM 8015-R
		<b>Sweep Netting.</b> Useful for collecting live flies for identification, but not very quantitative.	Minimum of 10 sweep net samples from 3 different locations.	TB MED 561 DA FORM 8015-R
<b>FLEAS</b>	<b>BREEDING HABITATS OR FROM HOSTS</b>	<b>Sticky Fly Paper</b> wrapped (sticky-side-out) around the legs of person on outside of pants. Method is used indoors.	Walk around room for 1 minute and count number of fleas on sticky paper.	
		<b>White Cloth on Floor.</b> Collect fleas as they jump or crawl on cloth.	Count number of fleas on cloth every minute for at least 10 intervals.	
		<b>Soapy water.</b> Place dead rodents in soapy water solution. Fleas can be collected and strained from soapy solution.	At least 10 rodents from 3 different locations.	
	<b>HOST BURROWS</b>	<b>Swabbing device.</b> Flexible stick with flannel cloth attached to end.	At least 10 rodent burrows from 3 different locations.	The Biology of Disease Vectors
<b>FLEA, HUMAN</b> ( <i>Pulex irritans</i> )	<b>INFESTED HOMES</b>	<b>Sifting and Flotation of Dust and Debris from Infested Homes.</b>	Minimum of 10 samples from 3 different locations.	
<b>HARD TICKS</b>	<b>TICK HABITAT –</b> Select several different edge habitats (interface areas between grassy and wooded areas) in areas of high mammal activity	<b>Tick Drags/Tick Flags.</b> Use white, soft cloth. Do NOT perform in rain or on wet vegetation such as after rainfall or in the early morning.	Use 100 meter transects, checking for ticks every 10 paces. Minimum of three transects at 3 different habitats.	AFPMB TIM No. 26 DA FORM 8016-R USAFSAM-SR-89-2

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<b>PEST SAMPLED</b>	<b>PHYSICAL LOCATION(S)</b>	<b>TYPE OF SAMPLING</b>	<b>SAMPLE SIZE</b>	<b>SAMPLING DOCUMENT (REFERENCE)</b>
		<b>Tick Walks.</b> Wear white, 100% cotton clothing or coveralls, OR surgical stocking net pulled over the legs of the BDU. Do NOT perform in rain or on wet vegetation such as after rainfall or in the early morning.	Use 100 meter transects, checking for ticks every 10 paces. Minimum of three transects at 3 different habitats.	AFPMB TIM No. 26 DA FORM 8018-R
		<b>CO<sub>2</sub> (Dry Ice) Traps.</b> Can yield the most ticks per man-hour expended. Use ¼ - 1 LB block of CO <sub>2</sub> per trap.	Minimum of 3 traps used over 24 hour period at 3 different locations.	AFPMB TIM No. 26 DA FORM 8017-R USAFSAM-SR-89-2
		<b>Host Trapping and Examination.</b> May provide most accurate assessment of a local tick population when appropriate hosts are sampled. See RODENT section.		AFPMB TIM No. 26 DA FORM 8019-R
<b>KISSING BUGS</b> Family Reduviidae	<b>RESTING HABITATS</b>	<b>Direct Observation Inside Houses.</b> Pick from crevices in walls, thatch roofs, or other hiding places.	Sample minimum of 10 houses	
		<b>Pyrethroid Sprays.</b> Excitorepellant flushes bugs from hiding places.	Sample minimum of 10 houses	
<b>MITES, ASTIGMATID</b> (dermatitis and allergic conditions)	<b>DUST INDOORS</b>	<b>Vacuum sampling of dust.</b>	Density of mites is expressed as mites per gram of dust examined.	The Biology of Disease Vectors
<b>MITES, PARASITIC</b> (Psoroptes, Sarcoptes, Chorioptes, Otodectes, Notoedres, Knemidocoptes)	<b>LESIONS OF HOSTS.</b>	<b>Skin Scrapings.</b> Scrape suspect areas and preserve or mount on microscopic slide.		
	<b>VISIBLE ON HOST ANIMAL.</b> Bedding, nests, and associated debris should also be examined.	<b>Aspirator or Camel-Hair Brush.</b>	Minimum of 10 sites at 3 different locations.	
<b>MOSQUITOES –</b> Family Culicidae <b>ADULT COLLECTIONS</b>	<b>AREA OCCUPIED BY PERSONNEL</b>	<b>Light Trap</b> (CDC, SSAM) Limited to nocturnal adult mosquito species. May be used with CO <sub>2</sub> or other attractants (i.e., Octenol)	Minimum of 3 light traps. Operate light traps between 3 and 7 nights a week from dawn to dusk, depending on mosquito populations and risk of mosquito-borne diseases.	TB MED 561 DA FORM 8010-R or DA FORM 8012-R
	<b>DARK, COOL, HUMID PLACES</b> (caves, culverts, houses, stables, latrines, etc.)	<b>Natural Resting Stations</b> Aspirator or place white sheet on floor and collect mosquitoes knocked down with an aerosol pesticide.	A minimum of 5 stations per installation, either natural or artificial, with collections made at least 2 days per week.	TB MED 561 DA FORM 8010-R
	<b>SHADED, HUMID AREAS THAT ARE PROTECTED FROM THE WIND</b>	<b>Artificial Resting Boxes (approx. 1 cu. ft.)</b> - Small wooden boxes to act as miniature enclosures. Use aspirator or aerosol pesticide to collect mosquitoes.	Minimum of 3 resting boxes per area to be sampled.	TB MED 561 DA FORM 8010-R

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<b>PEST SAMPLED</b>	<b>PHYSICAL LOCATION(S)</b>	<b>TYPE OF SAMPLING</b>	<b>SAMPLE SIZE</b>	<b>SAMPLING DOCUMENT (REFERENCE)</b>
	<b>INDOORS OR OUTDOORS DEPENDING ON BLOOD FEEDING BEHAVIOR OF SUSPECTED VECTOR</b>	<b>Visual Landing Rate Counts. CAUTION – This technique may increase the exposure of survey personnel to disease.</b> Use aspirator to collect mosquitoes as they land.	Minimum of 3 stations once every 1-2 weeks. Time landing counts depending on peak biting activity: dusk (1900-2100 hrs), night (2400-0330 hrs) or dawn (0400-0600 hrs)	TB MED 561 NEHC-TM 6250.98-2 DA FORM 8010-R
		<b>Animal Baited Traps.</b> Usually used for pathogen transmission studies. Not recommended in operational settings.		
<b>MOSQUITOES – Family Culicidae</b> <b>EGG COLLECTIONS</b> ( <i>Aedes aegypti</i> , <i>Ae. albopictus</i> and other container breeding mosquitoes)	<b>SHADED AREAS PROTECTED FROM SUN AND WIND</b>	<b>Ovitrap</b> s – Place in areas in full or partial shade most of the day (near walls, fences, hedges, shrubs, junk piles, tires or sheltered areas).	Place one trap at each collection site. Minimum of 3 collections sites in separate areas. Inspect ovitrap at least weekly.	TB MED 561 DA FORM 8010-R
<b>MOSQUITOES – Family Culicidae</b> <b>LARVAL COLLECTIONS</b>	<b>STANDING WATER</b>	<b>Plastic Dipper</b> <i>Culicines</i> –use a quick intercepting move in the water.  <i>Anophelines</i> – skim dipper along surface of water.	Identify all breeding sites within a 2-mile radius of the area to be protected. Sample a representative number (10-20% - 3 stations minimum) of breeding sites identified during initial survey	TB MED 561 DA FORM 8010-R or DA FORM 8012-R
	<b>ARTIFICIAL CONTAINERS</b> (tin cans, barrels, tires, rain gutters, animal troughs, etc.)	<b>Plastic Dipper</b> (Container breeding <i>Aedes</i> such as <i>Aedes aegypti</i> , <i>Aedes albopictus</i> )	Minimum of 10 sites sampled or 10-20% of breeding sites identified.	TB MED 561 DA FORM 8010-R or DA FORM 8012-R
<b>MOSQUITOES – Family Culicidae</b> <b>LARVAL COLLECTIONS</b>	<b>TREE HOLES</b>	<b>Large-mouth pipette, turkey baster or siphon</b>	Minimum of 10 tree holes sampled or 10-20% of breeding sites identified.	TB MED 561 DA FORM 8010-R or DA FORM 8012-R
<b>MYIASIS-PRODUCING FLIES LARVAL COLLECTIONS.</b> Bot Flies and Warble Flies ( <i>Oestridae</i> ), Rodent Bot Flies ( <i>Cuterebridae</i> ), Blow flies ( <i>Calliphoridae</i> ), Flesh Flies ( <i>Sarcophagidae</i> )	<b>HOST ANIMALS</b>	<b>Visual Examination of Host Animals.</b> Collect larvae directly from body openings or “express” them from dermal cysts.	Examine a minimum of 10 animals of each species from 3 different locations.	
<b>RODENTS AND OTHER MAMMALS</b>	<b>NEAR BRUSH PILES, FALLEN LOGS, BURROWS, ADANDONED DEBRIS AND OTHER AREAS THAT PROVIDE SHELTER</b>	<b>Live Traps</b> – Best method if collecting rodent blood samples and ectoparasites. Set traps out before dark.	Minimum of 50 traps used at 3 different locations. Place traps in lines of 10-20 traps at approximately 5-meter intervals.	AFPMB TIM No. 40 DA FORM 8019-R
		<b>Snap traps</b> – Not useful for collecting rodent blood samples or collecting ectoparasites. Set traps out before dark and collect at dawn.		
<b>SAND FLIES</b> Family <i>Psychodidae</i>	<b>AREAS WITHIN A RADIUS OF 50-100 METERS OF SLEEPING AREAS</b>	<b>Light Trap Collections</b> – hang traps at knee level. May be ineffective in the open desert.	Minimum of 3 light traps, operated 2-7 nights a week from dawn to dusk.	TB MED 561 DA FORM 8020-R

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<b>PEST SAMPLED</b>	<b>PHYSICAL LOCATION(S)</b>	<b>TYPE OF SAMPLING</b>	<b>SAMPLE SIZE</b>	<b>SAMPLING DOCUMENT (REFERENCE)</b>
	<b>LARVAL BREEDING HABITATS</b>	<b>Sticky (Oil) Paper Traps.</b> Paper covered with castor oil, rolled and placed inside animal burrows, soil crevices, and rock piles. Oil traps are effective in open and dry areas.	Minimum of 10 traps in at least 3 different locations.	
	<b>NEAR LARVAL BREEDING HABITATS</b>	<b>Animal Baited Traps.</b> Usually used for pathogen transmission studies. Not recommended in operational settings.		
	<b>DAYTIME RESTING HABITATS</b>	<b>Aspirator and flashlight.</b>		TB MED 561 DA FORM 8020-R
<b>SOFT TICKS ONLY</b>	<b>NESTING SITES OF HOSTS OR HIDING PLACES</b>	<b>Hand Picking in Tick's Natural Habitat.</b> Crudest method of survey.	Minimum of 10 sites at 3 different locations.	
	<b>INSIDE ANIMAL DENS</b>	<b>Rubbing cloth wrapped around stick on roof of den.</b>	Minimum of 10 dens at 3 different locations.	The Biology of Disease Vectors
<b>STORED-PRODUCT PESTS</b>	<b>INSIDE OR OUTSIDE OF WAREHOUSES &amp; SUBSISTENCE STORAGE AREAS</b>	<b>Pheromone/Food Attractant Trap (PFAT).</b> Pinpoints the location of an infestation. Check traps weekly. Do not place traps within 30 ft. of exterior doors.	<b>Trap Density</b> <b>Indianmeal Moth</b> - 1 trap per 25,000 cu. ft. <b>Beetles</b> - Arrange traps in grid pattern at 25-50 ft. intervals.	TIM No. 27
		<b>Rodent glue boards and/or roach traps.</b>	Need higher density of placement than PFAT.	
		<b>Light Traps.</b> Place 6 ft. above the floor. Does not collect saw-toothed grain beetle or other "non-flying" stored-product insects.		
<b>SUCKING LICE</b> Anoplura	<b>HOST SPECIFIC</b>	<b>Visual Inspection of Host.</b> Depends on meticulous examination of the hair or wool of the host animals. Grossly infested animals may have large areas of skin that become raw, bruised, and denuded of hair as a result of constant rubbing.	Minimum of 10 host animals from 3 different locations. Critically examine a representative sample of the herd.	
<b>TSETSE FLIES</b> Family Glossinidae Genus Glossina (Occurs only in Equatorial Africa.)	<b>SUSPECT HABITAT</b>	<b>Visual Landing Rate Counts</b> – thickets around permanent pools of water or inside huts. Use aspirator to collect flies as they land.	Usually in intervals from 5 minutes to 1 hour.	TB MED 276 TB MED 561 DA FORM 8020-R
	<b>VARIETY OF SUSPECT HABITATS</b>	<b>Vehicular or Foot Patrols.</b> Human or vehicle moving slowly (<15 mph) and stopping at frequent intervals (every 200–500 meters). Collect flies as they land.	Minimum of 5 transects in at least 3 different habitats.	
		<b>Fly-Rounds.</b> Used to determine the focus and density of infestations. Standard paths along fixed compass bearings.	Collection spots are indicated every 100-200 meters along a path not to exceed 8 km. At each spot, the team collects all flies.	

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PEST SAMPLED	PHYSICAL LOCATION(S)	TYPE OF SAMPLING	SAMPLE SIZE	SAMPLING DOCUMENT (REFERENCE)
<b>VENOMOUS ARTHROPODS -</b> Spiders, Bees, Wasps, Fire Ants, Centipedes, Millipedes, and Scorpions	<b>TYPICAL HABITATS AND NESTS.</b>	<b>Observation of typical habitats</b>		TB MED 561 DA FORM 8020-R
		<b>Pitfall or Dish Traps.</b> May be baited with various substances depending on intended species.	Minimum of 3 days trapping at 3 different locations. Inspect traps daily.	
		<b>Sugar Bait</b> – Works well for bees and wasps.	Minimum of 3 days trapping at 3 different locations. Inspect traps daily.	

#### 4.3.1 Mosquito Sampling.

Mosquitoes are probably the most important military entomological pests encountered by military personnel. Mosquitoes are vectors of serious diseases such as malaria, yellow fever, dengue, and encephalitis. Although mosquito-borne diseases are not common throughout developed countries, they are present and very common, in lesser-developed countries. Wherever these diseases are present, the vectors are usually abundant; therefore, the danger of a disease outbreak is always present. The annoyance to humans caused by high mosquito populations is an equally important factor. Nuisance biting mosquitoes can make some areas almost unusable and may be numerous enough to justify control efforts. Therefore, with only a few exceptions, such as a desert environment, routine mosquito sampling should be conducted. Depending on the disease present, the frequency and type of mosquito sampling to be conducted must be tailored to the needs of each deployment. Different mosquito population sampling techniques include, adult collections (light traps, resting stations, landing counts), larval collections (dipping), and egg collections (ovitrap).

Adult collections are frequently the primary means of mosquito surveillance because the adult female mosquito carries disease pathogens and causes annoyance through biting. Adult mosquitoes are usually easier to survey, collect, and identify than the immature stages of the insect. Light traps are used to gather data on the density and species makeup of nocturnal adult mosquito species that are attracted to light. Wide differences in capture efficiency have been noted between species due to differences in their reactions to light. Some species are caught in great numbers while others are rarely taken even though they may be plentiful in the vicinity. Because of these behavioral differences, other types of adult mosquito collection methods, including resting stations and landing counts, are needed to obtain a valid index of the total population.

Larval collections are an important part of a mosquito sampling effort. Not only can larval collections be used to determine requirements for control operations, but they may also detect the presence of important species that are not attracted to light traps as adults. Control efforts based on larval surveillance are preferred because significant populations can be eliminated before the mosquitoes become an annoyance as adults. In addition, pesticide application can be pinpointed to only those areas where mosquito populations are known to exist.

Egg collections using ovitraps are a very effective means of monitoring mosquito populations and can be more efficient than larval sampling, depending on the target species of mosquito. In some instances, this is the sampling method of choice.

As demonstrated above, the most desirable collection method(s) will vary greatly depending on the target species. Prior to deployment entomologists on the staff at USACHPPM can provide assistance and guidance on appropriate surveillance techniques. However, once deployed, assets from deployed preventive medicine units must be used.

#### 4.3.2 Filth Fly Sampling.

Filth flies are medically important arthropod pests that are carriers of organisms causing typhoid, dysentery, and other diarrheas. They transport these organisms to food on their feet or body hairs and further contaminate food when they regurgitate on the food to liquefy it for their ingestion. Many of these flies habitually enter dwellings and come in contact with human food or drink after breeding or feeding in excrement, dead animal material, or other contaminated media. Other filth fly species, which do not necessarily enter dwellings, are closely associated with man and can also mechanically transmit diseases.

Filth fly sampling is necessary to identify and prevent the accumulation of sites suitable for filth fly breeding. Once the force has been deployed, sampling will be used to determine the effectiveness of sanitary practices and to determine the need for pesticide applications. Normally pesticides should not be necessary to control a filth fly population if proper sanitation is maintained. Sampling methods include the use of traps, visual counts, and the use of collection nets. The method to be used should be tailored to the target species. Table 4-2 includes sampling methods that should be considered. Assistance in developing a thorough sampling plan can be obtained from USACHPPM prior to deployment. However, once deployed, assets from deployed preventive medicine units must be used.

There are many techniques for sampling adult filth flies. However, to determine if they are transporting any disease organisms, the most appropriate techniques are the use of sticky traps or live capture. Both of these methods will permit analysis of the population density and the presence of disease, if they are conducted at a standardized time and at the same locations.

#### 4.3.3 Rodent Sampling.

Rodents may be found almost anywhere that humans live and where food and harborage are available. Rats and mice are responsible for the spread of many diseases through their bites and by contamination of human food with urine or feces. Rodents also spread disease indirectly through their ectoparasites (e.g., fleas). These diseases include Plague, Murine Typhus Fever, Rat Bite Fever, Salmonellosis, Leptospirosis, Trichinosis, and Hemorrhagic Fever. The presence of disease will depend on the species of rodent present and the parasites it may have on it. Sampling of the rodent population will help to identify the species present and will provide a method to assess the approximate size of the rodent population and that population's distribution within the available habitat.

Trapping provides the most realistic assessment of a rodent population. Effective trapping depends on placing the traps where the rodents will contact them. The best locations for traps are against walls, behind or under objects, and other places where rodents seeking concealment might go. Trapping should be conducted on 3 consecutive nights. Live traps and glue boards are not recommended due to the problem of disposal of live specimens. Each method requires experienced personnel to operate effectively. Since the rodent population may be diseased, the dead rodents should be collected in plastic bags when servicing the traps and gloves should be worn when handling them. Once the species identification and the population analysis is complete, dispose of the dead rodents in a landfill or by incineration.

Another sampling method is to monitor the rodent population by measuring its consumption of non-toxic baits at bait stations or by tracks in a tracking powder used around the bait.

USAEHA TG No. 138, *Guide to Commensal Rodent Control*, can be used for rodent identification. If rodents cannot be identified as to species, contact the USACHPPM offices listed in Paragraph 4.2.4. The following measurements, in millimeters, will be needed before making the call: total length, length of the tail, length of the hind foot, and length of the ear from the notch to the tip.

#### **4.4 Other Military Entomological Pests.**

The animals and plants that occur throughout the world that can be considered to be a hazard to any deployed force are numerous and varied. This category of hazard can include plants (e.g., poison ivy and oak) and animals (e.g., snakes, centipedes, bees and wasps, ticks, chiggers, bats, lions, tigers and bears), or any other organism that could degrade the health or morale of any portion of a deployed fighting force. Very few of these medical pests will, however, affect the entire force. Knowledge of their presence and training on the identification of the most hazardous and most commonly encounter pests for the particular geographic region must occur prior to deployment. Although some sampling techniques are included in Table 4-2, sampling in the deployment area is not proactive and is primarily accomplished by noting complaints. If problems exist or begin, training must be conducted to prevent exposure to these pests. There are no definitive measures to reduce the population size of these pests.

#### **4.5 Presence of Pesticides.**

If the deployment area has been subjected to pesticide applications in the past, there could still be pesticide residues present. These pesticide residues will vary in their toxicity and in their affect on deployed personnel. To determine if there have been pesticides applied in the past, chemical sampling measures discussed elsewhere in this Technical Guide must be used. Historical data for pesticide use by deployed U.S. Army personnel are maintained by the USACHPPM, Entomological Sciences Program, ATTN: MCHB-TS-OEN, Aberdeen Proving Ground, Maryland 21010-5422, (410) 436-3613, DSN: 584-3613.

#### **4.6 References.**

- a. Department of the Army (DA), *Control of Communicable Diseases Manual*. FM 8-33, 2000. American Public Health Association, 800 I Street, NW, Washington, DC 20001-3710.
- b. U.S. Army Environmental Hygiene Center (USAEHA) TG 138, *Guide to Commensal Rodent Control*, 6 January 1992.

## CHAPTER 5

### FIELD WATER SAMPLING METHODS AND ANALYTICAL REQUIREMENTS

#### 5.1 Purpose

The information contained in this section is provided to for preventive medicine personnel. They must be aware of the sampling requirements needed to certify and monitor field water supplies to meet the Tri-Service field water standards for environmental health monitoring of potable and non-potable water sources. This guide will focus on approving water sources and certifying potability by conducting water reconnaissance and sampling at the water consumption points. It will also provide details on the testing procedures for sampling the water sources even if the sampling is not being conducted by the preventive medicine personnel.

#### 5.2 General

Field water monitoring is conducted to ensure safe drinking water for deployed personnel. Water point reconnaissance, certification, and continuing health surveillance together provide insurance against the spread of waterborne diseases and pathogens that can eliminate the combat capability of a military unit.

##### 5.2.1 Preventive Medicine Responsibilities

It is the responsibility of the preventive medicine officer to—

- Approve water sources (i.e., reconnaissance).
- Certify water potability.
- Conduct health inspections.

##### 5.2.2 Water Exposure Routes

The primary routes of exposure to contaminated water are through ingestion (consumption) or dermal absorption (skin contact).

##### 5.2.3 Department of Defense Tri-Service Standards

The Department of Defense (DOD) Tri-Service standards contained in Technical Bulletin, Medical (TB MED) 577, *Sanitary Control and Surveillance of Field Water Supplies (Draft)*, for field water quality were developed for parameters to measure the treatability and potability of water. The standards were developed to protect against acute performance-degrading effects resulting from the ingestion of field water. The standards do not take into account the potential for chronic or lifetime effects from consuming contaminated drinking water. Both short-term (i.e., 7 days or less) and long-term, (i.e., up to one year) standards are included in TB MED 577, Appendix 5-3. Alternate field water standards for North Atlantic Treaty Organization and the Quadripartite Nations are also included in TB MED 577, Appendix 5-3. When water that meets the Tri-Service long-term standards cannot be obtained, short-term standards will be used. However, each day the imposition of short-term standards remains in effect, the commander must accept the risk of degraded troop performance, increased incidence of disease, casualties from toxic substances, and reduced combat efficiency.

#### **5.2.4 DOD Short and Long-term Health Guidelines**

In addition to the DOD Tri-Service standards, the short- and long-term health guidelines for toxic industrial compounds (TICs) are provided in the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Technical Guide (TG) 230, *Chemical Exposure Guidelines for Deployed Military Personnel (Draft)*. This guide is designed for use by the preventive medicine officer to determine the short and long-term health effects to soldiers exposed to TICs that may or may not be covered in the TB MED 577. Sampling for these TICs is required to ensure the health of the soldier.

#### **5.2.5 Environmental Contaminants of Concern**

Environmental contaminants of concern (ECOCs) are determined on a site-specific basis and depend on the water source reconnaissance; these are in addition to the standard field water testing parameters. The ECOCs include but are not limited to the parameters in TB MED 577 and USACHPPM TG 230. Due to current technology shortfalls, not all contaminants can be sampled in the field. Preventive medicine personnel must use their best professional judgment to determine whether a site is a potential water source, determine what the ECOCs are for the site, and determine what impact the ECOCs will have on the treated water quality. Factors that have the greatest short-term (acute) impact, such as microbiological quality, are of most concern. The ECOCs fall into several categories, some of which are shown in Table 5-1, with activities that can result in contamination.

**Table 5-1. Potential ECOCs Based on Site Activity**

Activity	Potential contaminants
Agricultural Activities: spraying, fertilizing, and livestock management	Pesticides and herbicides, nitrates, nitrites, bacteria, <i>Cryptosporidium</i> , <i>Giardia</i> , other microbiological contaminants
Wastewater Treatment Plant Discharge	Nitrates, nitrites, bacteria, viruses, protozoans, heavy metals, other chemicals (organic and inorganic)
Improper Household Waste Disposal	Cleaning fluids, degreasers, used motor oil, paints and paint thinners, soaps and detergents
Leaking Storage Tanks (Above or Underground)*	Petroleum products, acids, bases, other organic chemicals
Hazardous Material Spills	Petroleum products, acids, bases, other organic chemicals
Landfills	Various organic and inorganic chemicals
Injection Wells	Arsenic, heavy metals, cyanide, various organic and inorganic chemicals
Mining Operations	Arsenic, heavy metals, oxidation by-products, acids
Drilling Operations	Petroleum products, chloride, sodium, barium, strontium, radionuclides
<p>*Examples of activities/industries associated with use/handling of listed hazardous materials or materials which may contaminate drinking water include: gas stations, dry cleaners, distribution centers, chemical manufactures, water and wastewater treatment facilities, car-care centers, airports, golf courses, electroplaters, metal finishers, laboratories, machine shops, railroads, highway maintenance storage areas (salts), military bases, oil/gas production facilities, printers, photo finishers, refineries, wood shops, leather tanning facilities, textile production.</p>	

**5.2.6 Water Quality Monitoring**

Water quality monitoring conducted by preventive medicine personnel is divided into two phases: Phase I, a short-term monitoring assessment, and Phase II, a long-term monitoring assessment.

**5.3 Short-Term Monitoring Assessment (Phase I)**

The environmental health Phase I assessment responsibilities for the preventive medicine personnel consist of being part of the water source reconnaissance team and certifying the potability of the drinking water provided from the quartermaster, contractors, or municipal sources. This section deals specifically with the inspection and sampling of these sources not the interpretation of the results. Interpretation of the results from the environmental health Phase I assessment should be done by personnel trained in the identification of suitable water sources using the Tri-service standards and reconnaissance procedures in TB MED 577 and TB MED 575, *Swimming Pools and Bathing Facilities*.

**5.3.1 Water Point Reconnaissance (Phase I)**

Water in the field may be obtained from various surface water and groundwater sources and existing municipalities. In choosing a raw-water source, quantity, quality, accessibility, security, and proximity to supported units must be taken into account. The reconnaissance team will consist of a water purification engineer, preventive medicine personnel, and possibly G2 personnel. The preventive medicine personnel are responsible for examining the proposed water point and the surrounding area for sources of pollution and evidence of contamination. Some valuable sources of information that can help to identify hazards include the Armed Forces Medical Intelligence Center (AFMIC), the U.S. Army Corps of Engineers Topographical Engineering Center at Fort Belvoir, USACHPPM, the U.S. Geological Survey for continental United States (CONUS) areas, and the World Health Organization (WHO) for outside the continental United States (OCONUS) areas.

Reconnaissance should include an assessment of watershed vegetation and forestation, organic debris in the water, and the type of source. Sources of water contamination may include accidental or deliberate chemical or biological spills or industrial pollution discharges. If visible evidence of contamination is present (e.g., dead fish, vegetation, oil film, garbage or other discharge from active industrial areas), an alternate location should be used or control measures implemented to minimize the exposure to the contamination.

Sampling of the raw water sources must be conducted to determine the treatability of the water. Table 5-2 provides a list of the contaminants and respective sampling equipment used for each parameter. The preventive medicine personnel should use DD FORM X340 provided in TB MED 577 when conducting the water point reconnaissance.

**Table 5-2: Water Reconnaissance Raw Water Source Sampling Requirements**

<b>Parameter</b>	<b>Recommended Equipment</b>
Turbidity	Turbidimeter
PH	pH* Tester / Phenol Red Test
Chlorine Residual (F/T) <sup>1</sup>	DPD* Chlorine Residual Test
TDS*	TDS* Tester
Color/Odor	Color Disk
Arsenic	Test Strips
Cyanide	Test Strips
Magnesium	Titration / Test Strips
Chloride	Test Strips
Sulfate	Test Strips
NBC* Agents	M272 Chemical Agent Test Kit
Lindane	Laboratory Analysis
Radiological	ANPDR and laboratory
Bacteria	Colilert <sup>®</sup> P/A. HPC* total count Sampler
ECOCs <sup>2</sup>	<b>Laboratory Analysis</b>

<sup>1</sup> Chlorine residual only tested for if water source is a municipal distribution system.

<sup>2</sup> ECOCs sample is collected using CHPPM deployment water kit for complete chemical analysis.

\* pH: hydrogen-ion concentration

\* DPD: N,N-diethyl-p-phenylenediamine

\* TDS: total dissolved solids

\* NBC: nuclear, biological, and chemical

\* ANPDR: Army/Navy Portable Detector Radiac

\* HPC: heterotrophic plate count

The ECOC sampling represents a split sample from the raw water source that will be analyzed in a laboratory. Field analysis of the source water will be conducted with the preventive medicine equipment sets to determine whether the source is treatable.

### 5.3.2 Certifying Potability (Phase I)

After appropriate treatment processes have been selected and installed, and the water point is used to produce treated water, the preventive medicine unit is responsible for certifying the potability of the product water.

Certification of potable water should include analysis of water collected from the—

- Water production facility (i.e., reverse osmosis water purification unit (ROWPU)).
- Distribution system consumption points (i.e., dining facilities, hospitals).
- Field water supplies (i.e., water buffaloes).

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Colilert<sup>®</sup> is a registered trademark of IDEXX Laboratories, Inc., Westbrook, Maine.

### **5.3.2.1 Testing Requirements (Phase I)**

The same parameters listed in Table 5-2 must be tested to determine the potability of the water. The results must meet the field water standards in TB MED 577. Some testing can be conducted in the field with direct reading instrumentation, while parameters like lindane and radiological contamination must be sampled and sent to a supporting laboratory for a complete chemical analysis. The unit normally analyses field parameters onsite or in a nearby sheltered environment (e.g., coliform bacteria testing) to provide the fastest results. These results can be provided in 24 hours or less using current field analysis.

The daily operating logs from the production facility should be reviewed to ensure that the production source is meeting the treatment standards for chlorine residual, TDS, and pH.

### **5.4 Environmental Health Long-Term Monitoring Assessment (Phase II assessment)**

The military field water distribution system is more vulnerable to post-treatment contamination than a permanent pressurized pipe water distribution system. In addition, changes in the chemical composition of military field water can occur in relatively short periods of time. The preventive medicine unit is required to conduct water monitoring for the duration of the deployment to ensure the water is potable.

The difference between source monitoring and environmental health surveillance lies with the responsibility of the unit conducting the tests. Source monitoring is considered operational monitoring to ensure that the purification process is working properly. This testing may be conducted by the quartermaster (77W), the contractor supplying water to the camp, or the municipal agency in charge of host-nation treatment facility. The preventive medicine unit is responsible for reviewing these records when conducting health surveillance as part of ensuring the product water is potable.

#### **5.4.1 Water Surveillance Parameters and Schedule (Phase II)**

Once the product water, distribution system, and field water supply points have been certified as potable, the commander must determine the sampling frequency depending on factors such as; terrorist activity, vulnerability of the system, changes in raw water quality, and preventive medicine responsibilities. The commander may rely on the practical experience of the preventive medicine personnel to determine the sampling frequency and schedule. Table 5-3 provides recommended sampling frequencies for field water.

Table 5-3. Parameters to Certify Potability and Water Monitoring Schedule

Parameter	Sampling Frequency			Recommended Equipment
	Product Water	Distribution	Field Container	
Bacteria <sup>1</sup>	Weekly/Monthly	Weekly/Monthly	Daily	Colilert P/A, HPC* Total Count Sampler
TDS <sup>1</sup>	Weekly/Monthly	-	-	TDS Tester
Chlorine Residual <sup>1</sup>	Weekly/Monthly	Weekly/Monthly	Daily	DPD Chlorine Residual Test
Temperature <sup>1</sup>	Weekly/Monthly	Weekly/Monthly	-	Thermometer
PH <sup>1</sup>	Weekly/Monthly	Weekly/Monthly	Daily	pH Tester/Phenol Red Test
Color/Odor <sup>1</sup>	Weekly/Monthly	-	-	Color Disk
Turbidity <sup>1</sup>	Weekly/Monthly	-	-	Turbidimeter
Arsenic	Quarterly	-	-	Test Strips
Cyanide	Quarterly	-	-	Test Strips
Magnesium	Quarterly	-	-	Titration / Test Strips
Chloride	Quarterly	-	-	Test Strips
Sulfate	Quarterly	-	-	Test Strips
Lindane	Quarterly	-	-	Laboratory Analysis
Radiological	Quarterly	-	-	AN/VDR
ECOCs <sup>2</sup>	Quarterly/Annual	Quarterly/Annual	-	Laboratory Analysis
NBC Agents	Table 5-6	Table 5-6	-	M272 Chemical Agent Test

<sup>1</sup> These parameters are monitored weekly during the initial field operations

<sup>2</sup> ECOC are samples for using the Interim Field Water Test Kit (IFWTK) as described in Appendix 5-2.

#### 5.4.2 Number of Samples.

The appropriate number of samples is dependent upon the population served and the distribution system. TB MED 576, Appendix H, lists guidelines for the minimum number of samples for bacteriological sampling that should be taken per month based upon population served.

Table 5-4 below was taken from the TB MED 576, *Occupational and Environmental Health, Sanitary Control and Surveillance of Water Supplies at Fixed Installation*, and should be used in planning.

Table 5-4. Bacteriological Samples

Population Served	Minimum Number of Samples per Month	Population Served	Minimum Number of Samples per Month
25 to 1,000	1	16,301 to 17,200	19
1,001 to 2,500	2	17,201 to 18,100	20
2,501 to 3,300	3	18,101 to 18,900	21
3,301 to 4,100	4	18,901 to 19,800	22
4,101 to 4,900	5	19,801 to 20,700	23
4,901 to 5,800	6	20,701 to 21,500	24
5,801 to 6,700	7	21,501 to 22,300	25
6,701 to 7,600	8	22,301 to 23,200	26
7,601 to 8,500	9	23,201 to 24,000	27
8,501 to 9,400	10	24,001 to 24,900	28
9,401 to 10,300	11	24,901 to 25,000	29
10,301 to 11,100	12	25,001 to 28,000	30
11,101 to 12,000	13	28,001 to 33,000	35
12,001 to 12,900	14	33,001 to 37,000	40
12,901 to 13,700	15	37,001 to 41,000	45
13,701 to 14,600	16	41,001 to 46,000	50
14,601 to 15,500	17	46,001 to 50,000	55
15,501 to 16,300	18	Over 50,000	Refer to NPDWR*

\*TB MED 576, Appendix H, based on USEPA National Primary Drinking Water Regulations (NPDWR)

#### 5.4.3 Review of Daily Water Production Logs (Phase II)

The pH, chlorine residual, and possibly TDS (depending on the monitoring requirements) can be monitored at the source by reviewing the daily production logs of the unit supplying the water (i.e., 77W quartermaster water specialist). The daily operator's logs are a good indication of the efficiency of the treatment process. Significant changes in these parameters may indicate changes in the source water quality or malfunctions in the treatment process. These logs should be reviewed weekly during start-up operations and monthly during sustainment operations.

#### 5.4.4 Monitoring of Bottled Water Supplies

When using bottled water, units will follow the requirements in TB MED 577. They will conduct bacteriological testing on one percent of the bottles in each lot received, up to ten samples. Every thirty days, the bacteriological testing will be repeated until the entire lot is consumed. The command surgeon sets the frequency and the number of samples and can increase or decrease these samples as necessary.

#### 5.4.5 Monitoring Swimming Pools and Natural Bathing Areas

Health monitoring must also be conducted on swimming pools and natural bathing areas when they are present in the unit's area of operations and used by the soldiers. All recreational waters are monitored weekly in the manner described in Appendix 5-3 and must meet the standards in TB MED 575.

Bacteriological testing of recreational water requires a quantitative analysis, as opposed to the drinking water presence absence approach, in order to compare results with established quality

standards. TB MED 575 specifies that the HPC test is the bacteriological test to provide quality data for swimming pools. Normally laboratories test for HPC bacteria using the pour-plate method and plate-count agar. Alternatively, the membrane filter method can determine HPC levels by using R2A agar instead of m-Endo media. A third option to determine HPC, and the simplest, is the Millipore<sup>®</sup> HPC Total Count sampler. Instructions for the HPC Sampler are included in Appendix 5-3. All three methods will provide a general estimate of total bacteria being shed from the bodies of swimmers. HPC levels under standard help verify the disinfection process. HPC levels above standard indicate that levels are inadequate and are cause to investigate the swimming pool disinfection process. TB MED 575 also recommends performing the total coliform (indoor pools) and fecal coliform (outdoor pools) tests to supplement the HPC data.

Test natural waters used for recreational swimming using the tests for fecal coliform, enterococci, or *E. coli*. The membrane filter method can be used for each of these tests; however, the correct selective growth media is required. In a deployment setting, using commercially available m-FC media to test for fecal coliforms, in a one-step procedure, is likely to be the simplest option. Note that the fecal coliform test requires incubation of samples at 44.5 degrees Celsius (°C) versus 35°C for total coliform analysis. Only trained preventive medicine personnel should perform bacteriological testing using the membrane filter method.

### **5.5 Sampling Equipment**

Several pieces of equipment are currently available for units to conduct field water testing and onsite analysis for a variety of contaminants. The equipment and methods necessary to conduct certified lab sampling are discussed in paragraph 5.4.1 and Appendices 5-1 and 5-2. All parameters with associated field water standards can be tested in the field except lindane and gross radiological contamination. Table 5-5 lists all of the available field-testing equipment and how detection ranges compare with the applicable Tri-Service standards. However, not all of the available field-testing equipment is capable of detecting contaminants at the low levels required by the tri-service standards, specifically the chemical agent standards. Due to this current technology shortfall, medical and preventive medicine personnel must use their best professional judgment based on the information available. Sampling methods are explained in Appendix 5-3.

Millipore® is a registered trademark of IDEXX Laboratories, Inc., Westbrook, Maine.

**Table 5-5. Sampling Equipment Capabilities and Tri-Service Field Water Standards**

Physical Properties	WQAS-PM*	WQAS-P*	Test strips	M27 2	IFWTK *	WQAS-P w/ Field Kit	HACH DREL® 2010	U.S. Tri-Service Short-Term (JUN 96) 5 L/Day 15 L/Day	
Free Acidity (mg/L)	0 - 500	--	--	--	--	--	--	--	--
Total Acidity (mg/L)	0 - 500	--	--	--	--	--	10 - 4,000	--	--
Dissolved Oxygen (mg/L)	0.2 +	--	--	--	--	--	0 - 10+	--	--
Turbidity (NTU)*	0 - 500	0 - 150	--	--	0.1 - 400	0 - 150	0.01 - 1,000	1	1
PH	4 - 10	2.0 - 12.0	--	--	0.1 - 14	2.0 - 12.0	0.01 - 14	5 - 9	5 - 9
TDS (mg/L)	--	0 - 50,000	--	--	10 - 2,000	0 - 50,000	0.01 - 19,990	1,000	1,000
Temperature (°C)	--	0 - 48	--	--	-15 - 170	0 - 48	-10 - 110	4 - 35	4 - 35
Color (Color Units)	--	0 - 100	--	--	0 - 500	0 - 100	--	50	50
<b>Chemical Properties</b>									
Arsenic (mg/L)	--	--	0.1 - 3.0	--	0.1 - 3.0	0.1 - 3.0	--	0.3	0.1
Cyanide (mg/L)	--	--	1.0 - 30	--	1.0 - 30	1.0 - 30	0.001 - 0.2	6	2
Magnesium (mg/L)	--	--	--	--	10 - 4,000	10 - 4,000	10 - 4,000	100	30
Chloride (mg/L)	1,000-20,000	0 - 1,500	500 - 3,000	--	500 - 3,000	0 - 1,500	10 - 8,000	600	600
Sulfate (mg/L)	0-150	0 - 3,000	200 - 1,600	--	50 - 1,600	0 - 3,000	0 - 70	300	100
Nitrate nitrogen (mg/L)	0-30	--	--	--	0.1 - 50	0 - 50	0.1 - 30	--	--
Ammonia Nitrogen (mg/L)	0 - 2.0	--	--	--	--	--	0.1 - 2.5	--	--
Fluorides (mg/L)	0 - 2.0	--	--	--	--	--	0.1 - 2.0	--	--
Ferrous Iron (mg/L)	0 - 2.0	--	--	--	--	--	--	--	--
Ferric Iron (mg/L)	0 - 10.0	--	--	--	--	--	--	--	--
Total Iron (mg/L)	0 - 2.0	--	--	--	--	--	0.1 - 3.0	--	--
Zinc (mg/L)	1.0 - 20.0	--	--	--	--	--	0.1 - 2.0	--	--
<b>Chemical Agents</b>									

Hydrogen Cyanide (mg/l)	--	--	--	20	--	--	--	6	2
Lewisite (as Arsenic) (µg/l)	--	--	--	2000	--	--	--	80	27
Sulfur Mustard (µg/l)	--	--	--	2000	--	--	--	140	47
Nerve Agents (µg/l)	--	--	--	20	--	--	--	12	4
BZ (ug/l)	--	--	--	--	--	--	--	7	2.3
T-2 Toxins (µg/l)	--	--	--	--	--	--	--	26	8.7
<b>Microbiological</b>									
Coliform (#/100 ml)	--	--	--	--	P/A	P/A	--	0	0

\* WQAS-PM: Water quality analysis set – preventive medicine

\* WQAS-P: Water quality analysis set - purification

\* NTU: Nephelometric turbidity unit

mg/L: milligram per liter

µg/L: microgram per liter

ml: milliliter

HACH DREL 2010<sup>®</sup> is a registered trademark of Hach Co., Loveland, Colorado.

### 5.5.1 Currently Available Equipment Through Army Supply System

Currently available equipment in the Army Supply System includes—

- Water quality analysis sets (WQAS-P and -PM).
- M272 chemical agent test kit.
- Microbiological test kit.

#### 5.5.1.1 Water Quality Analysis Set - Purification (WQAS-P) - (National Stock Number (NSN) 6630-01-365-5588)

Water treatment personnel use this kit to conduct operational monitoring of the treatment processes. The WQAS-P is capable of testing for pH, temperature, TDS, turbidity, and chlorine residual. It includes an M272 chemical agent water testing kit, which is also available separately. Operational monitoring should occur as frequently as necessary to ensure proper equipment performance, water potability prior to issue, and detection of significant changes in source water quality that can affect treatment. The technical manual (TM) for ROWPU operation (TM 10-4610-240-10, *Operator’s Manual, Water Purification Unit, Reverse Osmosis, 600 GPH Trailer Mounted, Flatbed Cargo, 5 Ton 4 Wheel Tandem ROWPU Model WPES-1 (4610-01-295-2720) and 600 GPH Skid Mounted ROWPU Model WPES-2 (4610-01-300-0918) (Air Force) Model WPES-3 (4610-01-295-2719) (Marine Corps)*) recommends hourly checks of the water quality. The WQAS-P replaced the old WQAS – Engineer (NSN 6630-00-140-7820). The TM for the WQAS-P is TM 10-6630-246-12&P, *Operator’s and Unit Maintenance Manual Including Repair Parts and Special Tools List (RPSTL), Water Quality Analysis Set: Purification.*

#### 5.5.1.2 Water Quality Analysis Set – Preventive Medicine (WQAS-PM)

**(NSN 6630-01-367-9402)**

Medical or preventive medicine personnel use this kit along with operational monitoring data to determine if drinking water is potable by comparing results to the Tri-Service standards. The WQAS-PM consists of five individually packaged colorimetric test kits and a spectrophotometer. It can conduct required tests for pH and turbidity and determine the level of free acidity, dissolved oxygen, fluorides, ferrous, ferric, and total iron, ammonia nitrogen, nitrates, and zinc in water. New versions of the WQAS-PM contain additional test kits for arsenic, cyanide, and updated chloride and sulfate tests, which are also required parameters. The TM for the WQAS-PM is TM 5-6630-215-12, *Operator and Organizational Maintenance, Water Quality Analysis/Sets: Preventive Medicine (NSN 6630-00-140-7826) Engineer (NSN 6630-00-140-7820)*.

**5.5.1.3 M272 Chemical Agent Water Test Kit (NSN 6665-01-134-0885)**

The M272 test kit includes test tubes and chemical-coated tickets that change color when levels of the various agents are present in the water sample. Water treatment and PM personnel will conduct tests for chemical agents in treated and raw water during NBC operations based on current mission-oriented protection posture (MOPP) levels. The required test frequency is shown in Table 5-6. The kit can be used to test for hazardous levels of lewisite, nerve agents, cyanide, and mustard agents. Tests resulting in the appropriate color change indicate the presence of threshold or danger concentrations of the agent. Although the cyanide and lewisite tests cannot detect contamination down to the applicable field water standard, acute health effects resulting from consumption of water contaminated with cyanide or lewisite at levels below the detection limits of the M272 test kit are not likely. The TM for the M272 is TM 3-6665-319-10, *Operator’s Manual for Water Testing Kit, Chemical Agents-M272*.

**Table 5-6. Frequency of Tests for Chemical Agents**

Threat Level	MOPP	Test Frequency
No known threat	0	Weekly
Slight threat	1	Daily
Medium threat	2	Twice daily
Severe threat	3	Four times daily
Imminent threat	4	Hourly
Known contamination	4	Hourly and before issue of each batch of water

\* TM 3-6665-319-10.

**5.5.1.4 Microbiological Test Kit (NSN 6665-00-682-4765)**

The Microbiological Test Kit is currently issued to preventive medicine units to conduct bacteriological surveillance of drinking water. The kit consists of the following equipment:

- Incubator.
- Filtration unit with filters and hand pump.
- Petri dishes.

- M-Endo broth as the growth media.

Using this equipment, preventive medicine personnel can perform the membrane filter test to determine total coliform bacteria count in drinking water. The M-Endo broth growth media must be refrigerated; otherwise it will expire and not allow the growth of bacteria. Other types of growth media can be used detect fecal coliform, enterococci, or *E. coli*.

### **5.5.2 Recommended Equipment for Preventive Medicine Units**

Additional recommended testing equipment for preventive medicine units includes the commercially available water quality labs and water test kits from companies such as HACH, EM Science<sup>®</sup>, and Millipore. These items are not part of the military supply system but can substitute for the currently available equipment sets.

#### **5.5.2.1 HACH DREL Water Quality Lab**

The HACH DREL is a commercially available water test kit that comes in three models, the HACH DREL 2010 Portable Laboratory, the HACH DREL 4000 Spectrophotometer, and the HACH DR 800 Series Field Colorimeter. The HACH DREL 4000 is for use in a permanent setting, such as a fixed facility water lab while the other two are easily deployable. The HACH DR 800 Series uses a colorimeter and the HACH DREL 2010 and 4000 use a spectrophotometer similar to the WQAS-PM. They can analyze for a host of inorganic contaminants in water including free and total chlorine residual, chloride, conductivity, fluoride, calcium hardness, pH, sulfate, and temperature. Kits can also be tailored to specific parameters or detection levels by purchasing various test reagents and apparatus such as that for turbidity, TDS, arsenic, cyanide, and magnesium hardness. However, some of the tests, such as arsenic, cannot be performed in the field due to their complex nature. All of the HACH DREL kits can test for a wide variety of inorganic contaminants in addition to those with Tri-Service standards.

#### **5.5.2.2 HACH MEL P/A Safe Drinking Water Lab**

This is a commercially available water test kit that consists of an incubator, ultraviolet lamp, chlorine and nitrate color comparators, electronic pH and TDS testers, and a thermometer. With this kit, preventive medicine personnel can use the MUG (4-methylumbelliferyl-*B-D*-glucuronide) method to test for total coliform and *E. coli* presence in drinking water. They can also monitor free and total chlorine residual, nitrate level, pH and TDS. The MUG method is simpler than the membrane filter method and both coliform and *E. coli* tests can be conducted simultaneously in 24 hours. Additionally, the growth media for the bacteria does not have to be refrigerated, as does the M-Endo broth used in the Microbiological Test Kit.

#### **5.5.2.3 Deployment Field Water Quality Kit**

This kit is comprised of commercially available equipment that will allow preventive medicine personnel to test for all contaminants with Tri-Service standards except chemical agents, lindane, and radiological contamination. The kit consists of—

- HACH MEL P/A Safe Drinking Water Lab.
- Pocket turbidimeter.

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EM Science<sup>®</sup> is a registered trademark of EM Industries, Inc., Gibbstown, New Jersey.

- Thermometer.
- Chlorine color parameter kit.
- pH color comparator kit.
- Magnesium titration test.
- Color disk kit.
- Test strips to determine arsenic, chloride, sulfate, and chloride.

It is deployable in two small boxes (21" X 11" X 11") and can also be packed with an M272. When health monitoring of swimming pools is also anticipated, an HPC Total Count Sampler can also be included (see paragraph 5.5.1.2). See Appendix 5-3 for a detailed description of this kit and sampling instructions.

#### **5.5.2.4 USACHPPM Interim Field Water Test Kit**

The IFWTK kit is used to monitor for the same contaminants regulated by the U.S. Environmental Protection Agency (USEPA), 822-R-96-001, *Drinking Water Regulations and Health Advisories*, but operates under reduced quality assurance and quality control measures in order to reduce the kit size and sample volume. The IFWTK is shipped in one 16-quart cooler and weighs only 8 pounds after filling the sample bottles. The laboratory analysis sample kit is shipped to the unit from the laboratory and will be used with the instructions in Appendix 5-2. The sampling kit provides appropriately prepared and pre-preserved containers to properly collect drinking water samples for most USEPA-regulated drinking water contaminants. The instructions provide step-by-step procedures for collecting and shipping the water samples to a supporting lab. This kit includes a set of 40 ml and 125 ml bottles, pre-preserved with the necessary chemicals, packing material, and one 16-quart cooler. Collecting one set of samples will usually take about half an hour or less since the bottles are pre-preserved.

### **5.6 Evaluation of Results**

Issuing treated water to using units should not be delayed while microbiological analysis is being completed. However, preventive medicine personnel must ensure that all analyses and determination of potential risks are completed in a timely manner. At a minimum, chlorine residual and pH testing must be conducted on all treated water before consumption. Once those results are available, it is up to the preventive medicine personnel to make recommendations to the commander based on the potential health threats. All water quality monitoring should be documented and presented on the appropriate form when applicable. The forms for documenting water quality monitoring and inspection results can be found in TB MED 577.

#### **5.6.1 Exceedence of Tri-Service Standard**

When the results of baseline monitoring exceed the Tri-Service standards, preventive medicine personnel should take the following actions:

- Immediately notify the water treatment unit the noncommissioned officer-in-charge (NCOIC) or officer-in-charge (OIC) and resample to verify the results.
- If the verified results still exceed the standards, identify the health threat and impact of the contaminant on personnel using TB MED 577 or USACHPPM TG 230. This information

should be communicated to the water treatment NCOIC/OIC and the commander through the command surgeon along with possible corrective actions.

- After appropriate corrective actions have been implemented, preventive medicine personnel should resample the product water. If the corrective actions have not resolved the problem, notify the command surgeon immediately. The command surgeon can advise the unit commander of the health threat. The unit commander can either modify the contaminant standard based on the particular situation and the command surgeon's advice, order the implementation of additional control measures, or order the development of a new water source.

#### **5.6.1.1 Evaluation of Environmental Contaminants of Concern Without Tri-Service Standard**

The importance of good professional judgment in health risk decision-making is paramount. Personnel without appropriate experience should seek guidance from qualified health care or water quality engineering professionals before making health-based decisions based upon the monitoring results. There are several sources of guidance for determining risks from consumption of contaminated drinking water as listed below—

- TB MED 577.
- USACHPPM TG 230.
- Overseas Environmental Baseline Guidance Document (OEBGD) and Final Governing Standards (FGS). The OEBGD holds the standards that fixed installations overseas must meet. These standards are more stringent than the Tri-Service standards, but not as strict as the USEPA regulations. They should be met when providing water to a base camp or similar semi-permanent installation. Final Governing Standards are country specific and apply only to U.S. military installations with the nation that developed that FGS. It is more stringent than the OEBGD, using the lower standards from both the host nation regulations and the OEBGD.
- USEPA Drinking Water Regulations and Health Advisories.

USACHPPM TG 230 is a risk management tool that can be used to help interpret data and identify potential health risks and effects on soldiers. The exposure levels in USACHPPM TG 230 apply to the military population only; they are not meant to apply to a civilian population that can include children, elderly, and the immuno-compromised. USACHPPM TG 230 provides toxic exposure levels for 5-day and 2-week time periods with potential toxic signs and symptoms, target organ, odor and taste thresholds, and notes (e.g., suspected carcinogen) and also provides the same information for exposure periods of 2 weeks up to a year. These reference numbers are adapted for military use from a variety of sources including TB MED 577 and USEPA Drinking Water Regulations and Health Advisories, which list health-related information on many contaminants found in drinking water including USEPA maximum-contaminant levels and Health Advisory levels for drinking water contaminants. Ideally, all drinking water provided to U.S. military personnel should meet USEPA standards, but that is not always a realistic goal in a deployed situation. Both USACHPPM TG 230 and USEPA documents are updated periodically to incorporate new research, regulations, and health related information. However, these documents do not provide standards, only guidelines to help determine the approximate health threat. The USACHPPM programs including the Water Supply Management, Deployment Environmental Surveillance, Environmental Health Risk Assessment, and Health Risk Communication can be

drawn upon to assist in evaluating drinking water environmental analyses and assessing risks based on exposure.

## **5.7 Definitions**

### **5.7.1 Raw Water**

Raw water is untreated water from a surface (e.g., lakes, rivers, snow, ice, seawater) or a ground (e.g., wells and springs) source. An existing municipal supply is also considered a raw water source until sufficient testing is performed to determine its potability. All raw water sources are considered non-potable regardless of how pristine the source may appear. Untreated water can transmit microorganisms that cause waterborne diseases such as viral hepatitis, gastroenteritis, and cryptosporidiosis.

### **5.7.2 Non-Potable Water**

Non-potable water is treated or untreated water that has not been inspected and certified by the command surgeon or has failed to pass a preventive medicine inspection. Non-potable water is not considered fit for human consumption until it has been tested and meets the Tri-service field water standards in TB MED 577, Table 5-3. Non-potable water can be used for non-consumptive purposes only (e.g., washing vehicles or bathing). However, with the exception of swimming pool and natural bathing area standards, no useful public health criteria exist for assessing the potential health risks associated with dermal contact of contaminated non-potable water. Swimming pool and natural bathing standards protect personnel from contracting diseases from water that comes in contact with their skin or are incidentally inhaled or ingested in small amounts. These standards are contained in TB MED 575.

### **5.7.3 Potable Water**

Potable water is treated water that is considered fit for human consumption. It must meet the Tri-Service standards and be sufficiently palatable to be accepted by the soldiers consuming the water. The consequences of unpalatable water can be just as dangerous as contaminated water when soldiers refuse to drink and become vulnerable to dehydration.

### **5.7.4 Bottled Water**

Bottled water is treated water purchased and shipped to the battlefield for consumption by the soldiers. Bottled water is addressed separately than water produced on the battlefield because it must meet different requirements. Bottled water must always come from a Veterinary Command (VETCOM) certified source. A list of all certified bottled water producers can be found in VETCOM Circular 40-1, *Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement*. When a unit receives bottled water from an approved source, it is considered potable, treated water. Raw water and environmental health baseline surveillances do not apply; however, health monitoring must be conducted as discussed in paragraph 5.5.1.1.

### **5.7.5 Surface water**

Surface water sources include rivers, lakes, streams, ponds, ice, snow, or seawater. Surface water is readily available in sufficient quantities in most areas. However, it is easily subject to pollution or contamination. The water quality is normally lower than that of groundwater and is generally much more variable. Surface water requires significantly greater effort to treat.

### 5.7.6 Groundwater

Groundwater sources include wells and springs. Though groundwater can be of excellent quality and can often be considered potable after minimal treatment (i.e., disinfection), there are often problems with accessibility and quantity. A well must be drilled properly, and the production of the well is limited by the quantity of water available in the aquifer.

### 5.8 References

- a. Department of the Army (DA), *Sanitary Control and Surveillance of Field Water Supplies (Draft)*. TB MED 577, undated.
- b. U.S. Army Center for Health Promotion and Preventive Medicine TG 230, *Chemical Exposure Guidelines for Deployed Military Personnel (Draft)*, 2001.
- c. Department of the Army (DA), *Swimming Pools and Bathing Facilities*. TB MED 575, 2 July 1993.
- d. Department of the Army (DA), *Sanitary Control and Surveillance of Water Supplies at Fixed Installations*. TB MED 576, 15 March 1982.
- e. Technical Manual (TM) 10-4610-240-10, *Operator's Manual, Water Purification Unit, Reverse Osmosis, 600 GPH Trailer Mounted, Flatbed Cargo, 5 Ton 4 Wheel Tandem ROWPU Model WPES-1 (4610-01-295-2720) and 600 GPH Skid Mounted ROWPU Model WPES-2 (4610-01-300-0918) (Air Force) Model WPES-3 (4610-01-295-2719) (Marine Corp)*, 5 March 1991.
- f. Technical Manual (TM) 10-6630-246-12&P, *Operator's and Unit Maintenance Manual Including Repair Parts and Special Tools List (RPSTL), Water Quality Analysis Set: Purification*, 1 February 1994.
- g. Technical Manual (TM) 5-6630-215-12, *Operator and Organizational Maintenance, Water Quality Analysis/Sets: Preventive Maintenance (NSN 6630-00-140-7826) Engineer (NSN 6630-00-140-7820)*, 9 July 1981.
- h. Technical Manual (TM) 3-6665-219-10, *Operator's Manual for Water Testing Kit Chemical Agents-M272*, 30 November 1983.
- i. USEPA 822-R-96-001, *Drinking Water Regulations and Health Advisories*. Office of Water, U.S. Environmental Protection Agency, October 1996.
- k. Veterinary Command Circular 40-1, *Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement*, 1 May 1997.

Forms:

DD Form X340, *Water Source Reconnaissance Report*.

DD Form 686, *Fluoride/Bacteriological Examination of Water*.

**APPENDIX 5-1**

**WATER LABORATORY ANALYSIS PROCEDURES AND REQUIREMENTS**

**USACHPPM DRAFT TG 251**

PARAMETERS	DLS TEST CODE	STANDARD METHOD (SM)	DETECTION LEVEL	PRESERVATIVE	HOLDING TIME
<b>Inorganic - nonmetals</b>					
Alkalinity (ALK)	206	EPA 310.1 or SM* 2320	1.0 mg/L as CaCO3	Cool 4 C	14 Days
Asbestos		EPA 600/4-83-043	Variable	Cool 4 C	<b>48 Hours</b>
Bromate		EPA 300.1			
Chloride (Cl)	1004	EPA 300.0	1.0 mg/L	Cool 4 C	28 Days
Chlorite	1132	EPA 300.0	0.01 µg/L	Add EDA, Cool 4 C	14 Days
Color	890	EPA 110.2	5 Color units	Cool 4 C	<b>48 Hours</b>
Conductivity, Specific (Cond)	297	EPA 120.1	1 µmhos/cm*	Cool 4 C	28 Days
Cyanide (CN)	236	EPA 335.2 or SM 4500B,C,E	0.01 mg/L	pH>12 (NaOH), Cool 4 C, For residual chlorine, add 0.6g Ascorbic Acid	14 Days
Fluoride (F)	1006	EPA 300.0	0.1 mg/L	Cool 4 C	28 Days
Fluoride	246	EPA 340.1 &.2 or SM 4500 F-C	0.1 mg/L	Cool 4 C	28 Days
Foaming Agents/MBAS	892	EPA 425.1	0.05 mg/L	Cool 4 C	<b>48 Hours</b>
Hardness	254	EPA 130.2	1.0 mg/L as CaCO3	pH<2 (H2SO4), Cool 4 C	6 Months
Nitrate (NO3)	903	EPA 353.2	0.05 mg/L as N	Cool 4 C	<b>48 Hours</b>
Nitrite (NO2)	902	EPA 353.2	0.05 mg/L as N	Cool 4 C	<b>48 Hours</b>
Nitrite/Nitrate	264	EPA 353.2	0.05 mg/L as N	pH<2 (H2SO4), Cool 4 C	28 Days
Ortho phosphate (O-PO4)	269	EPA 365.1	0.02 mg/L as P	Cool 4 C	<b>48 Hours</b>
pH	893	EPA 150.1 or SM 4500 H&B	0.1 pH Units	Cool 4 C	<b>Immediately &amp; 48 Hours</b>
Phosphate (PO4)	642	EPA 365.2	0.01 mg/L	pH<2 (H2SO4), Cool 4 C	28 Days
Silica	641	EPA 370.1	0.2 mg/L SiO2	Cool 4 C	28 Days
Sulfate (SO4)	1005	EPA 300.0	1.0 mg/L	Cool 4 C	28 Days
Sulfate	303	EPA 375.1	1.0 mg/L	Cool 4 C	28 Days
Sulfate	305	EPA 375.2	1.0 mg/L	Cool 4 C	28 Days
TDS	900	EPA 160.1	1.0 mg/L	Cool 4 C	7 Days
Total Organic Carbon (TOC)	319	EPA 415.1	1.0 mg/L	pH<2 (H2SO4), Cool 4 C	28 Days
Turbidity	340	EPA 180.1	0.18 NTU	Cool 4 C	<b>48 Hours</b>
Turbidity	1003	EPA 180.1	1.0 NTU	Cool 4 C	28 Days

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PARAMETERS	DLS TEST CODE	STANDARD METHOD (SM)	DETECTION LEVEL	PRESERVATIVE	HOLDING TIME
<b>Inorganic - metals<math>\mu\mu</math></b>					
Aluminum (Al)	670	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Antimony (Sb)	674	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Arsenic (As)	671	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Barium (Ba)	672	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Beryllium (Be)	673	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Cadmium (Cd)	679	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
PARAMETERS	DLS TEST CODE	STANDARD METHOD	DETECTION LEVEL	PRESERVATIVE	HOLDING TIME
Calcium (Ca)	367	EPA 200.7 - ICP	0.10 mg/L	pH<2 (HNO3), Cool 4 C	6 Months
Chromium (Cr)	675	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Copper (Cu)	678	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Iron (Fe)	390	EPA 200.7 - ICP	0.050 mg/L	pH<2 (HNO3), Cool 4 C	6 Months
Lead (Pb)	682	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Magnesium (Mg)	397	EPA 200.7 - ICP	0.20 mg/L	pH<2 (HNO3), Cool 4 C	6 Months
Manganese (Mn)	680	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Mercury (Hg)	401	EPA 245.1	0.20 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	28 Days
Nickel (Ni)	681	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Selenium (Se)	934	EPA 200.8 - ICP/MS	2.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Silver (Ag)	712	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Sodium (Na)	430	EPA 200.7 - ICP	0.20 mg/L	pH<2 (HNO3), Cool 4 C	6 Months
Thallium (Tl)	713	EPA 200.8 - ICP/MS	1.0 $\mu\text{g/L}$	pH<2 (HNO3), Cool 4 C	6 Months
Zinc (Zn)	452	EPA 200.7 - ICP	0.020 mg/L	pH<2 (HNO3), Cool 4 C	6 Months
<b>Organics</b>					
<b>Haloacetic acids (HAA5)</b>		EPA 551.1/551.2 or SM 6251B		Cool 4 C, no headspace, For residual Cl, add 65 mg NH4Cl	14 Days
Dichloroacetic acid			1.0 $\mu\text{g/L}$		
Monochloroacetic acid			1.0 $\mu\text{g/L}$		
Trichloroacetic acid			1.0 $\mu\text{g/L}$		
Dibromoacetic acid			1.0 $\mu\text{g/L}$		
Monobromoacetic acid			1.0 $\mu\text{g/L}$		
<b>Semi-volatile</b>	1008	EPA 525.2		Sodium sulfite, Cool 4 C, HCL pH<2,	14 Days

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PARAMETERS	DLS TEST CODE	STANDARD METHOD (SM)	DETECTION LEVEL	PRESERVATIVE	HOLDING TIME
<b>organic compounds (SVOC)</b>				For residual Cl, add 50 mg Na2SO3	
Benzo[a]pyrene			0.2 µg/L		
Di(2-ethylhexyl)adipate			2.6 µg/L		
Bis(2-ethylhexyl)phthalate			3.1 µg/L		
Hexachlorobenzene			0.5 µg/L		
Hexachlorocyclopentadiene			1.0 µg/L		
<b>Volatiles organic compounds(VOC)</b>	479	EPA 524.2		Ascorbic acid, Cool 4 C, HCL pH<2, no headspace, For residual Cl, add 25 mg C6H8O6	14 Days
Benzene			0.5 µg/L		
Carbon tetrachloride			0.5 µg/L		
Chlorobenzene			0.5 µg/L		
1,2-Dichlorobenzene (o-DCB)			0.5 µg/L		
1,4-Dichlorobenzene (p-DCB)			0.5 µg/L		
<b>PARAMETERS</b>	<b>DLS* TEST CODE</b>	<b>STANDARD METHOD</b>	<b>DETECTION LEVEL</b>	<b>PRESERVATIVE</b>	<b>HOLDING TIME</b>
1,2-Dichloroethane			0.5 µg/L		
1,1-Dichloroethylene			0.5 µg/L		
cis-1,2-Dichloroethylene			0.5 µg/L		
Ethylbenzene			0.5 µg/L		
Dichloromethane (methylene chloride)			1.0 µg/L		
1,2-Dichloropropane			0.5 µg/L		
trans-1,3-Dichloropropene			0.5 µg/L		
Styrene			0.5 µg/L		
Tetrachloroethylene			0.5 µg/L		
Toluene			0.5 µg/L		
1,2,4-Trichlorobenzene			0.5 µg/L		
1,1,1-Trichloroethane			0.5 µg/L		
1,1,2-Trichloroethane			0.5 µg/L		
Trichloroethylene			0.5 µg/L		

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PARAMETERS	DLS TEST CODE	STANDARD METHOD (SM)	DETECTION LEVEL	PRESERVATIVE	HOLDING TIME
Trihalomethanes, total (TTHM)			0.5 µg/L		
Vinyl chloride			0.5 µg/L		
Xylene, total			0.5 µg/L		
2,3,7,8-TCDD (Dioxin)	1109	EPA 1613A		Cool 4 C, no light exposure	7 Days
<b>Pesticides, polychlorinated biphenyls, and herbicides</b>					
Carbamates (CARB)	492	EPA 531.1		pH<3 (Monochloroacetic acid), no headspace, Cool 4 C	28 Days
Aldicarb			3 µg/L		
Aldicarb sulfone			2 µg/L		
Aldicarb sulfoxide			2 µg/L		
Carbofuran			4 µg/L		
Oxamyl (Vydate)			4 µg/L		
Diquat	821	EPA 549.1	10 µg/L	pH<2(h2SO4), Cool 4 C, For residual Cl, add 100 mg Na2S2O3, no light exposure	7 Days
Endothall	820	EPA 548.1	20 µg/L	Cool 4 C, no headspace	7 Days
Glyphosate	822	EPA 547	50 µg/L	Cool 4 C, no headspace, For residual Cl, add 4 mg Na2S2O3	14 Days
Pesticides/Herbicides - (neutral)	1123	EPA 507/508		Cool 4 C, For residual Cl, add 60 mg Na2S2O3	14 Days
Alachlor			0.8 µg/L		
Atrazine			0.8 µg/L		
Chlordane			0.05 µg/L		
Endrin			0.05 µg/L		
Heptachlor			0.05 µg/L		
Heptachlor epoxide			0.05 µg/L		
gamma-HCH (BHC) - Lindane			0.05 µg/L		
Methoxychlor			0.4 µg/L		
PCB's			0.05 µg/L		
Simazine			0.8 µg/L		
PARAMETERS	DLS TEST CODE	STANDARD METHOD	DETECTION LEVEL	PRESERVATIVE	HOLDING TIME

**USACHPPM DRAFT TG 251**

PARAMETERS	DLS TEST CODE	STANDARD METHOD (SM)	DETECTION LEVEL	PRESERVATIVE	HOLDING TIME
Toxaphene			1 µg/L		
Organochlorine Pesticides	519	EPA 504.0		pH<2 (HCL), Cool 4 C, no headspace, For residual Cl, add 3 mg Na2S2O3	28 Days
1,2-Dibromo-3-chloropropane (DBCP)			0.02 µg/L		
Ethylene dibromide (EDB)			0.02 µg/L		
Herbicides - (acidic)	1002	EPA 515.1		Cool 4 C, For residual Cl, add 80 mg Na2S2O3	14 Days
2,4,5-TP			0.1 µg/L		
2,4-D			0.3 µg/L		
Dalapon			1.5 µg/L		
Dinoseb			0.2 µg/L		
Pentachlorophenol (PCP)			0.1 µg/L		
Picloram			0.3 µg/L		
<b>Radiochemicals</b>					
Gross Alpha	763	STD AB001	2 pCi/L*	pH<2 (HNO3)	6 months
Gross Beta	763	STD AB001	1 pCi/L	pH<2 (HNO3)	6 months
Combined Radium 226 & 228	574/575	STD R6001/R8001	0.1/1 pCi/L	pH<2 (HNO3)	6 months
Strontium-90	581	STD S9001	1 pCi/L	pH<2 (HNO3)	6 months
Uranium	586	STD U_002	1 µg/L	pH<2 (HNO3)	6 months
Tritium	583	STD H_002	600 pCi/L		6 months

\*SM: Standard method

\* µmhos/cm: microhos per centimeter

\* DLS: USACHPPM Directorate of Laboratory Services

\* pCi/L: picocuries per liter

## APPENDIX 5-2 DEPLOYMENT FIELD WATER TEST KIT INSTRUCTIONS

### 5-2.1 Purpose.

To provide guidance to Medical Detachment or preventive medicine service personnel on the collection of potable water sampling using the USACHPPM deployment potable water sampling kit.

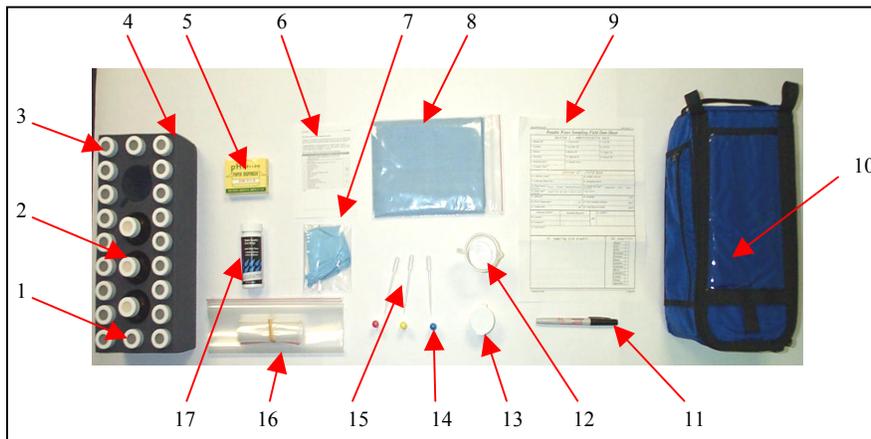
### 5-2.2 Sampling Equipment

The water kit sampling kit contains pre-preserved containers, blanks, preservatives, and administrative items. Table 5-2-1 and Figure 5-2-1 outlines the contents of one deployment potable water sampling kit. All containers and items are new, and should be used only once. The kit will either be contained in a cooler or bag.

**Table 5-2-1. Inventory of Equipment in Deployment Potable Water Sampling Kit**

ITEM #	ITEM DESCRIPTION	QUANTITY
1	40 ml glass containers ((Diquat\Paraquat , Glyphosate/Carbomates, SVOC, VOC, Tritium, Herbicides, Pesticides, EDB/DBCP, Endothall, Cyanide, TOC*, Nitrate/Nitrite, Total Phosphate, MBAS, Asbestos)	16
2	125 ml glass containers (Metals, Gross Alpha/Beta, Alkalinity, pH, Color, Conductivity, TDS, Chloride, Sulfate)	3
3	Blanks - 40 ml glass containers (Diquat\Paraquat, EDB\DBCP*, SVOC, VOC)	4
4	Foam Insert with cover	1
5	Water Sampling Field Data Sheet	1
6	Water Sampling Bag (Blue)	1
7	Water Sampling Instructions	1
8	Preservative Holder	1
9	Pipettes - [if required]	3
10	Sample pitcher (100 ml)	1
11	Dropper bottle or ampule of hydrochloric acid (HCl)	1
12	Permanent Marker	1
13	Re-closable plastic bags (5" x 10") & (9" x 15")	4 each
14	Nitrile Gloves	1 pair
15	Chlorine Paper	1 package
16	pH Paper	1 package
17	Wipes	2

\* EDB/DBCP: ethylene dibromide/dibromochloropropane

**Figure 5-2-1****5-2.3 Water Sources****5-2.3.1 Source Water**

Raw water prior to any treatment (e.g. well water, surface water, etc)

**5-2.3.2 Treated Water**

Water after it passes through a typical type of treatment such as a ROWPU prior to distribution.

**5-2.3.3 Distribution System**

Water collected at representative points in the distribution system. Sampling at the dead end of a distribution line should be avoided.

**5-2.4 Field Data Sheet.**

The sample collector is responsible for filling out the “Potable Water Sampling Field Data Sheet” included in each sampling kit. The data sheet should be completed and the original returned with the sample in a supplied re-closable plastic bag. A copy should be maintained by the sample collector for future reference.

**5-2.5 General Sample Collection.**

The potable water sampling kit is capable of testing for all regulated environmental contaminants (organic, inorganic, and radiological). The kit is not designed to analyze for bacterial analysis, bacterial analysis should be conducted on site. Samples can be collected from potable water sources or sources of potential potable water.

Generally there are two types of water sample point configurations. Closed source and open source.

**5-2.5.1 Closed Water Source**

A closed water source (e.g., municipal system, ROWPU outlet) is usually accessed through a utility spigot or faucet. To collect a sample from this configuration turn the spigot or faucet on, and allow the water to run at a moderate flow for 3 to 5 minutes. This will clear out water that may have been standing in the plumbing system and should begin a draw of water directly from the source or pipe main. A way to assure the withdrawal of water from the source or pipe main is to monitor the temperature. Once the temperature has stabilized, samples can be taken. If the water flow is too great to fill the containers without spillage or overflow use the included sampling pitcher to collect

the water from the source and transfer into the sampling kit containers.

### 5-2.5.2 Open Water Source

Open water source (e.g., lakes, ponds, rivers) usually do not have a utility spigot or faucet access. To collect the sample from this configuration use the included sampling pitcher to collect the water from the source and transfer into the sampling kit containers.

### 5-2.6 Sample Collection Procedure.

1. Identify sampling point.
2. Remove foam insert, nitrile gloves, wipes, pitcher, permanent marker, “Potable Water Field Data Sheet”, preservatives and pipettes from shipping container.
3. Record the following on the “Potable Water Field Data Sheet” according to the instructions on the back of the data sheet:
  - “Administrative” Section—
    - Sample ID
    - Sampling Date
    - Sampling Time
    - Collected By
  - “Field Data” Section—
    - Collectors Name
    - Collectors Phone No
    - Water Source
    - Water Type
    - Geolocation
4. Put on provided nitrile gloves and remove wipes from plastic bag.
5. Using the included pH and chlorine test strips record the *pH* and *Free Available Chlorine* on the on the “Potable Water Field Data Sheet”. If other testing instrumentation is available record Temperature, Conductivity or TDS and Turbidity. [Figure 5-2-2].
6. Fill and label the provided containers one at a time from the water source by following steps 7 through 14.
7. Remove container from foam insert. [Figure 5-2-3]



Figure 5-2-2



Figure5-2-3

8. Carefully unscrew the container cap ensuring the cap is placed in a matter to avoid contamination [Figure 5-2-4].



Figure 5-2-4

9. Fill container slowly to avoid splashing [Figure 5-2-5 and 5-2-6].



Figure 5-2-5



Figure 5-2-6

10. Completely fill the container ensuring it is not over filled.

11. For filling the VOC, Endothall, and Glyphosates containers follow these additional steps

– VOC, Endothall and Glyphosate containers must be collected carefully to avoid the presence of air bubbles in the containers. Pour sufficient sample into the containers to form a reverse meniscus (rounded surface) at the top of the container. [Figure 5-2-7]

– For the VOC container ONLY, after the container is filled with sample and reverse meniscus obtained, add 3 drops of hydrochloric acid (HCl) either from the provided dropper bottle or from ampule using the provided pipette. [Figure 5-2-8]



Figure5-2-7



Figure5-2-8

12. Carefully replace the container cap hand tight. Some sample liquid may be expelled from the container when the cap is tightened. Invert the sample container a several times to effect preservative mixing. [Figure 5-2-9]



Figure 5-2-9

13. For the VOC, Endothall and Glyphosate containers ensure that no air bubbles remain in the sample. To check this turn the capped container upside down and tap the side lightly (with the palm of your hand) to force any bubbles to rise. If bubbles are present, remove the cap (do not empty the container) and add enough water to remove the headspace at the top of the container. [Figure 5-2-10]



Figure 5-2-10

14. Complete the container label using the supplied permanent marker and the following guidelines. [Figure 5-2-11]

PROJECT:	47-24-2606-99	Optional Data either completed by laboratory or entered in the field: <i>Project, Installation, POC</i>
INSTALLATION:	Camp Bondsteel	
POC:	Hutchens	Required Data: <i>Sample #, Date Collected, Time Collected</i>
SAMPLE #:	APG_01W_99246	
DATE COLLECTED:	03 SEP 1999	Pre-labeled Data: <i>Sample Preserved, Analysis Required</i>
TIME COLLECTED:	1500	
SAMPLE PRESERVED:	25 mg ascorbic acid / 5 drops 1:1 HCl	
ANALYSIS REQUIRED:	VOC	

Figure 5-2-11 Example Water Sample Label

– All sample containers should be pre-labeled. Each label will have the Preservative and Analysis Required fields completed. The POC and Project Number field should also be completed if containers were prepared for a specific sampling mission. If these field are not complete enter the name of the collector in the *POC* field and operation name in the *Project Number* field

– The sampling personnel are responsible for recording the *Sample #, Date Collected* and *Time Collected*. If the *Installation* field is not completed on the sample label the camp name should be recorded.

15. Replace container in foam insert.

16. Repeat steps 1 though 16 for each of the sampling containers.

17. Blanks. As part of the Quality Control/Quality Assurance (QA/QC) procedures for the analysis, EDB/DBCP, Diquat/Paraquat, SVOC and VOCs blanks (40-milliliter containers already filled with water from the USACHPPM laboratory) are included in the sampling kit. Keep the blanks with the sample containers at all times, in storage and in the field. **DO NOT**

Figure 5-2-7

**OPEN THEM AT ANY TIME.****5-2.7 PACKAGING OF SAMPLES.**

1. Ensure that all containers are labeled completely and accurately.
2. Ensure that the caps are placed securely on each of the sample containers.
3. Place containers in the foam insert in which they arrived.
4. Place the foam insert and cover into the included large plastic bag and seal it with tie.
5. Place the bagged foam insert into the blue water pack.
6. Fold original “Potable Water Field Data Sheet “ and place in the original re-closable plastic bag. Then place in the slip pocket on the outside tip of the bag.
7. Place insert in cooler.
8. Place ice or ice packs in cooler; **(DO NOT use dry ice)**.
9. Seal and secure cooler with tape.
10. Place return address (Collectors Address) in the top left hand corner of the sampling pack or cooler and address it to the following:

Gerri Miles  
USACHPPM  
ATTN: MCHB-DC-LLI, Bldg E-2100  
5158 Blackhawk Road  
Aberdeen Proving Ground, MD 21010-5422  
PHONE: (410) 436-3269

**5-2.8 SHIPPING OF SAMPLES.**

Samples should be transported from the field as soon as possible to ensure holding times are met. Transportation is usually accomplished by a major carrier such as Federal Express or United Parcel Service. However, if these services are not available, U.S. Postal or military shipping should be arranged.

**5-2.9 POINT OF CONTACTS.**

Questions and/or comments concerning the deployment potable water sampling kit should be referred to the USA-CHPPM, Deployment Environmental Surveillance, at DSN 312-584-6096 or commercial 410-436-6096 or by email at [Brad.Hutchens@apg.amedd.army.mil](mailto:Brad.Hutchens@apg.amedd.army.mil).

USACHPPM-DESP

PW-FDS-V1

## Potable Water Sampling Data Sheet

<b>Section I – Administrative Data</b>																													
1. Sample ID*:	7. Collected By*:	11. Lab ID:																											
2. Location:	8. Unit Spec ID:	12. Job No:																											
3. Country:	9. Mission ID:	13. Project No:																											
4. Operation:	10. Shipping ID:	14. Europe ID:																											
5. Sampling Date*:	15. Sample Notes:																												
6. Sampling Time*:																													
<b>Section II – Field Data</b>																													
16. Collectors Name*		20. Sample Amount:																											
17. Collectors Phone #*		21. Sampling Device:																											
18. Water Source*: <small>(Circle One)</small> Source / Treated / Distribution System		22. Sample Kit Type* <small>(Circle One)</small> Deployment / EPA / DREL																											
19. Water Type* <small>(Circle One)</small> RWW / TW / RS / DS / T / FD / F / WC																													
23. Initial pH:	26. Turbidity:		NTU																										
24. Water Temperature:	oC	27. Free Available Chlorine:	mg/L																										
25. Conductivity:	mV	28. Total Dissolved Solids	mg/L																										
GEOLOCATION	Degree	Minute	Decimal Degrees																										
29. Latitude*:																													
30. Longitude*																													
31. MGRS																													
32. Field Notes*																													
33. Sampling Site Graphic		34. Analysis <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>Metals:</td><td><input type="checkbox"/></td></tr> <tr><td>VOC:</td><td><input type="checkbox"/></td></tr> <tr><td>SVOC:</td><td><input type="checkbox"/></td></tr> <tr><td>Herbicides:</td><td><input type="checkbox"/></td></tr> <tr><td>Pesticides:</td><td><input type="checkbox"/></td></tr> <tr><td>Diquat:</td><td><input type="checkbox"/></td></tr> <tr><td>Endothall:</td><td><input type="checkbox"/></td></tr> <tr><td>Glyphosate:</td><td><input type="checkbox"/></td></tr> <tr><td>MBAS:</td><td><input type="checkbox"/></td></tr> <tr><td>EDB/DBCP:</td><td><input type="checkbox"/></td></tr> <tr><td>Cyanide:</td><td><input type="checkbox"/></td></tr> <tr><td>Tritium:</td><td><input type="checkbox"/></td></tr> <tr><td>Alpha/Beta:</td><td><input type="checkbox"/></td></tr> </table>		Metals:	<input type="checkbox"/>	VOC:	<input type="checkbox"/>	SVOC:	<input type="checkbox"/>	Herbicides:	<input type="checkbox"/>	Pesticides:	<input type="checkbox"/>	Diquat:	<input type="checkbox"/>	Endothall:	<input type="checkbox"/>	Glyphosate:	<input type="checkbox"/>	MBAS:	<input type="checkbox"/>	EDB/DBCP:	<input type="checkbox"/>	Cyanide:	<input type="checkbox"/>	Tritium:	<input type="checkbox"/>	Alpha/Beta:	<input type="checkbox"/>
Metals:	<input type="checkbox"/>																												
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Endothall:	<input type="checkbox"/>																												
Glyphosate:	<input type="checkbox"/>																												
MBAS:	<input type="checkbox"/>																												
EDB/DBCP:	<input type="checkbox"/>																												
Cyanide:	<input type="checkbox"/>																												
Tritium:	<input type="checkbox"/>																												
Alpha/Beta:	<input type="checkbox"/>																												

\* Required Fields

11-Feb-00

CHPPM-DESP

*Bold Items are required entries*

## POTABLE WATER SAMPLING FIELD DATA SHEET INSTRUCTIONS

### -----SECTION I - ADMINISTRATIVE DATA-----

1. **Sample ID** - Sample ID number XXX\_YYY\_DDDDD  
Where: XXX – Camp or location abbreviation (i.e. first three letters of camp or location name)  
YYY – Water sample number for that camp on that particular day (e.g. 01W, 02W, 03W, etc)  
DDDDD - jday code, last two digits of the year & three digit julian day of the year [e.g 00001 for 1-Jan-2000].
2. Location – Camp or location of sample
3. Country – Country in which location or camp is located.
4. Operation – Name of operation ongoing in the area of the sample [e.g. Operation Allied Force (OAF), etc] if applicable
5. **Sampling Date** – Date sample was collected (e.g. 01-Jan-2000)
6. **Sampling Time** – Time sample was taken (e.g. 16:00)
7. **Collected By** - Unit collecting the sample (e.g. TAML, 71<sup>st</sup> MEDDET, etc).
8. Unit Spec ID – Unit specific ID associated with the sample if any.
9. Mission ID – Unit mission ID associated with the sample if any.
10. Shipping ID – Shipping ID associated with sample (e.g. Fedex tracking number)
11. Lab ID – Unique ID number assigned at CHPPM-Main laboratory, if applicable.
12. Job No. – Job number assigned at laboratory.
13. Project No. – Project number assigned by laboratory or project officer.
14. Europe ID - Unique ID number assigned at CHPPM-Europe laboratory, if applicable.
15. **Sampling Notes** – Any notes or comments associated with the sample (e.g. short holding time, unusual circumstances, etc).

### -----SECTION II - FIELD DATA-----

*Note: The Sample ID, Sampling Date, and Sampling Time at minimum should also be recorded on the sample label.*

16. **Collectors Name** – The name of the person collecting the sample.
17. **Collectors Phone No** - The phone number of the person collecting the sample.
18. **Water Source:**  
Source Water - Raw water before treatment  
Treated Water - Collected after the water passes through a typical type of treatment such as a ROWPU  
Distribution System - Collected at representative points in the distribution system
19. **Water Type:**  
**RWW** - Raw Well Water                      **DS** - Distribution System              **F** – Flushed  
**TW** - Treated Water                          **T** – Tap                                      **WC** - Water Coolers  
**RS** - Raw Surface                              **FD** - First Draw
20. **Sample Amount** – Amount of sample collected if sample is not part of a kit.
21. **Sampling Device** – The device used to collect the sample if a unique device was used.
22. **Kit Type** – Type of collection kit used.  
Deployment kit – Deployment sampling kit  
EPA Kit – Regular EPA sampling kit  
Other – Sample collected or analyzed by other kits or methods, explain
23. **Initial pH** – The initial pH of the water before the sample is taken or before preservatives are added, if known
24. **Water Temperature** – The initial ambient temperature of the water being sampled, if known
25. **Conductivity** – The initial conductivity of the water being sampled, if known
26. **Turbidity** – The initial turbidity of the water being sampled, if known
27. **Free available chlorine** – The initial free-available chlorine (FAC) of the water being sample, if known
28. **Total dissolved solids** – The initial total-dissolved-solids (TDS) of the water being sampled, if known
29. **Latitude** – Sample latitude location in decimal degrees [from GPS]
30. **Longitude** – Sample longitude location in decimal degrees [from GPS]
31. **MGRS** – Location in Military Grid Reference System (MGRS) from GPS, ten digit grid with grid square identifier (e.g. BQ1234567890)
32. **Field Notes** - Notes relating to sampling episode (e.g. unusual circumstance, weather, potential pollution sources, etc)
33. **Sampling Site Graphic** – Any graphical or pictorial description of the sampling site. May include a digital picture of the sampling site once sample is processed.
34. **Analysis** – Check boxes for laboratory analysis, if no boxes are checked it will be assumed all laboratory analysis are requested.

16-May-00

Water\_Datasheet\_instructions\_V1.11

### 5.2.2 Container Description and Preservative Requirements

Container ID	Sampling Group	Preservative for pH	Amount	Preservative Residual CL	Amount	Volume (ml)	Holding Time
1*	Diquat/Paraquat	pH<2 Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> )	3 drops	Sodium Thiosulfate (Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> )	3 mg	40	7 days
2*	Glyphosate/Carbamates	pH<3, 1.2 ml monochloroacetic acid		Sodium Thiosulfate (Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> )	3 mg	40	14 days
3*	Herbicides			Sodium Thiosulfate (Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> )	3 mg	40	14 days
4*	Pesticides			Sodium Thiosulfate (Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> )	3 mg	40	7 days
5*	EDB/DBCP			Sodium Thiosulfate (Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> )	3 mg	40	14 days
6*	Endothall			Sodium Thiosulfate (Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> )	3 mg	40	7 days
7*	Cyanide (Total)	pH>12 Sodium hydroxide (NaOH)	5 drops	Ascorbic acid (C <sub>6</sub> H <sub>8</sub> O <sub>6</sub> )	24 mg	40	14 days
8*	TOC	pH<2 Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> )	5 drops			40	28 days
9*	Nitrite/Nitrate	pH<2 Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> )	5 drops			40	28 days
10	Cyanide (Free)	pH>12 Sodium hydroxide (NaOH)	5 drops	Ascorbic acid (C <sub>6</sub> H <sub>8</sub> O <sub>6</sub> )	24 mg	40	14 days
11*	MBAS					40	48 hours
12*	SVOC (Un-Chlorinated)	pH<2, 1:1 Hydrochloric acid (HCL)	3 drops			40	14 days
13*	SVOC (Chlorinated)	pH<2, 1:1 Hydrochloric acid (HCL)	3 drops	Sodium sulfite (Na <sub>2</sub> SO <sub>3</sub> )	25 mg	40	14 days
14*	VOC (incl TTHM)	pH<2, 1:1 Hydrochloric acid (HCL)	3 drops	Ascorbic acid (C <sub>6</sub> H <sub>8</sub> O <sub>6</sub> )	25 mg	40	14 days
15*	Tritium					40	na
16*	Chloride, Fluoride, Sulfate					40	48 hours
17*	Metals (incl Mercury), Turbidity, Hardness	pH<2, Nitric acid (HNO <sub>3</sub> )	15 drops			125	28 days
18*	Gross Alpha/Beta	pH<2, Nitric acid (HNO <sub>3</sub> )	15 drops			125	na
19*	Alkalinity, pH, Color, Conductivity, TDS					125	48 hours
20	Blank (EDB\DBCP)					40	
21	Blank (Diquat/Paraquat)					40	
22	Blank (SVOC)					40	
23	Blank (VOC)					40	

**APPENDIX 5-3****INTERIM FIELD WATER SAMPLING KIT AND ANALYSIS INSTRUCTIONS****5-3.1 PURPOSE**

This standardized document provides quality control (QC) guidelines for field water sampling to meet the field water standards of TB MED 577. It provides guidance to the Medical Detachment or preventive medicine service personnel on field water sampling using the USACHPPM field water sampling kit.

The guide can also serve as a training and reference document for the Medical Detachment or preventive medicine service personnel.

**5-3.2 SAMPLE LOCATIONS**

There are 3 locations to collect water samples in the field—

**5-3.2.1 Source water**

Raw water prior to any treatment.

**5-3.2.2 Treated water**

Water after some type of treatment [e.g., ROWPU or chlorination] and before the distribution system.

**5-3.2.3 Distribution water**

Water from representative points in the distribution system. (TTHM, HAA5, lead and copper sampling, bacteriological, and asbestos).

**5-3.3 TYPE OF SAMPLING****5-3.3.1 Health Monitoring**

Health monitoring is weekly microbiological and limited chemical monitoring for chlorine residual and pH. Sampling will be performed on distribution system water from tanks or distribution lines away from the point of production.

**5-3.3.2 Field Water Testing**

Field water testing is done during the water point reconnaissance, on the initial treated water before consumption, and semi-annually on the treated water. Sampling will be performed on the source water and on the treated water at the entry point to the distribution system. Treated water samples will be taken from available taps on storage tanks or distribution lines at or near the point of production.

**5-3.3.3 Environmental Surveillance**

Environmental surveillance is a comprehensive laboratory analysis performed on water samples taken in the field and shipped to a certified lab. Sampling will be performed on treated water from available taps on storage tanks or distribution lines at or near the point of production. Procedures for this are provided in the Deployment Environmental Surveillance Program Water Sampling Kit Instructions.

## **5-3.4 EQUIPMENT**

### **5-3.4.1 General Equipment**

1. Foil hood. A foil hood is required to protect bottle from contamination from an outside source
2. Containers used for various chemical analyses should be clean and triple rinsed with the sample water before use. Sterile containers are not necessary.

### **5-3.4.2 Health Monitoring Equipment**

1. Prepared sample bottle
2. Ice chest if more than 1 hour will elapse between collection and examination of bacteriological samples
3. Non-H<sub>2</sub>O soluble writing instrument (to label sample)
4. DD Form 686, *Fluoride/Bacteriological Examination of Water*.
5. Chlorine Test Kit
6. pH Test Kit or tester
7. Thermometer
8. Microbiological Test Kit or HPC Total Count Sampler and magnifying glass for swimming pools

### **5-3.4.3 Field Water Testing Equipment**

1. All health monitoring sampling equipment (Section 5-3.4.1)
2. TDS or conductivity tester
3. Turbidimeter
4. M272 Chemical Agent Test Kit
5. Test kits to determine arsenic, cyanide, chloride, magnesium (hardness), and sulfate levels in water
6. Laboratory sample kit for lindane and gross radiological contamination

## **5-3.5 SAMPLE CONTAINER PREPARATION FOR MICROBIOLOGICAL ANALYSIS**

### **5-3.5.1 Sample bottle**

1. Minimum capacity of 120 ml, wide mouth, with intact caps
2. Sterile plastic or glass. Colilert plastic bottles come sealed with thiosulfate
3. Ensure there are not chips, cracks, or etched surfaces
4. Ensure bottle material does not inhibit bacterial growth
5. Give the bottle a final rinse with distilled water if not sterile and/or sealed

**5-3.5.2 Whirlpak®**

1. Ensure sterility
2. Comes with or without sodium thiosulfate
3. Needs no autoclave
4. Arrives from factory ready to use

**5-3.5.3 Sodium thiosulfate for bacteria samples**

1. Dechlorinating agent
2. Prepare 10% solution
3. Add 0.1 ml of 10% sol to 120-ml bottle with a pipette

**5-3.6 SAMPLE COLLECTION SITE CRITERIA**

1. Ensure line is directly from main and not a storage tank unless testing storage tank water
2. Faucet is clean, uncorroded, and not leaking
3. Without aerators\screens, filtering device, or internal threads if possible
4. Not from mixing faucet, if avoidable
5. Not from a dead-end line or fire hydrant
6. Cold water tap only
7. Not from drinking fountains

**5-3.7 Field measurements.**

When collecting samples, you should take the following field measurements:

- 1) PH
- 2) Temperature
- 3) Free available chlorine (FAC) residual

Also, measure conductivity or total dissolved solids and turbidity if you have the capabilities to do them. The equipment necessary to do these measurements is pictured in Figure 1. Record the measurements and the grid coordinates where the samples were collected on the field water data sheet in Appendix 5-2, TBMED 577, or other water quality log. Also record any unusual conditions present, such as the presence of a scum or film on the water, debris or garbage in or around the water, and industrial or agricultural activity in the area. The severity of any unusual conditions should be rated L, M, or H based on the judgement of the sampler.

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Whirlpak® is a registered trademark of Nasco Products, Fort Atkinson, Wisconsin.



**Figure 5-3-1. Interim Field Water Test Kit Assembled Water Quality Field Set.**

Item Number	Description
1	CO-1 Color Disk Test
2	Pocket Pal Thermometer
3	Pocket Turbidimeter
4	HAC-DT Total Hardness and Calcium Test
5	Test SF-1 Sulfate Kit (0 – 200 mg/L, range)
6	MEL P/A Safe Drinking Water Lab
7	Test Kit Carrying Case Style J
8	Chlorine/pH Color Comparator
9	EM Quant Arsenic Test Kit
10	EM Quant Cyanide Test Kit
11	EM Quant Sulfate Test Strips (200 – 1600 mg/L, range)
12	EM Quant Chloride Test Strips

**5-3.7.1 Chlorine.**

The most common FAC test is the DPD or color comparator kit. Most kits also come with a pH color comparator test.

1. Triple rinse the test tubes with the sample water then fill to mark
2. Add one DPD #1 tablet (Aseptically)

3. Rinse the rod and crush the tablet
4. Rinse the cap and cap the tube and shake it to dissolve the tablet
5. Immediately insert the tube in the comparator and match the color of the sample with the color standards. Color matching should be completed within 1 minute once the tablet has been added.
6. Total available chlorine (TAC) is measured using the same procedures, substituting the DPD #4 tablet (TAC) for the DPD #1 tablet.
7. Combined available chlorine (CAC) is found by subtracting the FAC from the TAC—

$$\text{CAC} = \text{TAC} - \text{FAC}$$

### 5-3.7.2 pH.

The pH of water can be determined by a color comparator test kit or using a direct reading pH meter. A pH meter must be properly calibrated **BEFORE** deployment and each time it is turned off. Standard solutions for pH 4.0, 7.0, and 10.0 are used to calibrate the meter in the field.

Procedure 1: pH can be determined with the color comparator by using the same procedures for chlorine (see paragraph 7a), substituting a phenol red tablet for the DPD #1 tablet.

Procedure 2: pH is determined with an electronic meter using the following procedures:

1. Calibrate the pH meter using solutions that bound the expected range of the sample (i.e., 4.0 and 7.0 pH solutions or 7.0 and 10.0 pH solutions). Start with the 7.0 pH solution first.
2. Rinse pH meter probe in deionized, sterile, or distilled water.
3. Fill a sterile, wide-mouth sample bottle or beaker with at least 100 ml of water.
4. Place pH meter electrode in sample, allow the reading to stabilize, and take the reading.

### 5-3.7.3 Temperature.

Temperature measurement can be taken with a standard or direct reading electronic thermometer. Thermometers must be properly calibrated or certified **BEFORE** deployment.

1. Open valve/tap/spigot and allow water to flow freely.
2. Place thermometer in water, allow the reading to stabilize, and take the reading.

### 5-3.7.4 Total Dissolved Solids.

TDS levels can be measured with a direct reading electronic meter. A TDS meter should be properly calibrated **BEFORE** deployment, but can be calibrated in the field using a known TDS standard solution. When calibrating a TDS meter, always start with the lowest TDS solution and work up to the highest TDS solution. You can also measure TDS with a conductivity meter. Follow the same procedures and use the conversion equation below:

$$\text{TDS (mg/L)} = \text{Conductivity } (\square\text{mhos/cm}) \times 0.64$$

1. Rinse TDS meter probe in deionized, sterile, or distilled water.
2. Fill a sterile, wide mouth sample bottle or beaker with at least 100 ml of water.
3. Place TDS meter electrode in sample, allow the reading to stabilize, and take the reading.

### 5-3.7.5 Turbidity.

Turbidity can be measured with a direct reading electronic turbidimeter. A turbidimeter should be properly calibrated **BEFORE** deployment, but can be calibrated in the field using a series of known turbidity standard solutions or gels. Each turbidimeter is slightly different. Always follow calibration instructions that are shipped with the turbidimeter.

1. Rinse turbidimeter sample vial in deionized, sterile, or distilled water.
2. Fill the sample vial to the line with water to be tested. Clean outside of sample vial with wipes.
3. Place sample vial in turbidimeter, cover the vial to prevent light from entering the meter, and take the reading.

### **5-3.7.6 Chemical Properties Testing.**

#### **5-3.7.6.1 Arsenic, cyanide, chloride, and sulfate**

These COCs are measured using a DREL spectrophotometer or the EM Science Test Kits that come with the WQAS-PM. The test kits can also be purchased separately.

#### **5-3.7.6.2 Lindane**

To test for lindane, PM personnel must take a sample and ship it to a certified lab for analysis. Lindane sampling is covered in the Deployment Environmental Surveillance Program Water Sampling Kit Instructions under pesticides.

#### **5-3.7.6.3 Magnesium**

Magnesium is tested using a hardness titration test. The titration test is performed twice, once using the reagents to determine calcium hardness as calcium carbonate, and once to determine total hardness as calcium carbonate. The difference between calcium hardness and total hardness is the magnesium hardness:

$$\text{Magnesium Hardness (mg/L)} = \text{Total Hardness (mg/L)} - \text{Calcium Hardness (mg/L)}$$

Magnesium hardness levels are converted to true magnesium levels using the following formula:

$$\text{Mg (mg/L)} = \text{Magnesium Hardness (mg/L)} \times 0.2431$$

1. Fill a sterile, wide mouth sample bottle or beaker with 100 ml of water. (This amount can vary from 25 – 500 ml depending on the specific test kit used and the anticipated hardness level of the water. This test may have to be performed more than once using different assumptions before a result is obtained.
2. Mix the proper reagent from the kit into the sample. Ensure complete mixing. This is important; the result depends on a color change in the sample. If incomplete mixing occurs, the color change may not occur, or can occur with inaccurate results.
3. Select the proper titration chemical concentration. If using a digital titrator, reset device and attach the titration tube and chemical. If titrating manually, pipette 10-ml titration chemical into a small syringe or pipette.
4. Hold or place sample bottle/beaker on a stirring plate in front of a solid white background. Slowly add titration chemical drop by drop, swirling or stirring mixture as the chemical is added. Count the drops until a color change takes place. The exact color will depend on the test. Most common colors are from dark purple to sky blue.

5. Use the conversion formula for the specific kit to convert the number of drops to a calcium hardness concentration as calcium carbonate.
6. Repeat steps (1) – (5) to determine total hardness. Then use the conversion equations to determine magnesium concentration.

#### **5-3.7.7 Chemical Agent Testing.**

Chemical agents are monitored using the M272 Chemical Agent Test Kit. Follow the instructions on the box to determine if hazardous concentrations of hydrogen cyanide, lewisite, sulfur mustard, or nerve agents are present in the water. The M272 kit will not give a quantitative result; it will only tell whether or not hazardous levels of the tested chemical exist.

#### **5-3.7.8 Microbiological Testing**

Only preventive medicine personnel with the proper training should conduct microbiological testing using the membrane filter test. However, with basic instruction the Colilert presence/absence test can be conducted by personnel who otherwise have limited laboratory experience.

1. Equipment: Treated water sample collection (using Colilert sample bottle)
2. Allow tap to flow freely for 2 – 3 minutes to allow clearing of service line if non-mixing faucet is used. Flow should be 5 – 7 minutes if a mixing faucet is used.
3. Fill out DD Form 686
4. Perform FAC, TAC and pH tests
5. Enter results on DD Form 686
6. Reduce water flow to a level that allows filling the container without splashing
7. Remove cap aseptically
8. Hold bottle near base
9. Fill sample bottle
10. Do not overfill bottle
11. Allow an air gap of one half inch ( $\frac{1}{2}$ " )
12. Do not flush out sodium thiosulfate Replace cap without touching the inside surfaces of either the cap or the bottle.
13. Label sample to correspond to number on DD Form 686
14. Swimming pool sample collection
15. Use SPC Sampler for quantitative results.
16. Collect sample from shallow and deep ends for pools using a Colilert sample bottle or Whirl-Pak bag with a dechlorination agent.
17. Remove cap aseptically
18. Hold bottle near base
19. Plunge sample bottle 6 inches below surface of water at a 45-degree angle; avoid collecting surface scum.

20. Hold bottle with mouth or opening always ahead of hand and move bottle forward. This is done so that water will enter the case before passing over the hand (creating an artificial flow).
21. Tear open poly bag. Remove the paddle from its clear plastic case while avoiding membrane contact with hands or other objects.
22. Transfer the sample from the bottle to the HPC Total Count Sampler case. Fill case with the sample liquid to the upper scored mark (18 ml). Reinsert paddle, immersing completely. Leave in place for 30 seconds.
23. Remove paddle, shake off excess liquid from membrane, discard sample from case. Reinsert paddle firmly into the case.
24. Perform FAC, TAC, and pH and record on DD Form 686

#### **5-3.7.9 Raw water sample collection**

1. Equipment: Same equipment as potable water sample.
2. Take a representative sample at least 25 feet from shore in water at least 2 ½ feet deep. Collect as close to the center of stream/river flow as possible, a boat may be required.
3. Avoid stagnant areas in streams/ivers.
4. Plunge sample bottle 6 inches below surface of water at a 45-degree angle; avoid collecting surface scum. Do not disrupt soil of river or lakebed.
5. Hold bottle with mouth or opening always ahead of hand and move bottle forward. This is done so that water will enter the case before passing over the hand (creating an artificial flow).
6. Leave a ½-inch air gap at the top of the bottle.
7. Perform FAC, TAC, and pH and record on DD Form 686.
8. Maximum holding time
  - 1 hr for unrefrigerated samples
  - Refrigerated samples (ice) – 6 hr
9. If sample mailed
  - No more than 30 hrs should elapse before analysis
  - Shipped in thermos-type insulated container
  - Do not use dry ice
  - If more than 30 hours have elapsed, but less than 48 hours, the lab may run the water sample with the requirement that the data is indicated to be possibly invalid
  - In the event that greater than 48 hours have elapsed, the laboratory must refuse the water sample as unsuitable for analysis.

#### **5-3.10 Sample preparation and analysis.**

##### **5-3.10.1 For Samples other than Swimming Pools**

1. Set incubator to 35° C. Use a thermometer in a small beaker or Erlenmeyer flask filled with water to monitor the temperature.
2. For potable water and raw water samples using Colilert or Colisure® growth media
3. Break open one powdered media packet and pour contents into sample bottle. Close the lid and place bottle into incubator. Incubate for 24 hours.
4. Log sample information and date-time group of when sample was incubated.
5. After 24 hours, remove sample from incubator and check color. For Colilert, a positive sample will change from a clear or very light yellow to dark yellow. Colisure will change from yellow to magenta. Check positive samples with a fluorescent light. If the sample fluoresces, it is positive for *E. Coli* bacteria. Record the results.

#### **5-3.10.2 Swimming pool sample**

1. Place sample case into incubator. Incubate for 24 hours.
2. Log sample information and date-time group of when sample was incubated.
3. With the aid of a stereoscopic microscope or magnifying glass, count the colonies. Blue colonies are coliforms. Record the results. Since 1 ml of sample was absorbed, multiply the results by 100 to be in keeping with the standard 100-ml reporting figure for coliforms.

#### **5-3.11 Radiological testing.**

To test for radiological contamination, PM personnel must take a sample and ship it to a certified lab for analysis. Radiological sampling is covered in the IFWTK Sampling Instructions.

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Colisure® is a registered trademark of IDEXX Laboratories, Inc., Westbrook, Maine.

## CHAPTER 6 – AMBIENT AIR SAMPLING METHODS AND ANALYTICAL REQUIREMENTS

### 6.1 Purpose.

The purpose of sampling the ambient air is to determine the level of contaminants of concern (COCs) at a proposed or existing deployment site. These COC levels are then compared to appropriate guidelines to determine potential health risk to deployed personnel. The monitoring methods proposed for use fall into two categories: direct reading measurement, and sample collection on media. Direct reading measurement consists of equipment designed to sample real-time. The types and application of the direct reading instrumentation is included in Section 3 of this guide. Media collection consist of equipment used to collect a sample on a particular media over a predetermined period of time. The media are then sent to an analytical laboratory where it is analyzed for COCs. This document is intended to be used in combination with the military air guidelines contained in the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Technical Guide (TG) 230, *Chemical Exposure Guidelines for Deployed Military Personnel (Draft)*.

### 6.2 Limitations

Field sampling methods are not available for all of the compounds listed in TG 230. This TG focuses on certain methods which are used to sample for a wide range of compounds present in the ambient air. There may be specific instances were a chemical is known to be present that needs a method not covered in this guide. Every effort has been made to identify applicable methods for these compounds. If unsure, you can contact USACHPPM for consultative advice on selecting a sampling method for a compound not covered in this TG.

### 6.3 Measuring Background Ambient Air Conditions.

This guide is intended to provide information to characterize the air for those compounds believed to be a threat based upon site conditions such as industry in the area, noticeable dust (particulate loading), heating/vehicle fuels used, etc. The intelligence information gathered, as well as preceding phases of sampling, will be crucial in determining target COCs and associated methods. Factors influencing ambient air monitoring include but are not limited to the following:

- Prior and current uses of the area.
- Basecamp operations.
- Local industrial sources.
- Observable pollution such as dust, odors, smoke, smog.
- Meteorological conditions.
- Terrain-type.
- Period collected (Sesonal variations in temperature, humidity, etc.).

This information should be gathered during the intelligence gathering and reconnaissance phase of the assessment. Additional resources for this information are contained in Section 2.4.

**6.4 Selection of Ambient Air Sampling Methods.**

During the selection of ambient air methods, the primary consideration is the COC. This is usually done from information on existing industrial operations and previous sampling results.

Once the COCs have been defined, environmental sampling methods can be selected accordingly. Unlike other environmental sampling, several methods can be used to sample ambient air for the same parameters. Factors such as detection limit, analytical turnaround time, maintenance calibration requirements, equipment portability, power requirements, and degree of acceptable sampling and measurement errors.

**6.4.1 Short-Term Environmental Health Monitoring (Phase I).**

Prior to conducting sampling at a site, reconnaissance and possibly sampling should be conducted according to the guidance in Section 3 of this TG to ensure the site is safe for the team to occupy.

The Phase I assessment will use methods to determine environmental baseline conditions which can be used to evaluate potential health risk associated with extended exposures to ambient air. These methods are based more on sample collection and laboratory analysis, which have lower detection limits and greater data confidence than direct reading instrumentation. Therefore, the methods are more resource-intensive with respect to increased size and weight, calibration and maintenance procedures, electrical power requirements, and equipment operation.

Given that the sampling site to be assessed is a base camp with a radius of less than 2 miles, it is assumed that one ambient air sampling site would adequately describe condition in the area. The following table outlines these methods.

**Table 6-1. Phase I - Air Sampling Methods**

<b>Method</b>	<b>Compounds</b>	<b>Laboratory Analytical Method</b>
Detector Tubes	Various organics/inorganics	NA
Low-Volume Particulate Sampler	Particulate, Metals	Gravimetric, USEPA 200 Series
High-Volume Particulate Sampler	Particulate, Metals	Gravimetric, USEPA 200 Series
TO14A	Volatile organic compounds (VOCs)	TO14A (Gas Chromatograph/Mass Spectrometry (GC/MS))
TO1	(VOCs)	TO1 (GC/MS)
TO17	(VOCs)	TO17 (GC/MS)
TO13 (if power is available)	Polynuclear aromatic compounds (PAHs) Explosives/Energetics	TO13A (GC/high performance liquid chromatography (HPLC))
TO9 (if power is available)	Dioxins/Furans	TO9A (High Resolution (HR)GC/HR MS)
TO10	Pesticides	TO10 (GC/Electron Capture Detector (ECD))
NIOSH Methods	Various tubes (Porapak, silica gel, charcoal, coconut)	Various

	shell charcoal) with personal sampling pumps	
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The methods to be considered and the frequency of sampling in the Phase I assessment will depend on many of the factors considered above.

Example: Situation definition—

- Initial entry sampling indicated no immediate health threats in the ambient air.
- Intelligence information shows an oil refinery to be in the general vicinity of the proposed base camp.
- Predominant residential heating fuel is coal.
- Vehicles use diesel fuel and leaded gasoline.
- Pesticides no longer manufactured or used in the U. S. may be commonly in used on agricultural areas in this area.

Table 6-1 indicates many of the methods to use in this instance, but not a frequency of sampling. The sample frequency may also depend on circumstances, such as the time of the year. For instance, coal use for heating and idling vehicles in the winter may be more important pollutants to capture than pesticides, which may be more of a springtime concern. So, sampling for PAHs, particulate, and metals may all be necessary on a rotating three-day basis. However, less frequent pesticides sampling may be required. Samples collected during a Phase I assessment are submitted to the laboratories as “high-priority” samples with a turnaround time of 1 to 2 weeks. The following table gives sampling schedule example for a Phase I assessment:

**Table 6-2. Example Phase I Sampling Schedule**

Day	Required Phase I Methods			Optional Methods Depending on Potential Sources	
	Particulate/ Metals Sampling	TO14	TO17	TO9 <sup>A</sup>	TO13 <sup>A</sup>
1	X		X		
2	X	X	X	X	
3	X		X		X
4	X	X	X		
5	X		X	X	

6	X	X	X		X
7	X		X		
8	X	X	X	X	
9	X		X		X
10	X	X	X		
11	X		X	X	
12	X	X	X		X
13	X		X		
14					
A – Sampling should only be conducted if there exists a significant source for these contaminants. Sampling requires power which may not be available during Phase I.					

**6.5 Direct Reading Instrumentation.**

The Phase I assessment will require direct reading instrumentation be used to determine if an immediately dangerous to life and health (IDLH) condition exists at the sampling sites. The purpose and methods to be used to ensure the safety of the monitoring team is provided in Section 3 of this TG.

**6.6 Long-Term Environmental Health Surveillance (Phase II).**

6.6.1 Application.

The Phase I assessment is conducted to establish a baseline of the ambient air quality in a region. The Phase II assessment is conducted to characterize the air both temporally and spatially for locations where a base deployment will be for an extended period of time, greater than 14 days

6.6.2 Data Quality Objectives.

6.6.2.1 Number of Samples.

The minimum number of samples would be influenced by results of the Phase I assessment and other outside data, but should include a minimum of five samples of each sample type. Individual method quality assurance/quality control (QA/QC) procedures should be followed to ensure the accuracy of the data and how representative of the data. All data concerning existing sources and available meteorological data should be recorded or collected and used to determine the requirements for Phase II assessment. Sample results should be reported as the average, maximum, and range of results. For decision-making, it will be assumed that the data will be normally distributed and the average used to compare to TG 230 unless the range of results or an extraordinary maximum sample concentration indicates an alternative method to analyze the data.

A baseline compound above the TG levels may need to be sampled on a more frequent basis. A large data range may require collection of a larger data set to accurately quantify the actual data, perhaps as frequently as once per month. Sampling for Phase II assessment data should be performed on a rotating basis of once every 6 days. Individual method QA/QC measures should be followed to ensure data representativeness and accuracy. The Phase II monitoring will require the distribution of the data to be determined and the appropriate confidence limits to be used. If Phase II monitoring is required, the range of the data collected, the season of the year, and the

concentration levels may determine how often samples should be collected. For example, if concentrations of PAHs are collected near the level considered to be a health threat and the data set has such a large range that the data representativeness is difficult to determine, more samples may be required. In cases such as this, perhaps sampling as often as every 6 days may be necessary. If concentrations are collected that indicate with reasonable certainty the concentrations above the health threat level, less samples may be collected but preferably sampled during each season.

#### 6.6.2.2 Selecting Sample Locations.

The following criteria should be followed when citing the sampling location:

- Sample locations should be based on surrounding operations that minimize non-background sources such as vehicle traffic on dirt roads, vehicle idling, etc.
- Sampler locations should be at a minimum of 15 to 20 feet from any nearby structure, trees, hills, that could compromise results.
- For those locations sited with the intent of characterizing that source, local meteorological data would assist in locating the station predominantly downwind of the source.
- Sampler inlets should be placed at about breathing level (approximately 2 meter above ground)

#### 6.6.3 Sampling Equipment and Procedures –

The sampling appendices for each type of equipment is contained in the appendices to this report. The following is a list of the respective appendices and equipment.

- Appendix 6-1 – Airmetrics MiniVol Particulate Sampling Instructions
- Appendix 6-2 – Sampling of Ambient Air for Total Suspended Particulate Using High Volume Sampler
- Appendix 6-3 – Volatile Organic Compound (VOC) Tube Method Sampling
- Appendix 6-4 – Ambient Air Volatile Organic Compound (VOC) Summa Canister Sampling (TO-14A)
- Appendix 6-5 – PS1 Sampling Instructions

#### 6.6.4 Analytical Requirements.

Analytical requirements will vary depending upon the method and compounds selected. The individual methods outline these requirements. Of note, the time to analyze most air samples has a limit. In addition, some media used to collect samples have a time limit prior to being used. It is important to be aware of these limits. These limits are explained in more detail in each method.

### **6.7 Meteorological and Climatological Data for Air Pollution Assessments**

In order to complete a comprehensive Phase I or II assessment, applicable meteorological data are needed to help explain air contaminant concentration data collected in a deployment. Historically, elevated levels of air contaminants are associated with specific meteorological conditions and, at times, surrounding terrain features. The combination of light wind speeds (in both the horizontal and vertical directions) and atmospheric inversions (defined as air temperature increasing with

height) provides for increased instances of higher/elevated contaminant levels near the surface. In addition, the statistics generated from long-term meteorological data records can assist in determining applicable relationships between air pollution episodes and observed meteorological conditions.

In summary, surface meteorological data are collected each hour at major worldwide airports and support the aviation (both civilian and military) industry and the numerical weather prediction community. In addition, the hourly meteorological observations collected every third-hour support the World Meteorological Organization synoptic weather requirements. Upper-air meteorological data are collected at selected (major) worldwide airports every 12-hours (0000 and 1200 hours on Coordinated Universal Time, or UTC), where UTC is equivalent to mean solar time at the prime meridian (0° longitude). These are the types of meteorological data that will be needed to be collected and recorded in the field to support the Phase I and Phase II. In addition, the climatology summaries which are derived from the above surface meteorological parameters normally include the following data elements:

- a. Means and extremes of temperature.
- b. Relative humidity.
- c. Dew point, surface winds.
- d. Cloud cover.
- e. thunderstorm and fog occurrence.
- f. Flying weather by ceiling and visibility categories.

The climatology summaries can be expressed in daily, monthly, annual, or period of record statistics and can support pre-deployment planning.

#### 6.7.1 METEOROLOGICAL DATA FOR CURRENT OPERATIONS/EXERCISE SUPPORT.

To support the Phase I, several surface and upper-air meteorological parameters need to be documented and archived to determine relationships to environmental health surveillance data. These surface meteorological parameters, normally obtained in METAR format (defined as Aviation Routine Weather Report) include ambient temperature, dew point, barometric pressure, wind speed, wind direction, and relative humidity. The upper-air meteorological parameters include temperature, relative humidity, wind speed, and wind direction at selected altitudes. From the upper-air observation data, a descriptive statistic, called the mixed layer height, is derived which describes the vertical depth for pollution transport and needs to be annotated with the surface meteorological data. All of these data need to be collected and recorded in support of the Phase I.

There are several sources of meteorological data to support current operations/exercise support. In summary, the above parameters can be obtained from the appropriate G3/S3/J3 Meteorology Operations Cell; the United States Air Force Weather Agency; and the National Oceanic and Atmospheric Administration/National Weather Service (NOAA/NWS). Table 6-3 provides a listing of the meteorological data sources (and comment) with world-wide-web universal record locator (URL) links.

**Table 6-3. Selected Meteorological Data Sources and Assets**

Name	URL	Comment
USAF Weather Agency	<a href="http://afwin.afwa.af.mil/cgi-bin/nfgwc.cgi?h_index.txt">http://afwin.afwa.af.mil/cgi-bin/nfgwc.cgi?h_index.txt</a>	Worldwide Hourly Observations; Charts; Satellite Imagery
National Oceanic Atmospheric Administration	<a href="http://weather.noaa.gov/weather/ccus.html">http://weather.noaa.gov/weather/ccus.html</a>	CONUS 24-hr Weather Observations
National Oceanic Atmospheric Administration	<a href="http://weather.noaa.gov/weather/ccworld.html">http://weather.noaa.gov/weather/ccworld.html</a>	OCONUS 24-hour Weather Observation
USN Fleet Numerical Meteorology and Oceanography Center	<a href="http://www.fnoc.navy.mil/PUBLIC/">http://www.fnoc.navy.mil/PUBLIC/</a>	DOD Numerical Weather Prediction Model Graphics (Unclassified and Password Protected)

In addition, the meteorological data needs to be recorded per the example template outlined in Table 6-4.



### 6.7.2. Meteorological and Climatology Data for Operation/ Exercise Planning

There are several sources of climatological data to support operation / exercise planning. In summary, the needed climatology parameters can be obtained from the appropriate G3/S3/J3 Meteorology Operations Cell; the United States Air Force Combat Climatology Center; and the United States Navy Fleet Numerical Meteorology and Oceanography (METOC) Detachment. These data can also be used in environmental health surveillance reconnaissance activities to identify the locations of pollution sources. Table 6-5 provides a listing of the climatological data sources (and comment) with URL links. It is recommended that the climatologic data be integrated into appropriate operation plans sections for identifying prevailing weather conditions.

Table 6-5. Selected Climatological Data Sources and Assets

Name	URL	Comment
USN Fleet Numerical METOC Detachment	<a href="http://navy.ncdc.noaa.gov/">http://navy.ncdc.noaa.gov/</a>	Climatology Support Services
USAF Combat Climatology Center	<a href="http://www.afccc.af.mil/cgi-bin/index.pl">http://www.afccc.af.mil/cgi-bin/index.pl</a>	Climatology Support

### 6.8 Limitations.

Sample representiveness is determined by interferences from weather, nearby sources, meteorology, etc. Data regarding any critical information effecting samples must be recorded with the samples.

### 6.9 Definitions

Atmospheric Inversion – Increase of ambient temperature with height.

Climatology – The science dealing with the prevailing or average weather conditions of a geographic location, as determined by meteorological conditions over a period of years.

Coordinated Universal Time (UTC) – mean solar time at the Prime meridian, 0 degrees longitude; formerly expressed in Greenwich Mean Time, or GMT.

METAR Format – Aviation routine weather report

METOC – Meteorology and Oceanography

Mixed Layer – vertical depth of the atmosphere applicable for pollution transport

### 6.10 References.

- a. U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) TG 230, *Chemical Exposure Guidelines for Deployed Military Personnel (Draft)*, 2001.
- b. Technical Assistance Document for Sampling and Analysis of Toxic Organic Compounds in Organic Air, EPA-600/4-83-027, June 1983.
- c. U.S. Environmental Protection Agency (USEPA) EPA/540/P-87/001, *Compendium of Superfund Field Operations Methods*, December 1987.

- d. U.S. Environmental Protection Agency (USEPA), EPA/625-R-96/010b, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, Second Edition.
- e. U.S. Environmental Protection Agency (USEPA), EPA-450/4-90-005, *Guidance for Applying the Data Quality Objectives Process for Ambient Air Monitoring around Superfund Sites*, March 1990.
- f. U.S. Environmental Protection Agency (USEPA), EPA/625/R-96/010a, *Compendium of Methods for the Determination of Inorganic Compounds in Ambient Air*, June 1999.
- g. National Institute for Occupational Safety and Health (NIOSH), *Manual of Analytical Methods*, Fourth Edition, August 1994.
- h. 40 Code of Federal Regulations Part 50, *Reference Method for the Determination of Suspended Particulates in the Atmosphere (High Volume Method)*. July 2000. Washington, D.C: U.S. Government Printing Office.

APPENDIX 6-1

AIRMETRICS MINIVOL PARTICULATE SAMPLER INSTRUCTIONS

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**6-1.1 APPLICATION**

The Airmetrics MiniVol Air Sampler samples the air at 5 liters per minute for particulate matter (TSP, PM10, and PM2.5; see Table 6-1-1). The sampler is designed to be portable to sample the air at a discrete location or to be used in saturation sampling. The sampler does not require electrical power or a permanent structure to house the sampler. The mini-vol samplers are not EPA approved as the reference method for particulate sampling but have been proven to be equivalent to the standard reference methods. The sample battery pack is designed to enable 24-hour continuous sampling and should be conducted so.

**6-1.2 REQUIRED MANHOURS**

Approximately 0.5-1 hour per sampling site.

**6-1.3 SAMPLING FREQUENCY**

Sampling during a Phase I assessment should be conducted daily. Sampling frequency during a Phase II assessment will be based on the results of Phase I sampling. A general rule assumes that sampling should be conducted every six days during a Phase II assessment. More frequent sampling may be required depending on the health hazard associated with particulates.

**6-1.4 EQUIPMENT INVENTORY**

The items listed in Table 6-1-1 are required for a sampling site using two collocated MiniVol samplers.

Table 6-1-1. Inventory of Equipment for Airmetrics MiniVol

ITEM DESCRIPTION	QUANTITY
MiniVol Sampler unit	2
MiniVol Batteries	4
MiniVol Battery Charger	2
Preseparator/filter assemblies with rain hats (PM10*, PM2.5*, or TSP*)	4
47-mm quartz filters pre-weighed on a 0.01 ug balance	2
Hexane or lighter fluid	100 ml
Glisseal Grease (Tube)	1
Grease/Hexane mixing bottle	1
Solvent rinse bottle	1
Tweezers	1
MiniFlow Calibration kit or dry calibrator or Gilibrator	1
Tripods or Y-shaped mounting brackets	2
Spare parts kit	1
Operating manual	1
Sampling Instructions	1
Field data sheets	2
Thermometer/Barometer	1
Mini-Screwdriver	1
Nitrile Gloves	2 pair
Utility Wipes	2
Plastic Bags (4" x 4")	2
Plastic Bags (4" x 9")	4
Permanent Marker	1

### 6-1.5 PREPARING THE PRESEPARATOR/FILTER HOLDER ASSEMBLY

To reduce contamination and simplify assembly, perform as much work as possible inside a vehicle or indoor work area (disassembling sampler, checking for leaks, replacing filter, *etc.*), particularly if the weather is rainy, windy, or snowy.

The “Preseparator/Filter Holder Assembly should be dismantled and the impactor cleaned and greased at regular intervals (*i.e.*, at minimum after every seventh sampling episode, but if heavy particulate loadings are observed on the target disk, as often as appropriate).

1. Unscrew the “Preseparator Adapter” section from the “Filter Support” assembly and remove the “Rain Hat”. [Figure 6-1-1.]
2. Pushing with your thumb from the bottom, remove the “Impactor” through the top of the housing into the palm of your free hand. [Figure 6-1-1]
3. Rinse the impactor from top to bottom with a solvent (hexane, white gas, lantern gas) using a squeeze bottle, paying particular attention to the impactor’s target disk. [Figure 6-1-1].
4. Let the impactor air-dry.
5. Prepare a mixture of solvent and impactor grease (Glisseal Ht) in a dropper bottle until thoroughly mixed and of a fluid consistency. Use a 1-inch length of grease to 100 ml of solvent. Vigorously shake the mixture until an opaque, uniform suspension, free from grease globs, is obtained. Other low-vapor pressure greases, such as silicone, are acceptable. However, removing the dirty grease from the impactor parts may be more difficult.
6. Put two or three drops of the cloudy solution on the impactor’s target disk. The drops should saturate the disk, flowing freely to the edge.
7. Let the target disk “dry” by allowing the solvent to volatilize, leaving a thin film of grease on the target disk.
8. Inspect the O-rings on the impactor for fitness and replace if necessary. Periodically the O-rings should be coated with a thin film of silicone lubricant. Remove any extraneous, loose, or hair-like shredded material from the exterior of the impactor unit since this material could fall onto the filter below and cause erroneous gravimetric results. Carefully re-insert the impactor into the top of the “Preseparator Adapter” until the top of the impactor is flush with the top of the assembly.

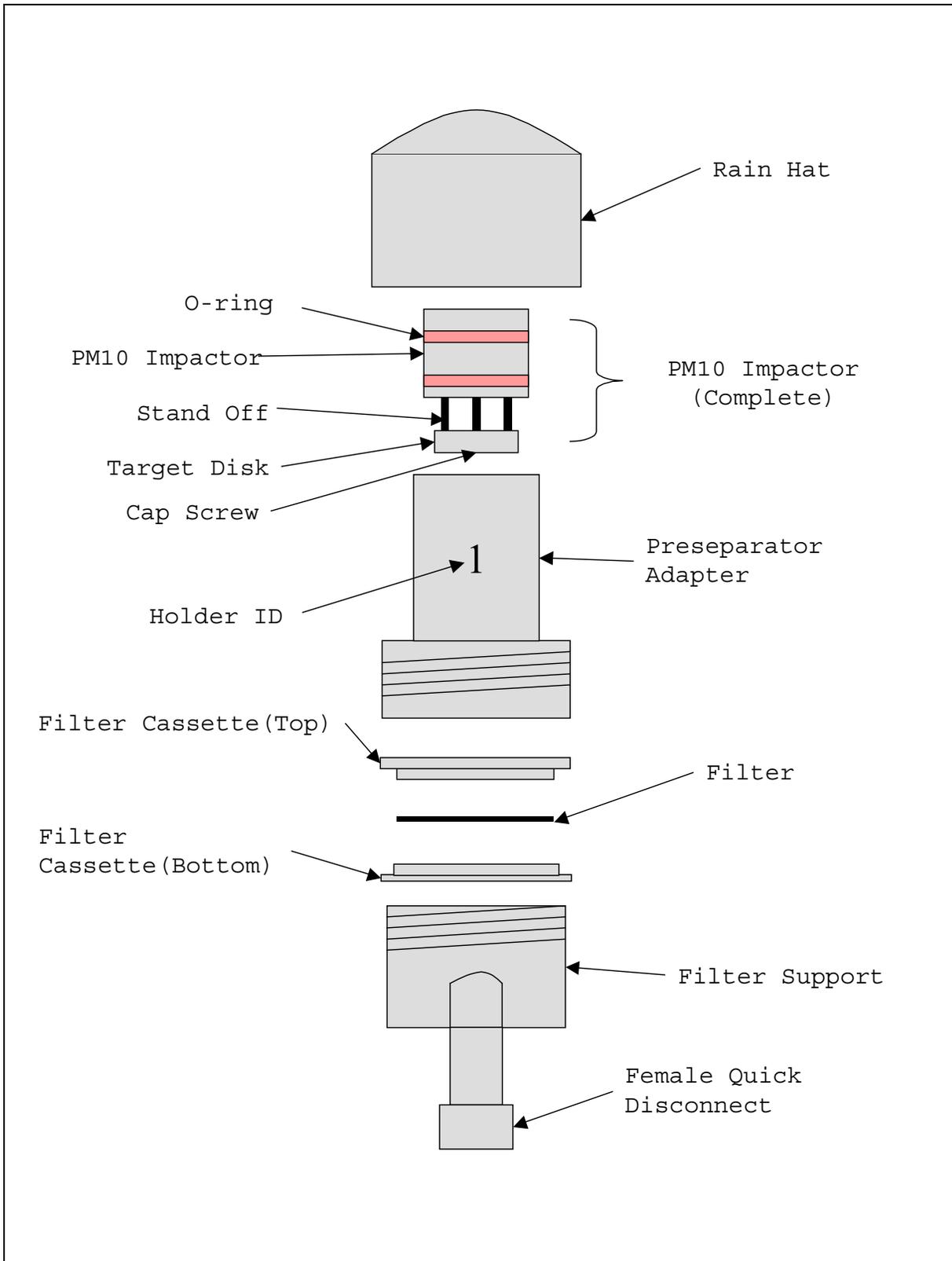


Figure 6-1-4. Preseparator/Filter Holder Assembly (V2.0)

### 6-1.5.1 ASSEMBLYING PRESEPARATOR FOR TSP SAMPLING

The assembly should not have any impactors if TSP sampling is to be performed. The preseparator/filter holder assembly should look like Figure 6-1-2.



FIGURE 6-1-2. TSP ASSEMBLY

### 6-1.5.2 ASSEMBLYING PRESEPARATOR FOR PM10 SAMPLING

Place the PM10 impactor in the preseparator/filter holder assembly prior to sampling. When placing the impactor into the assembly, remember to push the impactor from the base up into the assembly as in Figure 6-1-3. The preseparator/filter holder assembly should look like Figure 6-1-4.



Figure 6-1-3. Impactor



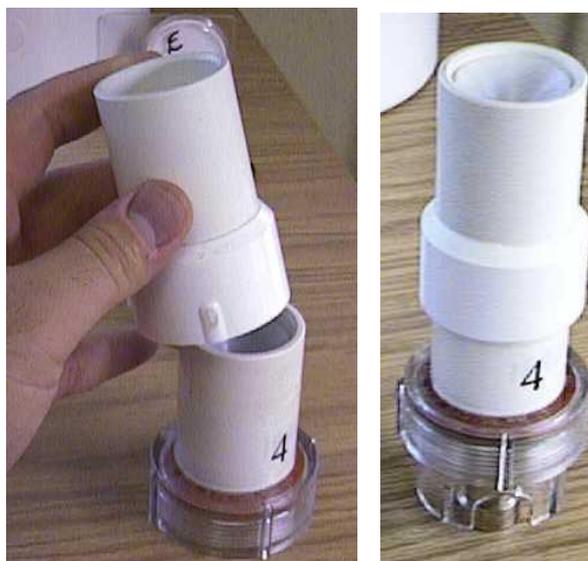
Figure 6-1-4. PM10 Assembly

### 6-1.5.3 ASSEMBLING PRESEPARATOR FOR PM2.5 SAMPLING

The assembly for the PM2.5 sampling uses both the PM10 and PM2.5 impactors in sequence. The PM10 impactor is placed in the multiple impactor adaptor and the PM2.5 impactor is placed in the preseparator adaptor (Figure 6-1-5). Then the multiple impactor adaptor is placed on top of the preseparator adaptor (Figures 6-1-6 and 6-1-7).



Figure 6-1-5. Preseparators



Figures 6-1-6 and 6-1-7. Assembly

### 6-1.6 INSTALLING 47-MM FILTERS INTO FILTER ASSEMBLY

1. Select a filter/petri slide and remove cover from petri slide. [Figure 6-1-8]



Figure 8. 47-mm Quartz Filter in Petri Dish

2. Remove the Filter Cassette from the Filter Support Assembly. [Figure 6-1-1]
3. Separate the top and bottom portions of the Filter Cassette by hand or use the Filter Cassette Shoe if available.
4. Using tweezers, install the new filter onto the “Drain Disk” which rests in the bottom portion of the “Filter Cassette”, taking care not to shred or damage the edges of the filter. [Figure 6-1-1]. Ensure the filter is placed in the “Filter Cassette” rough side up.
5. Reassemble the “Filter Cassette” by inserting the top portion into the bottom portion.
6. Insert the “Filter Cassette” into the “Preseparator Adapter” and screw down hand-tight. Reattach the “Rain Hat”
7. If a unique ID does not already exist on the “Preseparator Adapter”, assign and place a unique identifying number on the filter holder. This establishes a relationship between the filter number and the “Preseparator Adapter”.
8. Record the following information on the field data sheet:
  - [\*Sample ID\*](#) - Sample ID number XXX\_YYYY\_DDDDD\_ZZ

Where:

XXX - Camp abbreviation (i.e. first three letters of camp name)

YYYY - Method type (e.g. PM10, PM25, TSP)

DDDD - jday code, last two digits of year and three digits Julian day of the year (e.g. 31-Jan-2000 = jday 00031).

ZZ – Sample type:

P – Primary sample, if collocated

C – Collocated sample, if collocated

FB – Field Blank

TB – Trip Blank

- Location - Camp or location sampled (not required)
  - Country – Country of camp or location sample (not required)
  - Operation – Name of operation, if applicable (not required)
  - Collected By – Unit collecting the sample (e.g., Army Medical Laboratory, 71<sup>st</sup>, etc).
  - Unit Spec ID – Unit specific ID associated with the sample if any (not required).
  - Mission ID – Unit mission ID associated with the sample if any (not required).
  - Sample Notes – Any notes or comments associated with the sample (e.g. short holding time, unusual circumstances, etc).
  - Filter Number – The filter ID # obtained from the filter cassette (e.g., QM-01)
  - Filter Type – Type of filter, one of the following types (not required)
    - TF- Teflon
    - QM – Quartz
    - GF – Glass Fiber
    - CE – Cellulose Ester
  - Holder ID – The ID associated with the filter holder assembly
  - PM Type – Type of particulate sampler (not required)
    - PM10 – Particulate matter less than 10 microns (DEFAULT)
    - TSP – Total Suspended Particulate
    - PM2.5 – Particulate matter less than 2.5 microns
9. Place the entire clean “Preseparator/Filter Holder Assembly” into a plastic bag, or other case, for transporting to the site. It is best to keep the “Preseparator/Filter Holder Assembly” in a vertical position until installed on the sampler.

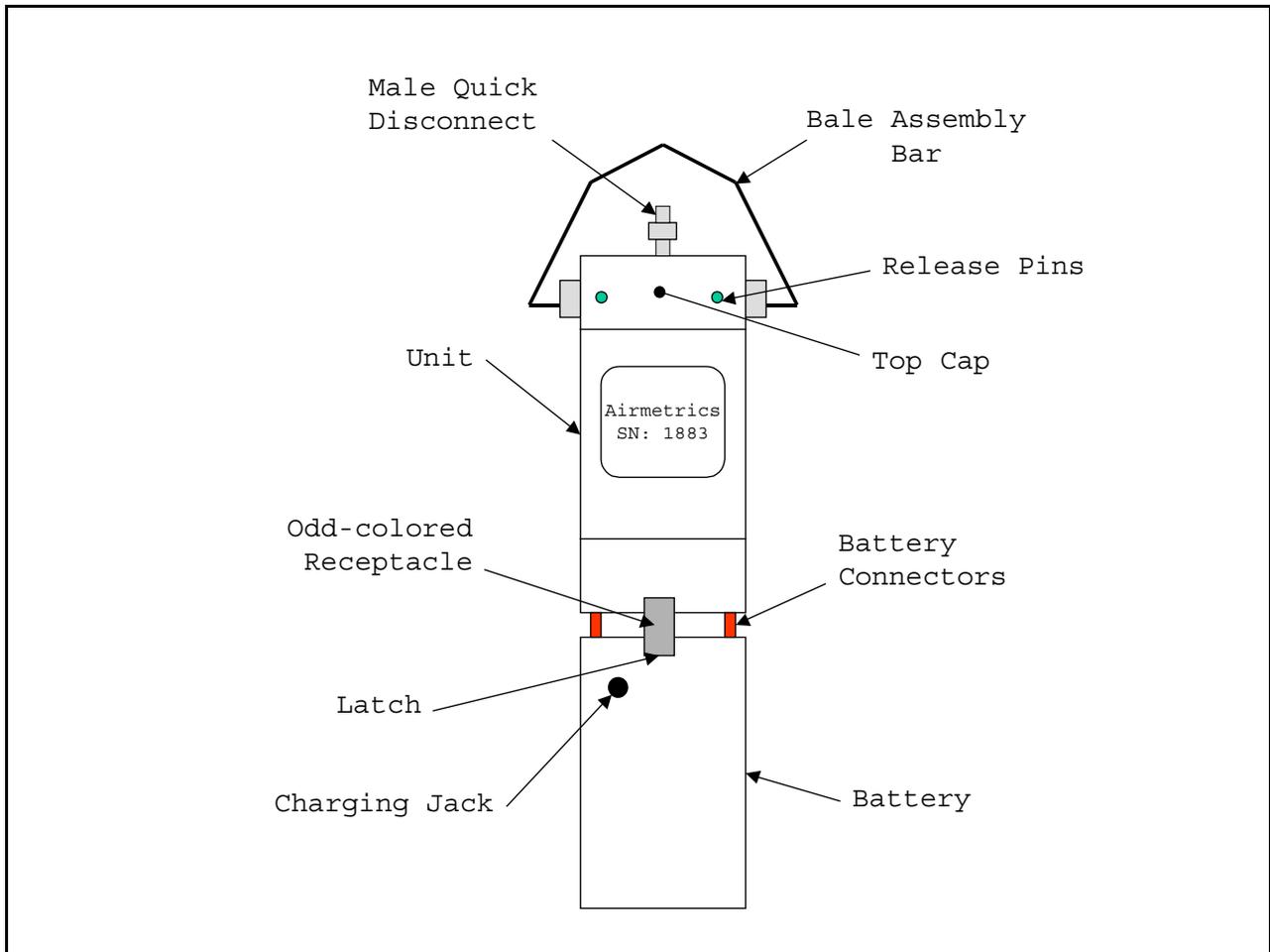
#### 6-1.7 PRE-SAMPLING SITE PROCEDURE

1. Carefully transport the equipment listed in Table 6-1-2 to the sampling site.

Table 6-1-2. Equipment Required at MiniVol Sampling Site

ITEM DESCRIPTION	QUANTITY
MiniVol Sampler unit	2
MiniVol Batteries	2
Preseparator/filter assemblies with rain hats (PM10, PM2.5, or TSP)	2
47-mm quartz filters pre-weighed on a 0.01 ug balance	2
Miniflow Calibration kit or dry calibrator or Gilibrator	1
Tripods or Y-shaped mounting brackets	2
Spare parts kit	1
Operating manual	1
Sampling Instructions	1
Field data sheets	2
Thermometer/Barometer	1
Mini-Screwdriver	1
Utility Wipes	2
Plastic Bags (4" x 4")	2
Plastic Bags (4" x 9")	4
Permanent Marker	1

2. Establish a location for the sampler using the mounting cradle. Verify that the sampler when finally installed in the mounting cradle will be positioned at least 5 feet off the ground with the intake upward in an unobstructed area at least 30 cm from any obstacle to air flow.
3. Place the battery on a firm level surface and secure the sampling pump to the battery using the two latches at the base of the sampler. Ensure that the pin behind the front latch is inserted into the "Odd-colored Receptacle" on the battery pack. [Figure 6-1-9]
4. Remove the clean "Preseparator/Filter Holder Assembly" from the plastic transport bag or case. Attach the assembly to the "Male Quick Disconnect" orifice on the top of the sampler.
5. Unscrew either cap of the "Bale Assembly Bar" and remove the assembly or press release pins to free the pump and timer assembly. [Figure 6-1-9]



**Figure 6-1-9. Airmetrics® Sampling Unit**

6. Lift the pump and timer assembly out by the 6" diameter "Top Cap" and rest it on the edge of the sampler casing, using the triangular mount stand. Take care not to pull the connecting wire loose or jar the pump hose fittings. Hold the "Top Cap" and do NOT grasp the center of the circuit board. [Figure 6-1-10]
7. Check the sampler faceplate for any error conditions. If an error condition exists, refer to the "Error Conditions" section of the operating manual. [Figure 6-1-10]

Airmetrics® is a registered trademark Airmetrics, Inc., Eugene, Oregon.

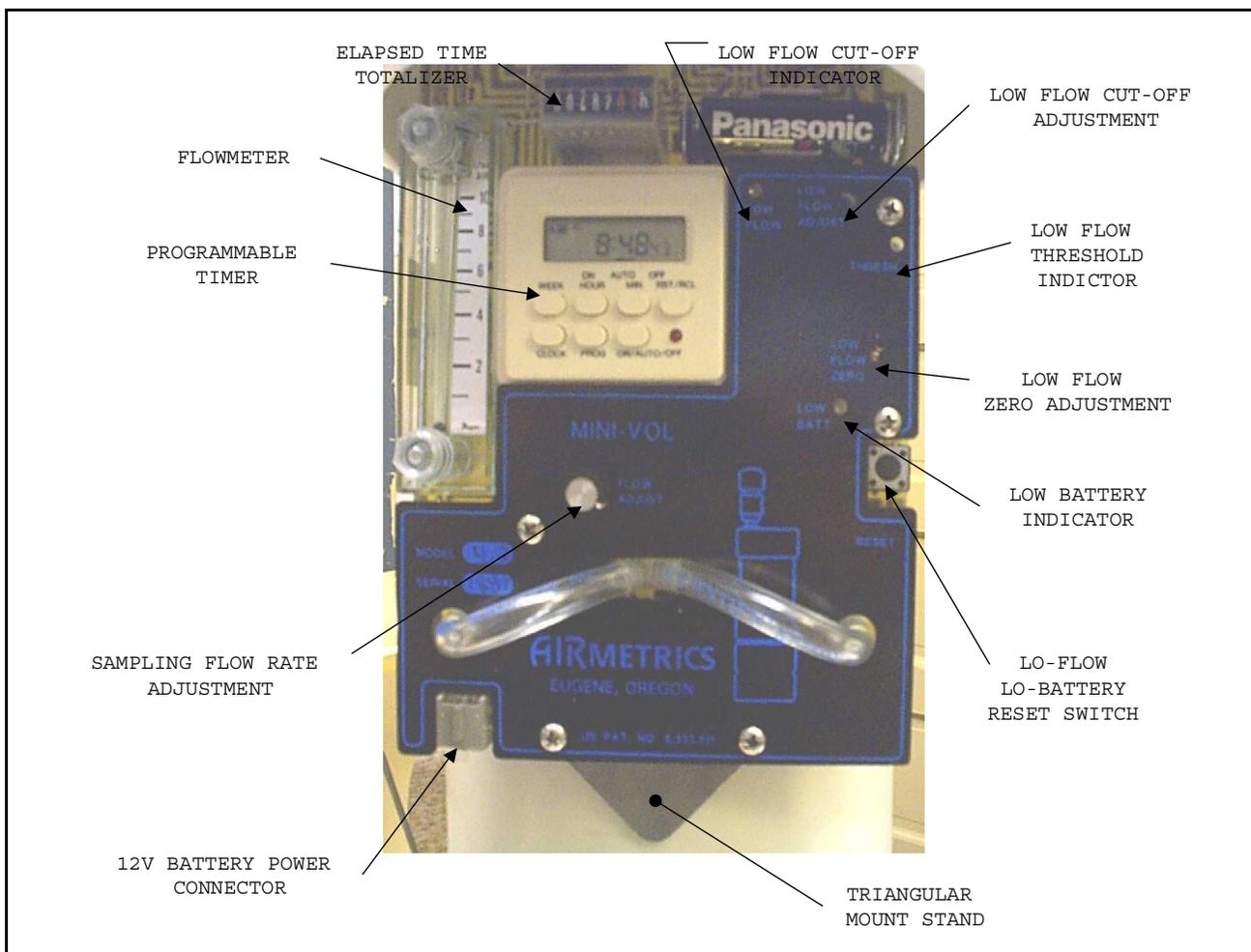


Figure 6-1-10. Sampler Controls and Adjustments

8. Turn the sampler on by pressing the “ On/Auto/Off” button [Figure 10]. Verify the sampler flow rate is approximately 5.0 liters per minutes (lpm)  $\pm 5\%$  by reading the “Flowmeter” to the nearest tenth at center of ball. If flow is outside the flow range use the “Flow Rate Adjustment” control to set the flowmeter flow within required flow range (5.0 lpm  $\pm 5\%$ ). The flow should be determined using a MiniFlow calibration kit or external flowmeter (DryCal® or Gilibrator) if available.
9. Turn off the pump by pressing the “ On/Auto/Off” button.

DryCal® is a registered trademark of BIOS International Corporation, Butler, New Jersey.

10. Record the following on the field data sheet:

- Collectors Name - Name of person operating the equipment.
- Unit Type - Type of sampling unit (“Airmetrics”)
- Unit ID – The serial number off the sampler (e.g. 1884) or leave blank if the sample is a field blank
- Battery ID – The battery number (BATT#) off the top of the battery used (e.g. 97-421)
- MGRS – Location in Military Grid Reference System (MGRS) from GPS, eight to ten digit grid with grid square identifier (e.g. BQ1234567890)

11. Verify correct time and day of week on time LCD. [Figure 6-1-11]

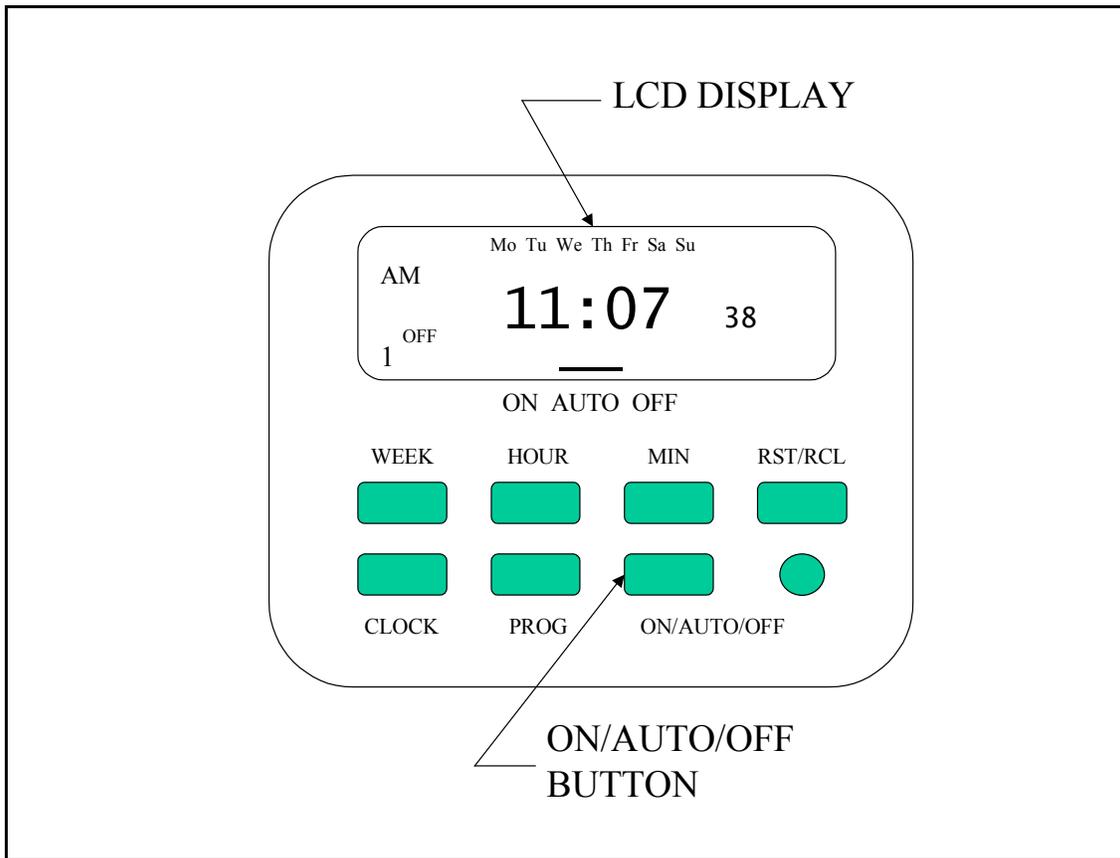


Figure 6-1-11. Programmable Timer

Note: It is recommended that the sampler be operated using the “Programmable Timer”. This allows documentation of the sampling time if an error occurs and the sampler shuts down.

12. Program the “Programmable Timer” if applicable or press the “ On/Auto/Off” button to start the pump and initiate the sampling period. If the pump is started manually skip the programming section and record the necessary information on the field data sheet. If the

timer is programmed press the “ON/AUTO/OFF” button to set the timer to "Auto" mode, it is very important to place the sampler in “Auto” mode if it is programmed.

**6-1.7.1 PROGRAMMING SAMPLER USING THE “PROGRAMMABLE TIMER”.**

**[FIGURE 6-1-11]**

1. Set the sample start time.
  - a. Press the “PROG” button, 1<sup>on</sup> will appear on the bottom-left corner of the LCD display
  - b. Using the “WEEK” button select the sample start day.
  - c. Using the “HOUR” button select the hour the sample will start. Pay particular attention that the correct time of day (i.e. AM or PM) is selected.
  - d. Using the “MIN” button select the minute the sample will start.
2. Set the sample end time.
  - a. Press the “PROG” button, 1<sup>off</sup> will appear on the bottom-left corner of the LCD display
  - b. Using the “WEEK” button, select the sample end day, this should be the day after the start day.
  - c. Using the “HOUR” button select the hour the sample will start, this should be 24-hours after the start hour. Pay particular attention that the correct time of day (i.e. AM or PM) is selected.
  - d. Using the “MIN” button select the minute the sample will start, this should be same minute as the start time.
3. Press the “CLOCK” button to return to clock display on the LCD.
4. Press the “PROG” button to toggle through the sample start and end times to verify they were entered correctly.
5. Press the “CLOCK” button to return to clock display on the LCD.
6. Press the “ON/AUTO/OFF” button to put the sampler in “AUTO” mode.
7. Record the following on the field data sheet:
  - Start Date – The day the sample was started, same as the “Sampling Date”
  - Start Time - Time of day sample was started in 24-hour time (e.g. 0800), same as “Sampling Time”
  - Pre Ambient Temperature (°C) - Ambient Temp in degrees C from thermometer at the start of the sampling episode
  - Pre Ambient Pressure (inches Hg) - Ambient Pressure in inches Hg from barometer at the start of the sampling episode
  - Pre Elapsed Time Reading (hours) - Pre-sampling Elapsed Time Reading in hours from sampler’s “Elapsed Time Totalizer” at the start of the sampling episode

- Field Notes - Notes relating to sampling episode (e.g. unusual circumstance, weather, potential pollution sources, etc), if applicable.

**6-1.8 OBTAINING SAMPLER PRE FLOW RATE.**

If the sampler was not programmed, start the sampler and place it vertically. Let the sampler warm up for approximately 2 minutes and acquire the flow rate using one of the following methods

**6-1.8.1 MINIFLOW CALIBRATOR (ANNEX 6-1-1)**

1. If a MiniFlow Calibrator is available remove the rain hat from the filter assembly and place the MiniFlow adapter on the filter assembly.
2. Attach the MiniFlow tubing and pressure meter (See Annex 6-1-1).
3. Record the presser reading in the “Pre Flow Calibration (in H2O)” field on the Field Data Sheet.

**6-1.8.2 DRYCAL OR GILIBRATOR® ANNEX 6-1-2**

1. If an external flowmeter (DryCal or Gilibrator) is used, remove the rain hat from the filter assembly and place adapter on the filter assembly.
2. Attach tubing to DryCal or Gilibrator and acquire flow rate (See Annex 6-1-2).
3. Record the flow rate in “Pre Flow Meter Reading (lpm)” field on the field data sheet.

**6-1.8.3 Flow Meter**

1. If no other flow devices area available acquire the flow rate from the flow meter on the sampler, to the nearest tenth at center of ball.
2. Record the flow rate in “Pre Flow Meter Reading (lpm)” field on the field data sheet.

**6-1.9 SAMPLING SITE PROCEDURES**

1. If the sampler was programmed, wait for the sampler to start and run for 2 minutes. Use one of the three methods outlined in Section 6-1.9 to acquire the sampler Pre Flowrate.

**Errors:** If the “Flowmeter”, which should be in the vertical position, indicates zero or a very low reading, check for restrictions in the tubing, or improperly seated screw fittings between the pump and the “Flowmeter”. If a RED LIGHT is lit (either low flow or low battery), press the Reset button to start pump.

2. Place the pump and timer assembly back into the sampler body and secure either through aligning release pins or replacement of the “Bale Assembly Bar”.
3. Using the hoisting pole, hook the “Bale Assembly Bar” and raise the sampler, as vertically as possible, to the mounting cradle. This position not only more easily accommodates the sampler's weight, but also prevents the hook from hitting and possibly dislodging or breaking the “Preseparator/Filter Holder Assembly”.

### 6-1.10 POST-SAMPLING SITE PROCEDURE

1. Arrive at the sampling location approximately 5-10 minutes before the sampling episode is scheduled to end.
2. Remove the sampler from the mounting cradle using the hoisting pole. Position yourself directly under the sampler, hook the “Bale Assembly Bar”, and lower the sampler as vertically as possible. This vertical take-away not only accommodates the sampler's weight, but also prevents the hook from dislodging the “Rain Hat” or damaging the “Preseparator/Filter Holder Assembly”.
3. Place the sampler on a firm level surface.
4. If the sampler is still running acquire the flow rate using one of the methods described in section 6-1.9. If the sampler is not running go to the next step.
5. Unscrew either cap of the “Bale Assembly Bar” and remove the assembly or press release pins to free the pump and timer assembly.
6. Lift the pump and timer assembly out by the “Top Cap” and rest it on the edge of sampler body using the triangular mount stand. Take care not to pull the connecting wires loose and hold the “Top Cap”.
7. Check the sampler faceplate for any error conditions. If an error condition exists, refer to the "Error Conditions" section in the operating manual and record the error in the “[Invalid Sample](#)” field on the field data sheet.
8. Verify the correct time and day of week on the LCD.
9. Record the following on the field data sheet:
  - [End Date](#) - The day the sample was ended
  - [End Time](#) - Time of day sample was ended in 24-hour time (e.g. 0800)
  - [Post Ambient Temperature \(°C\)](#) - Ambient Temp in degrees C from thermometer at the end of the sampling episode
  - [Post Ambient Pressure \(inches Hg\)](#) - Ambient Pressure in inches Hg from barometer at the end of the sampling episode
  - [Post Elapsed Time Reading \(hours\)](#) - Pre-sampling Elapsed Time Reading in hours from sampler’s “Elapsed Time Totalizer” at the end of the sampling episode
  - [Field Notes](#) - Notes relating to sampling episode (e.g. unusual circumstance, weather, potential pollution sources, etc), if applicable.
10. If the pump was not running when returning to the site. Attempt to start the sampler. If the sampler starts allow it to warm up for 2 minutes and acquire the flow rate as outlined in Section 4. Press the ON/AUTO/OFF button twice to stop the pump. If the sampler does not start, record any errors and not sampler failure in the “[Field Notes](#)”
11. Place the pump and timer assembly back into the sampler body and secure either through

- aligning release pins or replacement of the “Bale Assembly Bar”.
- 12. Remove the clean “Preseparator/Filter Holder Assembly” from the sampling unit and place in the original plastic transport bag or other case.
- 13. Transport the equipment listed in Table 6-1-3 back to the work area.
- 14. The sampling episode is complete, reapply directions to next sampling episode.

Table 6-1-3. Sampling Equipment Returned to Work Space After Sampling Episode.

ITEM DESCRIPTION	QUANTITY
MiniVol® Sampler unit (not required if sampler is placed in a secure area)	2
MiniVol Batteries	2
Preseparator/filter assemblies with rainhats (PM10, PM2.5, or TSP)	2
47-mm quartz filters pre-weighed on a 0.01 ug balance	2
MiniFlow Calibration kit or dry calibrator or Gilibrator	1
Tripods or Y-shaped mounting brackets (Only remove tripods and mounting brackets if site is not to be sampled again)	2
Spare parts kit	1
Operating manual	1
Sampling Instructions	1
Field data sheets	2
Thermometer/Barometer	1
Mini-Screwdriver	1
Utility Wipes	2
Plastic Bags (4” x 4”)	2
Plastic Bags (4” x 9”)	4
Permanent Marker	1

6-1.11 47mm Filter Recovery Procedure

1. In the laboratory, unscrew the “Preseparator Adapter” from the “Filter Support” assembly (Figure 6-1-1).
2. Locate the appropriate numbered petri slide associated with the sample filter. Use the relation between the filter number and the “Holder ID” to verify the appropriate filter is place in the proper petri slide.
3. Disassemble the “Filter Cassette”.
4. Using tweezers, carefully remove the exposed filter from the “Drain Disk” and place it into its original petri slide, replacing the petri slide lid when finished. (Be sure to replace the

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“Drain Disk” back on the filter support grid in the “Filter Support” assembly if it came off when the filter was removed).

5. Replace the “Filter Cassette” and screw the “Preseparator Adapter” onto the “Filter Support” assembly.

#### 6-1.12 PACKING SAMPLES FOR SHIPMENT

1. Filters should be replaced in their respective petri dishes and sealed (i.e. with rubberbands) to prevent the filters from falling out of the petri dishes. Place the petri slide containing the filter in a 4” x 4” plastic bag for shipment.
2. Include datasheets with respective filters in packing box, tri-fold datasheet and place in 4” x 9” plastic bag for shipment.
3. Include enough packing material in shipping box to ensure that filters do not move in shipping container. Filters that move in shipment may lose sample collected on the filter.

#### 6-1.13 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

1. Note in the “*Invalid Sample*” field the appropriate code of sampler malfunction or filter damage.
2. Ensure all required fields on the “Air – Particulate Sampling (Low Volume) Field Data Sheet” are complete and legible.
3. Enter field data sheet information into “Deployment Environmental Surveillance Database” if applicable.
4. Complete datasheets as required for field blanks, and indicate the type of blank in the “*Blank*” field on the field data sheet. Blanks should be approximately 10% of all samples.

#### 6-1.14 INVOL SAMPLER ERROR CONDITIONS

##### 6-1.14.1 Low Battery Indicator ON

Should the “Low Battery Indicator” be ON at the end of a sampling period, check the “Elapsed Time Totalizer” to determine the length of time the sampler ran before shutting off. If the time is short (e.g., only 12 hours out of a programmed 24 hours), perhaps the battery was not completely charged or is failing to hold a charge. Note the battery number and, after recharging in the lab, observe performance in the next sampling period. If the battery fails again, it is most likely defective and should be replaced.

If a different battery performs in the same manner after shown to be fully charged, the pump motor is perhaps drawing more current than it should. If possible, install a pump from another sampler. If this solves the problem, the previous pump motor is likely defective and should be replaced. If the problem continues, a more serious fault is occurring which should be referred to the manufacture or CHPPM.

##### 6-1.14.2 Low Flow Indicator ON

Should the “Low Flow Indicator” be found ON at the end of sampling period, first check the “Elapsed Time Totalizer” to determine the length of time the sampler ran before shutting off. Check the operating manual for a more detailed explanation of Low Flow errors.

## **6-1.15 BATTERY MAINTENANCE**

### **6-1.15.1 Battery Storage**

DO NOT store the battery while attached to the sampler, as this will cause irreparable damage to the battery. The indicator lights that remain on when the battery is connected to the sampler will discharge the battery past its 10.3-volt safety cut-off point

### **6-1.15.2 Battery Charging**

After each sampling episode, the used battery pack should be charged for a minimum of 18 hours or overnight.

### **6-1.15.3 Circuit Board Battery**

A single AA battery on the circuit board operates the “Programmable Timer”. The lifetime for this battery is approximately six months when it is left in place on the circuit board.

## Air - PM10 Low Volume Field Data Sheet

Section I - Administrative Data			
1. Sample ID*:	7. Collected By*:	11. Lab ID:	
2. Location:	8. Unit Spec ID:	12. Job No:	
3. Country:	9. Mission ID:	13. Project No:	
4. Operation:	10. Shipping ID:	14. Europe ID:	
5. Sampling Date*:	15. Sample Notes:		
6. Sampling Time*:			
Section II - Field Data			
16. Filter No*:	20. PM Type: PM10 / PM2.5 / TSP <small>(Circle One)</small>	23. Battery ID*:	
17. Filter Type:	21. Collectors Name*:	24. Blank?: No / FB / TB / LB <small>(Circle One)</small>	
18. Holder ID*:	22. Unit Type:	25. Invalid Sample?:	
19. Unit ID*:	26. Flow Meter Used* Unit Flow Meter / Gilibrator / Calibration Manometer <small>(Circle One)</small>		
27. Flow Calibrator ID*:	30. Calibration Target Flow (H): inches of H2O		
28. Slope (m):	$\Delta H = \left( \frac{5.0 - b}{m} \right)^2 * \left( \frac{P_{amb}}{T_{amb}} \right)$ Where: <i>Pamb</i> = Ambient pressure in mm of Hg <i>Tamb</i> = Ambient temp in degrees K		
29. Intercept (b):			
SAMPLER DATA	Start/Pre	End/Post	Average
31. Date*			
32. Time*			
33. Ambient Temperature (oC)*			
34. Ambient Pressure (inHg)*			
35. Flow Calibration (in H2O)*			
36. Flow Meter Reading (lpm)*			
37. Elapsed Time Reading (hrs):			
GEOLOCATION	Decimal Degrees	OR	40. MGRS*:
38. Latitude*:			
39. Longitude*			
41. Field Notes*			

\* Required Fields

## AIR – PM10 LOW-VOLUME SAMPLING FIELD DATA SHEET INSTRUCTIONS

## -----SECTION I - ADMINISTRATIVE DATA-----

1. **Sample ID** - Sample ID number XXX\_YYYY\_DDDDD\_ZZ  
Where: XXX : First three letters of camp name  
YYYY : Method type PM10  
DDDDD - jday code, last two digits of the year & three digit julian day of the year [e.g 00001 for 1-Jan-2000].  
ZZ : **P** - primary, **C** - collocated, **FB** - field blank
2. **Location** - Name of camp or location of sample.
3. **Country** - Name of country in which location or camp is located.
4. **Operation** - Name of operation ongoing in the area of the sample [e.g. Operation Allied Force (OAF), etc] if applicable
5. **Sampling Date** - Date sample was collected (e.g. 01-Jan-2000).
6. **Sampling Time** - Time sample was taken (e.g. 16:00)
7. **Collected By** - Unit collecting the sample (e.g. TAML, 71<sup>st</sup> MEDDET, etc).
8. **Unit Spec ID** - Unit specific ID associated with the sample if any.
9. **Mission ID** - Unit mission ID associated with the sample if any.
10. **Shipping ID** - Shipping ID associated with sample (e.g. Fedex tracking number)
11. **Lab ID** - Unique ID number assigned at CHPPM-Main laboratory, if applicable.
12. **Job No.** - Job number assigned at laboratory.
13. **Project No.** - Project number assigned by laboratory or project officer.
14. **Europe ID** - Unique ID number assigned at CHPPM-Europe laboratory, if applicable.
15. **Sampling Notes** - Any notes or comments associated with the sample (e.g. short holding time, unusual circumstances, etc).

## -----SECTION II - FIELD DATA-----

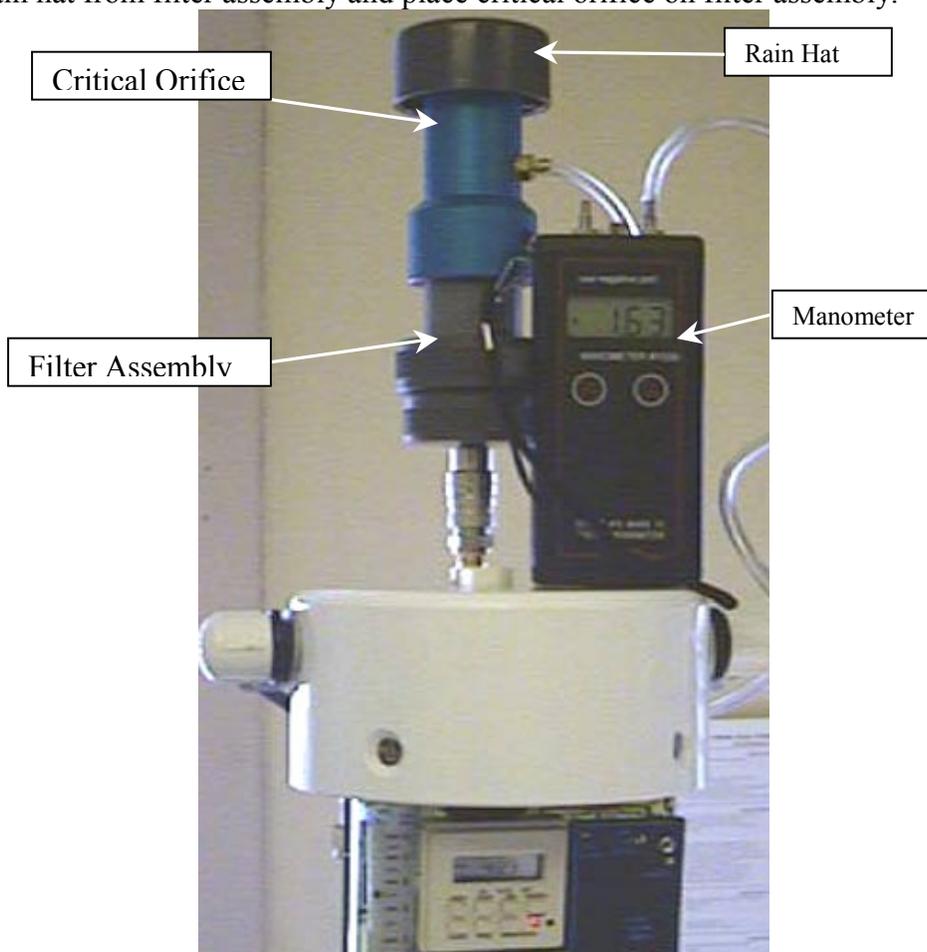
16. **Filter No** - The filter ID number that will be on the filter cassette. (e.g. KOV-01 or 47-100)
17. **Filter Type** - **TF** - Teflon; **QM** - Quartz; **GF** - Glass fiber; **CE** - Cellulose ester
18. **Holder ID** - The ID associated with the filter holder assembly
19. **Unit ID** - The serial number off the top of the sampler (e.g. 1884) or "FB" if filter is a field blank
20. **PM Type** - PM10 - Particulate matter less than 10 microns (DEFAULT CHOICE)  
TSP - Total Suspended Particulate  
PM25 - Particulate matter less than 2.5 microns
21. **Collectors Name** - Name of the person operating the sampler.
22. **Unit Type** - Type of sampling unit (e.g. Airmetrics, etc)
23. **Battery ID** - The battery number (BATT #) off the top of the battery used (e.g. 97-421) or "FB" if filter is a field blank
24. **Blank** - Is the sample a QA/QC blank, if it is what type? (Circle appropriate one)  
**NO** - not a blank (DEFAULT CHOICE)      **WB** - weighing blank  
**FB** - field blank      **LB** - lab blank
25. **Invalid Sample** - Is the sample invalid, if so why? (select appropriate code)  
**NO** - Sample is valid (DEFAULT CHOICE)  
**M** - Missing Field Data - e.g. sample time, flow rates, etc  
**B** - Battery Failure - battery failed during sampling episode.  
**F** - Flow Differential -pre and post flow calibrations deviation was greater than 10%  
**T** - Timer Malfunction -pump timer failed.  
**S** - Sample Malfunction -other part of sampler failed, e.g. tubing, etc  
**D** - Damage Sampling Media - filter was damage during shipment or sampling episode
26. **Flow Meter Used** - Indicate with flow meter used to determine flow. (Circle One)
27. **Flow Calibrator ID** - ID of Mini-Flow calibrator (e.g. MNF 0023) or Gilibrator SN if used to obtain flow rate
28. **Slope (m)** - Slope from Mini-Flow Calibrator.
29. **Intercept (b)** - Intercept from Mini-Flow Calibrator
30. **Calibration Target Flow ( $\Delta H$ )** - Target flow for Mini-Flow Calibrator Manometer in inches of water calculated using the associated equation.
31. **Date** - Date which the sampling episode was started and ended - DD MON YR - (e.g. 01 Jan 00)
32. **Time** - Time which the sampling episode was started and ended in a 24 hour standard format
33. **Ambient Temperature** - Ambient Temp in degrees Celsius from thermometer at the start and end of the sampling episode
34. **Ambient Pressure** - Ambient Pressure in inches Hg from barometer at the start and end of the sampling episode
35. **Flow Calibration (in H<sub>2</sub>O)** - Mini-Flow calibration reading off of digital manometer attached to calibration office in inches of water.
36. **Flow meter reading** - Flow Meter Reading in liter per minute (lpm) from sampler at the start and end of the sampling episode
37. **Elapsed Time reading** -Elapsed Time Reading in hours from sampler at the start and end of the sampling episode
38. **Latitude** - Sample latitude location in decimal degrees [from GPS]
39. **Longitude** - Sample longitude location in decimal degrees [from GPS]
40. **MGRS** - Location in MGRS from GPS, ten digit grid with grid square identifier (e.g. BQ1234567890)
41. **Field Notes** - Notes relating to sampling episode (e.g. unusual circumstance, weather, potential pollution sources, etc)

**ANNEX 6-1-1 :  
USING CRITICAL ORIFICE TO SET FLOW RATE**

1. Record the ambient pressure (mm Hg) and temperature in degrees Kelvin (°K) [°K = °C + 273]
2. Calculate the delta H required to obtain 5 lpm volumetric flow rate by placing the temperature and pressure into the equation on the back of the MiniFlow container.

$$\Delta H = (\text{Constant}) * \frac{P_{\text{amb}}}{T_{\text{amb}}} \quad \text{Constant} - \text{Found on back of Miniflow Container}$$

3. Take the sampler and MiniFlow calibration kit to the field.
4. Set up sampler in the field and place the filter assembly on sampler.
5. Attach Tygon tubing from critical orifice to negative port of manometer.
6. Turn on and zero the manometer.
7. Remove rain hat from filter assembly and place critical orifice on filter assembly.



8. Turn on pump and adjust flow rate using flow rate adjustment knob on the sampler until the manometer reads the  $\Delta H$  set point.
9. Turn off pump, replace rain hat on filter assembly, and begin sampling.
10. After sampling is complete, check the final  $\Delta H$  (**Do not adjust the flowrate**).

## Appendix 6-2

### SAMPLING OF TOTAL SUSPENDED PARTICULATE MATTER USING HIGH VOLUME SAMPLER

CONTENTS	Page
Application .....	6-2-1
Required Manhours .....	6-2-1
Equipment Inventory .....	6-2-1
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TSP Sampling Set-Up .....	6-2-8
TSP Filter Recovery .....	6-2-9
Filter Cassette Unloading .....	6-2-10
Maintenance of TSP Sampler .....	6-2-10
Siting Criteria .....	6-2-11

#### 6-2.1 APPLICATION

Total suspended particulate (TSP) is collected according to EPA Method IO-2.1: Sampling of Ambient Air for Total Suspended Particulate Matter (SPM) and PM<sub>10</sub> Using High Volume (HV) Sampler, June 1999. The EPA Method IO-2.1 is codified at 40 CFR 50, Appendix B, Reference Method for the Determination of Suspended Particulates in the Atmosphere (High Volume Method). The high volume sampler is commonly used to collect the airborne particulate component of the atmosphere. The sampler is designed to be portable to sample the air at a discrete location or to be used in saturation sampling. However, the high volume sampler requires electrical power (~10 amperes), which may be a limiting factor for sampling site selection. Air is drawn into the sampler and through a glass fiber or quartz fiber filter by means of a blower, so that particulate material collects on the filter surface. Aerodynamic particles of 100-micron size and less enter the sampling inlet and are collected on the downstream filter. The sampler is normally operated for a 24 hour period. The total volume of air sampled is typically between 1,600-2,400 m<sup>3</sup> with a flow rate of between 1.1 and 1.7 m<sup>3</sup>/minute. The filter is pre and post weighed to determine the mass of TSP and may also be analyzed chemically. Final TSP concentration is calculated by dividing the mass of TSP found on the filter by the total volume of air collected.

#### 6-2.2 REQUIRED MANHOURS

Approximately 0.5-1 hour per sample site.

#### 6-2.3 EQUIPMENT INVENTORY

The items listed in Table 6-2-1 are required for a sampling site using one TSP high volume sampler:

Table 6-2-1. TSP Sampling Inventory of Required Equipment

ITEM DESCRIPTION	QUANTITY
TSP Tri-pod shelter w/ leg holders	1
Aluminum legs	3
High volume blower motor assembly	1
Stainless steel filter holders w/ lids (8" x 10")	2
Slack tube manometers with colored liquid (in extremely cold weather, a digital manometer capable of reading between 0.5 and 16 inches of water may be substituted)	2
Motor voltage control/elapsed time indicator (if possible)	1
Calibrated orifice transfer standard kit	1
# 8" x 10" quartz or glass fiber filters	1
Rubber tubing for digital manometer	1 pieces
Tweezers	1
Cord to secure Tripod assembly	1
Duct Tape Roll	1
Operating manual	1
Sampling Instructions	1
Field data sheets	2
Thermometer/Barometer	1
Screwdriver	1
Nitrile Gloves	2 pair
Utility Wipes	2
Permanent Marker	1

**6-2.4 CALIBRATION PROCEDURE FOR TSP SAMPLER**

1. Place the orifice transfer standard faceplate on the filter support screen and fasten hand tight. Figure 6-2-1 displays the orifice transfer standard, resistance plates, and gasket. Tighten alternate corners to ensure even tightening.



Figure 6-2-1. Orifice Transfer Standard With Resistance Plates.

2. Install orifice transfer standard and resistance plate No. 18 on the orifice faceplate (See Figure 6-2-2 and Figure 6-2-3). Ensure a gasket is on top of and underneath the resistance plate. Hand-tighten the orifice coupling.



Figure 6-2-2. Resistance Plate No. 18 Placed on the Orifice Faceplate.



Figure 6-2-3. Orifice Transfer Standard Placed on top of Resistance Plate.

3. Open the valves on the manometers 3/4 to 1 turn and connect the tubing to each manometer's inlet. The manometers should not be filled more than half full (the fluid may be sucked into the motor or ejected from the manometer's inlet). Gently blow into the connecting tubes to check the manometers for free fluid movement.
4. Connect the 0 to 8-inch scale manometer to the pressure tap on the sampler motor Delta P<sub>ex</sub> (P<sub>ex</sub>). Zero the manometer by adjusting slide scale so the liquid levels on both sides are as close as possible to the zero mark.
5. Perform a leak test on the sampler by: Caution: Run the sampler motor for no more than 30 seconds to prevent damage to the motor when performing the leak check.
  - a. Disconnect the flexible tubing between the manometer and the pressure tap on the orifice, if connected.
  - b. Block the orifice transfer standard's inlet hole with palm of your hand and the orifice pressure tap **Orifice Pressure (□H)** with your finger.
  - c. Turn on the sampler and gently rock the orifice while observing the manometer connected to the motor's pressure tap (P<sub>ex</sub>). If the manometer does not read 0, a leak exists in the system. If a leak is detected, make sure all fittings are firmly snug, all gaskets are in place and the manometer inlet is not loose. Repeat this process until no leaks are detected.
6. Reconnect the orifice transfer manometer (0-16 inch scale) to the orifice pressure tap (□H).

7. Turn the sampler on and let it warm up for 5 minutes. Note: The sampler hood may be partially lowered over the orifice to act as a shield from wind and weather. Secure the sampler hood, leaving at least 2 inches clearance between the orifice inlet and the hood.
8. Measure the transfer standard manometer's deflection to the nearest 0.05 inch on each leg. Add the readings from each manometer leg and record in the calibration data sheet in the restrictor plate row as the (P<sub>H</sub>). Use the bottom of the meniscus when measuring manometer deflections.
9. Record the motor's pressure tap manometer deflection. Record the reading in the calibration data sheet in the restrictor plate row as the Sampler Pressure (P<sub>ex</sub>). Make sure the reading is taken to the nearest 0.05 inch on each leg, then added.
10. Turn off the sampler. Remove resistance plate No. 18 and install plate No. 13.
11. Repeat steps 5 through 9 for plates 13, 10, 7, and 5.
12. Enter the following information in the calibration data sheet:
  - Ambient temperature in degrees Kelvin ( $\square K = \square C + 273$ )
  - Ambient pressure in millimeters of Mercury (mm Hg)
  - Orifice calibration values (m, b, r)
  - Orifice serial number
  - Sampler/motor serial number
  - Date of sampler calibration
  - Location (include country, elevation, latitude and longitude)
  - Operator
13. Perform linear regression on the transfer standard flow rates versus the measured flows rates of the motor.

#### 6-2.5 QUALITY ASSURANCE DURING FIELD SAMPLING

1. At least 3 of the 5 calibration flow rates must be between 1.1 to 1.7 standard m<sup>3</sup>/min.
2. The correlation coefficient (r) must be greater than 0.990.
3. The percent deviation (%Dev) between the calculated Y and the calculated Y (Y cal) adjusted for linear regression must be no more than +/-5.0 percent for all 5 calibration points.
4. If any part of step 6-2.5.13 is not met, locate problem, correct, and recalibrate the sampler. Note: Repeat all the set-up connections and checks.

### Air - TSP Calibration Field Data Sheet

<b>Section I - Administrative Data</b>		
1. Sampler ID*:	5. Calibration Date*:	10. Calib Orifice SN*:
2. Location*:	6. Julian Date*:	11. Calib Orifice Date:
3. Country:	7. Operator*:	12. Slope (Moc)*:
4. Operation:	8. Ambient Temp (Ta) oC*:	13. Intercept (Boc)*:
15. Calibration Notes:	9. Ambient Pressure (Pa) in Hg*:	14. Corr Coeff (Roc)*:

<b>Section II - Sampler Calibration</b>						
16. Plate No.	17. Orifice Manometer (H Orifice) [in H2O]*	18. Sampler Manometer (P Mano) [in H2O]*	19. Qa Orifice X- Axis(1) [m3/min]	20. Sampler Pext Y- Axis(2)	21. Q'std (3) Derived Flow [m3/min]	22. % Deviation (4)
18						
13						
10						
7						
5						

<b>Equations</b>	<b>Linear Regression Worksheet</b>																																										
$PT = \left( \frac{Pa * 25.4}{760} * \frac{298}{Ta + 273} \right) = \boxed{\phantom{000}}$ <p>(1) <math display="block">Qa_{Orifice} = \frac{\sqrt{H_{Orifice} * PT} - B_{oc}}{M_{oc}}</math></p> <p>(2) <math display="block">Sampler P_{ext} = \sqrt{P_{Mano} * PT}</math></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Reading</th> <th style="width: 15%;">xy</th> <th style="width: 15%;">x<sup>2</sup></th> <th style="width: 15%;">X̄ =</th> <th style="width: 15%;">Ȳ =</th> <th style="width: 15%;"></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">1</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td style="text-align: center;">2</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td style="text-align: center;">3</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td style="text-align: center;">4</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td style="text-align: center;">5</td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td style="text-align: center;">6</td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> $M_{sc} = \frac{5 \sum xy - (\sum x)(\sum y)}{5 \sum x^2 - (\sum x)^2}$ $B_{sc} = \bar{Y} - M_{sc} \bar{X}$ $M_{sc} = \frac{\boxed{\phantom{000}} - \boxed{\phantom{000}}}{\boxed{\phantom{000}} - \boxed{\phantom{000}}}$	Reading	xy	x <sup>2</sup>	X̄ =	Ȳ =		1						2						3						4						5						6					
Reading	xy	x <sup>2</sup>	X̄ =	Ȳ =																																							
1																																											
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4																																											
5																																											
6																																											
<p>After linear regression of Qa orifice and Sampler Pext</p> <p>(3) <math display="block">Q'_{std} = \frac{(Sampler P_{ext} - B_{sc})}{M_{sc}}</math></p> <p>(4) <math display="block">\%Deviation = \frac{(Q_{std} - Q'_{std})}{Q'_{std}}</math></p> <p>If % deviation is greater than 4% redo calibration</p>																																											

<b>Sampler Calibration Relationship</b>		
23. Slope (Msc)*:	24. Intercept (Bsc)*:	25. Corr Coeff (Rsc):

\* Required Fields

AIR - TSP HIGH VOLUME SAMPLER CALIBRATION INSTRUCTIONS

-----SECTION I - ADMINISTRATIVE DATA-----

1. **Sampler ID** – Unique ID of sampler (e.g. serial number or MMCN number)
2. **Location** – Camp or location of calibration
3. **Country** – Country in which location or camp is located.
4. **Operation** – Name of operation ongoing in the area of the sample [e.g. Operation Allied Force (OAF), etc] if applicable
5. **Calibration Date** – Date calibration was conducted
6. **Julian Day** – Corresponding year specific Julian day calibration was conducted. A Julian day is the sequential numeric day of the year. The database can be used to calculate the Julian day of the year.  
*Example: 01-Jan-1999 would be Julian day 99001 where "99" is the last digit of the year and "001" is the day of the year.*  
*Example: 31-Dec-2000 would be Julian day 00366 where "00" is the last digit of the year and "366" is the day of the year (leap year).*
7. **Operator** – Name of person conducting the calibration.
8. **Ambient Temperature (Ta)** - Ambient temperature at the time of calibration in degrees Celsius (°C)
9. **Ambient Pressure (Pa)** - Atmospheric pressure at the time of calibration in inches of mercury (in Hg)  
*(All orifice calibration data can be obtained from the calibration sheet located with the orifice calibrator)*
10. **Orifice Calibration SN** – The serial number of the calibration orifice
11. **Orifice Calibration Date** – Date calibration orifice was calibrated to a primary standard.
12. **Slope (M<sub>oc</sub>)** – Slope of Orifice Calibration curve.
13. **Intercept (B<sub>oc</sub>)** – Slope of Orifice Calibration curve.
14. **Correlation Coefficient (R<sub>oc</sub>)** – Slope of Orifice Calibration curve.
15. **Calibration Notes** – General notes on the calibration

-----SECTION II – SAMPLER CALIBRATION DATA-----

16. **Plate No** – The plate number of each plate used during the calibration, predetermined to be (18, 13, 10, 7 and 5).
17. **Orifice Manometer (H orifice)** – Manometer reading from calibration orifice for each plate in inches of water.
18. **Sampler Manometer (P mano)** - Manometer reading from the sampler motor for each plate in inches of water.
19. **Q<sub>a Orifice</sub> (X-Axis)** - derived from the orifice calibration relationship using the following equation:

$$Q_{a\text{ Orifice}} = \frac{\sqrt{H_{\text{Orifice}} * \frac{Pa * 25.4}{760} * \frac{298}{Ta + 273}} - B_{oc}}{M_{oc}}$$

H<sub>orifice</sub> = manometer reading from calibration orifice in inches of water  
 Pa = Ambient barometric pressure in inches of mercury (in Hg)  
 Ta = Ambient temperature in degrees celcius (°C)  
 Boc = Intercept obtained from the calibration orifice  
 Moc = Slope obtained from the calibration orifice

20. **Sampler P<sub>ext</sub> (Y-Axis)** – Sampler manometer reading corrected to standard temperature and pressure using the following equation:

$$Sampler\ P_{Ext} = \sqrt{P_{Mano} * \frac{Pa * 25.4}{760} * \frac{298}{Ta + 273}}$$

Sampler P<sub>ext</sub> = manometer reading from sampler in inches of water  
 Pa = Ambient barometric pressure in inches of mercury (in Hg)  
 Ta = Ambient temperature in degrees celcius (°C)

**Conduct linear regression of Q<sub>std</sub> (X-axis) and M<sub>std</sub> (Y-Axis), either by using regression worksheet, calculator or spreadsheet to obtain sampler calibration:**

**Slope (M<sub>sc</sub>), Intercept (B<sub>sc</sub>) and Correlation Coefficient (R<sub>sc</sub>) if R<sub>sc</sub> < 0.98 calibration must be redone.**

21. **Q' <sub>std</sub> (Derived Flow)** - Standard flow calculated using the following equation:

$$Q'_{std} = \frac{(Sampler\ P_{Ext} - B_{sc})}{M_{sc}}$$

Sampler P<sub>ext</sub> = Sampler P<sub>ext</sub> from previous equation  
 B<sub>sc</sub> = Intercept obtained from the TSP sampler calibration.  
 M<sub>sc</sub> = Slope obtained from the TSP sampler calibration.

22. **%Deviation** - Percent deviation from Q' <sub>std</sub> and Q<sub>std</sub> Orifice

$$\%Deviation = \frac{(Q_{std} - Q'_{std})}{Q'_{std}} * 100 \quad \text{If \% deviation is greater than 4\% calibration must be redone.}$$

23. **Slope (M<sub>sc</sub>)** – Sampler calibration slope derived from linear regression
24. **Intercept (B<sub>sc</sub>)** – Sampler calibration intercept derived from linear regression
25. **Correlation (R<sub>sc</sub>)** – Correlation coeff of calibration

### 6-2.6 TSP SAMPLING SET-UP

1. Unscrew the top two thumbscrews on the filter cassette.
2. Remove the filter hold down plate from the filter support screen.
3. Check the gaskets on the filter cassette for tears and cracks. Replace as necessary.
4. Wipe the filter support screen clean.
5. Remove filter folder and data sheet from the envelope.
6. Put on disposable plastic gloves and remove filter from the folder. Do not handle the filter with bare hands. Do not use a filter that is torn or has a hole in it.
7. Place the filter, roughest textured side up, on the filter support screen (normally, number side up).
8. Place the gasket side of the filter hold down plate on the filter, making sure the filter remains centered on the filter support screen.
9. Screw the top two thumbscrews on the filter cassette as tight as possible by hand.
10. Place a piece of duct tape on the filter cassette and note the installed filter number, date of sample, and location.
11. Record filter ID on the TSP Sampler Field Data Sheet.
12. Unlatch the inlet fastener and gently tilt back the sample inlet to gain access to the filter support screen.
13. Place the filter cassette on the filter support screen.
14. Position the 4 thumbnut screws on the corners of the filter cassette.
15. Tighten the 4 thumb nuts a little at a time going from corner to corner to properly align and seat the gasket. **Note: Hand-tighten only.** Once completed, the filter set-up should look like Figure 6-2-4.



Figure 6-2-4. Filter Installed and Ready for Sampling.

16. Lower the sample inlet and relatch it.
17. Enter the following on the TSP Sampler Field Data Sheet.
  - Installation name.
  - Sampling site location.
  - Date of the 24 hour run day.
  - Operator name
  - Serial number of sampler at the sampling site.
  - m, b, r values of sampler at the sampling site. NOTE: The m, b, r values will come from the TSP high volume Sampler Calibration Datasheet.
  - Military grid reference system (MGRS) of sampling site
18. Open both valves on the manometer 3/4 to 1 turn and lightly blow on each leg of the manometer. The fluid should move freely when a pressure or vacuum is applied to the manometer.
19. Connect the manometer to the pressure tap on the motor.
20. Using the slide scale, zero the manometer so the fluid in both legs are at zero.
21. Turn on the sampler and let warm-up for 5 minutes.
22. Read and record the initial Delta  $P_{ex}$  ( $\Delta P_{ex}$ ) from the manometer on the TSP Sampler Field Data Sheet. NOTE: Read both legs of the manometer and add the values together to measure the total manometer deflection.
23. Calculate the  $Q_{std}$  using the equation shown in section C. The initial flow rate must be between 1.1 and 1.7  $m^3/min$ . If too high, use a voltage regulator to the voltage supplied to the motor (this in turn will reduce the flow rate to within acceptable limits).

### 6-2.7 TSP FILTER RECOVERY

As soon as possible after sampling, the operator should return to the monitoring site to retrieve the exposed filter.

1. Record the following on the TSP Sampler Field Data Sheet:
  - The elapsed time of the sampling period in minutes.
  - The average ambient temperature for the 24 hour run day in ( $^{\circ}K$ ).
  - The average ambient barometric pressure for the 24 hour run day in (mm Hg).
  - The weather conditions for the 24 hour run day.
2. Connect a 0 to 8-inch manometer to the pressure tap on the motor.
3. Open both valves on the manometer 3/4 to 1 turn and lightly blow on each leg of the manometer. The fluid should move freely.
4. Using the slide scale, zero the manometer so the fluid in both legs are at zero.
5. Turn on the sampler and allow it to equilibrate to operating temperature (5 minutes).

6. Read and record the final  $\Delta P_{ex}$  from the manometer on the TSP Sampler Field Data Sheet.  
Note: Read both legs of the manometer and add the values together to measure the total manometer deflection.
7. Calculate the Qstd flow rate using the **Mean**  $\Delta P_{ex}$  value [ Equation 6-2-1]. Note: The Qstd flow rate should be within the 1.1 to 1.7 std m<sup>3</sup>/min range. If not in this range repeat steps 2 through 6 to check to confirm a mistake was not made. If the flow is indeed outside the range, note this on the data sheet.

$$Q_{std} = \left[ \sqrt{\Delta P_{ex} \times \frac{P_a}{P_{std}} \times \frac{T_{std}}{T_a}} - b \right] \times \frac{l}{m} \quad \text{Equation 6-2-1}$$

8. Unlatch the inlet fastener and gently tilt back the sample hood to gain access to the filter.
9. Loosen the 4 black thumbscrews and remove the filter cassette.
10. Return the filter cassette to the filter recovery area.

#### 6-2.8 FILTER CASSETTE UNLOADING

The recovery of the filter from the cassette needs to be done in a relatively clean environment.

1. Unscrew the top 2 thumbscrews on the filter cassette.
2. Remove the filter hold down plate from filter support screen.
3. Check the filter for tears and particulate traces on the area of the filter covered by the gasket. Record on data sheet if any are found.
4. Put on disposable plastic gloves and remove filter from filter cassette.
5. Fold the filter in half (long side to long side) with the exposed side of the filter in and the edges of the filter aligned as close as possible.
6. Place the folded filter back in the properly marked folder.
7. Place filter folder and TSP Sampler Field Data Sheet in the properly marked envelope. **Note: Do not place the TSP Field Data Sheet in the filter folder.**
8. Seal the envelope for shipment.

#### 6-2.9 MAINTENANCE OF TSP SAMPLER

1. Make sure all gaskets (including motor cushion) are in good shape and that they all seal properly.
2. Check all power cords for good connections and for cracks (replace if necessary).  
**CAUTION: Do not allow power cord or outlets to be immersed in water!**
3. Inspect the filter screen and remove any foreign deposits.
4. Inspect the filter holder frame gasket each sample period and make sure the seal remains airtight (if it is not, dark streaks will be seen on the filter edges).
5. Inspect tubing for any cracks and make sure the manometer ports fit securely.

6. Check or replace motor brushes every 500 hours.
7. Make sure motor voltage control/elapsed time indicator is working properly.

**6-2.10 TSP SAMPLER SITING CRITERIA**

1. Height above ground should be 2 - 7 meters.
2. Samplers should be greater than 20 meters from trees.
3. Distance from sampler to obstacle, such as buildings, must be twice the height the obstacle protrudes above the sampler.
4. Must have unrestricted airflow 270 degrees around the sampler inlet.
5. Do not place near roads, especially unpaved, unless specified.

**Air - TSP High Volume Field Data Sheet**

<i>Section I - Administrative Data</i>			
1. Sample ID*:	7. Collected By*:	11. Lab ID:	
2. Location:	8. Unit Spec ID:	12. Job No:	
3. Country:	9. Mission ID:	13. Project No:	
4. Operation:	10. Shipping ID:	14. Europe ID:	
5. Sampling Date*:	15. Sample Notes:		
6. Sampling Time*:			
<i>Section II - Field Data</i>			
16. Filter No*:	19. PM Type: TSP	22. Unit ID*:	
17. Filter Type: Glass Fiber	20. Collectors Name*:	23. Blank? (Yes/No):	
18. Holder ID*:	21. Unit Type:	24. Invalid Sample?:	
<i>Sampler Calibration Data</i>			
25. Slope (Msc)*:	26. Intercept (Bsc)*:	27. Correlation Coeff (Rsc):	
SAMPLER DATA	Start/Pre	End/Post	Average
28. Date*:			
29. Time*:			
30. Ambient Temperature (oC)*:			
31. Ambient Pressure (in Hg)*:			
32. Manometer Reading (in H2O)*:			
33. Elapsed Time Reading (hrs):			
GEOLOCATION	Decimal Degrees	OR	36. MGRS*:
34. Latitude*:			
35. Longitude*:			
37. Field Notes*:			

\* Required Fields

## AIR – TOTAL SUSPENDED PARTICULATE HIGH VOLUME DATA SHEET INSTRUCTIONS

## -----SECTION I - ADMINISTRATIVE DATA -----

1. **Sample ID** - Sample ID number XXX\_YYY\_DDDDD\_ZZ  
Where: XXX : First three letters of camp name  
YYY : TSP  
DDDDD : jday code, last two digits of the year & three digit julian day of the year [e.g 00001 for 1-Jan-2000].  
ZZ : **P** - primary, **C** - collocated, **FB** - field blank
2. **Location** - Camp or location of sample.
3. **Country** - Country in which location or camp is located.
4. **Operation** - Name of operation ongoing in the area of the sample [e.g. Operation Allied Force (OAF), etc] if applicable
5. **Sampling Date** - Date sample was collected (e.g. 01-Jan-2000)
6. **Sampling Time** - Time sample was taken (e.g. 16:00)
7. **Collected By** - Unit collecting the sample (e.g. TAML, 71<sup>st</sup> MEDDET, etc).
8. **Unit Spec ID** - Unit specific ID associated with the sample if any.
9. **Mission ID** - Unit mission ID associated with the sample if any.
10. **Shipping ID** - Shipping ID associated with sample (e.g. Fedex tracking number)
11. **Lab ID** - Unique ID number assigned at CHPPM-Main laboratory, if applicable.
12. **Job No.** - Job number assigned at laboratory.
13. **Project No.** - Project number assigned by laboratory or project officer.
14. **Europe ID** - Unique ID number assigned at CHPPM-Europe laboratory, if applicable.
15. **Sampling Notes** - Any notes or comments associated with the sample (e.g. short holding time, unusual circumstances, etc).

## ----- SECTION II - FIELD DATA -----

16. **Filter No** - The filter ID number that will be on the filter cassette. (e.g. 6528212)
17. **Filter Type** - Glass fiber
18. **Holder ID** - The ID associated with the filter holder assembly if applicable
19. **PM Type** - TSP - Total Suspended Particulate
20. **Collectors Name** - Name of the person operating the sampler.
21. **Unit Type** - Type of sampling unit (e.g. Grasbey Anderson, etc)
22. **Unit ID** - The serial number off the the sampler (e.g. G0001) or "FB if filter is a field blank
23. **Blank (Yes/No)**- Is the sample a QA/QC blank?
24. **Invalid Sample** - Is the sample invalid, if so why? (select appropriate code)  
NO - Sample is valid (DEFAULT CHOICE)  
M - Missing Field Data - e.g. sample time, flow rates, etc  
B - Battery Failure - battery failed during sampling episode, if applicable.  
F - Flow Differential -pre and post flow calibrations deviation was greater than 10%  
T - Timer Malfunction -pump timer failed.  
S - Sample Malfunction -other part of sampler failed, e.g. tubing, etc  
D - Damage Sampling Media - filter was damage during shipment or sampling episode
25. **Slope (Msc)** - Slope of sampler calibration from "TSP Calibration Field Data Sheet"
26. **Intercept (Bsc)** - Intercept of sampler calibration from "TSP Calibration Field Data Sheet"
27. **Correlation Coeff (Rsc)** - Correlation coefficient of sampler calibration from "TSP Calibration Field Data Sheet"
28. **Date** - Date which the sampling episode was started and ended - DD MON YR - (e.g. 01 Jan 00)
29. **Time** - Time which the sampling episode was started and ended in 24 hour standard format (e.g. 16:00)
30. **Ambient Temperature** - Ambient Temp in degrees Celsius from thermometer at the start and end of the sampling episode
31. **Ambient Pressure** - Ambient Pressure in inches Hg from barometer at the start and end of the sampling episode
32. **Flow Meter Reading (in H<sub>2</sub>O)** - Flow meter reading of manometer attached to sampler in inches of water.
33. **Elapsed Time Reading** - Reading off elapsed time meter, if present in minutes at the start and end of the sampling episode
34. **Latitude** - Sample latitude location in decimal degrees [from GPS]
35. **Longitude** - Sample longitude location in decimal degrees [from GPS]
36. **MGRS** - Location in MGRS from GPS, ten digit grid with grid square identifier (e.g. BQ1234567890)
37. **Field Notes** - Notes relating to sampling episode (e.g. unusual circumstance, weather, potential pollution sources, etc)

**APPENDIX 6-3**

**VOLATILE ORGANIC COMPOUND (VOC) TUBE METHOD SAMPLING**

CONTENTS	PAGE
Application .....	6-3-1
Required Manhours .....	6-3-1
Sampling Frequency .....	6-3-1
Equipment Inventory .....	6-3-1
General TO-17 Method Information.....	6-3-2
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TO17 Sample Recovery.....	6-3-7
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Sampler Battery Recycling and Recharging .....	6-3-7

**6-3.1 APPLICATION**

The total organics method 17 (TO-17) is an EPA method for determining VOCs in ambient air. The method uses a metal Supelco Carbosieve 300 sampling tube, filled with 3 different collection media. Each tube is spiked before and after the sampling episode by the laboratory to ensure quality control/quality assurance (QA/QC).

**6-3.2 REQUIRED MANHOURS**

Approximately 0.5-1 hour per sampling site.

**6-3.3 SAMPLING FREQUENCY**

Sampling during a STMA should be conducted daily. Sampling frequency during a LTMA will be based on the results of the STMA. A general rule assumes that sampling should be conducted every six days during a LTMA. More frequent sampling may be required depending on the health hazard identified in the area.

**6-3.4 EQUIPMENT INVENTORY**

Each sampling episode consists of using the equipment presented in Table 1.

Table 6-3-1. Inventory of Equipment for Ambient Air VOC Tube Method Sampling

ITEM DESCRIPTION	QUANTITY
Sampling Tubes (Primary, Collocated, Field Blank)	3
Sampling Pumps	2
Battery Charger (Multi-Charger)	1
Tygon Tubing	2 sets
Pump Calibrator (DryCal or Gilibrator®)	1
Operating manual	1
Sampling Instructions	1
Field data sheets	3

ITEM DESCRIPTION	QUANTITY
Sample Labels	3
Thermometer/Barometer	1
Mini-Screwdriver	1
Nitrile Gloves	2 pair
Utility Wipes	2
Plastic Bags (4" x 9")	4
Permanent Marker	1
Global Position System (GPS)	1

### 6-3.5 GENERAL TO-17 METHOD INFORMATION

#### 6-3.5.1 Handling

When handling the sampling tubes do so by holding the middle of the tube. Do not hold the sampling tube by the ends. Oils from your could be adsorbed into the sampling tube causing contamination problems.

#### 6-3.5.2 Storage/Shipping

The sampling tubes should be refrigerated before and after sampling. Do not allow tubes to get wet! Ship sampling tubes in cooler with ice and ensure they are sealed in zip lock bags to prevent water contamination.

#### 6-3.5.3 Shipping Container

Each metal sampling tube is contained in a Teflon shipping container. The tube number (e.g. C1025) is usually indicated on the tube's shipping container from the laboratory. Ensure the appropriate container is labeled with the appropriate sample information on the tube label. If information contained on the shipping container is incorrect the sample will be considered invalid and the sampling site must be re-sampled.

#### 6-3.5.4 Sample Volume

The sample volume for general VOC sampling should range between 18-20 liters, not to exceed 20 liters. Generally 19 liters is desired which corresponds to approximately 39.5 mL/min flow rate over an 8-hour sampling period.

#### 6-3.5.5 Analytical

The sampling tubes are submitted to an analytical laboratory where they are analyzed using a gas chromatograph / mass spectrum (GC/MS) system.

### 6-3.6 PROGRAMMING THE SAMPLING PUMP

The pumps can be programmed for delayed start using SKC Datatrack software. If the pump is programmable, it is suggested that it be programmed to conduct the sampling. There are two primary types of sampling pumps; SKC PocketPump® Sampler and an SKC AirChek 2000® Sampler. Figure 6-3-2 presents these two types of samplers. This function can be used to ensure the primary and collocated pumps are started at the same time and allows for the programming to be conducted off site. If the software is not available, ensure that the samples are recovered as close to

480-minutes as possible.



Figure 6-3.2. PocketPump and AirCheck 2000

### 6-3.7 SAMPLING PUMP CALIBRATION

Calibration should be conducted in a controlled inside work area. Pump(s) calibration(s) should be conducted before and after each sampling episode. A calibration tube must be connected in the calibration system to simulate media resistance, see Figure 1. A calibration tube is just a sampling tube dedicated to pump calibration, once used for pump calibration the calibration tube should not be used for sampling.

#### 6-3.7.1 Pre-Calibration Procedure

1. Record the following on the “VOC Tube Method Field Data Sheet”
  - Calibration Location – Camp or location samplers were calibrated
  - Calibrator Id – Unique identification number of calibrator
  - Calibration Operator – Person conducting the calibration
  - Calibration Date – Date of calibration
  - Pump ID – Unique pump ID number (e.g. serial number)
2. Connect the calibration tube (an extra tube dedicated to calibration) to Tygon® tubing with black arrow on tube arrow pointing toward pump (Figure 6-3-1).

PocketPump® and AirChek 2000® are registered trademarks of SKC, Inc., Eighty Four, Pennsylvania.

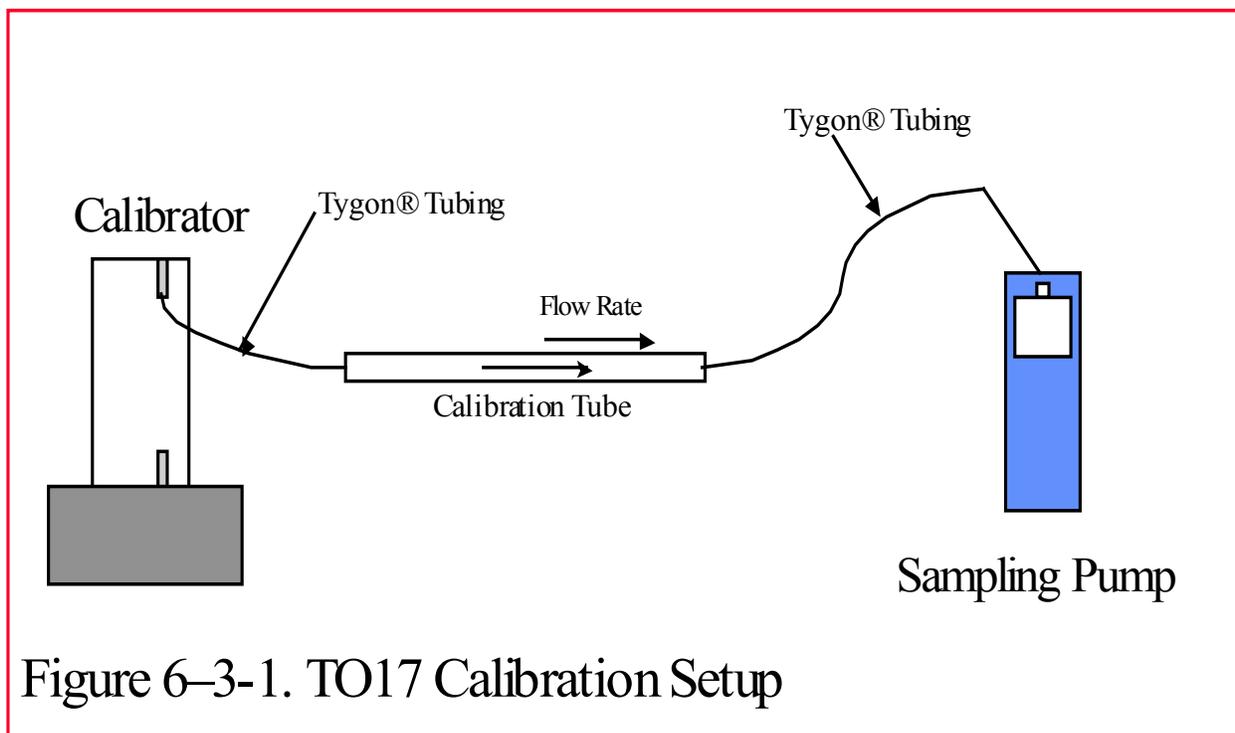


Figure 6–3-1. TO17 Calibration Setup

3. Connect other end of sample calibration tube to the calibrator (Dry Cal®).
4. Turn the pump on [▲▼]
5. Enter setup mode \*▲▼\* (Note. You only have 10 seconds to enter the setup mode. After 10 seconds you must turn off pump and try again)
6. Adjust flow rate for pump using ▲ and ▼ keys.
  - a. PocketPump – 40 ml/min. Press \* key to advance to ADJ screen
  - b. AirChek2000 – 1000 ml/min. Press \* until END appears. Press [▲▼].
7. DryCal Instructions
  - a. Turn the DryCal on while pump is running.
  - b. Depress the “Read” button on the DryCa® and observed pump flow.
  - c. PocketPump Flow Adjustment – Make sure the pump is in ADJ mode (ADJ will be flashing in the top center of the screen). Adjust the flow by using the ▲ or ▼. Each time you press the key, the flow is adjusted by 0.1 ml. Press \* to exit ADJ mode
  - d. AirChek 200 Flow Adjustment - Turn the fine adjustment, located on the pump’s low flow adapter, to achieve desired flow rate. For the TO-17 method a flow rate of 39.5 ml/min will yield a sample volume of 19 liters over an 8-hour sampling period.
  - e. Take 3-5 readings from the calibrator and record average flow on the “VOC Tube Method Field Data Sheet” [Flow Rate Pre](#) field in ml/min (cc/min).
8. Turn Pumps off by pressing [▲▼]
9. Clear the pumps memory

- a. Press \*▲▼\* to enter setup mode.
- b. Clear the pumps memory
  - i. PocketPump ® - Press \*\* during setup mode
  - ii. AirChek 2000 – Press \* until CLR appears. Then press [▲▼].
- c. Pumps are now ready for sampling

**6-3.8 TO-17 SAMPLING Procedures**

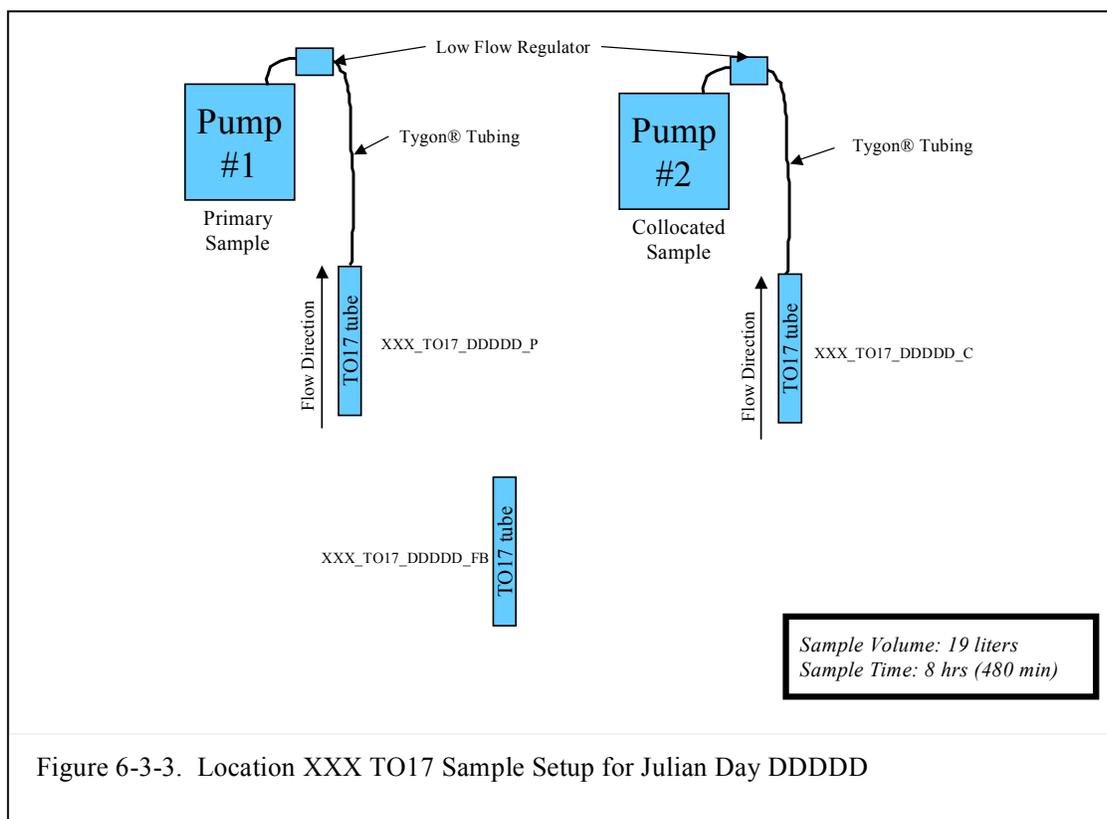
1. Before taking equipment to the sampling location, select three tubes to be used for the sampling episode. Obtain three shipping container labels and three “VOC Tube Method Field Data Sheets”.
2. Record the following information on the shipping container labels and “VOC Tube Method Field Data Sheets” and attach labels to the appropriate sampling tube shipping container.
  - Sample ID - Sample ID number XXX\_YYY\_DDDDD\_ZZ  
Where:
    - XXX - Camp abbreviation (i.e. first three letters of camp name)
    - YYY - Method type (e.g. TO17)
    - DDDD - jday code, last two digits of year and three digits Julian day of the year (e.g. 31-Jan-2000 = jday 00031).
    - ZZ – Sample type:
      - P – Primary sample, if collocated
      - C – Collocated sample, if collocated
      - FB – Field Blank
      - TB – Trip Blank
  - Pump ID – ID off of sampling pump
  - Start Date - Date sample was started
  - Tube ID - ID off sampling tube, or tube ID (e.g. C3025) on shipping container.
3. Take the equipment listed in Table 6-3-2 to the sampling site.

Table 6-3-2. Sampling Equipment Required to Collect TO-17 Sample From Field

ITEM DESCRIPTION	QUANTITY
Sampling Tubes (Primary, Collocated, Field Blank)	3
Sampling Pumps	2
Low-Volume adapters	2
Tygon® Tubing	2 sets
Field data sheets	3
Thermometer/Barometer	1
Nitrile Gloves	2 pair
Utility Wipes	2
Plastic Bags (4" x 9")	1
Permanent Marker	1
GPS	1

4. Record the following data on the “VOC Tube Method Field Data Sheet”. See back of data sheet for more detailed instructions for the data sheet
  - Collectors Name – The name of the person collecting the sample.
  - Collectors Phone # - The phone number of the person collecting the sample.
  - Field Blank ID – ID of field blank associate with the particular sample. For a field blank sample this entry would be blank.
  - VOC Type – Type of sample one of the following (not required).
    - S-Sample
    - FB-Field Blank
    - TB-Trip Blank
  - VOC Method - Sampling method type TO1 or TO17 or DAAMS.
  - MGRS – Location in Military Grid Reference System (MGRS) from GPS, eight to ten digit grid with grid square identifier (e.g., BQ1234567890)
5. Attach pumps to an appropriate structure to support them approximately 6 feet off the ground in an unobstructed area. Sample location must be determined before sampling is initiated.

6. Insert sample tubes into Tygon tubing (see Figure 6-3-3) and ensure they are attached so the flow is in the proper direction (e.g. for TO-17 the arrow on tube points toward pump).



7. Place pump in zip-lock bag if raining and note in the “Rain?” field on the “VOC Tube Method Field Data Sheet”.
8. Handle field blank in identical fashion as sample tubes and return it to its shipping container.
9. Record the following data on the “VOC Tube Method Field Data Sheet”.
  - Start Time - Time of day sample was started in 24-hour time (e.g., 0800), same as “Sampling Time”
  - Location - Camp or location sampled (not required)
  - Country - Country of camp or location sample (not required)
  - Operation - Name of operation, if applicable (not required)
  - Unit Spec ID - Unit specific ID associated with the sample if any.
  - Mission ID - Unit mission ID associated with the sample if any.
  - Sample Notes - Any notes or comments associated with the sample (e.g., short holding time, unusual circumstances, etc).
10. Turn the pumps on by pressing [▲▼].

**6-3.9 TO17 SAMPLE RECOVERY**

1. At the end of sampling period, bring field blank to the sampling site and handle in identical fashion as the samples.
2. If the pump has not been programmed. Turn off pump by pressing [▲▼].
3. Remove sampling tubes from pump ensuring the correct tube is returned to its appropriate labeled storage container. Take the three sample tubes and place in zip-lock bag.
4. Record the *End Date* on the sample label.
5. Record the following data on the “VOC Tube Method Field Data Sheet”
  - *End Date* - Date sample was ended
  - *End Time* - Time of day sample was ended in 24-hour time (e.g., 0800)
  - *Sample Time* – Time the sample ran in minutes, from the LCD pump display at the end of the sampling episode
  - *Field Notes* – Notes relating to the sampling episode (e.g., unusual circumstances, weather, potential pollution sources, etc).

**6-3.10 POST SAMPLING INSTRUCTIONS**

1. Retrieve sampling tubes and pumps and return to work area.
2. Store zip-lock bag containing sample tubes in refrigerator or cooler.
3. Conduct post-sampling calibration on sampling pumps (See Section 6-3.7). Assemble calibration setup and record the average of 3-5 readings from calibration. Record flow rate in the “*Flow Rate Post*” field on the “VOC Tube Method Field Data Sheet”. If battery is dead and you are unable to obtain final flow reading, note on field data sheet. Note: Post calibration should record final average flow rate with no adjustments to flow.

**6-3.11 SAMPLER BATTERY RECYCLING AND RECHARGING**

1. Only charge a totally discharged battery (use a battery discharger if available).
2. Charge battery for a minimum of 12 hrs.
3. Use only a fully charged battery for sampling; a fully charged battery will last for approximately 10 hrs.

**Air - VOC Tube Method Field Data Sheet**

<b>Section I - Administrative Data</b>		
1. Sample ID*:	7. Collected By*:	11. Lab ID:
2. Location:	8. Unit Spec ID:	12. Job No:
3. Country:	9. Mission ID:	13. Project No:
4. Operation:	10. Shipping ID:	14. Europe ID:
5. Sampling Date*:	15. Sample Notes:	
6. Sampling Time*:		
<b>Section II - Calibration Data</b>		
16. Calibration Location*:	20. Pump ID*:	
17. Calibrator ID*:	21. Flow Rate Pre*:	cc/min
18. Calibration Operator*:	22. Flow Rate Post*:	cc/min
19. Calibration Date*:	23. Flow Rate Average:	cc/min
25. Calibration Notes:	24. Range:  $\text{Range} = \frac{\text{Flow Rate Pre} - \text{Flow Rate Post}}{\text{Flow Rate Post}} \times 100$	
<b>Section III - Field Data</b>		
26. Collectors Name*:	29. VOC Type: S / FB / TB <small>(Circle One)</small>	32. Invalid Sample?:
27. Collectors Phone No*:	30. VOC Method:	33. Rain (Yes/No)?:
28. Field Blank ID*:	31. Tube ID* :	
<b>SAMPLER DATA</b>	<b>Start</b>	<b>End</b>
34. Date*:		
35. Time*:		
36. Sample Time: <span style="float: right;">min</span>	37. Sample Volume <span style="float: right;">Liters</span> <small>[=(Sample Time * Flow Rate Average) / 1000]</small>	
<b>GEOLOCATION</b>	<b>Decimal Degrees</b>	<b>OR</b>
38. Latitude*:		
39. Longitude*		
40. MGRS*:		
41. Field Notes*		

\* Required Fields

## AIR - VOC TUBE SAMPLING FIELD DATA SHEET INSTRUCTIONS

## -----SECTION I - ADMINISTRATIVE DATA-----

1. **Sample ID** - Sample ID number XXX\_YYYY\_DDDDD\_ZZ  
Where: XXX - Camp abbreviation (i.e. first three letters of camp name)  
YYYY - Method type (e.g. TO17)  
DDDDD - jday code, last two digits of the year & three digit julian day of the year [e.g 00001 for 1-Jan-2000].  
ZZ - Sample type: **P** - Primary sample; **C** - Collocated sample; **FB** - Field Blank; **TB** - Trip Blank
2. Location - Camp or location of sample.
3. Country - Country in which location or camp is located.
4. Operation - Name of operation ongoing in the area of the sample [e.g. Operation Allied Force (OAF), etc] if applicable
5. **Sampling Date** - Date sample was collected (e.g. 01-Jan-2000)
6. **Sampling Time** - Time sample was taken (e.g. 16:00)
7. **Collected By** - Unit collecting the sample (e.g. TAML, 71<sup>st</sup> MEDDET, etc).
8. Unit Spec ID - Unit specific ID associated with the sample if any.
9. Mission ID - Unit mission ID associated with the sample if any.
10. Shipping ID - Shipping ID associated with sample (e.g. Fedex tracking number)
11. Lab ID - Unique ID number assigned at CHPPM-Main laboratory, if applicable.
12. Job No. - Job number assigned at laboratory.
13. Project No. - Project number assigned by laboratory or project officer.
14. Europe ID - Unique ID number assigned at CHPPM-Europe laboratory, if applicable.
15. **Sampling Notes** - Any notes or comments associated with the sample (e.g. short holding time, unusual circumstances, etc).

## -----SECTION II - CALIBRATION DATA-----

16. **Calibration Location** - Camp or location samplers were calibrated.
17. **Calibrator ID** - Identification number of calibrator (e.g. serial number).
18. **Calibration Operator** - Operator of calibration equipment.
19. **Calibration Date** - Date of calibration
20. **Pump ID** - Pump ID number, either MMCN number or serial number.
21. **Flow Rate Pre (cc/min)** - Pre-sampling calibration sampler flow rate.
22. **Flow Rate Post (cc/min)** - Post-sampling calibration sampler flow rate.
23. Average Flow Rate (cc/min) (*Calculated*) - [Average = (Flow Rate Pre + Flow Rate Post)/2]
24. Range (*Calculated*) - [Range = [(Flow Rate Pre - Flow Rate Post) / Flow Rate Post]\*100]
25. Calibration Notes - Notes relating to calibration (e.g. unusual circumstance, etc)

## -----SECTION III - FIELD DATA-----

[Note: The Sample ID, Pump ID, Start Date and Tube ID (if present on tube) should also be recorded on the sample label.]

26. **Collectors Name** - The name of the person collecting the sample.
27. **Collectors Phone No** - The phone number of the person collecting the sample.
28. **Field Blank ID** - ID of field blank associated with the particular sample. For a field blank sample this entry would be blank.
29. VOC Type: **S** - Sample; **FB** - Field Blank; **TB** - Trip Blank
30. VOC Method - Method (e.g. TO1, TO17, DAAMS)
31. Tube ID - Unique ID on tube, or tube ID (e.g. C3025) on shipping container.
32. **Invalid Sample** - Was the sample determined to be invalid? If so, why?  
No - Sample is valid (*default if entry is left blank*)  
M - Missing Field Data - e.g. sample time, flow rates, etc  
B - Battery Failure - battery failed during sampling episode.  
F - Flow Differential - pre and post flow calibrations deviation was greater than 10%  
T - Timer Malfunction - pump timer failed.  
S - Sample Malfunction - other part of sampler failed, e.g. tubing, etc  
D - Damage Sampling Media - sampling media was damage during shipment or sampling episode.
33. Rain (Yes/No)? - Indicate whether or not it rained at the sample location during the sampling episode.
34. **Date** - Date which the sampling episode was started and ended - DD MON YR - (e.g. 01 Jan 99)
35. **Time** - Time which the sampling episode was started and ended in military time
36. **Sample Time** - Time pump ran in minutes, from the pump's LCD at the end of the sampling episode.
37. Sample Volume (liters) (*Calculated*) - [Volume = (Sample Time \* Average Flow Rate) / 1000]
38. **Latitude** - Sample latitude location in decimal degrees [from GPS]
39. **Longitude** - Sample longitude location in decimal degrees [from GPS]
40. **MGRS** - Location in MGRS from GPS, eight to ten digit grid with grid square identifier (e.g. BQ1234567890)
41. **Field Notes** - Notes relating to sampling episode (e.g. unusual circumstance, weather, potential pollution sources, etc)

ANNEX 6-3-1  
PROGRAMMING SKC AIRCHEK 2000 SAMPLING PUMP

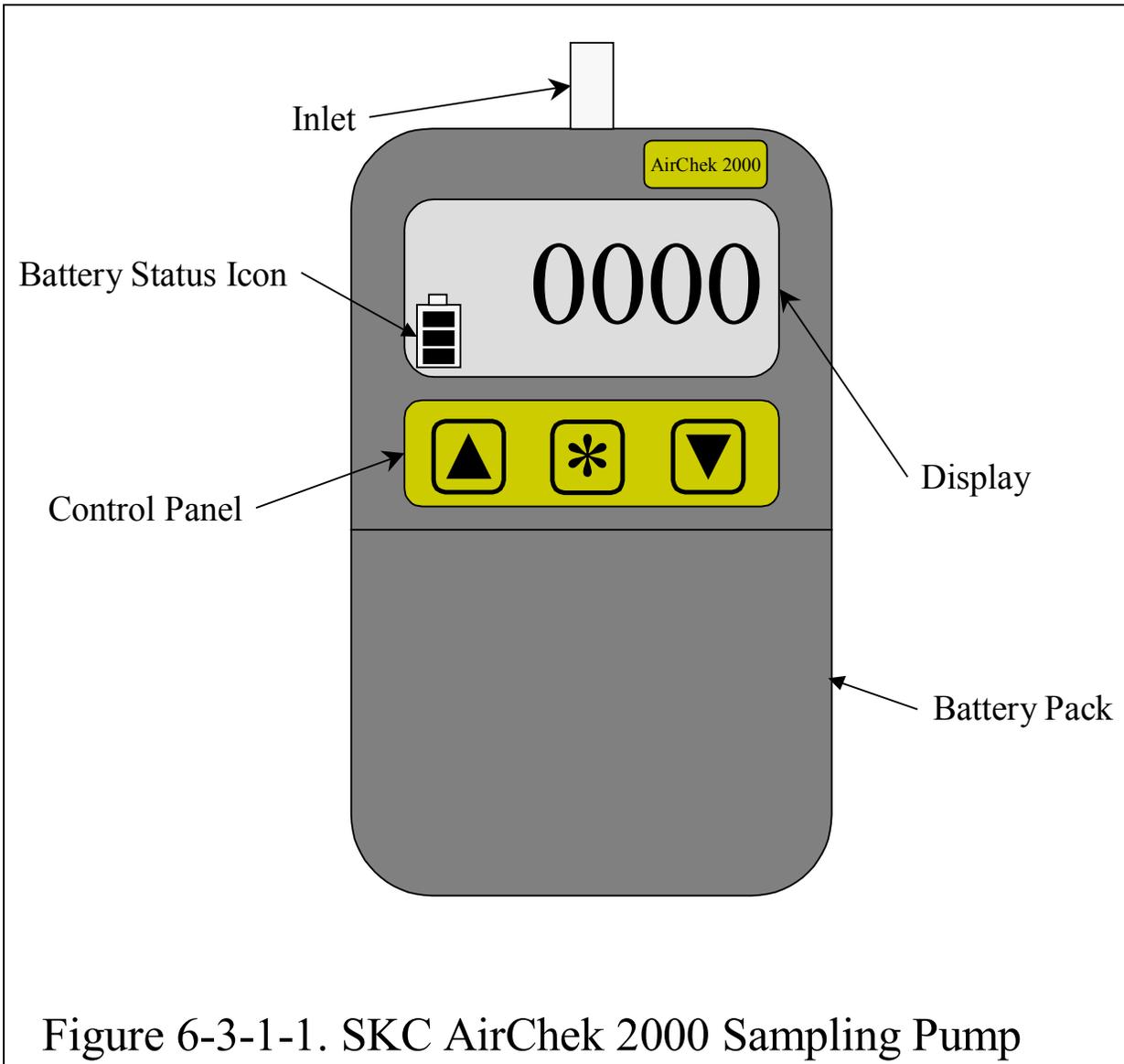


Figure 6-3-1-1 illustrates the controls for a standard programmable SKC AirChek 2000 pump.

### 6-3-1 PROGRAMMING THE SKC AIRCHECK 2000 PUMP

This Annex to Appendix 6-3 contains the necessary steps to program the SKC AirCheck 2000 pump prior to field sampling.

#### 6-3-1.1 AIRCHECK 2000 CONTROLS

- Star Button \* – Scrolls through run-time data, display options and sampling parameters during pump setup.
- Up and down arrow buttons ▲▼ - Increases or decreases sampling parameters and toggles between display choices in setup.
- Button Sequence – Buttons must be pressed in the sequence shown.
- Bracketed sequence [▲▼] – Buttons must be pressed simultaneously.
- Security Code \*▲▼\* - Prevents unauthorized changes to the pump’s sampling program. Must be pressed within 10 seconds of the previous command.

#### 6-3-1.2 CHECK PUMP SETTINGS

1. Turn the unit on by pressing the \* button. You should see a flashing “ST” followed by “XX” or Flashing “S” “XXX”. The “ST” or “S” represents Sample Time and the “XX” or “XXX” represents the actual sampling time depending on whether it is two units (i.e. <100 minutes) or “XXX” (> 99 minutes).
2. “Hold” should appear on the display and be flashing. This indicates the pump is in hold mode.
3. Verify the pumps units for flow rate, volume, temperature, time, and pressure. Press the \* button, “Flow” should appear at the top of the display and the flow should read 1000 ml/min. This is the required flow for the pump when using a low flow adapter. If the flow is different than 1000 ml/min please refer to the owners manual or “Quick Guide” to change the flow to 1000 ml/min.

#### 6-3-1.3 RESET VOLUME TO ZERO

1. Press the \* button again, “Vol” should appear at the top of the display and the vol should be zero. If the flow is not zero do the following:
2. While the pump is running (press [▲▼] to turn on the pump)
3. Press [▲▼] to turn pump off
4. Press \* ▲ ▼ \* to initialize setup (This must be done within 10-seconds of turning the pump off)
5. Press the \* until “Clr” displays
6. Press [▲▼]
7. Press \* until “End” displays
8. Press [▲▼] to exit setup mode

#### 6-3-1.4 SET TEMPERATURE UNITS TO °C

1. Press the \* button again, °C or °F should appear in the lower left part of the display indicating the ambient temperature. Most situations required entries into data sheets to be °C to change the display from °C to °F do the following:
2. While the pump is running (press [▲▼] to turn on the pump)
3. Press [▲▼] to turn pump off
4. Press \*▲▼\* to initialize setup mode (This must be done within 10-seconds of turning the pump off)
5. Press \* until temperature screen displays (“SET” should be flashing in the upper left part of the display)
6. Press ▲ or ▼ to switch units
7. Press \* until “End” displays
8. Press [▲▼] to exit setup mode

#### **6-3-1.5SET PUMP TIME**

1. Press the \* button again, the time should appear on the display. If the time is not correct do the following: To change time scale (12-Hr/24Hr)
2. While the pump is running (press [▲▼] to turn on the pump)
3. Press [▲▼] to turn pump off
4. Press \*▲▼\* to initialize setup mode (This must be done within 10-seconds of turning the pump off)
5. Press \* until 12-Hr or 24-Hr screen displays
6. Press ▲ or ▼ to switch units
7. Press \* until “End” displays
8. Press [▲▼] to exit setup mode
9. To change real time
10. While the pump is running (press [▲▼] to turn on the pump)
11. Press [▲▼] to turn pump off
12. Press \*▲▼\* to initialize setup mode (This must be done within 10-seconds of turning the pump off)
13. Press \* until real-time screen displays
14. Press ▲ or ▼ to change flashing units.
15. Press \* until “End” displays
16. Press [▲▼] to exit setup mode

#### **6-3-1.6SET PRESSURE UNITS TO INCHES**

1. Press the \* button again, the pressure display should appear with “ins” (inches of mercury), “m” (millibars), or “mm” (millimeters of mercury). Most situations required entries into data sheets to be inches of Mercury (ins) to change the units to ins, do the following:
2. While the pump is running (press [▲▼] to turn on the pump)

3. Press [▲▼] to turn pump off
4. Press \*▲▼\* to initialize setup mode (This must be done within 10-seconds of turning the pump off)
5. Press \* until pressure screen displays (“SET” should be flashing in the upper left part of the display)
6. Press ▲ or ▼ to switch units to “ins”
7. Press \* until “End” displays
8. Press [▲▼] to exit setup mode

#### **6-3-1.7 PROGRAMMING A DELAYED START**

1. While the pump is running (press [▲▼] to turn on the pump)
2. Press [▲▼] to turn pump off
3. Press \*▲▼\* to initialize setup mode (This must be done within 10-seconds of turning the pump off)
4. Press \* until the display reaches the “12-Hr/24-Hr” clock, unless the pump is in delayed start already. Press ▲ or ▼ until the display shows “DELA” (delayed start)
5. Press \* until the real time displays. Enter the time that you desire the pump to begin sampling (e.g. 11:00) Note: The time entered here will be the next occurrence of this time. There is no a.m. or p.m. designation.
6. Press \* until “ST” displays, Set the desired run-time in minutes (e.g. 480). If the run-time is left at 0, the pump will not enter the Delayed Start mode.
7. Press \* until “End” appears
8. Press [▲▼] to exit setup mode
9. The “PROG” icon and a flashing “HOLD” will appear in the upper left corner of the display. The pump is now set for delayed start.

#### **6-3-1.8 CLEARING A DELAYED START**

1. While the pump is running (press [▲▼] to turn on the pump)
2. Press [▲▼] to turn pump off
3. Press \*▲▼\* to initialize setup mode (This must be done within 10-seconds of turning the pump off)
4. Pressing \* scroll to the flashing “OFF” indicator and press the [▲▼].
5. Press \* until “End displays.
6. Press [▲▼] to exit setup mode, the “PROG” icon will be gone.

#### **6-3-1.9 PROGRAMMING SAMPLE PERIOD WITHOUT DELAYING THE START**

1. Determine sample period [usually 480 minutes (8-hours)]
2. While the pump is running (press [▲▼] to turn on the pump)
3. Press [▲▼] to turn pump off
4. Press \*▲▼\* to initialize setup mode (This must be done within 10-seconds of turning the pump off)

5. Press \* until “ST 00” displays
6. Press ▲ or ▼ to change flashing units.
7. Press \* until “End” displays
8. Press [▲▼] to exit setup mode

ANNEX 6-3-2  
PROGRAMMING SKC UNIVERSAL XR SAMPLING PUMP

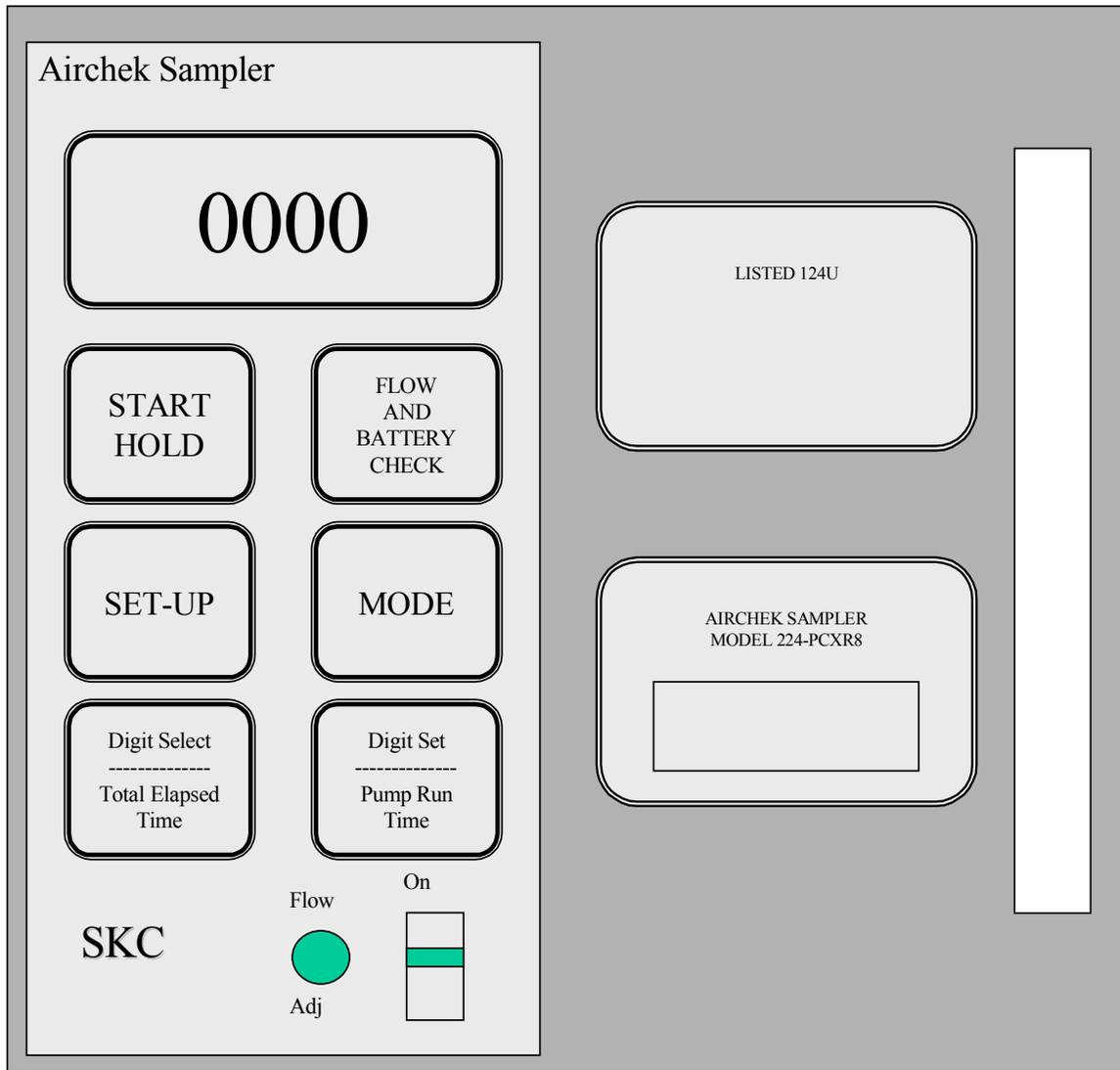


Figure B-1. SKC Universal XR Sampling Pump Control Panel

Figure 6-3-2-1 presents the controls for a standard programmable SKC pump.

### **6-3-2.1 PROGRAMMING THE SKC UNIVERSAL XR SAMPLING PUMP**

This annex to appendix 6-3 contains the necessary steps to program the SKC Universal XR sampling pump prior to field sampling.

#### **6-3-2.2 INITIALIZING PROGRAMMING**

1. Turn pump on
2. Press START/HOLD
3. Press SET UP

#### **6-3-2.3 PROGRAMMING DELAYED START**

1. Determine the delayed start required (e.g. 15 minutes) and sample time [usually 480 minutes (8-hours)]
2. Press MODE until “Delayed Start” is displayed on LCD.
3. Set DELAY START (e.g. 15 min) using the digit select and digit set buttons.

#### **6-3-2.4 PROGRAMMING SAMPLE PERIOD**

1. Determine sample period [usually 480 minutes (8-hours)]
2. Press MODE until “Sample Period” is displayed on LCD.
3. Set SAMPLE PERIOD, using the digit select and digit set buttons (i.e. 480 min.)

#### **6-3-2.5 PROGRAMMING PUMP PERIOD**

1. Determine pump period, pump period is the same as sample period [usually 480 minutes (8-hours)]
2. Press MODE until “Pump Period” is displayed on LCD.
3. Set PUMP PERIOD, using the digit select and digit set buttons (i.e. 480 min.)
4. Toggle through the “Delayed Start”, “Sample Period”, and “Pump Period” menus by pressing MODE to ensure the correct times have been entered.
5. Press START/HOLD to put the sampler in “Hold” mode. Once in “Hold” mode the sample will begin counting down the delayed start. Once the delayed start has reached zero the sampling period will begin.

ANNEX 6-3-3  
PROGRAMMING SKC POCKET PUMP

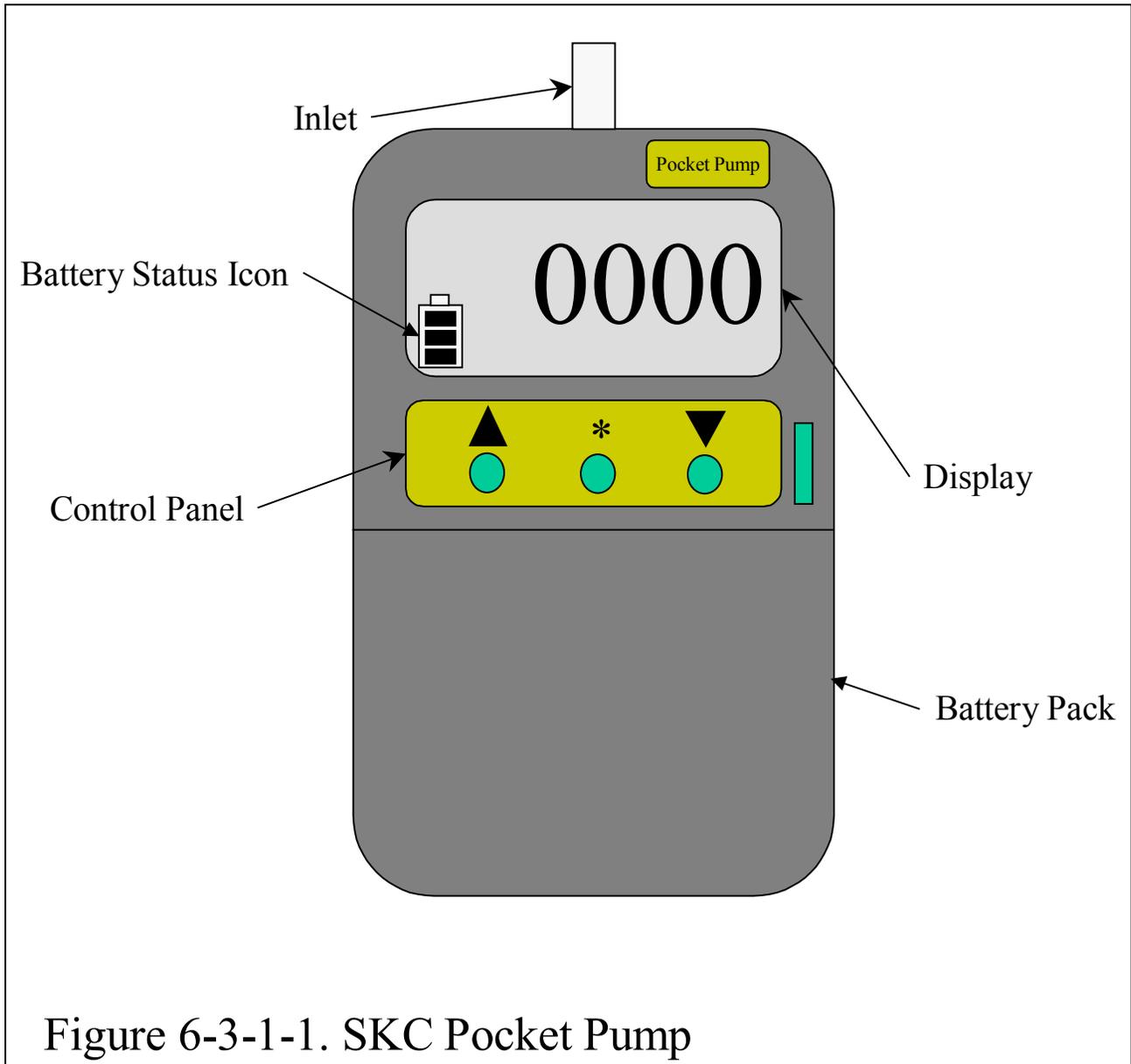


Figure 6-3-1-1 illustrates the controls for a standard programmable SKC pump.

## 6-3-2 PROGRAMMING THE SKC POCKET PUMP

This Annex to Appendix 6-3 contains the necessary steps to program the SKC Pocket Pump pump prior to field sampling.

### 6-3-2.1 AIRCHEK 2000 CONTROLS

- Star Button \* – Scrolls through run-time data, display options and sampling parameters during pump setup.
- Up and down arrow buttons ▲▼ - Increases or decreases sampling parameters and toggles between display choices in setup.
- Button Sequence – Buttons must be pressed in the sequence shown.
- Bracketed sequence [▲▼] – Buttons must be pressed simultaneously.
- Security Code \*▲▼\* - Prevents unauthorized changes to the pump's sampling program. Must be pressed within 10 seconds of the previous command.
- Security Code \*\* resets pump during “Hold” setup

### 6-3-2.2 CHECK PUMP SETTINGS

1. Turn the unit on by pressing the \* button. You should see a flashing “Hold”. If you press the “\*” button again you total minutes sampled, “S” represents Sample Time.
2. “Hold” should appear on the display and be flashing. This indicates the pump is in hold mode.
3. Verify the pumps units for flow rate, volume, temperature, time, and pressure. Press the \* button, “Flow” should appear at the top of the display and the flow should read 40 ml/min. If the flow is different than 40 ml/min please refer to the owners manual or “Quick Guide” to change the flow to 40 ml/min.

### 6-3-2.3 RESET VOLUME TO ZERO

1. Press the \* button again, “Vol” should appear at the top of the display and the vol should be zero. If the flow is not zero do the following:
2. While the pump is running (press [▲▼] to turn on the pump)
3. Press [▲▼] to turn pump off
4. Press \* ▲ ▼ \* to initialize setup (This must be done within 10-seconds of turning the pump off)
5. Press \*\*, the serial number of the pump should appear and the pump is reset

### 6-3-2.4 SET TEMPERATURE UNITS TO °C

1. Press the \* button again, °C or °F should appear in the lower left part of the display indicating the ambient temperature. Most situations required entries into data sheets to be °C to change the display from °C to °F do the following:
2. While the pump is running (press [▲▼] to turn on the pump)
3. Press [▲▼] to turn pump off
4. Press \*▲▼\* to initialize setup mode (This must be done within 10-seconds of turning the pump off)

5. Press [\*▼] to change the temperature units between F and C
6. Repeat these steps to change units back

#### **6-3-2.5 SET PRESSURE UNITS TO INCHES HG**

1. Press the \* button again, the pressure display should appear with “ins” (inches of mercury), “m” (millibars), or “mm” (millimeters of mercury). Most situations required entries into data sheets to be inches of Mercury (ins) to change the units to ins, do the following:
2. While the pump is running (press [▲▼] to turn on the pump)
3. Press [▲▼] to turn pump off
4. Press \*▲▼\* to initialize setup mode (This must be done within 10-seconds of turning the pump off)
5. Press [\*▲] to change the temperature units between ins and mm
6. Repeat these steps to change units back

#### **6-3.2.6 Adjust Flow Rate**

1. Press [▲▼] to turn on the pump
7. Press \*▲▼\* to initialize setup mode (This must be done within 10-seconds of turning the pump on)
2. Adjust the set flow to 40 using the ▲ or ▼ button
3. Press \* once so “ADJ” is blinking next ot “FLOW”
4. Check the flow rate with calibration device
5. Adjust flow with ▲ or ▼ button. Each press is approximately 0.1 cc
6. When set press \* and then [▲▼] to turn pump off then clear pump

**APPENDIX 6-4**  
**AMBIENT AIR VOLATILE ORGANIC COMPOUND (VOC) SUMMA CANISTER**  
**SAMPLING (TO-14A)**

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#### **6-4.1 Application**

Volatile organic compounds (VOCs) are collected according to EPA Method TO-14A using SUMMA polished, evacuated stainless steel canisters. Sub-atmospheric, passive, sampling does not require the use of a power source. Therefore, this type of sampling provides a high level of portability for remote field sampling of VOCs. Sampling periods (8-hr, 24-hour, 1-week) can be selected for the sampling mission requirements. Flow rates are determined by the capacity of the canister, the desired sampling period(s), and the ambient conditions (temperature and barometric pressure). Flow rates are controlled using a flow restrictor manufactured by Entech<sup>®</sup> and canister vacuum measurements are taken with the vacuum gauge attached to the restrictor. See Figure 1 for the assembled sampler. It is assumed that prior to field deployment, the canisters and flow restrictors have been prepared in accordance with TO-14A. The vacuum gauge on the flow restrictors is also assumed to have been calibrated prior to field deployment. Only the flow rate of the restrictor will need to be set/calibrated.

#### **6-4.2 Required Manhours**

Approximately 0.75 -1 hr per sampling site.

#### **6-4.3 Equipment Inventory**

The equipment listed in Table 6-4-1 are required for each single canister sampling site.

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Entech<sup>®</sup> is a registered trademark of Entech, Inc., Simi Valley, California.

Table 6-4-1. TO14 Passive Sampling Equipment

ITEM DESCRIPTION	QUANTITY
Entech Flow Restrictor with attached vacuum gauge	1
6 Liter (L) leak-free SUMMA polished sample canister evacuated to approximately 29 inches of Mercury (in Hg)	1
Alicat Scientific <sup>®</sup> primary (calibrated) flow rate standard	1
Spare frits and o-ring	1
Operating manual	1
Sampling Instructions	1
Field data sheets	1
Thermometer/Barometer	1
Nitrile Glove	2 pair
9/16" wrenches	2
1 - 1/2" wrench	1
1/8" Hex key	1
Pair of tweezers	1
Permanent Marker	1

Alicat Scientific® is a registered trademark of Alicat Scientific, Inc., Tuscon, Arizona.

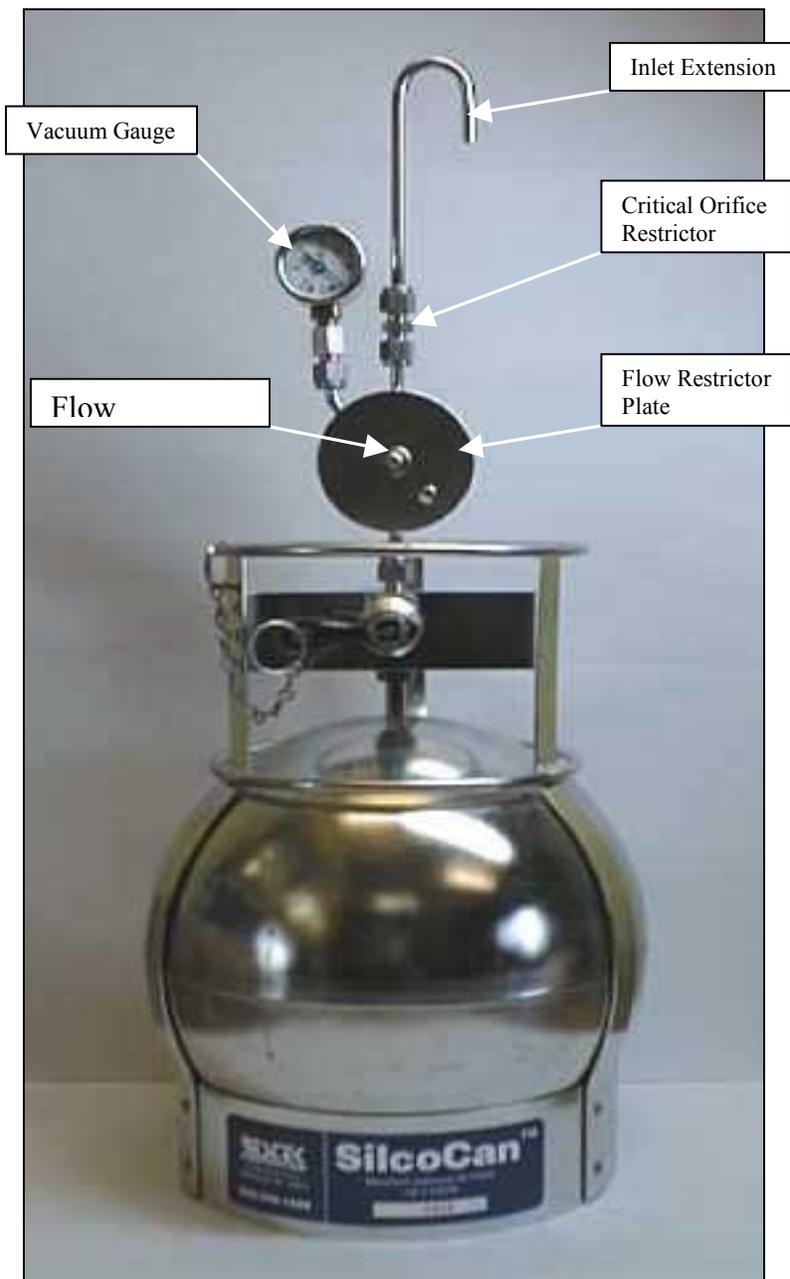


Figure 6-4-1. Assembled TO14 passive sampler.

#### 6-4.4 REPLACING THE FRIT PARTICULATE FILTER

Perform the following steps in a clean environment that is protected from the weather. If possible, perform the following on a clean, level surface

1. Remove the sample inlet extension from the flow controller with a 9/16" wrench. If the swagelock nut on the critical orifice turns with the nut on the sampling extension outlet, grasp and hold it with a 1/2" wrench.

2. Remove the old O-Ring and frit filter by turning the restrictor upside down and lightly, tapping it if necessary.
3. Replace the frit filter and O-ring with new ones using a pair of clean tweezers to prevent contamination. Do not handle the filter or O-ring with bare hands. The frit filter is installed first, then the O-ring (Figure 6-4.2).

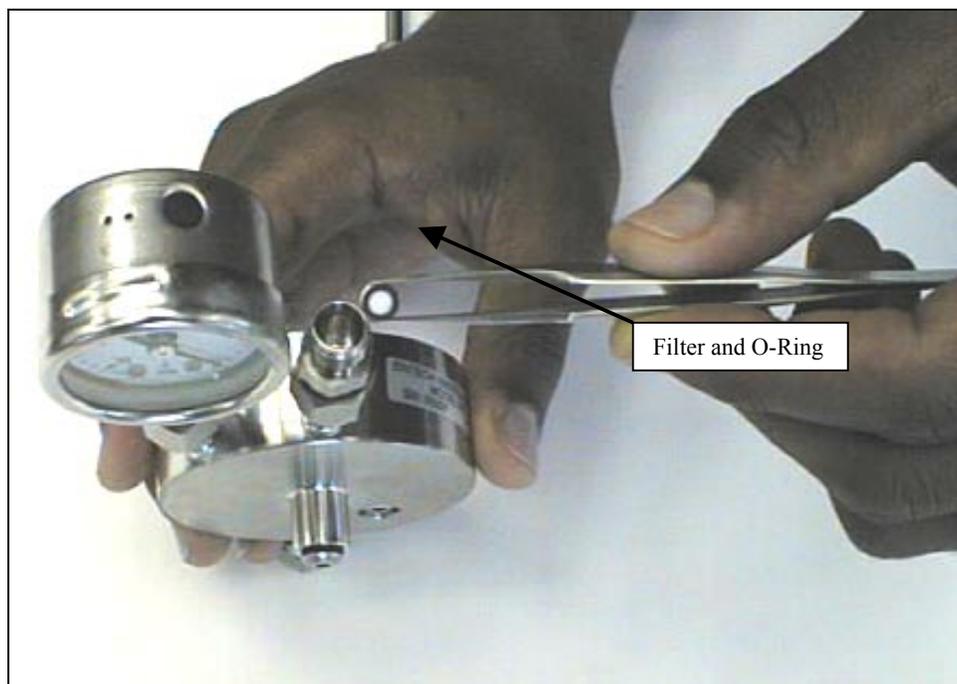


Figure 6-4-2. Installation of frit filter and O-ring into flow controller

4. Replace the sample inlet extension. Tighten the swagelock nut until firmly snug, but do not over tighten. If the swagelock nut on the orifice turns with the nut on the inlet, grasp and hold it with a 1/2" wrench.
5. Discard the used frit filter. The O-ring may be reused after cleaning it with water and inspecting it for cracks or tears (if necessary).

#### 6-4.5 CALIBRATING THE RESTRICTOR FLOW RATE AND LEAK CHECK

1. Perform the following steps in a clean environment that is protected from the weather.
2. Note the critical orifice's code located on the top swagelock nut. Refer to Table 6-4-1 for the fill times and target flow rates for a 6 L canister.

Table 6-4-1. Fill Times and Target Flow Rates for a 6 L Canister

Critical Orifice PN	Stamp Code	Fill Time for a 6L Canister <sup>1</sup> (hours)	Target Flow Rate (ccm)
39-23010	1	1	80
39-23030	2	3	27
39-23080	3	8	10

39-23240	4	24	3.4
39-14010	5	1 week	0.5

<sup>1</sup>Fill time will be reduced by the ratio of ambient pressure to standard pressure (760 mmHg or 29.92 in Hg) or  $P_a / P_o$ .

3. Unscrew the swagelok cap on the practice canister inlet with a 9/16" wrench (Figure 6-4.3). Grasp and hold the canister inlet to prevent any movement.

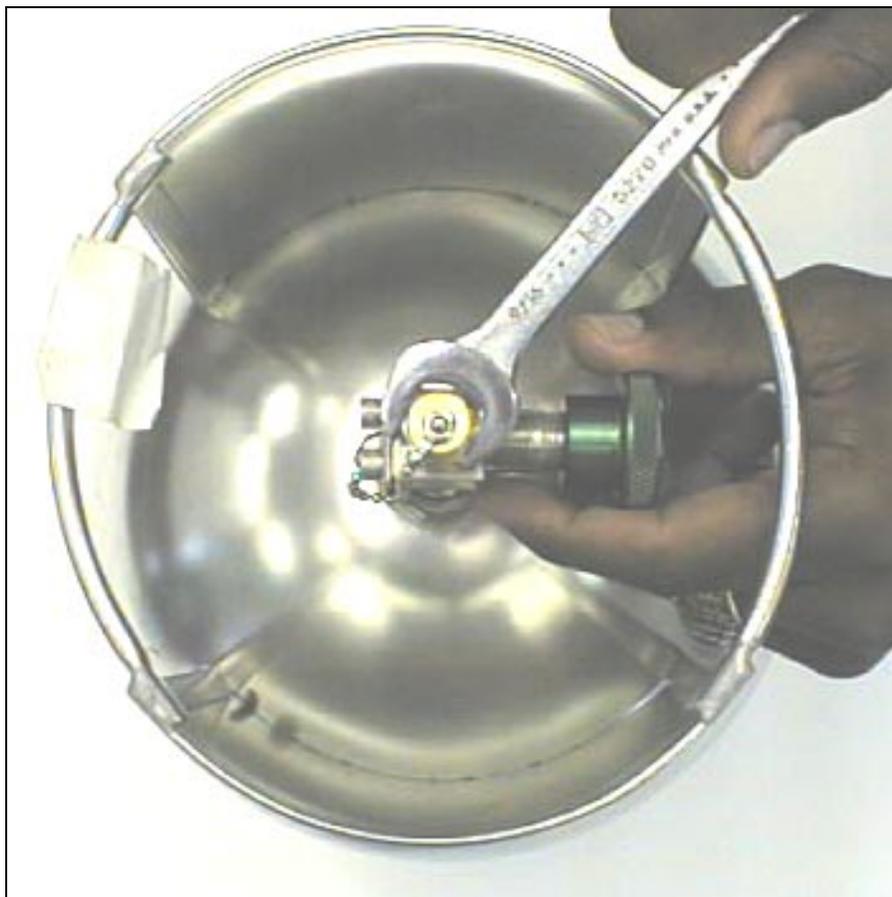


Figure 6-4.3. Removing swagelok cap from 6-L canister

4. Choose a restrictor that fills the 6 L canister in the desired time period using Table 1 and the restrictor stamp code.
5. Remove the sample inlet extension of the restrictor using a 9/16" wrench. Use a 1/2" wrench to hold the swagelok nut of the critical orifice restrictor in place as shown in Figure 6-4.4.



Figure 6-4.4. Removing sample inlet extension

6. Connect the restrictor outlet to the inlet of the evacuated practice canister as shown in Figure 6-4.5. Grasp the canister inlet with a free hand while tightening the swagelock nut on the restrictor outlet until firmly snug. Do not over tighten the swagelock nut.



Figure 6-4.5 Attaching flow restrictor to canister

7. Connect the outlet of the Alicat flow check device to the inlet of the restrictor as shown in figure 6-4.6. The arrow on the Alicat device should be pointing toward the canister. Tighten the swagelock on the outlet of the Alicat<sup>®</sup> with a 9/16" wrench until firmly snug. If the swagelock nut on the inlet of the restrictor turns with the swagelock nut on the outlet of the Alicat, grasp the swagelock nut on the restrictor inlet with a 1/2" wrench and hold.

There is only one way for the Alicat to attach to the inlet of the restrictor. Note: There is only one way for the Alicat to attach to the inlet of the restrictor.



Figure 6-4.6. Connecting Alicat flow check device to flow restrictor

8. Turn on the Alicat.
9. Press the zero button on the face of the Alicat until a zero is displayed on the digital screen.
10. Open the canister valve and wait 30 seconds or until the flow stabilizes.
11. Cover the inlet of the Alicat until the flow stops (a zero is displayed on the digital screen).
12. Close the canister valve and wait 5 minutes.
13. Uncover the inlet of the Alicat. If the flow fails to start, a leak exists in the flow path. Carefully retighten the swagelock nuts and repeat steps 11 through 14 until there are no leaks detected.
14. Open the canister valve and wait 30 seconds or until the flow stabilizes.
15. Remove the outer protective screw located on the center of the flow restrictor's face using the 1/8" hex key as shown in Figure 6-4.7. The flow set screw is recessed under this protective screw.



Figure 6-4.7. Removing protective cover for flow set screw

16. Slowly adjust the set screw with the 1/8" hex key until the flow rate as measured by the Alicat is as close as possible to the target flow rate listed in Table 6-4-1 (note the stamped code on the restrictor; see diagram below). DO NOT turn the set screw more than 3 turns. The internal diaphragm can be damaged by over tightening!

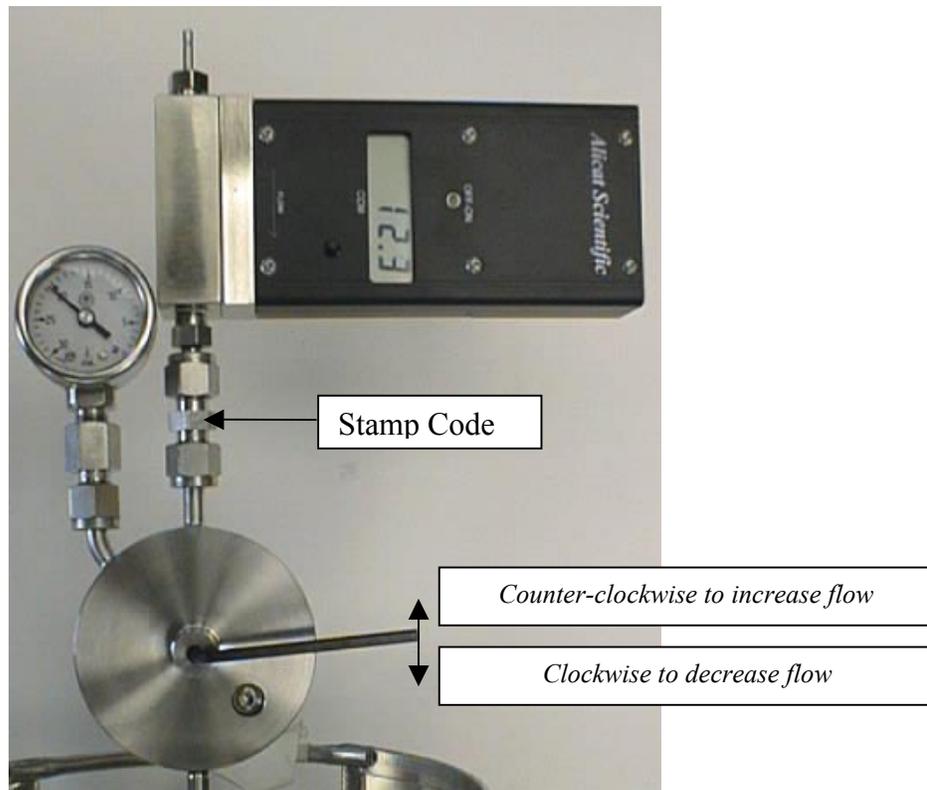


Figure 6-4.8. Adjusting flow set screw in restrictor plate

17. Wait 30 seconds until the flow rate stabilizes.
18. Record the measured flow rate in cubic centimeters per minute (ccm) and the serial number of the restrictor in the sample data sheet.
19. Close the practice canister's inlet valve and tighten to prevent leakage.
20. Replace the outer protective screw on the flow restrictor's face and tighten until firmly snug.
21. Unscrew the swagelock nut on the outlet of the Alicat and remove it.
22. Unscrew the swagelock nut on the outlet of the restrictor and remove it.
23. Reinstall the sample inlet extension on the restrictor. Tighten the connecting swagelock nut on the sample inlet extension until firmly snug.
24. Replace the black plastic cap on the sample inlet extension.
25. Store the flow restrictor in a plastic bag or wrap with aluminum foil until ready for field use to prevent contamination.
26. Repeat the above process for the each of the remaining flow restrictors.
27. Replace the swagelock cap on the practice canister and tighten until firmly snug when finished. Do not over tighten and avoid moving the canister inlet when tightening the swagelock cap.

**NOTE:** If the barometric pressure differs from standard conditions (760 mm Hg or 29.92 in Hg) significantly, the sample period or flow rate will have to be modified to prevent premature filling of the canister (a canister with a zero vacuum has reached atmospheric pressure and is to be considered suspect). This is especially true in mountainous areas with high elevations. Either the sample period or the sample flow rate will need to be *reduced* by a factor of  $P_a/P_o$  where  $P_a$  is the average ambient barometric pressure and  $P_o$  is the pressure at standard conditions. For example, if the average ambient barometric pressure is 650 mm Hg, either the flow will need to be reduced *or* the sample period will need to be reduced by  $650/760 = 0.85$ . Either the target flow rate or the sample period would then be multiplied by 0.85. If possible, the canisters should be monitored during the sample event to prevent them from reaching 0 vacuum or atmospheric pressure.

#### **6-4.6 PRESAMPLING PROCEDURES**

1. Prior to mounting the canister, perform the following steps in a clean environment that is protected from the weather.
2. Choose the flow restrictor that will fill the 6 L canister in the desired time period. Calibrate the restrictor using the steps in Section 6-4.6, noting the stamp code on the top swagelock nut at the restrictor's inlet.
3. Remove the swage cap from the sample canister. Grasp and hold the canister inlet with a free hand and do not allow the inlet to move.
4. Remove the flow restrictor from the protective plastic bag or aluminum foil.
5. Connect the outlet of the restrictor to the inlet of the 6 L sample canister. Tighten the swagelock nut on the restrictor outlet until firmly snug. If the canister inlet turns with the nut on the outlet of the restrictor, grasp and hold it with a free hand. Do not over tighten.

6. Choose a sampling site that will properly assess the content of VOCs in the ambient air. Normally, a sampling location will not be very close to a pollution source, but a certain distance away in order to assess the ambient air in the "vicinity" of the source.
7. Remove the black plastic cap from the sample inlet and place in the protective plastic bag or in the aluminum foil (don't lose it).
8. Open the canister inlet valve all way, then turn ½ turn back.
9. Record the initial reading displayed on the vacuum gauge in the data sheet.
10. Mount the canister so that the sample inlet is at a height of approximately 6 feet from the ground (i.e. in the breathing zone), unless otherwise specified. The site should generally be a certain distance from obstacles such as buildings or trees to avoid air turbulence generated by them. If no mounting hardware is available, the canister may be placed on a level, horizontal surface during the sample event. If rain is expected to occur during the sample event, shield the sample inlet extension so that it will remain dry.
11. Shield the canister from direct sunlight using a sheet of cardboard, for example. Direct sunlight (especially in a desert environment) will heat the air collected inside the canister above the ambient temperature, thereby reducing the pressure difference between the canister and the ambient atmosphere. This results in a reduction in the total volume of air collected and will risk premature filling of the canister.
12. Record the following information in the data sheet:
  - Initial vacuum gauge reading. The vacuum gauge should display approximately 29 in Hg vacuum.
  - Ambient temperature (Measure the ambient temperature of the air away from direct sunlight)
  - Wait 5 minutes and record the ambient barometric pressure displayed on the portable barometer
  - Initial flow rate from the calibration procedure
  - Sample date
  - Initial start time
  - Name of the sampling location, including the following:
    - Country
    - MGRS location (10 digit)
    - Canister serial number
    - Flow restrictor serial number
  - Current weather conditions and any other relevant information in the remarks section of the data sheet. The location of nearby sources or polluting activities should also be recorded in the data sheet.

#### **6-4.7 POST SAMPLING PROCEDURES**

1. Remove the canister from where it was mounted.
2. Record the final vacuum gauge reading in the data sheet. If the canister vacuum has reached less than 1 in Hg, the sample period may need to be shortened or the flow rate reduced.
3. Close the canister inlet valve tight.

4. Replace the black plastic cap on the sample inlet extension.
5. Record the following information in the data sheet:
  - Stop time
  - Sample duration
  - Ambient Temperature (Measure the ambient temperature of the air away from direct sunlight)
  - Wait 5 minutes and record the atmospheric pressure displayed on the portable barometer
  - Current weather conditions (in remarks section)
  - Any active pollution sources nearby (in remarks section)
6. Perform the following steps in a clean area protected from the weather.
7. Unscrew the swagelock nut at the outlet of the flow restrictor with a 9/16" wrench to remove it from the canister inlet. If the canister inlet turns with the swagelock nut on the restrictor's outlet, grasp and hold it with a free hand.
8. Screw the swagelock cap on the canister inlet and tighten with a 9/16" wrench until firmly snug. Grasp and hold the canister inlet to prevent it from moving. Do not over tighten.
9. Place the flow restrictor in a sealable plastic bag or wrap in aluminum foil to prevent contamination.
10. Store the canister in a area until shipment.

#### **6-4.8 MEASURING FINAL RESTRICTOR FLOW**

1. Perform the following steps in a clean environment that is protected from the weather.
2. Remove the restrictor from its protective bag or aluminum foil.
3. Attach the restrictor to the practice canister as described in CALIBRATING THE FLOW RESTRICTOR.
4. Remove the sample inlet extension.
5. Connect the Alicat to the inlet of the flow restrictor.
6. Turn on the Alicat.
7. Press the zero button on the front face until a zero is displayed on the digital screen. The assembly should look like the following figure.



Figure 6-4-9. Measuring post flow rate using practice canister

8. Open the practice canister's inlet valve all the way. Make sure the vacuum gauge reads at least 5 in Hg.
9. Cover the inlet of the Alicat until the flow reaches zero.
10. Close the canister inlet valve and wait 5 minutes.
11. Uncover the Alicat inlet. If the flow rate remains zero, there is a leak in the system. Inspect for leaks and tighten any loose swagelocks. Repeat steps 7 through 10 until no leaks are detected.
12. Open the canister inlet valve and allow the flow rate displayed on the Alicat to stabilize.
13. Record the final flow rate displayed on the digital screen of the Alicat<sup>®</sup> in the data sheet.
14. Close the canister inlet valve.
15. Remove the Alicat.
16. Replace the sample inlet extension on the flow restrictor. Make sure the O-ring and frit filter are still in place at the inlet of the restrictor.
17. Remove the flow restrictor from the canister inlet.
18. Place the flow restrictor in a protective plastic bag or rewrap in aluminum foil.
19. Repeat this process for each flow restrictor used during a sample event.

20. Turn off the Alicat when finished.

**6-4.9 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES**

1. Note in the data sheet if a sample canister has reached atmospheric pressure (0 in Hg on the vacuum gauge).
2. Ensure all field in the data sheet are complete.
3. Enter field data sheet information into "Deployment Environmental Surveillance Database", if applicable.
4. No field blanks are required for the TO-14A method, unless specified.
5. Note in the data sheets which canisters are being used as background samples, if applicable.
6. Use caution when using VOC containing fluids near the canisters.

**6-4.10 ERROR CONDITIONS**

1. Loss of vacuum during canister storage. This is an indication the sample has been contaminated. Note serial number and error in a data sheet for the canister.
2. Flow controller failure has occurred if the flow rate does not change while the set-screw is turned more than once. Label the controller and do not use.
3. If the canister has reached atmospheric pressure (0 in Hg as displayed on the vacuum gauge), note this in the data sheet.

**Air - T014 Field Data Sheet**

<i>Section I - Administrative Data</i>			
1. Sample ID*:	7. Collected By*:	11. Lab ID:	
2. Location:	8. Unit Spec ID:	12. Job No:	
3. Country:	9. Mission ID:	13. Project No:	
4. Operation:	10. Shipping ID:	14. Europe ID:	
5. Sampling Date*:	15. Sample Notes:		
6. Sampling Time*:			
<i>Section II - Field Data</i>			
16. Collectors Name*:	19. Certification Date*:	22. Fill Time*:	
17. Collectors Phone No*:	20. Flow Calibrator ID*:	23. Set Flow*:	
18. Canister ID*:	21. Flow Adapter ID*:	24. Invalid Sample?:	
SAMPLER DATA	Start/Pre	End/Post	Average
25. Date*:			
26. Time*:			
27. Ambient Temperature (oC)*:			
28. Ambient Pressure (inHg)*:			
29. Canister Pressure (in Hg)*:			
30. Flow Rate (cc/min)*:			
31. Sample Time (min):		= End Time - Start Time	
32. Volume (liters):		= Sample Time (min) * Avg Flow Rate (cc/min)	
GEOLOCATION	Decimal Degrees	<b>OR</b>	35. MGRS*:
33. Latitude*:			
34. Longitude*:			
36. Field Notes*:			

\* Required Fields

## AIR - VOC TO14 SAMPLING DATA SHEET INSTRUCTIONS

## -----SECTION I - ADMINISTRATIVE DATA-----

1. **Sample ID** - Sample ID number XXX\_YYYY\_DDDDD\_ZZ  
 Where: XXX - Camp abbreviation (i.e. first three letters of camp name)  
 YYYY - Method type (e.g. TO17)  
 DDDDD - jday code, last number of the year & three digit julian day of the year [e.g. 00001 for 1-Jan-2000]  
 ZZ - Sample type: **P** - Primary sample; **C** - Collocated sample; **FB** - Field Blank; **TB** - Trip Blank
2. **Location** - Camp or location of sample.
3. **Country** - Country in which location or camp is located.
4. **Operation** - Name of operation ongoing in the area of the sample [e.g. Operation Allied Force (OAF), etc] if applicable
5. **Sampling Date** - Date sample was collected (e.g. 01-Jan-2000)
6. **Sampling Time** - Time sample was taken (e.g. 16:00)
7. **Collected By** - Unit collecting the sample (e.g. TAML, 71<sup>st</sup> MEDDET, etc).
8. **Unit Spec ID** - Unit specific ID associated with the sample if any.
9. **Mission ID** - Unit mission ID associated with the sample if any.
10. **Shipping ID** - Shipping ID associated with sample (e.g. Fedex tracking number)
11. **Lab ID** - Unique ID number assigned at CHPPM-Main laboratory, if applicable.
12. **Job No.** - Job number assigned at laboratory.
13. **Project No.** - Project number assigned by laboratory or project officer.
14. **Europe ID** - Unique ID number assigned at CHPPM-Europe laboratory, if applicable.
15. **Sampling Notes** - Any notes or comments associated with the sample (e.g. short holding time, unusual circumstances, etc).

## -----SECTION II - FIELD DATA-----

16. **Collectors Name** - The name of the person collecting the sample.
17. **Collectors Phone No** - The phone number of the person collecting the sample.
18. **Canister ID** - Unique ID off of canister or canister tag.
19. **Certification Date** - Date canister was certified laboratory clean
20. **Flow Calibrator ID** - Unique ID off of flow calibrator
21. **Flow Adapter ID** - Unique ID off of flow adapter
22. **Fill Time** - Fill time for particular flow adapter (e.g. 8-hour, 24-hour, 1-week)
23. **Set Flow** - The set flow from the Flow Adapter sheet for a particular sampling duration
24. **Invalid Sample** - Was the sample determined to be invalid? If so, why?  
 No - Sample is valid (*default if entry is left blank*)  
 M - Missing Field Data - e.g. sample time, flow rates, etc  
 B - Battery Failure - battery failed during sampling episode.  
 F - Flow Differential -pre and post flow calibrations deviation was greater than 10%  
 T - Timer Malfunction -pump timer failed.  
 S - Sample Malfunction -other part of sampler failed, e.g. tubing, etc  
 D - Damage Sampling Media - sampling media was damage during shipment or sampling episode.
25. **Date** - Date which the sampling episode was started and ended - DD MON YR - (e.g. 01 Jan 00)
26. **Time** - Time which the sampling episode was started and ended in 24 hour standard (e.g. 13:30)
27. **Ambient Temp** - Ambient Temp in degrees Celsius from thermometer at the start and end of the sampling episode
28. **Ambient Pressure** - Ambient pressure in inches Hg from barometer at the start and end of the sampling episode
29. **Canister Pressure** - Canister pressure in inches of Hg from flow adapter at the start and end of the sampling episode
30. **Flow Rate (cc/min)** - Flow rate in cc/min from flow calibrator at the start and end of the sampling episode
31. **Sample Time (min)** - Time the canister collected sample, from the start and end time.
32. **Volume (liters)** - Volume of sample collected in liters. (*Calculated*) - [Volume = (Sample Time \* Average Flow Rate) / 1000]
33. **Latitude** - Sample latitude location in decimal degrees [from GPS]
34. **Longitude** - Sample longitude location in decimal degrees [from GPS]
35. **MGRS** - Location in MGRS from GPS, eight to ten digit grid with grid square identifier (e.g. BQ1234567890)
36. **Field Notes** - Notes relating to sampling episode (e.g. unusual circumstance, weather, potential pollution sources, etc)



Appendix 6-5  
PS1 Sampling Instructions

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**6-5.1 APPLICATION**

The PS-1 sampler is used to conduct EPA reference methods TO-4A, TO-9A and TO-13A. These methods determine levels of common pesticides and polychlorinated biphenyls (PCBs)(TO-4A), polychlorinated/ polybrominated and chlorinated/brominated debenzo-p-dioxins and dibenzofurans (TO-9A), and polycyclic aromatic hydrocarbons (PAHs)(TO-13A). These sampling methods are used only in the event that a source(s) have been identified in the sampling area (i.e. incinerators, open burning, manufacturing facilities, aerial spraying of crops, etc.)

**6-5.2 REQUIRED MANHOURS.**

This is a labor intensive method which requires routine visits to the sampling site to record field information. An average 24-hour sampling site will require 2-3 hours for preparation, sampling and recovery.

**6-5.3 EQUIPMENT INVENTORY**

Table 6-5-1. Inventory of Equipment for PS-1 Sampler

ITEM DESCRIPTION	QUANTITY
Specially-cleaned glass sample cartridge containing either resin or polyurethane foam (PUF) plug and 102 mm glass fiber filter	1
Sample Module Assembly (2 sample modules may allow for more efficient deployment/recovery of samples)	1 or 2
Ambient air thermometer and atmospheric barometer	1 each
Red polytetrafluoroethylene (PTFE) gaskets	2
White teflon gaskets	2
Lint-free nylon or powder-free surgical gloves	2
Flathead screwdriver	1
Teflon tipped tweezers	1
Reagent grade hexane	1 bottle
Box of aluminum foil	1

ITEM DESCRIPTION	QUANTITY
Teflon squeeze bottle	1
Sample Module Preparation Procedure	1
PS-1 Sampler Assembly that includes the following: a) Housing assembly b) Quick release connection for sampling module c) Magnehelic gauge (0-100 in water) c) Venturi assembly with connections for magnehelic gauge d) Lever connected to the flow control valve contained inside the venturi assembly e) 10-15 Amp Blower motor f) 10 foot Exhaust hose and a hose clamp (with a flat head screw) g) Elapsed time indicator with built in voltage variac h) Optional 7 day timer	1



Figure 6-5-1. PS-1 Sampler.

#### 6-5.4 PS1 SAMPLE MODULE PREPARATION

Sample module set-up and recovery should be accomplished in a clean controlled environment. Avoid transporting sample modules containing cartridges for long distances. Sample cartridges should be placed in the sampling module as close to the sampling site as possible and just prior to beginning a sampling event to prevent/minimize contamination.

1. Disassemble the sample module as shown in Figure 6-5-2.



Figure 6-5-2. Disassembled sample module ready to be rinsed with Hexane.

2. Rinse each piece of the sample module with the reagent grade hexane contained in a Teflon squeeze bottle (see Figure 6-5-3).



Figure 6-5-3. Reagent hexane and teflon bottle.

3. Affix a numbered sample label to the shipping container (if one is not already present).
4. While wearing gloves, remove the sample cartridge from the shipping container.
5. Remove the protective aluminum foil wrapping from around the sample cartridge and place aluminum foil back into the shipping container. Place lid back on the container.
6. Install sample cartridge into the bottom of the sample module (make sure a PTFE gasket is located between the inside bottom of the sample module and the sample cartridge bottom. There should be another PTFE gasket that seals the top of the cartridge to the bottom of the sample module top, also).
7. Screw sample module top on to sample module bottom. Tighten until the top is hand tight. Caution: Over tightening the module can break the glass sample cartridge.
8. Place one of the hexane rinsed white teflon gaskets on the filter support screen.
9. Using Teflon tipped tweezers, remove a 102 mm glass fiber filter from the filter container and install it on top of the white hexane rinsed teflon gasket.
10. Place the second hexane rinsed white teflon gasket on top of the glass fiber filter.

11. Install the filter hold down ring and then the sample module cover plate on the sample module.
12. Hand tighten the three finger nuts.
13. Install a clean piece of aluminum foil around the sample module inlet connector. Figure 6-5-4 shows how the sample module should appear by now.



Figure 6-5-4. Assembled sample module

14. Using tape, mark the sample module with the *Media Id* obtained from the shipping container. Use a ball point pen or pencil, but do not use a marker (markers may contribute to background levels of analytes).

#### 6-5.5 PS1 SAMPLING FIELD SET-UP

1. Record the following information on the "PS1 Data Sheet" (See Section 6-5.11)

– *Sample ID* -- Sample ID number XXX\_YYY\_DDDD\_ZZ

Where:

XXX - Camp abbreviation (i.e. first three letters of camp name)

YYY - Method type (e.g. TO13, TO9)

DDDD - jday code, first digit is the last number of the year and remaining three digits are the jday of the year.

ZZ – Sample type:

P – Primary sample, if collocated

C – Collocated sample, if collocated

FB – Field Blank

TB – Trip Blank

– *Location* – Sampling location

– *Operator* – Name of person conducting the sampling

- *PSI Type* – Type of PS1 sample TO-13, TO-9, or TO-4
- *Sampler ID* – Serial number of the sampler
- *Calibration ID* – Unique ID of associated calibration (from “PS1 Calibration Sheet”)
- *Media ID* – Media ID number, if shipping container is not numbered then assign a unique ID to the sampling media.
- *Pre-Ambient Temperature* – Pre-sampling ambient temperature in degrees Celsius (°C) from the thermometer.
- *Pre-Ambient Pressure* – Pre-sampling ambient barometric pressure in inches of mercury (in Hg) from barometer. Prior to use of the barometer during sampling, it should be calibrated next to a reliable source such as the barometer at a local airport.
- *Latitude (degrees)* – Sample latitude location in degrees (from global positioning system (GPS)).
- *Latitude (minutes)* - Sample latitude location in minutes (from GPS).
- *Longitude (degrees)* - Sample longitude location in degrees (from GPS).
- *Longitude (minutes)* - Sample longitude location in minutes (from GPS).
- The calibration values for the sampler (*Msc, Bsc, Rsc*) and PS1 orifice transfer standard values (*Moc, Boc, Roc*). These can be obtained from the associated “PS1 Calibration Sheet”.

#### 6-5.6 PS1 SAMPLER SETUP AND SAMPLE COLLECTION

Note: The 10 foot exhaust hose should vent downwind. This will help prevent the same air from being resampled.

1. Remove the aluminum foil cover from the inlet, insert the sampling module into the sampler connector and push down the two locking arms completely.
2. Remove the protective cover from the loaded sampling module. Make sure the finger nuts are retightened in order to hold the filter retaining ring in place. Avoid storing tools, aluminum foil or other items with the sampling module during a sampling event (storing items with the sampling module during sampling may introduce contamination).
3. Lower the sampler cover and relatch.
4. Reset the clock timer to 0000 minutes or record the initial clock timer reading if the timer cannot be reset.
5. Set the sampler start-stop timer for the sample run period.
6. Wait for the timer to start the sampler and adjust the flow controller valve for these magnehelic gauge readings.
  - For PUFF cartridge sampling set the magnehelic gauge to a reading of 60 (or the maximum level if unable to reach 60 in H<sub>2</sub>O).

- For resin cartridge sampling set the magnehelic gauge to the maximum reading that can be obtained for the cartridge, which may only be as high as 13 in H<sub>2</sub>O (the red handled flow controller lever is turned vertically).
- 7. It is preferable that the variac not be turned to the maximum voltage prior a sampling event, *unless the collected sample volume is estimated (calculated based on approximate flow and sample time) to be insufficient to support desired concentration detection limits (i.e. the volume is too small to yield a low enough concentration of the contaminants)*. When the volumes are consistently too low, the sampler should be recalibrated with the variac set at a higher voltage. Refer to Appendix 6-5, Annex 1 to recalibrate.
- 8. After approximately 5 minutes of run time take a magnehelic gauge reading. If the reading has dropped, increase the flow back to the initial magnehelic setting by further opening the flow controller valve.
- 9. Record the magnehelic reading on the PS1 Sampler Field Data Sheet.
- 10. Make sure to record the ambient barometric pressure (in Hg) and the ambient temperature (°C) on the data sheet.
- 11. Return to the sampling site at least 3 times during the sampling event and record the magnehelic readings in the data sheet. Adjust the flow controller lever, if possible, until the initial magnehelic reading is attained (or else the maximum possible magnehelic reading).
- 12. At least 5 minutes prior to the end of a sampling event, return to the sampling site to record the final magnehelic reading.

#### 6-5.7 PS1 SAMPLE MEDIA RECOVERY

As soon as possible after sampling, the operator should return to the monitoring site to retrieve the exposed sample media.

1. Record on the PS1 Sampler Field Data Sheet the following:
  - Record the final magnehelic reading just before the sampling period is to end, if possible.
  - Record the elapsed time of the sampling run in minutes.
  - If the sampler has already stopped, turn on the sampler and take a final magnehelic reading as soon as the reading is stable. Avoid arriving at the sampling site long after the sample has ended. This reduces the chance of contaminating the sample.
2. Turn off the PS1 sampler.
3. Install the cover plate on the sample module and hand tighten the 3 finger nuts.
4. Unlatch the sample module inlet fasteners and remove from the sampler.
5. Using clean aluminum foil, seal off the sample module inlet connector.
6. Obtain and record the ambient temperature (Ta) in °C.
7. Obtain and record the ambient barometric pressure (Pa) in in Hg.

8. In comments section on PS1 Sampler Field Data Sheet note weather conditions, traffic in the area, or any other condition that might affect the sample.

#### **6-5.8 SAMPLE MODULE RECOVERY PROCEDURE**

These steps should be performed in a clean environment as close as possible to the sampling site. Avoid transporting the sampling module for long distances while it contains the sample cartridge. Additional contamination **will** be introduced to the sample.

1. Unscrew lid of the wide mouth jar with the sample number that matches the recovered cartridge.
2. Unscrew the sample module bottom from the sample module top.
3. While wearing surgical gloves remove the sample cartridge from the sample module bottom and place it on the original aluminum foil the sample cartridge came in.
4. Loosen the three finger nuts and remove the sample module cover plate.
5. Remove the sample module filter hold down ring and the Teflon top filter gasket.
6. Using Teflon tweezers, remove the filter and fold it in half twice and place it in the top of the sample cartridge.
7. Wrap the sample cartridge in the original aluminum foil the sample cartridge came in or use new clean aluminum foil if original foil is ripped.
8. Placed the wrapped sample cartridge back into the wide mouth jar it came in.
9. Reinstall the original securing packing that came in the wide mouth jar.
10. Install the lid on the jar and seal. Gently shake the jar to check for cartridge movement. If the cartridge rattles, remove the lid and add additional packing, preferably clean aluminum foil.
11. Complete the affixed sample label on the sample jar.

#### **6-5.9 PACKING AND SHIPPING INSTRUCTIONS**

1. Refrigerate samples at 4 °C until ready for shipment to the analytical laboratory.
2. Ship samples on ice as soon as possible since sample holding time should not exceed 14 days. Make sure the jars are secure in the shipping containers. If the jars rattle in the container, add additional packing.

### Air - PSI Field Data Sheet

<i>Section I - Administrative Data</i>							
1. Sample ID*:		7. Collected By*:		11. Lab ID:			
2. Location:		8. Unit Spec ID:		12. Job No:			
3. Country:		9. Mission ID:		13. Project No:			
4. Operation:		10. Shipping ID:		14. Europe ID:			
5. Sampling Date*:		15. Sample Notes:					
6. Sampling Time*:							
<i>Section II - Field Data</i>							
16. Unit ID*:		18. PSI Type: (Circle One)      TO13 / TO9		20. Blank? (Yes/No)			
17. Media ID*:		19. Collectors Name*:		21. Invalid Sample?:			
SAMPLER DATA		Start/Pre		End/Post		Average	
22. Date*:							
23. Time*:							
24. Ambient Temperature (oC)*:							
25. Ambient Pressure (in Hg)*:							
26. H Orifice (in H2O)*:							
27. Volume (m3):							
28. Reading	29. Time*	30. M Gauge*	31. M Std	32. Q Std	33. Qstd Orifice		
Initial							
6-Hour							
12-Hour							
18-Hour							
Mean							
34. Sampler Calibration Relationship		Slope (Msc):		Intercept (Bsc):		Correlation (Rsc):	
35. Orifice Calibration Relationship		Slope (Moc):		Intercept (Boc):		Correlation (Roc):	
GEOLOCATION		Decimal Degrees		OR	38. MGRS		
36. Latitude*:							
37. Longitude*:							
39. Field Notes*:							

\* Required Fields

## PS1 FIELD DATA SHEET INSTRUCTIONS

## -----SECTION I - ADMINISTRATIVE DATA -----

1. **Sample ID** - Sample ID number XXX\_YYYY\_DDDDD\_ZZ  
Where: XXX : First three letters of camp name  
YYYY : Method type TO13 or TO09  
DDDDD - jday code, last two digits of the year & three digit julian day of the year [e.g 00001 for 1-Jan-2000].  
ZZ: **P** - primary, **C** - collocated, **FB** - field blank
2. Location - Name of camp or location of sample.
3. Country - Name of country in which location or camp is located.
4. Operation - Name of operation ongoing in the area of the sample [e.g. Operation Allied Force (OAF), etc] if applicable
5. **Sampling Date** - Date sample was collected (e.g. 01-Jan-2000)
6. **Sampling Time** - Time sample was taken (e.g. 16:00)
7. **Collected By** - Unit collecting the sample (e.g. TAML, 71<sup>st</sup> MEDDET, etc).
8. Unit Spec ID - Unit specific ID associated with the sample if any.
9. Mission ID - Unit mission ID associated with the sample if any.
10. Shipping ID - Shipping ID associated with sample (e.g. Fedex tracking number)
11. Lab ID - Unique ID number assigned at CHPPM-Main laboratory, if applicable.
12. Job No. - Job number assigned at laboratory.
13. Project No. - Project number assigned by laboratory or project officer.
14. Europe ID - Unique ID number assigned at CHPPM-Europe laboratory, if applicable.
15. **Sampling Notes** - Any notes or comments associated with the sample (e.g. short holding time, unusual circumstances, etc).

## -----SECTION II - FIELD DATA -----

*Note: The Sample ID, Sampler ID, Start Date and Media ID should also be recorded on the sample label.*

16. **Unit ID** - Serial number off of sampling unit
17. **Media ID** - ID from media
18. **PS1 Type** - PS1 type either TO9 or TO13
19. **Collectors Name** - Name of the person operating the sampler.
20. **Blank** - Is the sample a QA/QC blank, yes or no
21. **Invalid Sample** - Is the sample invalid, if so why? (select appropriate code)  
NO - Sample is valid (DEFAULT CHOICE)  
M - Missing Field Data - e.g. sample time, flow rates, etc  
T - Timer Malfunction - pump timer failed.  
S - Sample Malfunction - other part of sampler failed, e.g. tubing, etc  
D - Damage Sampling Media - filter was damage during shipment or sampling episode
22. **Date** - Date which the sampling episode was started and ended - DD MON YR - (e.g. 01 Jan 00)
23. **Time** - Time which the sampling episode was started and ended in 24 hour standard (e.g. 13:30)
24. **Ambient Temp** - Ambient Temp in degrees celcius from thermometer at the start and end of the sampling episode
25. **Ambient Pressure** - Ambient Pressure in inches Hg from barometer at the start and end of the sampling episode
26. **H Orifice (in H<sub>2</sub>O)** - The initial and final reading off of the orifice attached to the inlet of the sampler, in inches of water.
27. **Volume** - Sample volume in cubic meters (m<sup>3</sup>) [*Calculated*]
28. **Reading** - Sampler reading (every 6 hours if possible) at minimum and initial and final reading.
29. **Time** - Time of reading in 24 hour standard (e.g. 13:30)
30. **M Gauge** - Associated M gauge reading from sampler in inches of Hg

$$31. M_{std} = \sqrt{M_{Gauge} * \frac{Pa * 25.4}{760} * \frac{298}{Ta * 273}} \quad [Calculated]$$

$$32. Q_{std} = \frac{(M_{std} - B_{sc})}{M_{sc}} \quad [Calculated]$$

$$33. Q_{std} \text{ Orifice} = \frac{\sqrt{H_{Orifice} * \frac{Pa * 25.4}{760} * \frac{298}{Ta + 273}} - B_{oc}}{M_{oc}} \quad [Calculated] \quad (\text{Only calculated for the initial and final } H_{Orifice})$$

34. **Sampler Calibration Relationship** - Slope, Intercept, and Correlation Coeff of sampler from "PS1 Calibration Field Data Sheet"
35. **Orifice Calibration Relationship** - Slope, Intercept, and Correlation Coeff of orifice from "PS1 Calibration Field Data Sheet"
36. **Latitude** - Sample latitude location in decimal degrees [from GPS]
37. **Longitude** - Sample longitude location in decimal degrees [from GPS]
38. **MGRS** - Location in MGRS from GPS, eight to ten digit grid with grid square identifier (e.g. BQ1234567890)
39. **Field Notes** - Notes relating to sampling episode (e.g. unusual circumstance, weather, potential pollution sources, etc)



## Appendix 6-5 - Annex 1

### PS1 Sampler Calibration

#### 6-5-1.1 Purpose

The instructions in this Annex are written as a step-by-step procedure to conduct a multi-point calibration on the PS1 sampler and establish a sampler specific calibration relationship prior to conducting field sampling.

#### 6-5-1.2 Application

The procedures outlined in this Annex are specific to the PS-1 sampler described herein. The calibration of the PS-1 is required when:

- When the unit is moved to a new sample location.
- When using a new unit in the field.
- After major repairs or maintenance of the PS-1 (e.g. motor brushes are due to be replaced after each 400-500 hours of operation).
- Whenever an audit point deviates from the calibration curve by more than  $\pm 7\%$ .
- When a different sample collection media, other than that which the sampler was originally calibrated for, will be used for sampling.
- At the frequency specified in the user Standard Operating Procedure (SOP) manual in which the samplers are utilized.

NOTE: The PS-1 sampler is designed to use glass cartridges packed with either granular XAD-2 resin or a polyurethane foam (PUF) plug. Due to the different flow characteristics of the two packings, a slightly different calibration ranges are needed. Generally, the range of calibration points selected on the magnehelic should match the range the sampler is expected to operate in during a sampling event (see Section 6-5-1.4).

#### 6-5-1.3 Equipment Inventory

The equipment listed in Table 6-5-1-1 are required to conduct the calibration of the PS-1 sampler.

Table 6-5-1-1. Equipment for Calibration of PS-1 Sampler

ITEM DESCRIPTION	QUANTITY
Complete PS1 sampler to include the housing, a motor, venturi/magnehelic assembly and exhaust hose	1
Empty sample cartridge	1
PS1 calibration kit to include the flow rate transfer standard orifice, a manometer, manometer coloring fluid, and orifice calibration sheet.	1
Thermometer	1
Barometer (mmHg)	1
Sample Module	2
Sample Module Preparation Procedure	1

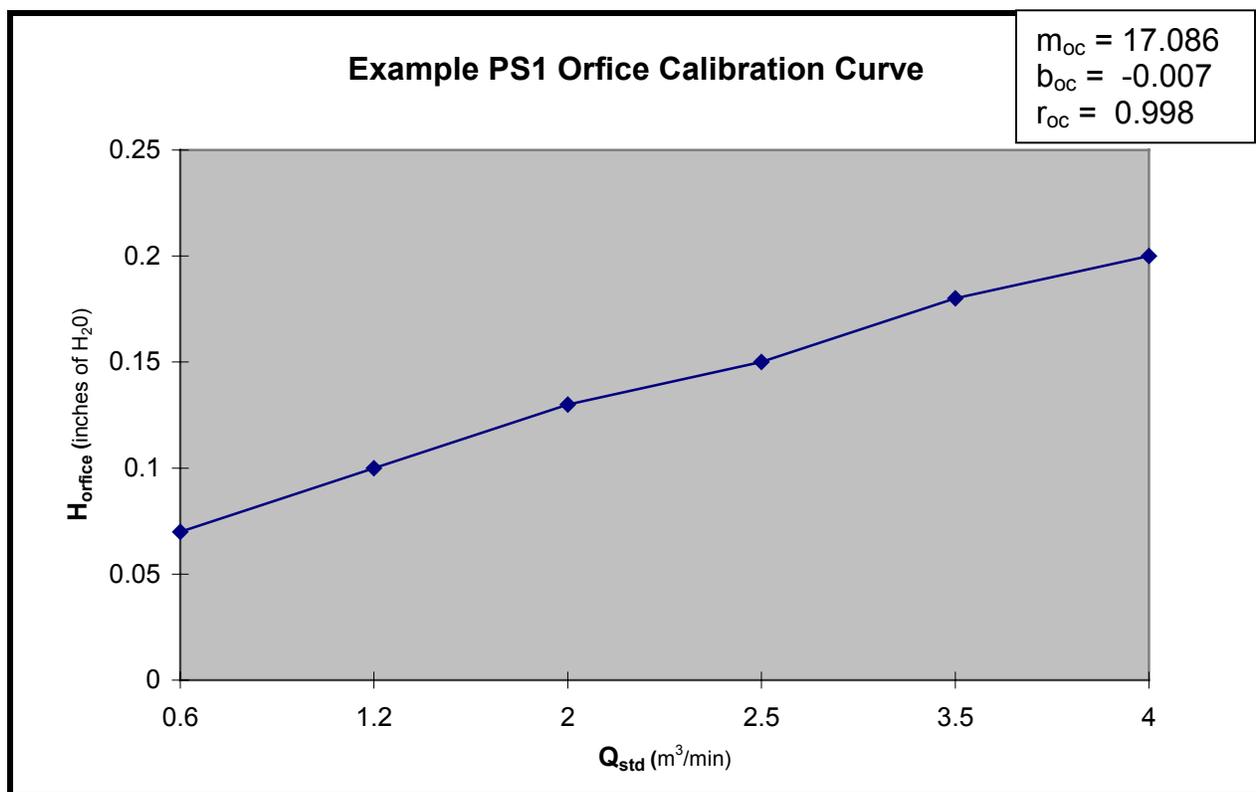
If a barometer is unavailable, barometric pressure can be obtained from the nearest airport meteorological station and then corrected for any elevation difference (subtract 2.5 mm Hg per each 30 meter increase in elevation from the airport; add 2.5 mm Hg per each 30 m drop in elevation from the airport).

An appropriate power source must support approximately 15 amps and be properly configured to the sampler motor specifications. A 120 volt/60 Hz motor can only be plugged into a 120 volt/60 Hz power source (United States standard) and a 240 volt/50 Hz motor can only be plugged into a 240 volt/50 Hz power source (European Standard). Mixing these power requirements will destroy the sampler motor.

**6-5-1.4 PS-1 Calibration Procedure**

1. NOTE: For PUF sampling, the calibration points should be 50, 40, 30, and 20 inches of H<sub>2</sub>O on the magnehelic. For resin cartridges the calibration points should be 25, 20, 15, 10, and 5 inches of H<sub>2</sub>O. If during an actual sampling event the magnehelic reading is outside the range of calibration points, the sampler should be recalibrated using a range that includes this reading.
2. Record the following information on the "PS1 Calibration Sheet"
  - Sampler ID
  - Calibration Date
  - Julian day
  - Location
  - Operator
  - Orifice Calibrator SN
  - Orifice Calibration Date
  - Slope ( $M_{oc}$ )

- Intercept ( $B_{oc}$ )
- Correlation Coefficient ( $R_{oc}$ )



3. Place a blank adsorbent cartridge into the sampling module of the PS1 sampler. NOTE: There should be a polytetrafluoroethylene (PTFE) gasket between the inside module bottom and the blank cartridge bottom. There should also be a PTFE gasket between the cartridge top and the base of the module top for proper sealing.
4. Install the flow rate transfer standard orifice on the sampling module and tighten the three finger nuts hand tight (do not install the filter hold down ring prior to installing the orifice standard). Tighten alternate corners little by little to ensure even tightening.
5. Open the valves on the manometer 3/4 to 1 turn and connect tubing to the manometer. Gently blow into the connecting tubes to check the manometer for free fluid movement. If there is no fluid movement or does not appear to flow freely, the valves may not be open far enough.
6. Gently blow into the manometer tubing until a pressure of 5 to 6 inches of water is reached, then pinch off the tubing. Observe the manometer pressure for movement. There should be no movement for at least 15 seconds. If there is movement in the manometer, the manometer connection has a leak somewhere in the line. Inspect connections for leaks and repeat this process until no movement is observed in the water level (a good possibility is that the manometer valves are open too far).
7. Turn the sampler on and turn the lever vertical so that the flow controller valve is fully open.

8. Set the voltage variac so that the magnehelic reads between 70 and 80 in H<sub>2</sub>O.
9. Perform a leak test on the sampler by blocking the orifice transfer standard top hole and pressure tap hole. Use the palm of the hand and a finger or hole-plugs. Gently rock the orifice while observing the PS1 sampler magnehelic gauge. The gauge should read zero and not waiver. Make sure the manometer is not connected to the transfer standard pressure port while performing a leak check!

**Caution: Plug the holes no more than 10 seconds to prevent damage to the motor.**

10. Turn the sampler off.
11. Record the ambient temperature (Ta) and ambient barometric pressure (Pa) on the "PS1 Calibration Sheet".
12. Connect the PS1 orifice transfer standard kit manometer to the orifice pressure tap. The assembled sampler with the transfer standard should resemble Figure 6-5-1-1.



Figure 6-5-1-1. Assembled Transfer Standard, sample module, and manometer.

13. Turn on the sampler, ensure the flow controller valve (restrictor lever is vertical) is fully open and the voltage variac is adjusted so that a sample flow rate corresponding to 110% of the desire flow rate (typically 0.20–0.28 m<sup>3</sup>/min) is indicated on the magnehelic gauge (approximately 70-80 in H<sub>2</sub>O).
14. Allow the motor to warm up for approximately 5 minutes.

**Note: If the calibration is being conducted in windy conditions the sampler inlet may be partially lowered over the orifice to act as a wind shield. Block the sampler inlet, leaving at least 2 inches clearance at the bottom.**

15. Obtain initial calibration point.
  - 1.) Adjust the flow controller valve until the magnehelic gauge reads 30 in H<sub>2</sub>O if sampling with XAD-2 resin. If sampling with PUF, start at 70 in H<sub>2</sub>O.
  - 2.) Record the manometer deflection from the orifice in the "Manometer" column on the "PS1 Calibration Sheet" - Calibration Data Section. Reading taken to the nearest 0.05 inch on each leg, then added. See Figure 6-5-1-2.

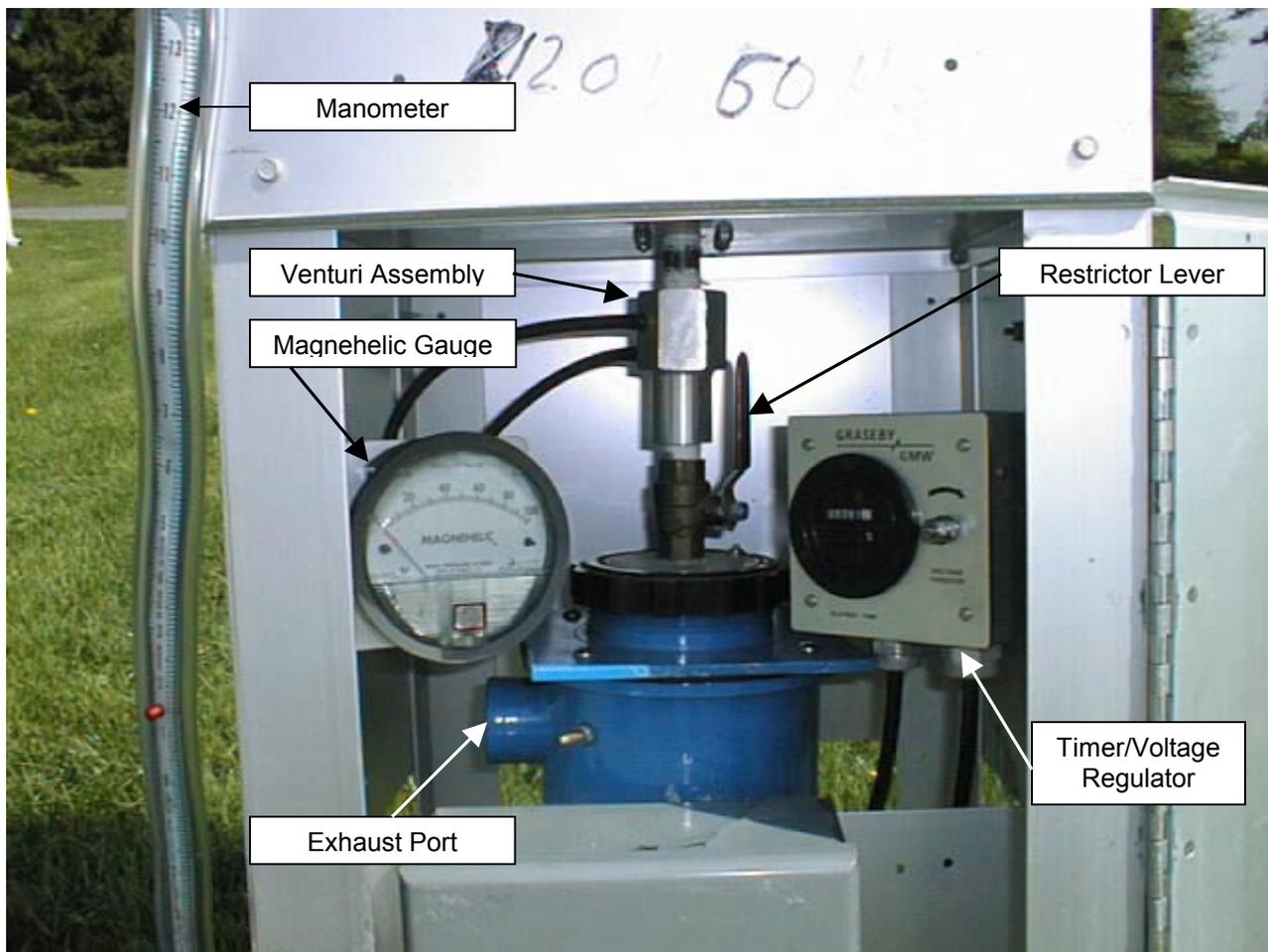


Figure 6-5-1-2. Interior section of PS-1

16. Repeat step 11 for magnehelic readings of 25, 20, 15, 10, and 5 in H<sub>2</sub>O for XAD-2 sampling. Repeat step 11 for readings of 60, 50, 40, 30, and 20 in H<sub>2</sub>O for PUF sampling.
17. Perform calculations to determine Qstd and Mstd (Section 6-5-1.5).

**6-5-1.5PS-1 Calibration Calculations**

The Qstd and Mstd must be calculated for each of the calibration points of 5, 10, 15, 20, 25, and 30 in H<sub>2</sub>O (the same goes for PUF sampling calibration points).

1. Calculate the "Qstd" and "Mstd" columns on the "PS1 Calibration Sheet" - Calibration Data Section and conduct linear regression. Use the equations 1 and 2 below or on the "PS1 Calibration Sheet" - Equations Section. The "DESP Environmental Database" may also be used to calculate calibration parameters.

$$Q_{std} = \frac{\sqrt{\text{Manometer} * \frac{Pa}{760} * \frac{298}{Ta} - B_{oc}}}{M_{oc}} \quad (Eq.1)$$

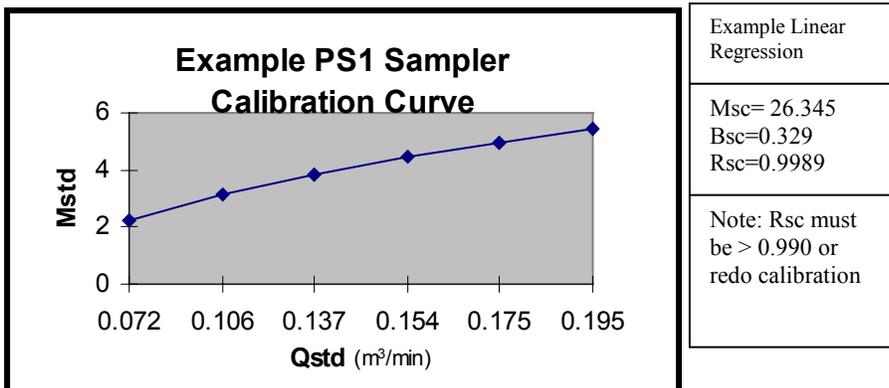
Where:

- Manometer = manometer reading in inches of water
- Pa = Ambient barometric pressure in millimeter of mercury (mm Hg)
- Ta = Ambient temperature in degrees Kelvin (°K) [°K=°C+273]
- Boc = Intercept obtained from the calibration orifice
- Moc = Slope obtained from the calibration orifice

$$M_{std} = \sqrt{\text{Magnehelic} * \frac{Pa}{760} * \frac{298}{Ta}} \quad (Eq.2)$$

Where:

- Magnehelic = magnehelic reading in inches of water
- Pa = Ambient barometric pressure in millimeter of mercury (mm Hg)
- Ta = Ambient temperature in degrees Kelvin (°K) [°K=°C+273]



2. Complete the table and equations in the linear regression worksheet to calculate the Slope ( $M_{SC}$ ), Intercept ( $B_{SC}$ ), and Correlation Coefficient ( $R_{SC}$ ). These calculations can be done longhand using the calculations below. It is recommended that a scientific calculator that does linear regression or a spreadsheet program be used to perform these calculation to decrease the margin for error.

$$M_{SC} = \frac{6 \sum xy - (\sum x)(\sum y)}{6 \sum x^2 - (\sum x)^2} \quad (Eq.3)$$

Where:  $x = Q_{std}$  for each respective calibration point

$y = M_{std}$  for each respective calibration point

$$B_{SC} = \bar{y} - M_{SC}\bar{x} \quad (Eq.4)$$

Where:  $\bar{y} =$  average of the  $M_{std}$  values

$M_{SC} =$  Slope obtained from the PS1 sampler calibration.

$\bar{x} =$  average of the  $Q_{std}$  values

–

$$R_{SC} = \frac{\sum xy * \left[ \frac{(\sum x)(\sum y)}{n-1} \right]}{\left\{ \left[ \sum y^2 - \frac{(\sum y)^2}{n-1} \right] * \left[ \sum x^2 - \frac{(\sum x)^2}{n-1} \right] \right\}^{\frac{1}{2}}} \quad (Eq.5)$$

Where:  $x = Q_{std}$  for each respective calibration point

$y = M_{std}$  for each respective calibration point

$n =$  number of calibration points, 6.

3. Calculate the "Q'std", and "Deviation" columns on the "PS1 Calibration Sheet" - Calibration Data Section from the linear regression. Use the equations 3 and 4 or on the "PS1 Calibration Sheet" - Equations Section. The "DESP Environmental Database" may also be used to calculate calibration.

$$Q'_{std} = \frac{(M_{std} - B_{sc})}{M_{sc}} \quad (Eq.6)$$

Where:

$$\%Deviation = \frac{(Q_{std} - Q'_{std})}{Q'_{std}} \quad (Eq.7)$$

Mstd = Mstd from equation (1)

Bsc = Intercept obtained from the PS1 sampler calibration.

Msc = Slope obtained from the PS1 sampler calibration.

### 6-5-1.6 Calibration Requirements

The following two criteria must be met to ensure that the PS-1 calibration is valid:

1. Standard deviations for each calibration point must be within  $\pm 4\%$
2. The correlation coefficient (Rsc) must be greater than 0.990.

If any of the calibration point standard deviations or the  $R_{SC}$  fall outside of these limits the PS-1 sampler must be re-calibrated.

## Air - PSI Calibration Field Data Sheet

Section I - Administrative Data		
1. Sampler ID*:	5. Calibration Date*:	10. Calib Orifice SN*:
2. Location*:	6. Julian Date*:	11. Calib Orifice Date:
3. Country:	7. Operator*:	12. Slope (Moc)*:
4. Operation:	8. Ambient Temp (Ta) oC*:	13. Intercept (Boc)*:
15. Calibration Notes:	9. Ambient Pressure (Pa) in Hg*:	14. Corr Coeff (Roc)*:

Section II - Sampler Calibration						
16. Reading	17. Magnehelic Reading (Mguage) [in H2O]*	18. Manometer Reading (Horifice) [in H2O]*	19. Qstd X- Axis(1) [m3/min]	20. Mstd Y- Axis(2)	21. Q'std (3) Derived Flow [m3/min]	22. % Deviation (4)
1						
2						
3						
4						
5						
6						

Equations	Linear Regression worksheet																					
$PT = \left( \frac{Pa * 25.4}{760} * \frac{298}{Ta + 273} \right) = \boxed{\phantom{000}}$ <p>(1) <math display="block">Q_{std} = \frac{\sqrt{H_{Orifice} * PT} - B_{oc}}{M_{oc}}</math></p> <p>(2) <math display="block">M_{std} = \sqrt{M_{Gauge} * PT}</math></p> <hr/> <p style="text-align: center;"><i>After linear regression of Mstd and Qstd</i></p> <p>(3) <math display="block">Q'_{std} = \frac{(M_{std} - B_{sc})}{M_{sc}}</math></p> <p>(4) <math display="block">\%Deviation = \frac{(Q_{std} - Q'_{std})}{Q'_{std}}</math></p> <p><i>If % deviation is greater than 4% redo calibration</i></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Reading</th> <th style="width: 15%;">xy</th> <th style="width: 15%;">x<sup>2</sup></th> </tr> </thead> <tbody> <tr><td>1</td><td></td><td></td></tr> <tr><td>2</td><td></td><td></td></tr> <tr><td>3</td><td></td><td></td></tr> <tr><td>4</td><td></td><td></td></tr> <tr><td>5</td><td></td><td></td></tr> <tr><td>6</td><td></td><td></td></tr> </tbody> </table> <div style="margin-top: 10px;"> <math display="block">\bar{X} = \boxed{\phantom{00}}</math> <math display="block">\bar{Y} = \boxed{\phantom{00}}</math> <math display="block">\sum x = \boxed{\phantom{00}}</math> <math display="block">\sum y = \boxed{\phantom{00}}</math> <math display="block">\sum xy = \boxed{\phantom{00}}</math> <math display="block">\sum x^2 = \boxed{\phantom{00}}</math> </div> <div style="margin-top: 10px;"> <math display="block">M_{sc} = \frac{6 \sum xy - (\sum x)(\sum y)}{6 \sum x^2 - (\sum x)^2}</math> <math display="block">B_{sc} = \bar{Y} - M_{sc} \bar{X}</math> </div> <div style="margin-top: 10px;"> <math display="block">M_{sc} = \frac{\boxed{\phantom{00}} - \boxed{\phantom{00}}}{\boxed{\phantom{00}} - \boxed{\phantom{00}}}</math> </div>	Reading	xy	x <sup>2</sup>	1			2			3			4			5			6		
Reading	xy	x <sup>2</sup>																				
1																						
2																						
3																						
4																						
5																						
6																						
23. Slope (Msc)*:	24. Intercept (Bsc)*:	25. Corr Coeff (Rsc):																				

\* Required Fields

PS1 SAMPLER CALIBRATION INSTRUCTIONS

-----SECTION I - ADMINISTRATIVE DATA-----

1. **Sampler ID** – Unique ID of sampler (e.g. serial number or MMCN number)
2. **Location** – Camp or location of calibration
3. **Country** – Country in which location or camp is located.
4. **Operation** – Name of operation ongoing in the area of the sample [e.g. Operation Allied Force (OAF), etc] if applicable
5. **Calibration Date** – Date calibration was conducted
6. **Julian Day** – Corresponding year specific Julian day calibration was conducted. A Julian day is the sequential numeric day of the year. The database can be used to calculate the Julian day of the year.  
*Example: 01-Jan-1999 would be Julian day 99001 where "99" is the last digit of the year and "001" is the day of the year.*  
*Example: 31-Dec-2000 would be Julian day 00366 where "00" is the last digit of the year and "366" is the day of the year (leap year).*
7. **Operator** – Name of person conducting the calibration.
8. **Ambient Temperature (Ta)** - Ambient temperature at the time of calibration in °C
9. **Ambient Pressure (Pa)** - Atmospheric pressure at the time of calibration in inches of mercury (in Hg)  
*(All orifice calibration data can be obtained from the calibration sheet located with the orifice calibrator)*
10. **Orifice Calibration SN** – The serial number of the calibration orifice
11. **Orifice Calibration Date** – Date calibration orifice was calibrated to a primary standard.
12. **Slope (M<sub>oc</sub>)** – Slope of Orifice Calibration curve.
13. **Intercept (B<sub>oc</sub>)** – Slope of Orifice Calibration curve.
14. **Correlation Coefficient (R<sub>oc</sub>)** – Slope of Orifice Calibration curve.
15. **Calibration Notes** – General notes on the calibration

-----SECTION II - SAMPLER CALIBRATION DATA-----

16. **Reading** – Calibration reading number predetermined to be (1, 2, 3, 4, 5, and 6).
17. **Magnehelic Reading** - Magnehelic reading from sampler, pre-determined to be (5, 10, 15, 20, 25, and 30)
18. **Manometer Reading (H<sub>orifice</sub>)** - Manometer reading from the calibration orifice for each magnehelic flow setting in inches of water
19. **Q<sub>std</sub> (X-Axis)** - derived from the orifice calibration relationship using the following equation:

$$Q_{std} = \sqrt{\frac{Manometer * \frac{Pa * 25.4}{760} * \frac{298}{Ta + 273}}{M_{oc}}} - B_{oc}$$

Manometer = manometer reading from calibration orifice in inches of water  
 Pa = Ambient barometric pressure in inches of mercury (in Hg)  
 Ta = Ambient temperature in degrees celsius (°C)  
 Boc = Intercept obtained from the calibration orifice  
 Moc = Slope obtained from the calibration orifice

20. **M<sub>std</sub> (Y-Axis)** - Magnehelic reading corrected to standard temperature and pressure using the following equation:

$$M_{std} = \sqrt{Magnehelic * \frac{Pa * 25.4}{760} * \frac{298}{Ta + 273}}$$

Magnehelic = magnehelic reading in inches of water  
 Pa = Ambient barometric pressure in inches of mercury (in Hg)  
 Ta = Ambient temperature in degrees celsius (°C)

**Conduct linear regression of Qstd (X-axis) and Mstd (Y-Axis), either by using regression worksheet, calculator or spreadsheet to obtain sampler calibration:**

**Slope (M<sub>sc</sub>), Intercept (B<sub>sc</sub>) and Correlation Coefficient (R<sub>sc</sub>) if R<sub>sc</sub> < 0.98 calibration must be redone.**

21. **Q'<sub>std</sub> (Derived Flow)** - Standard flow calculated using the following equation:

$$Q'_{std} = \frac{(M_{std} - B_{sc})}{M_{sc}}$$

Mstd = Mstd from previous equation  
 Bsc = Intercept obtained from the PS1 sampler calibration.  
 Msc = Slope obtained from the PS1 sampler calibration.

22. **%Deviation** - Percent deviation from Q'<sub>std</sub> and Q<sub>std</sub> Orifice

$$\%Deviation = \frac{(Q_{std} - Q'_{std})}{Q'_{std}} * 100 \quad \text{If \% deviation is greater than 4\% calibration must be redone.}$$

23. **Slope (M<sub>sc</sub>)** – Sampler calibration slope derived from linear regression
24. **Intercept (B<sub>sc</sub>)** – Sampler calibration intercept derived from linear regression
25. **Correlation (R<sub>sc</sub>)** – Correlation coeff of calibration

## CHAPTER 7

### SURFACE WIPE SAMPLING METHODS AND ANALYTICAL REQUIREMENTS

#### 7.1 GENERAL

##### 7.1.1 Scope.

The purpose of surface wipe sampling during a deployment is to determine the potential health risks to deployed personnel from exposure to the surfaces within man-made structures (i.e., walls and floors). Surface wipe sampling should occur during the initial environmental monitoring so that mitigation, if needed, can occur before the bulk of the deployed personnel have the potential to be exposed to contaminated surfaces. However, if there are areas where there are high levels of suspected contaminants (e.g., chemical storage warehouses, strong chemical odors coming from the surfaces, obvious signs of corrosion, large amounts of metal dusts, or populations of dead insects or rodents), the personnel conducting the sampling can recommend against exposures (i.e., occupation) in that area based on professional judgment, rather than wipe sampling results. This chapter will describe the methodology for collecting and evaluating wipe samples in order to document the extent of environmental contamination on man-made surfaces at a site.

##### 7.1.2 Phase I Surface Wipe Assessment.

A Phase I surface wipe assessment (wipe assessment) is a methodical approach to evaluating the conditions in the areas where deployed personnel are living and working. This includes a complete site characterization based on both the current conditions as well as the knowledge (or lack thereof) about the historical conditions of the site. The only surfaces that need to be characterized are the surfaces that deployed personnel have the potential to be exposed. Rooms that are sealed and unoccupied are encapsulated, and there is no potential for surface exposure by deployed personnel. Additionally, most ceilings and wall surfaces above four meters can be excluded, as direct contact with them is minimal.

##### 7.1.3 Phase II Surveillance

Unlike water, there is no need for a Phase II assessment or monitoring of surface contamination unless there is some event, for example a spill or other release, like a pesticide application, that would have a significant impact on the level of contaminants present on the surfaces.

##### 7.1.4 Direct Measurement Instruments versus Laboratory Analysis.

While the wipe samples will be collected during the initial surveillance, they will have to be shipped out of the theater of operations for analysis in a dedicated laboratory. There are no on-site analyses methods available for wipes at this time.

#### 7.2 ANALYTICAL METHODS AND SAMPLE PARAMETERS.

##### 7.2.1 General.

The primary contaminants of concern (COCs) on the man-made surfaces in a deployment scenario are common pesticides and their constituents. Other COCs may be added or deleted depending on the past use of a site, if known. If the prior use of the site is unknown, the initial wipe samples collected from the site should be analyzed for the entire potential range of COCs. Future sampling at the site can use information gathered in the initial screening to determine a more specific list of analytes. Table 7-1 shows the classes of contaminants and the analytical methods used for the

analysis of each class of contaminant. Appendix 7-1 lists the specific analytes of concern in each chemical class.

Table 7-1. Specific Contaminants of Concern.

Class of Contaminant	Analytical Methods
Arsenic	USEPA Method 7061A
Mercury	USEPA Method 7470A
Organochlorine(OC)/ Organophosphate(OP) Pesticides/ Neutral Herbicides	If all samples are to be analyzed by USACHPPM in-house laboratories: USACHPPM Directorate of Laboratory Sciences Chromatographic Analysis Division Method 38.1  If any of the samples are to be analyzed by an outside or contract laboratory, USEPA Methods 8181A/8082/8141A/8141
Acidic Herbicides	USEPA Method 8151A

7.2.2 Evaluation of the Sampling Results.

The results of the analysis of the samples are statically compared to the wipe screening levels described in the USACHPPM, MCHB-TS-EHR, Derivation of Wipe Surface Screening Levels for Environmental Chemical: Industrial Scenarios, Interim Report. If the 95 percent upper confidence limit on the mean levels of contaminants in the wipe exceeds the screening levels, the potential for deployed personnel to be exposed to potentially hazardous levels of those contaminants exists. At that time, a determination needs to be made to either move the potentially exposed deployed personnel to another area, or consider what measures are necessary to mitigate exposure to the contaminants such as proper cleaning of the contaminated surfaces or adequate personal protective equipment (PPE).

7.2.3 Sample Methodology.

7.2.3.1 Number of Samples.

The number of samples to collect must be determined first. Assuming a 95 percent confidence level (1- $\alpha$ ), 80% power (1- $\beta$ ), the minimum relative detectable difference of 10 percent, and the coefficient of variation of 10 percent, the number of samples required is 15. Therefore, 15 samples can be used to characterize any size room based on the assumption that the COC, if applied, was normally distributed throughout the space.

7.2.3.2 Quality Assurance/Quality Control (QA/QC).

To determine the quality of the collected data, QA/QC samples must be collected and sent to the laboratory for analysis. Blank samples should be collected at a rate of between 5-10 percent of the total number of samples. This allows a check on both the wipe media and a check of the transportation inputs into the sample. The collection and handling of the blank samples is detailed in Appendix 7-2. In other media, a duplicate sample is also collected to check the laboratory methods and further evaluate the sample collection methods for reproducibility; however, the high spatial variability between discrete sample points does not present a meaningful investigation. Therefore, no duplicate samples should be taken.

7.2.3.3 Sample Locations.

Sample locations should be chosen by systematic grid sampling. Systematic grid sampling involves the collection of samples at fixed intervals when the contamination is assumed to be normally distributed. We are assuming a normal distribution based on total room exposure whether that room is a former aircraft hanger or a tool shed. The grid and starting points should be randomly laid out

over the site allowing for rather easy location of exact sample locations within each grid. Since the sample locations are predetermined, they can be programmed into a geographical positioning system (GPS) receiver. This allows the sampler to rapidly and accurately go from sample point to sample point. Hand measuring and laying out a grid over a site is very time consuming and should be avoided if the GPS receivers are available.

#### 7.2.4 Selecting Sample Locations.

##### 7.2.4.1 Site Survey.

A site survey is invaluable for wipe sampling design. The information that should be obtained during a site survey includes—

- General site layout.
- Site access.
- Inventory of current materials.
- Existing site conditions.
- Site history.
- Visible staining of surface.
- Deposition of dusts and other friable material.

The site history should include factors such as previous use both on and nearby the site, types of industrial operations conducted on the site and on the adjoining property, types of contaminants to which the site has been exposed, and locations of possible dumping/burial areas. The site history can be derived from aerial photographs and interviews with people familiar with the site.

##### 7.2.4.2 Sampling Plan.

Prior to beginning any sampling effort as detailed as a wipe assessment, a sampling plan should be developed. The sampling plan details the efforts that will be undertaken in order to complete the characterization. The sampling plan also includes the specific analyses that will be performed on the samples. A written plan will also document the steps taken to complete the characterization if there is a change in personnel. The entire area occupied by U.S. forces does not need to be characterized, only those areas where personnel are repeatedly directly exposed to the floor or wall surfaces or the dusts generated by contact with those surfaces. Examples of these areas include—

- Shower/latrines areas.
- Physical training areas.
- Medical activities.
- Common storage areas.
- Sleeping locations.
- Living/eating/working areas.

##### 7.2.4.3 Developing the Sample Grid.

The size of the grid is calculated by dividing the area of the room by the number of samples required (15 samples) assuming the room has four walls. The result of this calculation is the area of each grid. By taking the square root of the grid area, the length of a grid side is determined.

$$A = [LW+(2L+8)+(2W+8)]/15]$$

$$G = \{[LW+(2L+8)+(2W+8)]/15\}^{1/2}$$

Where:

- A = area of each individual grid
- G = length per side of each individual grid
- L = length of room
- W = width of room

One sample should be collected within each grid to provide more representative data. Sampling within the grid will have the effect of averaging the contaminate concentrations over the area. Since the purpose of a site characterization is to determine the mean concentration of the contamination in an area, this is appropriate. Figure 7-1 shows one simulated room with study grids overlaid. Use the random number generator in Appendix 7-2 to select 15 of the grid squares to sample. To determine where in each grid to collect the samples, lay a 10 by 10 centimeter (cm) inner grid over each main grid, number the new inner grid, and then use the random number generator to select the location. Figure 7-2 shows how to select the specific sample points.

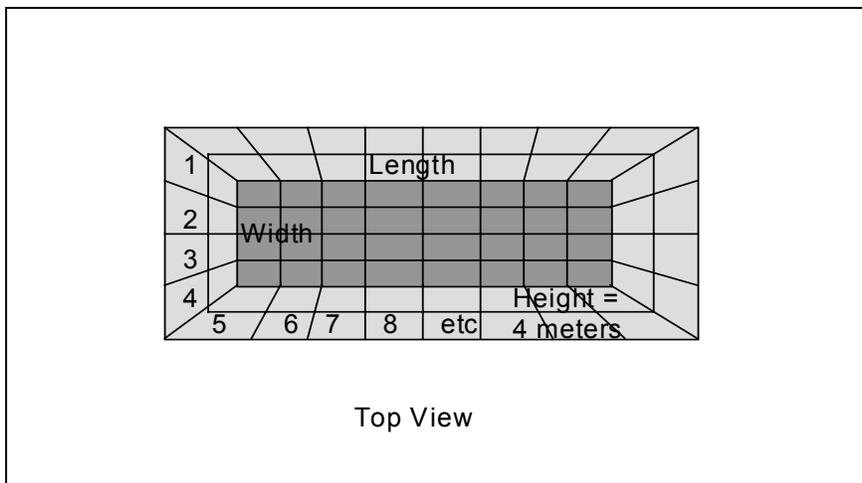


Figure 7-1. Main Grid

Overlays on Study Area.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

1. Overlay 10x10 cm inner grid on area of randomly chosen main sample grid.
2. Use the random number table to select area of the inner grid overlay to collect sample (see shaded area).
3. For the next grids to be selected using the random number table, start at the end point on the table for the last grid. Otherwise, the sample points will be the same for every grid sampled.

Figure 7-2. Selecting Sample Points in a Single Area of an Inner Grid.

After the sample points have been located in this manner, they may have to be moved if they fall on corners of walls or holes. This can be done by moving them a few centimeters in any direction, if possible. If a large area of floor or wall is missing, eliminate that numbered grid and select the next random number to get another grid to sample.

#### 7.2.5 Sampling Equipment and Procedures.

The equipment and sampling procedures used in the field to collect wipe samples is presented in Appendix 7-2.

#### 7.2.6 Estimated Sampling Effort.

Depending on the size of the site, and the number of locations where deployed personnel are exposed to the surfaces, the effort to collect the wipe samples at a site could take from between 1 to 5 days. This would include—

- Inspecting the site to gather background data.
- Preparing the sampling plan.
- Establishing the grid to designate sampling points to include programming a GPS receiver to locate the sample points.
- Making a sketch of the site to show the general area around the sample points.
- Filling out the data sheets, to include the location of the sample points.
- Collecting and documenting the samples.

#### 7.2.7 Sampling Limitations.

The design and execution of this type of sampling effort will be very time consuming for a relatively short period of time. The limitations of this type of sampling include lack of direct measuring instruments and influence of spatial variability between discreet sample points on conventional quality control/ quality assurance procedures.

### **7.3 SAFETY.**

#### 7.3.1 Chemical Hazards.

The chemical hazards associated with wipe sample refer to the potential for personnel conducting the sampling to be exposed to potentially dangerous levels of different chemical contaminants. Personnel conducting the sampling should be aware of this potential while conducting the site survey, and take it into consideration while planning the sampling event. The latex gloves provided with the sampling kit will provide rudimentary protection against many hazards in the wipe. Washing hands after completing any wipe sampling will also provide protection to the sampler. Finally, if more personnel protective equipment is needed to safely sample an area, that should be an indicator that the site is not safe as either a working or living area.

#### 7.3.2 Unexploded Ordnance (UXO) Hazards.

Do not sample any areas that have not been cleared for UXO if there is a UXO threat. Consult with Engineer or Explosive Ordnance Disposal personnel before sampling any area if you are unsure whether it has been cleared for UXO.

### **7.4 REFERENCES.**

1. U.S. Environmental Protection Agency (USEPA), EPA 540/R-95/128, *Wipe Screening Guidance: Technical Background Document*, May 1996.

2. U.S. Environmental Protection Agency (USEPA), EPA/600/8-89/046, *Soil Sampling Quality Assurance Users Guide*, Second Edition, March 1989.
3. U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), MCHB-TS-EHR, *Derivation of Wipe Surface Screening Levels for Environmental Chemical: Industrial Scenarios*, Interim Report.

**APPENDIX 7-1**  
**SPECIFIC ANALYTES IN LISTED ANALYTICAL METHODS**

Table 7-1-1. Specific Metals and EPA Method 6020.

Antimony	Arsenic	Barium
Beryllium	Cadmium	Chromium
Cobalt	Copper	Lead
Manganese	Mercury	Molybdenum
Nickel	Selenium	Silver
Thallium	Vanadium	

Table 7-1-2. Specific Acidic Herbicides in EPA Method 8151A.

Dalapon	2,4-DP (Dichloroprop)	2,4,5-T
Dicamba	2,4-D	2,4-DB
MCPP	Pentachlorophenol (PCP)	Dinoseb
MCPA	2,4,5-TP (Silvex)	DCPA

Table 7-1-3. Specific OC Pesticides in EPA Methods 3550B/8081A & 8082.

Aldrin	Dieldrin
BHC, alpha-	Endosulfan I (Endosulfan, alpha-)
BHC, beta-	Endosulfan II (Endosulfan, beta-)
BHC, delta-	Endosulfan sulfate
BHC, gamma- (Lindane)	Endrin
Chlordane, cis- (Chlordane, alpha-)	Endrin aldehyde
Chlordane, technical	Heptachlor
Chlordane, trans-	Heptachlor epoxide
DDD, p,p'- (4,4'-DDD )	Methoxychlor
DDE, p,p'- (4,4'-DDE)	Toxaphene
DDT, p,p'- (4,4'-DDT)	

Table 7-1-4. Specific OC/OP Pesticides/Neutral Herbicides in CAD Method 38.1.

Alachlor	DDT, o,p'-	Leptophos
Aldrin	DDT, p,p'- (4,4'-DDT)	Malathion
Aspon	Demeton	Merphos
Atrazine	Diazinon	Methoxychlor
Azinphos-Ethyl	Dichlofenthion	Mevinphos
Azinphos-Methyl	Dichlorvos (DDVP)	Monocrotophos
Benefin	Dicloran	Nonachlor, trans-
BHC, alpha-	Dieldrin	Oxadiazon
BHC, beta-	Dimethoate	Oxychlorthane
BHC, delta-	Dioxathion	Parathion, Ethyl
BHC, gamma- (Lindane)	Disulfoton	Parathion, Methyl
Bolstar	Endosulfan I (Endosulfan, alpha-)	Permethrin, cis-
Bromacil	Endosulfan II (Endosulfan, beta-)	Permethrin, trans-
Captafol	Endosulfan sulfate	Phorate
Captan	Endrin	Phosalone
Carbophenothion	EPN	Phosmet
Chlordane, cis- (Chlordane, alpha-)	Ethion	Phosphamidon
Chlordane, Technical	Ethoprop	Procymidone
Chlordane, trans-	Etridiazole	Pronamide
Chlordene, gamma-	Famphur	Propazine
Chlorfenvinphos	Fenarimol	Propetamphos
Chloroneb	Fenitrothion	Protothiophos
Chlorothalonil	Fensulfothion	Simazine
Chlorpyrifos (Chlorpyrifos-ethyl)	Fenthion	Sulfotep (TEDP, Sulfotepp)
Chlorpyrifos-methyl	Fluchloralin	Terbufos
Coumaphos	Folpet	Tetrachlorvinphos
Crotoxphos	Fonofos	Toxaphene
Dacthal	Heptachlor	Trichlorfon
DDD, o,p'-	Heptachlor epoxide	Trichloronate
DDD, p,p'- (4,4'-DDD )	Hexachlorobenzene (HCB)	Trifluralin

DDE, o,p'-	Isazophos	Vinclozolin
DDE, p,p'- (4,4'-DDE)	Isofenphos	Zinophos (Thionazin)

Table 7-1-5. Specific OP Pesticides in EPA Method 3540/3620B/8141A.

Aspon	Fenitrothion	Monocrotophos
Azinphos-Methyl	Fensulfothion	Naled
Carbophenothion	Fenthion	Parathion, Ethyl
Chlorfenvinphos	Fonofos	Phorate
Chlorpyrifos (Chlorpyrifos-ethyl)	Isofenphos	Phosmet
Diazinon	Malathion	Phosphamidon
Dimethoate	Merphos	Propetamphos
Disulfoton	Mevinphos	Ronnel
Ethion		

Table 7-1-6. Specific Neutral Organonitrogen Herbicides in EPA Method 8141.

Alachlor	pronamide	simazine
Atrazine	propazine	

APPENDIX 7-2

WIPE SAMPLING EQUIPMENT AND SAMPLING PROCEDURES

<b>7-2.1 Contents</b>	<b>Page</b>
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**7-2.2 Purpose**

To provide guidance to Medical Detachment or preventive medicine service personnel on the collection of surface wipe samples using the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) deployment surface wipe sampling kit.

**7-2.3 Sampling Equipment**

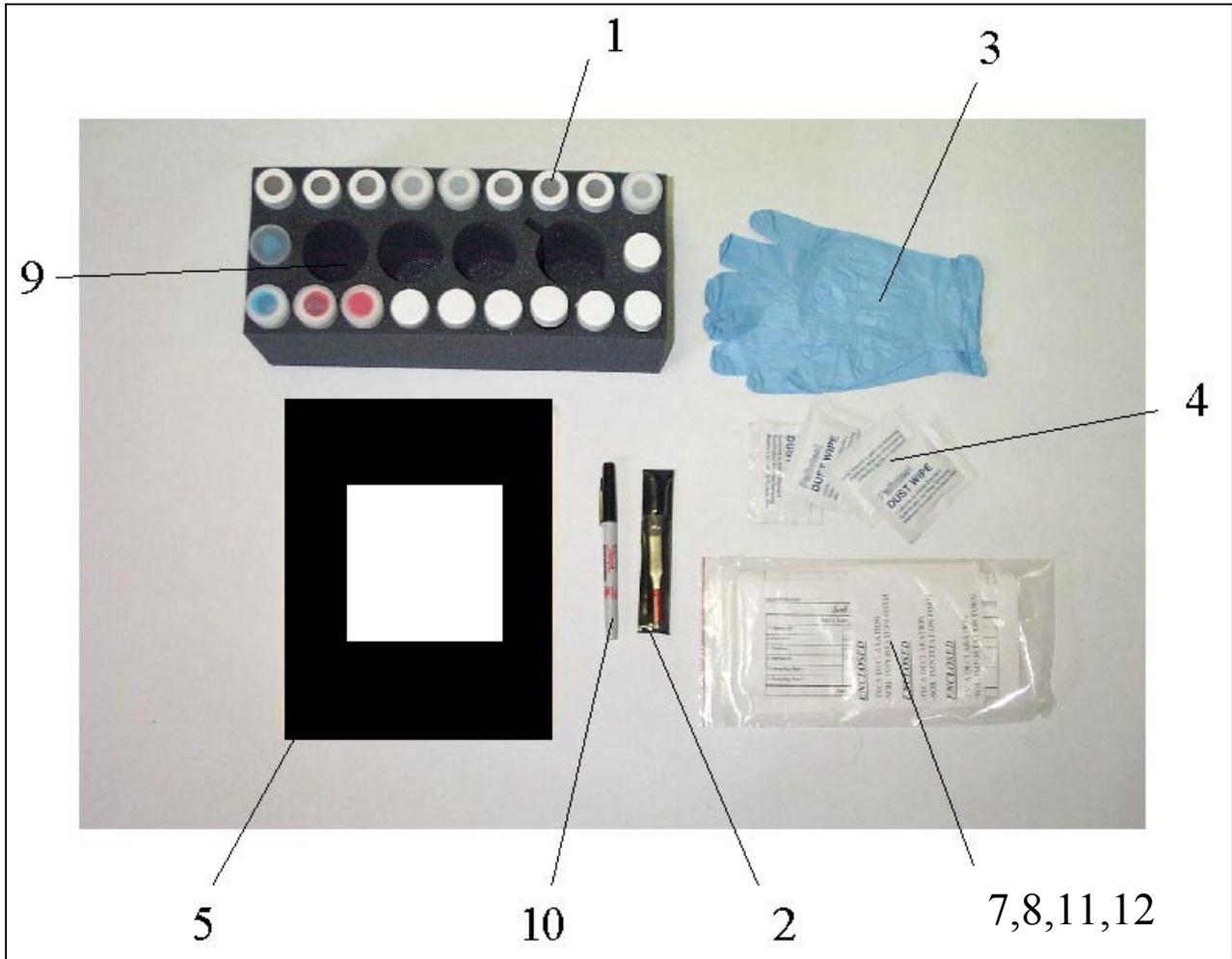
Each deployment surface wipe sampling kit contains twenty wipe sampling containers and supplies as listed in Table 7-2-1. Table 7-2-1 and Figure 7-2-1 outlines the contents of one deployment potable soil sampling kit. The sampling team must decide on the number of kits required to meet the number samples calculated in Chapter 7 to meet the data quality objectives. All containers should only be used once.

**Table 5-2-1. Inventory of Equipment in Deployment Soil Sampling Kit**

ITEM #	ITEM DESCRIPTION	QUANTITY
1	40 ml glass vial	20
2	Disposable Tweezers	10
3	Nitrile gloves	10
4	Palintest dust wipes prewetted with deionized water	25
5	Surface Wipe Template	10
6	Surface Wipe Sampling Bag (Yellow) *	1
7	Surface Wipe Data Sheets	10
8	Surface Wipe Instructions	1
9	Foam Insert ( Surface Wipe)	1
10	Permanent Marker (Black)	1

ITEM #	ITEM DESCRIPTION	QUANTITY
11	Chain of custody seals	
12	Toxic Substances Control Act (TSCA) Certification	4

Figure 7-2-5



**7-2.4 Personal Protective Equipment.**

Sample collection personnel should wear the latex gloves provided in the sample kit while collecting each sample to prevent cross contamination and reduce wipe exposure. Gloves should be changed between each discrete sample.

**7-2.5 Collecting Discrete Surface Wipe Samples.**

1. Remove foam insert, nitrile gloves, tweezers, squirt bottle, palintest wipes, permanent marker, and “Surface Wipe Field Data Sheet”.
2. Identify Sampling Location (Chapter 8)

3. Record the following on the “Soil Field Data Sheet” according to the instructions on the back of the data sheet, see attached.
  - a. “Administrative” Section
  - b. Sample ID
  - c. Sampling Date
  - d. Sampling Time
  - e. Collected By
  - “Field Data” Section
  - Collectors Name
  - Collectors Phone No
  - Temperature
  - Sample Type
  - Collection Type
  - Weather Conditions
  - Sampling Site Graphic with military grid reference system (MGRS) location of sampling site
4. Put on provided nitrile gloves
5. Place clean 10cm X 10cm template upon surface location.
6. Open the Palintest dust wipe packet and remove the dust wipe with clean forceps. The dust wipe should be prewetted with deionized water.
7. Using the forceps to hold the dust wipe, thoroughly and systematically wipe the surface exposed inside of the template using left to right strokes in a back and forth motion. Fold the dust wipe to expose the opposite side of the dust wipe and wipe the area a second time with the same dust wipe, this time using top to bottom strokes.
8. Drop the dust wipe into a sterile, 40-ml vial, align the inner seal and screw top on tightly. Overseal top with custody labels.
9. Make sure proper sample label is affixed, with all entries completed, and aligned on the outside surface of the sample vial so that all label entries are clearly visible.

Figure 7-2-4. Surface Wipe Sample Label

PROJECT:	47-24-2606-99	Optional Data either completed by laboratory or entered in the field: <u>Project, Installation, POC</u>
INSTALLATION:	Camp Bondsteel	
POC:	Hutchens	Required Data: <u>Sample #, Date Collected, Time Collected</u>
SAMPLE NUMBER:	APG_01W_99246	
DATE COLLECTED:	03 SEP 1999	Pre-labeled Data: <u>Analysis Required</u>
TIME COLLECTED:	1200	
ANALYSIS:	Pesticides or Metals	

10. Place 40 ml sample container in foam insert.
11. Discard the gloves, template, and tweezers and retrieve new ones for the next sample point.
12. Move template slightly to a new “dirty” area and repeat the above procedure for the remainder of the analytes at that sample point the number of vial collected from a sample location will depend on the size of the are (See Chapter 7).

#### **7-2.6 Collecting Blank Samples.**

A blank sample should be collected for every 15 wipe samples collected. If less than 15 samples are collected, then one blank sample must be collected. Follow the preceding steps to collect the blank samples.

1. Put on nitrile gloves provided.
2. Open the Palintest dust wipe packet and remove the dust wipe with clean forceps. The dust wipe should be prewetted with deionized water.
3. Drop the dust wipe into a sterile, 40-ml vial, align the inner seal and screw top on tightly. Overseal top with custody labels. Make sure proper sample label is affixed, with all entries completed, and aligned on the outside surface of the sample vial so that all label entries are clearly visible. Overseal the label with clear tape.
4. Place vial foam insert and store in a vertical position preventing movement and contact with other vials and place in a cooler with frozen "blue ice."

#### **7-2.7 Recordkeeping.**

Several pieces of information should be recorded in a log book or notebook for each sample. After the sample number, record the date and time the sample was taken. Record the general weather conditions at the time the sample was collected. Record the location that the sample was located (this should be a general location at the center of the three surface sample sites, not the location of each of the analyte samples). A simple sketch of the area should also be drawn. Any information about the site history should be recorded. The units located in the area (i.e., company size and larger) should be recorded. Also, any information as to its deployment usage should be included. For example, is this a site from which sand bags are being filled, a maintenance area or a bivouac site? This same information should be recorded on the datasheet packed with the sample containers.

#### **7-2.8 Packing Surface Wipe Samples**

1. Ensure that all containers are labeled completely and accurately.
2. Ensure that the caps are placed securely on each of the sample containers.
3. Place containers in the foam insert in which they arrived.
4. Place the foam insert and cover into the included large plastic bag and seal it with tie.
5. Place the bagged foam insert into the yellow surface wipe pack.
6. Fold original “Surface Wipe Field Data Sheet “ and place in the original re-closable plastic bag. Then place in the slip pocket on the outside tip of the bag.

7. Place insert in cooler.
8. Place ice or ice packs in cooler, **(DO NOT use dry ice)**
9. Seal and secure cooler with tape.
10. Place return address (Collectors Address) in the top left hand corner of the sampling pack or cooler and address it to the following:

Gerri Miles USACHPPM ATTN: MCHB-DC-LLI, Bldg E-2100 5158 Blackhawk Road Aberdeen Proving Ground, MD 21010-5422 PHONE: (410) 436-3269
---

11. A copy of the following forms should be placed in the shipping container with the soil samples:
  - Toxic Substances Control Act (TSCA) Certification (Figure 7-2-2) signed by the person packing the samples

**7-2.9 SHIPPING SURFACE WIPE SAMPLES.**

Samples should be transported from the field as soon as possible to ensure holding times are met. Transportation is usually accomplished by a major carrier such as Federal Express or United Parcel Service. However, if these services are not available U.S. Postal or military shipping should be arranged.

**7-2.10 POINT OF CONTACTS.**

Questions and/or comments concerning the deployment soil sampling kit should be referred to the USACHPPM, Deployment Environmental Surveillance, at DSN 312-584-6096 or commercial (410) 436-6096 or by email at [Brad.Hutchens@apg.amedd.army.mil](mailto:Brad.Hutchens@apg.amedd.army.mil).

Figure 7-2-2

**TOXIC SUBSTANCE CONTROL ACT (TSCA)  
CERTIFICATION**

1. DATE \_\_\_\_\_

POSITIVE CERTIFICATION:

XXXXX “I certify that all chemical substances in this shipment comply with all applicable rules or orders under TSCA and that I am not offering a chemical substance for entry in violation of TSCA or any applicable rule or order thereunder.”

NEGATIVE CERTIFICATION:

\_\_\_\_\_ “I certify that all chemicals in this shipment are not subject to TSCA”

2. Company name and address:

3. Name

4. Signature

5. Title

6. Method of Shipment

7. Shipment Number

**APPENDIX 7-3**  
**RANDOM NUMBER TABLE**

USACHPPM DRAFT TG-251

	1	2	3	4	5	6	7	8	9	10
1	96268	11860	83699	38631	90045	69696	48572	05917	51905	10052
2	03550	59144	59468	37984	77892	89766	86489	46619	50236	91136
3	22188	81205	99699	84260	19693	36701	43233	62719	53117	71153
4	63759	61429	14043	44095	84746	22018	19014	76781	61086	90216
5	55006	17765	15013	77707	54317	48862	53823	52905	70754	68212
6	81972	45644	12600	01951	72166	52682	37598	11955	73018	23528
7	06344	50136	33122	31794	86723	58037	36065	32190	31367	96007
8	92363	99784	94169	03652	80824	33407	40837	97749	18361	72666
9	96083	16943	89916	55159	62184	86206	09764	20244	88388	98675
10	92993	10747	08985	44999	35785	65036	05933	77378	92339	96151
11	95083	70292	50394	61947	65591	09774	16216	63561	59751	78771
12	77308	60721	96057	86031	83148	34970	30892	53489	44999	18021
13	11913	49624	28519	27311	61586	28576	43092	69971	44220	80410
14	70648	47484	05095	92335	55299	27161	64486	71307	85883	69610
15	92771	99203	37786	81142	44271	36433	31726	74879	89384	76886
16	78816	20975	13043	55921	82774	62745	48338	88348	61211	88074
17	79934	35392	56097	87613	94627	63622	08110	16611	88599	02890
18	64698	83376	87527	36897	17215	74339	69856	43622	22567	11518
19	44212	12995	3581	37618	94851	63020	65348	55857	91742	79508
20	89292	00204	00579	70630	37136	50922	83387	15014	51838	81760
21	08692	87237	87879	01629	72184	33853	95144	67943	19345	03469
22	67927	76855	50702	78555	97442	78809	40575	79714	06201	34576
23	62167	94213	52971	85794	68067	78814	40103	70759	92129	46716
24	45828	45441	74220	84157	23241	49332	23646	09390	13031	51569
25	01164	35307	26526	80335	58090	85871	07205	31749	40571	51755
26	29283	31581	04359	45538	41435	61103	32428	94042	39971	63678
27	19868	49978	81699	84904	50163	22652	07845	71308	00859	87984
28	14292	93587	55960	23159	07370	65065	06580	46285	07884	83928
29	77410	52135	29495	23032	83242	89938	40516	27252	55565	64714
30	36580	6921	35675	81645	60479	71035	99380	59759	42161	93440
31	07780	18093	31258	78156	07871	20369	53977	08534	39433	57216
32	07548	08454	36674	46255	80541	42903	37366	21164	97516	66181
33	22023	60448	69344	44260	90570	01632	21002	24413	04671	05665
34	20827	37210	57797	34660	32510	71558	78228	42304	77197	79168
35	47802	79270	48805	59480	88092	11441	96016	76091	51823	94442
36	76730	86591	18978	25479	77684	88439	34112	26052	57112	91653
37	23439	02903	20935	76297	15290	84688	74002	09467	41111	19194
38	32927	83426	07848	59372	44422	53372	27823	25417	27150	21750
39	51484	05286	77103	47284	00578	88774	15293	50740	07932	87633
40	45142	96804	92834	26886	70002	96641	36008	02239	91563	66423

Source: U.S. Air Force Field Manual 97-1, Bioenvironmental Engineering Sampling, May, 1998.

## CHAPTER 8

### SOIL SAMPLING METHODS AND ANALYTICAL REQUIREMENTS

#### 8.1 General

##### 8.1.1 Introduction.

The purpose of soil sampling during a deployment is to determine the health risks to soldiers from exposure to the soil. This chapter will describe the methodology for collecting and evaluating soil samples in order to document the extent of environmental contamination in the soils at a site.

There is one basic requirement that will determine the need for soil sampling. Will U.S. forces be exposed to the soil? If the answer to this question is no, there is no need for soil samples. Also, if there are areas where there are high levels of suspected contaminants (strong chemical odors coming from the soil), the personnel conducting the Initial Entry sampling can recommend against soil exposures in that area based on professional judgment.

Collecting soil samples is an important site characterization activity. Soil samples are used to determine the nature and extent of contamination and to identify hazardous substance source areas. With knowledge about the nature and extent of soil contamination, the appropriate measures to mitigate exposures can be implemented. For the deployment scenarios, the most appropriate method of mitigation is avoidance of the contaminated area.

Compared to air or water, there is little change in the chemical composition of soil in the relatively short periods of time involved in a deployment. There is no need for a long-term surveillance or monitoring of soils unless there is some event, for example a spill or other release, that would have an impact on the level of contaminants present in the soil. Soil samples only need to be collected at one time to characterize the potential chemical exposures to soldiers. Soil samples also only need to be collecting in areas where soldiers have the potential to be exposed to the soil.

Soil sampling should occur during the Initial Entry phase of environmental monitoring so that any mitigation can occur before the bulk of the soldiers in a deployment have the potential to be exposed to contaminated soil. While the samples will be collected in the Initial Entry, they will have to be shipped out of the theater of operations for analysis. That is the major difference between collecting the soil samples and the other characterizations conducted during the Initial Entry.

##### 8.1.2 Direct Measurement versus Laboratory Analysis.

While there are on-site sampling kits available for soils, they tend to be very specific in the types of analysis they can perform and are of limited use. For example, while Polychlorinated Biphenyl (PCB) kits or trinitrotoluene (TNT) kits are available, they will only analyze for that specific parameter. Similar or related chemical compounds may result in a positive detection but not a definitive concentration with the kit since the kits are designed to be most sensitive to a very narrow range of compounds. This makes them unsuitable for a deployment environment since the in-theater presumptive analyses are not fully exploitable due to limited capabilities. Retrograde shipping of the samples out of the theater of operations for analysis in a dedicated laboratory is the only feasible alternative at this time.

**8.1.3 Evaluation of the Sampling Results**

The interpretation from the data collected in both types of sampling scenarios is basically the same. The results of each analyses are compared to the soil screening levels described in the U.S Army Center for Health Promotion and Preventive Medicine (USACHPPM) Technical Guide (TG) 230, *Chemical Exposure Guidelines for Deployed Military Personnel*. If any of these levels exceed the screening levels, the population statistics for that analyte will need to be determined (mean, variance, distribution – normal or lognormal), and the 95 percent upper confidence level (UCL) calculated. If the 95 percent UCL exceeds the screening levels, the potential exists for deployed soldiers to be exposed to dangerous or unsafe levels of those contaminants. Any samples that greatly exceed the screening levels should also be considered in evaluating the data because they may indicate a grossly contaminated area, especially considering the averaging effect that composite sampling will have. After determining that soil contaminants exceed the screening levels, a determination needs to be made to either move the potentially exposed soldiers to another area, or consider what measures are necessary to mitigate exposure to the contaminants such as adequate personal or collective measures, duration of work periods, or removal of contaminants.

**8.2 Analytical Methods and Sample Parameters.**

8.2.1 General

Contaminants of concerns (COCs) in the soil will fall into ranges or types of chemical compounds. The types of compounds soil samples are analyzed for will depend on the past use of a site if known. If the prior use of the site is unknown, the initial soil samples collected from the site should be analyzed for the entire potential range of contaminants. Future sampling at the site can use information gathered in the initial screening to determine a more specific list of analytes. Table 8-1 shows some types of prior uses at a site along with the types of contamination soil samples should be analyzed for at those types of sites.

Table 8-1. Typical Sites of Concern with Potential Contaminants.

<b>Type of Site</b>	<b>Potential Site Contaminants</b>
Storage/Military Depots	VOCs*, SVOCs*, Explosives, PCBs/Herbicides/Pesticides, Metals
Fuel Storage/Refining	VOCs, SVOCs, and Metals
Industrial (Manufacturing/Processing)	VOCs, SVOCs, Metals, and PCBs/Pesticides/Herbicides
Residential/Agricultural	Metals and PCBs/Pesticides/Herbicides
Mining - Metals/Inorganic Ores	Metals
Mining - Coal/Petroleum Products	Metals, SVOCs, and VOCs
Former Combat/Mined/Impact Area (for example the Base Camps placed in the Zone of Separation in Bosnia)	Metals and Explosives

\* VOCs: Volatile organic compounds

\* SVOCs: Semi-volatile organic compounds

8.2.2 Specific COCs

Contaminants of Concern are usually grouped together with other chemicals with similar characteristics and uses. Table 8-2 shows the classes of contaminants, common sources of each type of contaminant, and the analytical methods used for the analysis of each class of contaminant. Complete lists of the specific compounds and their respective analytical methods within each class of COC listed here are shown in Appendix 8-1.

Table 8-2. Specific Contaminants of Concern.

Class of Contaminant	Common Sources of Contamination	Analytical Methods
Metals	Residue from refining or manufacturing, metal finishing operations, part of chemical formulations, present as refined or oxidized metal, naturally occurring in soil, explosive primer compounds, coal/incinerator ash	Various – See Appendix 8-1.
VOCs	Fuels, solvents, dry cleaning operations, degreasing compounds	Extraction – USEPA Method 5035 Analysis – USEPA Method 8260
SVOCs	Fuels, lubricants, greases, asphalt plant residues, plastics, coal products	USEPA Method 8270B
Explosives	Manufacturing of explosives, demolition sites, impact areas	USEPA Method 8330
Pesticides/PCBs/Herbicides	Pesticides/Herbicides – manufacturing centers, depot or storage areas, agricultural operations, residential areas PCBs – areas where large electrical equipment was used, stored, maintained, disposed, areas where oil was used for dust control on unpaved roads	If all samples are to be analyzed by USACHPPM in-house laboratories, USACHPPM DLS CAD Method 38.1 for Organochlorine(OC)/ Organophosphate(OP) Pesticides/PCBs/ Neutral Herbicides and USEPA Method 8151A for Acidic Herbicides. If any of the samples are to be analyzed by an outside or contract laboratory, USEPA Methods 8181A/8082/8141A/ 8141 for OC/OP

		Pesticides/PCBs/select Neutral Herbicides and USEPA Method 8151A for Acidic Herbicides.
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**8.3 Phase I Soil Assessment**

A Phase I soil assessment is a considered and methodical approach to evaluating the conditions in the areas where soldiers are living and working. This includes as complete a site characterization as possible based on both the conditions the soldiers are deployed in as well as the knowledge (or lack thereof) about the historical conditions of the site. The only soil that needs to be characterized is the soil which soldiers have the potential to be exposed. Areas covered by buildings or *paved* parking lots are encapsulated and there is no potential for soil exposure by soldiers. Data Quality Objectives (DQOs)

8.4.1.1 Systematic Grid Sampling

Systematic grid sampling involves the collection of samples at fixed intervals when the contamination is assumed to be randomly distributed. This method is commonly used with the populations when estimating trends or patterns of contamination. The grid and starting points should be randomly laid out over the site, yet the method allows for rather easy location of exact sample locations within each grid. Since the sample locations are predetermined, they can be programmed into a global positioning system (GPS) receiver. This allows the sampler to rapidly and accurately go from sample point to sample point. Hand measuring and laying out a grid over a site is very time consuming and should be avoided if the GPS receivers are available. Systematic grid sampling will be the method used to complete the soil assessment.

The number of samples to collect for systematic grid sampling must be determined first. This involves some rudimentary statistics. A good starting point for the data quality objectives would be to set the confidence level (1- $\alpha$ ) to 95 percent, the power (1- $\beta$ ) to 80 percent, the minimum relative detectable difference to 10 percent, and the coefficient of variation to 15 percent. In accordance with the U.S. Environmental Protection Agency (USEPA), the null hypothesis for the statistical test is that the site is contaminated. If the null hypothesis is rejected, it would indicate that the site is not contaminated.

For the purposes of the site characterization, it is more important to ensure there is less potential for Type I Error ( $\alpha$ ) (estimating that the site is uncontaminated when it actually is) than there is for Type II Error ( $\beta$ ) (estimating that the site contaminated when it isn't). Using the statistical parameters set above, the number of samples that would be required would be 15. This number of samples would be adequate to characterize an approximate area of 7 acres  $\pm$  25 percent (approximately 28,600 square meters), or a base camp made up of about one Battalion of soldiers (approximately 600-800 soldiers). If the area to be sampled has a greater or lesser number of soldiers or surface area, the number of samples can be modified up or down. This can be done by assuming a significantly smaller area will have less variability and that a larger area will have more variability. Proposed sample numbers for different sized study areas are shown in Table 8-3 in Section 8.4.2.2 below.

8.4.1.2 Quality Assurance/Quality Control (QA/QC)

To ensure the quality of the collected data, QA/QC samples should be collected and sent to the laboratory for analysis. Split samples should be collected at a rate of between 5-10 percent of the total number of samples. This allows a check on both the mixing of the composite aliquots and a blind check of the laboratory analyzing the samples. The collection and handling of the split samples is detailed in Appendix 8-3.

#### 8.4.2 Selecting Sample Locations

##### 8.4.2.1 Site Survey

A site survey is invaluable for soil sampling design. The information that should be obtained during a site survey includes—

- General site layout.
- Site access.
- Soil types and depths.
- Surface water drainage pathways.
- Existing site conditions.
- Visible staining of surface soil.
- Vegetation stress.

The site history should be compiled and include factors such as previous land use both on and nearby the site, types of industrial operations conducted on the site and on the adjoining property, types of contaminants to which the site has been exposed, and locations of possible dumping/burial areas. The site history can be derived from aerial photographs and interviews with people familiar with the site.

##### 8.4.2.2 Sampling Plan

Prior to beginning any sampling effort as detailed as a soil assessment, a sampling plan should be developed. This sampling plan should detail the efforts that will be undertaken in order to complete the characterization. The sampling plan should also detail the specific analyses that will be performed on the samples. A written plan will also document the steps taken to complete the characterization if there is a change in personnel. The entire area occupied by U.S. forces does not need to be characterized, only those areas where personnel are exposed to the soil. Examples of these areas include—

- Fields/open areas where physical training is performed.
- Areas where digging by hand is being conducted.
- Locations where sandbags are being filled.
- Living/eating/working areas.

If a study area is approximately the same size as the 7-acre area used in discussed previously, overlay the grid over the site as shown in Section 8.4.2.3. If the size of the site is either larger or smaller than the 7-acre site use Table 8-3 to determine the appropriate number of samples to collect. USACHPPM can also be contacted to help determine the number and types of samples to collect.

Table 8-3. Appropriate Number of Samples to Collect.

Area To Be Sampled (Acres)	Area To Be Sampled (Meters <sup>2</sup> )	Number of Samples	Estimated Coefficient of Variation
2	8100	7	10 percent
7	28000	15	15 percent
10+	40500	26	20 percent
20+	81000	40	25 percent

8.4.2.3 Developing the Sample Grid

The size of the grid is calculated by dividing the area of the site by the number of samples required. The product of this calculation is the area of each grid. By taking the square root of the grid area, the length of a grid side is determined.

$$G = (a/n)^{1/2}$$

Where:

G = length per side of each individual grid

a = area

n = number of samples required

A composite sample should be collected within each grid to provide more representative data. Composite samples within the grid will have the effect of averaging the contaminate concentrations in a grid. Since the purpose of a site characterization is to determine the mean concentration of the contamination in an area, this is appropriate. Figure 8-1 shows two simulated base camps with study grids overlaid. Four to six aliquots should be collected from each grid of the oval example (15 samples) and then mixed to collect each composite sample. For the square/oval example, use the random number generator in Appendix 8-4 to select 15 of the 16 grid squares to sample. To determine where in each grid to collect the aliquots, lay a five by five or six by six grid over each main grid, number the new grid, and then select four to six sample points within the new grid using the random number generator in Appendix 8-4. Figure 8-2 shows how to select the composite sample points.

Figure 8-1. Grid Overlays on Study Area.

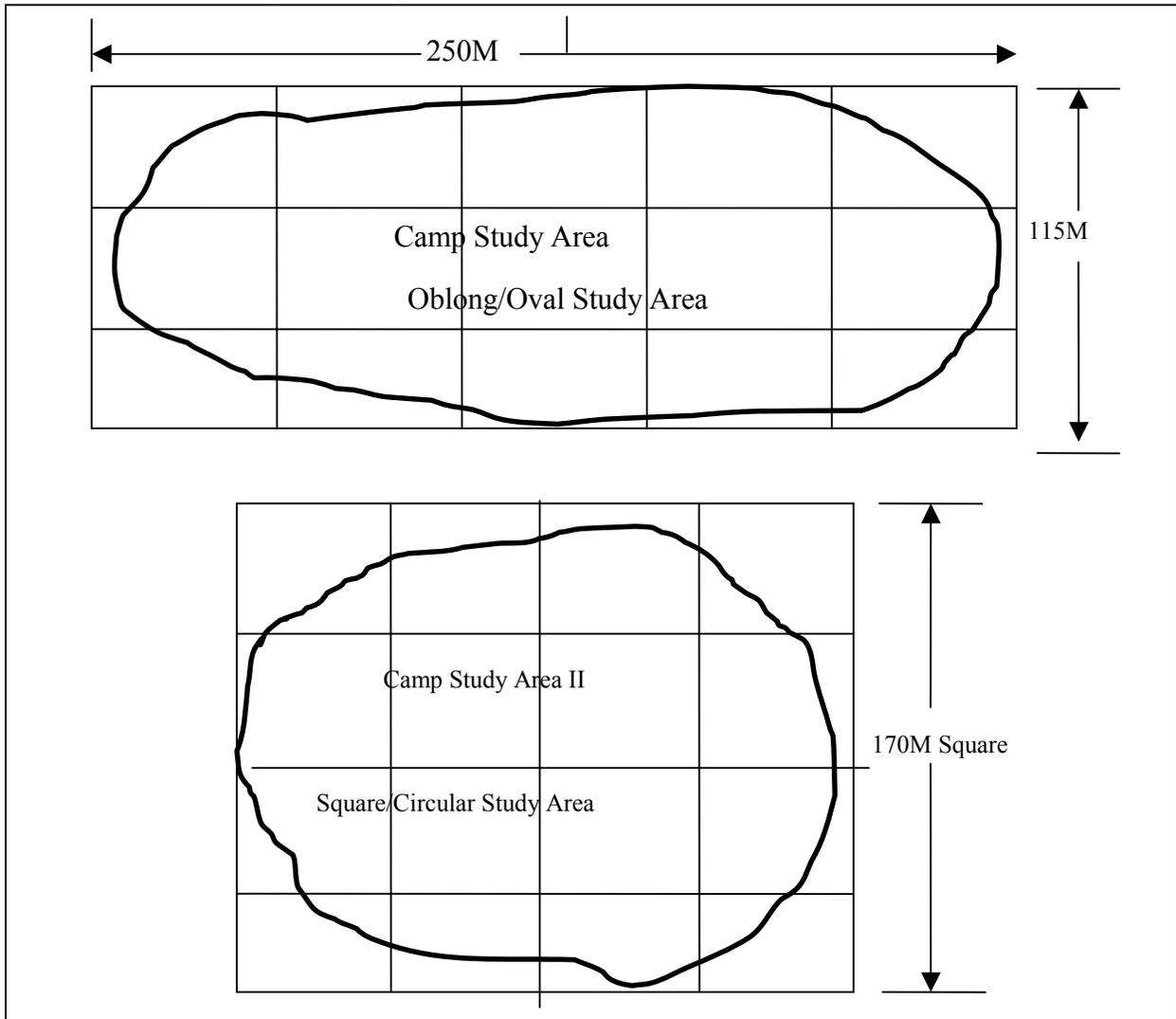


Figure 8-2. Selecting Sample Points in a Single Area of Grid.

1	6	11	16	21
2	7	12	17	22
3	8	13	18	23
4	9	14	19	24
5	10	15	20	25

1. Overlay 5×5 grid on area of overall sample grid.
2. Select 4-6 areas of the grid overlay to collect sample aliquots using random number table (for this example the first two digits were used starting in column 1, going down the column vertically). The numbers highlighted in gray were the ones selected from the random number table.
3. For the next grid to be selected using the random number table, start at the end point for the last grid. Otherwise, the sample points will be the same for every grid sampled.

After the sample points have been located in this manner, they may have to be moved if they fall on either buildings or paved surfaces. This can either be done by moving them a few feet in any direction if possible. If a large area of soil is covered, eliminate that numbered grid and select the next random number to get another grid to sample.

8.4.3 Sampling Equipment and Procedures. All samples collected during the soil assessment should be composite samples collected from areas where soldiers are living and working as identified in the sampling plan. Composite samples for a soil assessment event should be collected from similar areas/activities. This is because compositing the samples will have the effect of averaging the amount of contamination that is present in the soil

8.4.3.1 Sampling Equipment. The equipment used to both collect soil samples and to decontaminate reusable sampling equipment is shown in Appendix 8-2.

8.4.3.2 Sampling Procedures. Sampling procedures for collecting soil samples are shown in Appendix 8-3.

Generally, only surface soil samples (from 0-6 inches) will be collected. If excavation work is ongoing, samples may be collected from the bottom of the excavation using the techniques listed for surface soil sampling. This would be considered representative of the subsurface soils at the depth of excavation. Specific sampling procedures for collecting composite soil samples are shown in Appendix 8-3.

If there is advanced knowledge of subsurface excavation that is going to be conducted, shallow subsurface samples to a depth of 5 or 6 feet can be collected and analyzed. The potential exposure to the soldiers conducting the excavation could then be characterized. The procedures for collection subsurface soils is also shown in Appendix 8-3.

8.4.4 Estimated Sampling Effort. Depending on the size of the site, and the number of locations where soldiers are exposed to the soil, the effort to collect the soil samples at a site could take from between 1 to 5 days. This would include—

- Inspecting the site to gather background data.
- Preparing the sampling plan.
- Gridding out the site to locate sampling points to include programming a GPS receiver to locate the sample points.
- Making a sketch of the site to show the general area around the sample points.
- Filling out the data sheets, to include the location of the sample points.
- Collecting and documenting the samples.

#### 8.4.5 Sampling Limitations.

The design and execution of this type of sampling effort will be very time consuming for a relatively short period of time. Composite sampling is another limitation in this type of sampling. While the averaging affects of the composite sampling are considered to be a positive benefit in terms of comparing samples to screening levels, this same averaging will dilute the maximum contaminant concentration at any single point. A rudimentary understanding of statistics will also be required to analyze the data and complete the soil assessment.

The inherent errors in some of the sampling equipment must also be considered. The AN/PSN-11 GPS receiver in its most accurate receiving condition with crypto loaded still has an estimated positional error of  $\pm 10$  meters.

### 8.5 Discrete Sample Collection.

There is the potential for the need to collect discrete samples. For example, if there is a spill, discrete samples could be collected from the site of the spill to determine the potential risk from contaminated soils at the spill location. Or, a discrete soil sample can be collected if there is a small area of obviously stained soil or distressed vegetation. The data from these discrete samples would be evaluated on an individual basis and would only be of use to describe a very limited area.

### 8.6 Safety.

#### 8.6.1 Chemical Hazards.

The chemical hazards associated with soil sample refer to the potential for personnel conducting the sampling to be exposed to potentially dangerous levels of different chemical contaminants. Personnel conducting the sampling should be aware of this potential while conducting the site survey, and take it into consideration while planning the sampling event. The latex gloves provided with the sampling kit will provide rudimentary protection against many hazards in the soil. Washing hands after completing any soil samples will also provide protection to the sampler. Finally, if more personnel protective equipment (PPE) is needed to safely sample an area, that should be a great indicator that the site is not safe as either a working or living area.

#### 8.6.2 Unexploded Ordnance (UXO) Hazards.

Digging or sampling in the soil provides a potential UXO exposure to sampling personnel. Do not sample any areas that have not been cleared for UXO if there is a UXO threat in the area of concern for the soil sampling. Consult with Engineer or Explosive Ordnance Disposal personnel before sampling any area if you are unsure that it has been cleared for UXO.

## 8.7 Definitions.

Alliquot: A portion of a sample which makes up a fraction of a larger sample.

Composite Soil Sample: A combination of soil aliquots collected at various sample locations, and/or at various depths at a single location. Analysis of composite samples yields a value representing an average over the various sampled sites or depths from which individual samples were collected.

Discrete Soil Sample: A sample that is a discrete aliquot from a distinct sampling interval (of a specific sample size) that is representative of one specific sample location at a specific point in time.

Split Sample: A sample that has been portioned into two or more containers from a single sample container or sample mixing container.

Surface Soil: Generally considered to be the top 6 inches of a soil horizon profile (i.e., soil from zero to 6 inches below ground surface (bgs) once surface vegetation has been removed). However, depending on the program or project within which soil sampling is being conducted, soil down to depths of 2 feet bgs may be considered surface soil.

Subsurface Soil: The soils (silts, sands, and clays) occurring between surficial soil and bedrock.

## 8.8 References.

1. U.S. Army Center for Health Promotion and Preventive Medicine TG 230, *Chemical Exposure Guidelines for Deployed Military Personnel Draft*, 2001.
2. U.S. Environmental Protection Agency (USEPA), EPA 540/R-95/128, *Soil Screening Guidance: Technical Background Document*, May 1996,
3. U.S. Environmental Protection Agency (USEPA), EPA/600/8-89/046, *Soil Sampling Quality Assurance Users Guide, Second Edition*, March 1989.

**APPENDIX 8-1**

**SPECIFIC ANALYTES IN LISTED ANALYTICAL METHODS**

**Table 8-1-1. Specific Metals and EPA Method.**

Metal	EPA Method	Metal	EPA Method	Metal	EPA Method
antimony	7040	chromium	7190	mercury	7470A
arsenic	7061A	cobalt	6010A	selenium	7441A
barium	6010A	copper	6010A	silver	6010A
beryllium	7090	lead	7420	thallium	6010A
cadmium	7130				

**Table 8-1-2. Specific VOCs in EPA Method 8260.**

dichlorodifluoromethane	n-butylbenzene	
vinyl chloride	1,2-dibromo-3-chloropropane (DBCP)	1-chlorobutane
chloroethane	hexachlorobutadiene	1,2-dichloroethane
ethyl ether	1,2,3-trichlorobenzene	1,2-dichloropropane
carbon disulfide	ethylbenzene	methyl methacrylate
1,1-dichloroethene	o-xylene	2-nitropropane
dichloromethane (methylene chloride)	bromoform	cis-1,3-dichloropropene
methyl-t-butyl ether	bromobenzene	toluene
1,1-dichloroethane	1,2,3-trichloropropane	1,1,2-trichloroethane
cis-1,2-dichloroethene	n-propylbenzene	tetrachloroethene
propionitrile	4-chlorotoluene (p-chlorotoluene)	2-hexanone
methacrylonitrile	tert-butylbenzene	1,2-dibromoethane (EDB)
bromochloromethane	1,2,4-trimethylbenzene	1,1,1,2-tetrachloroethane
1,1,1-trichloroethane	chloromethane	m/p-xylene
1,1-dichloropropene	bromomethane	styrene
benzene	trichlorofluoromethane	isopropylbenzene (Cumene)
trichloroethene	iodomethane	1,1,2,2-tetrachloroethane
dibromomethane	acetone	trans-1,4-dichloro-2-butene
bromodichloromethane	allyl chloride	2-chlorotoluene (o-chlorotoluene)
chloroacetonitrile	acrylonitrile	1,3,5-trimethylbenzene
4-methyl-2-pentanone	trans-1,2-dichloroethene	pentachloroethane
trans-1,3-dichloropropene		sec-butylbenzene
ethyl methacrylate	2,2-dichloropropane	4-isopropyltoluene
1,3-dichloropropane	2-butanone	1,2-dichlorobenzene (o-dichlorobenzene)
dibromochloromethane	methyl acrylate	hexachloroethane
chlorobenzene	tetrahydrofuran	1,2,4-trichlorobenzene
1,3-dichlorobenzene (m-dichlorobenzene)	chloroform	naphthalene
1,4-dichlorobenzene (p-dichlorobenzene)	carbon tetrachloride	

**Table 8-1-3. Specific SVOCs in EPA Method 8270**

n-nitrosodimethylamine	4,6-dinitro-2-methylphenol	2-methylnaphthalene
phenol	4-bromophenyl-phenylether	2,4,6-trichlorophenol
2-chlorophenol	pentachlorophenol	2-chloronaphthalene
1,4-dichlorobenzene	anthracene	dimethylphthalate
1,2-dichlorobenzene	fluoranthene	2,6-dinitrotoluene
bis(2-chloroisopropyl) ether	butylbenzylphthalate	acenaphthene
n-nitrous-di-n-propylamine	benzo(a)anthracene	4-nitrophenol
nitrobenzene	bis(2-ethylhexyl) phthalate	2,4-dinitrotoluene
2-nitrophenol	benzo(b)fluoranthene	4-chlorophenyl-phenylether
bis(2-chloroethoxy) methane	benzo(a)pyrene	4-nitroaniline
1,2,4-trichlorobenzene	bis(2-chloroethyl) ether	n-nitrosodiphenlyamine
4-chloroaniline	1,3-dichlorobenzene	hexachlorobenzene
4-chloro-3-methylphenol	benzyl alcohol	phenanthrene
hexachlorocyclopentadiene	2-methylphenol	di-n-butylphthalate
2,4,5-trichlorophenol	4-methylphenol	pyrene
2-nitroaniline	hexachloroethane	chrysene
acenaphthylene	isophorone	di-n-octyl phthalate
3-nitroaniline	2,4-dimethylphenol	benzo(k)fluoranthene
2,4-dinitrophenol	2,4-dichlorophenol	indeno(1,2,3-cd) pyrene
dibenzofuran	naphthalene	benzo(g,h,i) perylene
diethylphthalate	hexachlorobutadiene	dibenzo(a,h) anthracene
fluorene		

**Table 8-1-4. Specific Explosives in EPA Method 8330.**

1,3,5-trinitrobenzene	2-nitrotoluene
1,3-dinitrobenzene	2-amino-2,6-dinitrotoluene
2,4,6-trinitrotoluene	4-nitrotoluene
2,4-dinitrotoluene	HMX
2,6-dinitrotoluene	nitrobenzene
2-amino-4,6-dinitrotoluene	RDX
2-nitrotoluene	Tetryl

**Table 8-1-5. Specific Acidic Herbicides in EPA Method 8151A.**

Dalapon	2,4-DP (Dichloroprop)	2,4,5-T
Dicamba	2,4-D	2,4-DB
MCPPP	Pentachlorophenol (PCP)	Dinoseb
MCPA	2,4,5-TP (Silvex)	DCPA

**Table 8-1-6. Specific OC/OP Pesticides/PCBs/Neutral Herbicides in CAD Method 38.1.**

Alachlor	Diazinon	Monocrotophos
Aldrin	Dichlofenthion	Nonachlor, trans-
Aspon	Dichlorvos (DDVP)	Oxadiazon
Atrazine	Dicloran	Oxychlorane
Azinphos-Ethyl	Dieldrin	Parathion, Ethyl
Azinphos-Methyl	Dimethoate	Parathion, Methyl
Benefin	Dioxathion	PCB (Aroclor 1016)
BHC, alpha-	Disulfoton	PCB (Aroclor 1221)
BHC, beta-	Endosulfan I (Endosulfan, alpha-)	PCB (Aroclor 1232)
BHC, delta-	Endosulfan II (Endosulfan, beta-)	PCB (Aroclor 1242)
BHC, gamma- (Lindane)	Endosulfan sulfate	PCB (Aroclor 1248)
Bolstar	Endrin	PCB (Aroclor 1254)
Bromacil	EPN	PCB (Aroclor 1260)
Captafol	Ethion	Permethrin, cis-
Captan	Ethoprop	Permethrin, trans-
Carbophenothion	Etridiazole	Phorate
Chlordane, cis- (Chlordane, alpha-)	Famphur	Phosalone
Chlordane, Technical	Fenarimol	Phosmet
Chlordane, trans-	Fenitrothion	Phosphamidon
Chlordene, gamma-	Fensulfothion	Procymidone
Chlorfenvinphos	Fenthion	Pronamide
Chloroneb	Fluchloralin	Propazine
Chlorothalonil	Folpet	Propetamphos
Chlorpyrifos (Chlorpyrifos-ethyl)	Fonofos	Protothiophos
Chlorpyrifos-methyl	Heptachlor	Simazine
Coumaphos	Heptachlor epoxide	Sulfotep (TEDP, Sulfotepp)
Crotoxypfos	Hexachlorobenzene (HCB)	Terbufos
Dacthal	Isazophos	Tetrachlorvinphos
DDD, o,p'-	Isofenphos	Toxaphene
DDD, p,p'- (4,4'-DDD )	Leptophos	Trichlorfon
DDE, o,p'-	Malathion	Trichloronate
DDE, p,p'- (4,4'-DDE)	Merphos	Trifluralin
DDT, o,p'-	Methoxychlor	Vinclozolin
DDT, p,p'- (4,4'-DDT)	Mevinphos	Zinophos (Thionazin)
Demeton	Mirex	

**Table 8-1-7. Specific OC Pesticides and PCBs in EPA Methods 3550B/8081A & 8082.**

Aldrin	DDT, p,p'- (4,4'-DDT)	Methoxychlor
BHC, alpha-	Dieldrin	PCB (Aroclor 1016)
BHC, beta-	Endosulfan I (Endosulfan, alpha-)	PCB (Aroclor 1221)
BHC, delta-	Endosulfan II (Endosulfan, beta-)	PCB (Aroclor 1232)
BHC, gamma- (Lindane)	Endosulfan sulfate	PCB (Aroclor 1242)
Chlordane, cis- (Chlordane, alpha-)	Endrin	PCB (Aroclor 1248)
Chlordane, technical	Endrin aldehyde	PCB (Aroclor 1254)
Chlordane, trans-	Heptachlor	PCB (Aroclor 1260)
DDD, p,p'- (4,4'-DDD )	Heptachlor epoxide	Toxaphene
DDE, p,p'- (4,4'-DDE)		

**Table 8-1-8. Specific OP Pesticides in EPA Method 3540/3620B/8141A.**

Aspon	Fenitrothion	Monocrotophos
Azinphos-Methyl	Fensulfothion	Naled
Carbophenothion	Fenthion	Parathion, Ethyl
Chlorfenvinphos	Fonofos	Phorate
Chlorpyrifos (Chlorpyrifos-ethyl)	Isofenphos	Phosmet
Diazinon	Malathion	Phosphamidon
Dimethoate	Merphos	Propetamphos
Disulfoton	Mevinphos	Ronnel
Ethion		

**Table 8-1-9. Specific Neutral Organonitrogen Herbicides in EPA Method 8141.**

alachlor	pronamide	simazine
atrazine	propazine	

**APPENDIX 8-2  
DEPLOYMENT SOIL SAMPLING KIT INSTRUCTIONS**

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**8-2.1 Purpose**

To provide guidance to Medical Detachment or preventive medicine service personnel on the collection of soil samples using the USACHPPM deployment soil sampling kit.

**8-2.2 Sampling Equipment**

Each deployment soil sampling kit contains three soil sampling containers and supplies as listed in Table 8-2-1. Table 8-2-1 and Figure 8-2-1 outlines the contents of one deployment potable soil sampling kit. The sampling team must decide on the number of kits required to meet the number of samples calculated in Chapter 8 to meet the data quality objectives. All containers should only be used once. Certain pieces of equipment, such as metal bowls and scoops, can be decontaminated between collections and used again.

**Table 8-2-1. Inventory of Equipment in Deployment Soil Sampling Kit**

ITEM #	ITEM DESCRIPTION	QUANTITY
1	12oz (360 ml) Teflon® Jars (labeled) with lids	3
2	Chain of custody seals	3
3	Foam Insert	1
4	Nitrile gloves	3
5	Permanent Marker (Brown)	1
6	Plastic Bags (12" x 15")	4
7	Plastic Bags (4" x 9")	4
8	Plastic scoop (4 oz)	3
9	Soil Field Datasheets	3
10	Soil importation permit	1
11	Soil Sampling Bag (Brown)	1
12	Soil Sampling Instructions	1
13	TSCA declaration	1
14	Wipes	4
	Teflon® is a registered trademark of DuPont de Nemours, Inc., Wilmington, Delaware.	1

ITEM #	ITEM DESCRIPTION	QUANTITY
16	Container of detergent for cleaning bowl	1
17	Magnifying glass	1
18	Small squirt bottle	1
19	Soil sampling stainless steel bowl (1-1/2 quart)	1



Figure 5-2-6. Deployment Soil Sampling Kit

### 8-3.2.1 Personal Protective Equipment.

Sample collection personnel should wear the latex gloves provided in the sample kit while collecting each sample to prevent cross contamination and reduce soil exposure. Gloves should be changed between each surface composite sample (the same gloves can be worn when collecting all of the aliquots in a composite sample) or between each grab sample. Depending on presence of environmental contaminants, appropriate personal protective equipment (PPE) should be worn to protect the sampler against inhalation and dermal hazards.

## 8-2.3 Soil Sample Collection Types

### 8-3.3.1 Discrete Sample

A discrete sample is collected from a single point to characterize the soil conditions at a specific location. Discrete samples are routinely collected to characterize the soil conditions at a site where a chemical spill has occurred and the spill is isolated to a very small area.

### 8-3.3.2 Composite Sample

A composite sample is a mixture of multiple samples collected from a defined area. The samples that make up the composite sample are called aliquots. Composite samples are collected to characterize the contaminants in soil in an area that may or may not be contaminated. Multiple aliquots are collected from the sampling location identified from the sample plan, homogenized in a large mixing bowl, and treated as one soil sample.

### 8-3.3.3 Sampling for VOCs.

Sampling only for VOC may be conducted when there is suspected or known contamination. Only discrete samples should be collected for VOC analysis. Each soil sample collected for analysis of VOCs will be placed directly into the appropriate sample container, with minimal agitation, aeration, or mixing – *note that the VOC sample is placed in the container before the rest of the soil sample is homogenized in a bowl.* The best approach for VOC samples is to collect the soil from the bottom of the sample interval (e.g., 6 inches bgs). Any samples to be analyzed for VOCs should be coordinated with the laboratory ahead of the sampling event. Special containers will have to be shipped prior to the collection of samples for VOCs.

## 8-2.4 Equipment Decontamination Procedures

The following procedures should be followed to decontaminate the equipment used to collect the soil samples. Equipment should be decontaminated between each sampling site to limit cross contamination of samples.

1. Using approximately one liter of bottled or tap water and one-half meal-ready-to-eat (MRE) spoonful of detergent, make a cleaning solution in a five-gallon bucket. If a bucket is not available, fill the mixing bowl with approximately 1-inch of water and ¼ MRE spoonful of detergent
2. Knock off as much of the soil from the item that is being decontaminated as possible.
3. Clean with tap water and soap (e.g. Liquinox®) using a brush if necessary to remove particulate matter and surface films. Equipment may be steam cleaned as an alternate to brushing (figure 8-2-2).

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Liquinox® is a registered trademark of Alconox, Inc., White Plains, New York.



Figure 8-2-2

4. Rinse thoroughly with bottled or tap water
5. Rinse thoroughly with analyte-free water.

### 8-2.5 Sample Collection Procedures

17. Identify sampling point.
18. Remove foam insert, nitrile gloves, plastic scoop, stainless steel bowl, squirt bottle, wipes, brush, detergent container, permanent marker, and “Soil Field Data Sheet”.
19. Decontaminate the mixing bowl and sampling scoops if used at a previous site. Sampling scoops can be discarded if supplies warrant.
20. Record the following on the “Soil Field Data Sheet” in accordance with the instructions on the back of the data sheet, see attached.
  - a. “Administrative” Section
    - Sample ID
    - Sampling Date
    - Sampling Time
    - Collected By
  - “Field Data” Section
    - Collectors Name
    - Collectors Phone No

- Temperature
- Sample Type
- Collection Type
- Weather Conditions
- Sampling Site Graphic with military grid reference system (MGRS) Corners of Sampling Site
- Geolocation of discret sample or samples for composite sample

21. Put on nitrile gloves provided, and remove wipes from plastic bag.
22. Unfold wipe and place sampling supplies on wipe.
23. Surface vegetation must be removed from the sampling site with a shovel/entrenching tool or sampling spoon/scoop.
24. Use sampling plastic scoop to collect a soil within the first 6-inches of soil. The sampler must remove pebbles, roots, etc. from the mixture as the sample is collected.
  - Discrete samples - Collect enough sample to fill the mixing bowl. If the discrete sample is for VOC do not mix and proceed to step 11.
  - Composite samples – Composite samples will be collected by placing equal amounts (or aliquots) of soil collected from multiple locations into the stainless steel bowl. (i.e. if the composite sample consists of collecting 6 discrete sample, use one full scoop from each location and place in mixing bowl.)



Figure 8-2-3

25. Once the mixing bowl has been filled with the soil sample mix the contents using the sampling scoop until completely homogenized. During mixing the sampler should remove any remaining pebbles, roots, organic material, etc. Again, if the analysis is only for VOCs, do not mix the sample.
26. Ensure that any organic material (e.g., roots, grass, insects, worms, etc.) has been removed from the soil. Also ensure that any rocks or pebbles have been removed from the soil.
27. Open sample container.
28. Fill sample jar about 1/3<sup>rd</sup> full and compact the soil using sampling scoop (Figure 8-2-4).



Figure 8-2-4

29. Fill the jar another 1/3<sup>rd</sup> full and compact again.
30. Fill the remaining space in jar with soil and pack. Ensure the jar is completely full and that there is no empty space at the top.
31. Clean any soil from the threads at the top of the jar and secure the top tightly.
32. Complete the label on the sampling container (Figure 8-2-5).

Figure 8-2-5. Soil Sample Label.

PROJECT: 47-24-2606-99	Optional Data either completed by laboratory or entered in the field: <u>Project, Installation, POC</u> Required Data: <u>Sample #, Date Collected, Time Collected</u> Pre-labeled Data: <u>Sample Preserved, Analysis Required</u>
INSTALLATION: Camp Bondsteel	
POC: Hutchens	
SAMPLE NUMBER: <i>APG_01S_99246</i>	
DATE COLLECTED: <i>03 SEP 1999</i>	
TIME COLLECTED: 1200	
ANALYSIS: Pesticides/Metals/Exp/PCB/SVOC/VOC	

33. Place the sample jar into the foam insert.
34. Decontaminate sampling equipment following steps in section 8-2.5 before collecting the next soil sample.
35. Repeat steps 1-17 to collect additional soil samples.
36. Collect a split sample for every 15 soil samples.

**8-3.5.1 Split Samples and Collection Procedure**

Split samples are quality assurance/quality control (QA/QC) samples collected at a rate of between 5-10 percent of the total number of samples. For every 15 samples collected (each sample grid), one split sample should be collected. At a minimum, one split sample should be collected if the number of samples collected is less than 15. This is a blind QA/QC check of the laboratory. Make sure to record which samples are split samples both on the data sheet and in the logbook.

1. Identify location to take split sample
2. While collecting sample in section 8-2.6, place twice the volume of soil into the collection bowl as for a normal sample.
3. Then fill two sample containers with the thoroughly mixed soil.
4. The sample containers will then be sealed tightly, labeled properly, and placed on ice in a shipping cooler.
5. The two samples should get two different sample numbers.

**8-2.6 Packing Soil Samples**

1. Ensure that all containers are labeled completely and accurately.
2. Ensure that the caps are placed securely on each of the sample containers.
3. Place containers in the foam insert in which they arrived.
4. Place the foam insert and cover into the included large plastic bag and seal it with tie.
5. Place the bagged foam insert into the brown soil pack.
6. Fold original "Soil Field Data Sheet" and place in the original re-closable plastic bag. Then place in the slip pocket on the outside tip of the bag.

7. Place insert in cooler.
8. Place ice or ice packs in cooler. **(DO NOT use dry ice)**
9. Seal and secure cooler with tape.
10. Place return address (Collector's Address) in the top left hand corner of the sampling pack or cooler and address it to the following:

Gerri Miles USACHPPM ATTN: MCHB-DC-LLI, Bldg E-2100 5158 Blackhawk Road Aberdeen Proving Ground, MD 21010-5422 PHONE: (410) 436-3269
---

11. A copy of the following forms should be placed in the shipping container with the soil samples:
  - USACHPPM Soil Importation Permit (Figures 8-2.4)
  - USACHPPM Soil Importation Compliance Agreement (Figure 8-2.5)
  - Toxic Substances Control Act (TSCA) Certification (Figure 8-2.6) signed by the person packing the samples
  - Plant Protection and Quarantine (PPQ) Form 550 (Soil Samples Restricted Entry) (Figure 8-2.7).

### **8-2.7 Shipping Soil Samples.**

Samples should be transported from the field as soon as possible to ensure holding times are met. Transportation is usually accomplished by a major carrier such as Federal Express or United Parcel Service. U.S. Postal or military shipping should be arranged if these services are not available

### **8-2.8 Points of Contact**

Questions and/or comments concerning the deployment soil sampling kit should be referred to the USACHPPM, Deployment Environmental Surveillance, at DSN 312-584-6096 or commercial 410-436-6096 or by email at [Brad.Hutchens@apg.amedd.army.mil](mailto:Brad.Hutchens@apg.amedd.army.mil).

Figure 8-2.4 Soil Importation Permit.



**UNITED STATES  
DEPARTMENT OF  
AGRICULTURE**

Animal and Plant  
Health Inspection  
Service

Plant Protection and  
Quarantine

**Soil Permit**

Permit Number: S-38232

**Issued To:** U.S. Army Center for Health Promotion and Preventive Medicine  
(William Smithson)  
Ground Water and Solid Waste Program  
Aberdeen Proving Ground, Maryland 21010-5422

TELEPHONE: (410) 671-4211

Under the authority of the Federal Plant Pest Act of May 23, 1957, permission is hereby granted to the facility/individual named above subject to the following conditions:

1. Valid for shipments of soil not heat treated at the port of entry, only if a compliance agreement (PPQ Form 519) has been completed and signed.
2. To be shipped in sturdy, leakproof, containers.
3. To be released without treatment at the port of entry.
4. To be used only for analysis and only in the facility of the permittee at U.S. Army Center for Health Promotion and Preventive Medicine, located in Aberdeen Proving Ground, Maryland.
5. No use of soil for growing purposes is authorized, including the isolation or culture of organisms imported in soil.
6. All unconsumed soil, containers, and effluent is to be autoclaved, incinerated, or heat treated by the permittee at the conclusion of the project as approved and prescribed by Plant Protection and Quarantine.
7. This permit authorizes shipments from all foreign sources, including Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands through any U.S. port of entry.

Expiration Date DECEMBER 31, 2003

Approving Official *Deborah M. Knott*  
**DEBORAH M. KNOTT**

PPQ FORM 525B (8/94)

PT 1 - PERMITTEE

Figure 8-2.5 Soil Importation Permit Compliance Agreement.

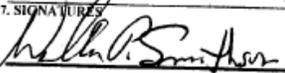
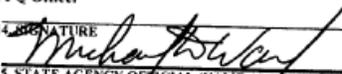
UNITED STATES DEPARTMENT OF AGRICULTURE ANIMAL AND PLANT HEALTH INSPECTION SERVICE PLANT PROTECTION AND QUARANTINE		
COMPLIANCE AGREEMENT		
1. NAME AND MAILING ADDRESS OF PERSON OR FIRM US ARMY CENTER FOR HEALTH PROMOTION AND PREVENTATIVE MEDICINE GROUND WATER AND SOLID WASTE PROGRAM ABERDEEN PROVING GROUND MD 21010-5403 ATTN: WILLIAM SMITHSON	2. LOCATION Shaefer Road BLDG E-1958 Edgewood area of APG 410-436-4211	
3. REGULATED ARTICLE(S) SOIL SAMPLES		
4. APPLICABLE FEDERAL QUARANTINE(S) OR REGULATIONS GOLDEN NEMATOD, IMPORTED FIRE ANT AND WITCH WEED		
6. I/We agree to the following That in authorizing and participating in these treatments as a basis for the certification of regulated articles, no liability shall be attached either to the United States Department of Agriculture, to cooperation agencies or to any of their employees in the event of injury to the property or regulated article; to handle, move, and process regulated articles in accordance with the provisions of applicable plant quarantines; to use all permits and certificates in accordance with instructions; to maintain and offer for inspections such records as may be required; to carry out all additional conditions, treatments, precautions and sanitary measures as may be required by the inspector in the following stipulations: See attachments for Stipulations: Attachment 1 Handling soil samples Attachment 2 Cleaning of soil moving equipment Attachment 3 Soil movement map Attachment 4 Laboratories approved to receive soil		
7. SIGNATURES 	8. TITLE Sup. Eng. Tech.	9. DATE SIGNED 27 Feb 2000
The affixing of the signatures below will validate this agreement which shall remain in effect until cancelled, but may be revised as necessary or revoked for noncompliance.		
10. AGREEMENT NO. PS-00-01		
11. DATE OF AGREEMENT 27JAN00		
12. PPQ OFFICIAL (NAME AND TITLE) Michael D. Ward PPQ Officer	13. ADDRESS 2200 Broening Highway Suite 140 Baltimore MD 21224	
14. SIGNATURE 		
15. STATE AGENCY OFFICIAL (NAME AND TITLE)	16. ADDRESS	
17. SIGNATURE		
PPQ FORM 519 (AUG77)		

Figure 8-2.6 TSCA Declaration

**TOXIC SUBSTANCE CONTROL ACT (TSCA)  
CERTIFICATION**

1. DATE \_\_\_\_\_

POSITIVE CERTIFICATION:

XXXXX “I certify that all chemical substances in this shipment comply with all applicable rules or orders under TSCA and that I am not offering a chemical substance for entry in violation of TSCA or any applicable rule or order thereunder.”

NEGATIVE CERTIFICATION:

\_\_\_\_\_ “I certify that all chemicals in this shipment are not subject to TSCA”

2. Company name and address:

--

8. Name

--

9. Signature

--

10. Title

--

11. Method of Shipment

--

12. Shipment Number

--

Figure 8-2.7 Soil Samples Restricted Entry Form (Form PPQ 550).

U. S. DEPARTMENT OF AGRICULTURE  
ANIMAL AND PLANT HEALTH INSPECTION SERVICE  
PLANT PROTECTION AND QUARANTINE PROGRAMS  
HYATTSVILLE, MARYLAND 20782

**IMPORTATION AUTHORIZED**

The material contained in this package is imported under authority of  
the Federal Plant Pest Act of May 23, 1957.

THIS PACKAGE CONTAINS

*Soil Samples for Release Without Treatment*

PERMIT NO.       S-38232      

VALID THRU:  
**Dec. 31, 2003**



SOIL SAMPLING FIELD DATA SHEET INSTRUCTIONS

-----SECTION I - ADMINISTRATIVE DATA-----

----

1. **Sample ID** - Sample ID number XXX\_YYY\_DDDDD  
 Where: XXX – Camp or location abbreviation (i.e. first three letters of camp or location name)  
 YYY – Soil sample number for that camp on that particular day (e.g. 01S, 02S, 03S, etc)  
 DDDDD - jday code, last two digits of the year & three digit julian day of the year [e.g 00001 for 1-Jan-2000].
2. Location – Camp or location of sample.
3. Country – Country in which location or camp is located.
4. Operation – Name of operation ongoing in the area of the sample [e.g. Operation Allied Force (OAF), etc] if applicable
5. **Sampling Date** – Date sample was collected (e.g. 01-Jan-2000)
6. **Sampling Time** – Time sample was taken (e.g. 16:00)
7. **Collected By** - Unit collecting the sample (e.g. TAML, 71<sup>st</sup> MEDDET, etc).
8. Unit Spec ID – Unit specific ID associated with the sample if any.
9. Mission ID – Unit mission ID associated with the sample if any.
10. Shipping ID – Shipping ID associated with sample (e.g. Fedex tracking number)
11. Lab ID – Unique ID number assigned at CHPPM-Main laboratory, if applicable.
12. Job No. – Job number assigned at laboratory.
13. Project No. – Project number assigned by laboratory or project officer.
14. Europe ID - Unique ID number assigned at CHPPM-Europe laboratory, if applicable.
15. **Sampling Notes** – Any notes or comments associated with the sample (e.g. short holding time, unusual circumstances, etc).

-----SECTION II - FIELD DATA-----

----

*Note: The Sample ID, Sampling Date, Sampling Time, Collectors Name, and MGRS (if applicable) should also be recorded on the sample label.*

16. **Collectors Name** – The name of the person collecting the sample.
17. **Collectors Phone No** - The phone number of the person collecting the sample.
18. **Temperature** – Temperature of soil, if known in degrees Celsius.
19. **Soil Sample Type:**  
 Surface – Soil sample taken within 6 inches of the surface  
 Sub-surface – Soil sample taken below 6 inches of surface
20. **Collection Type:**  
 Composite –Soil sample taken from several locations and consolidated into one sample  
 Discrete – Soil sample taken from one unique location.
21. Weather Conditions – weather conditions at the time of sampling.
22. **Field Notes** - Notes relating to sampling episode (e.g. Location description, current uses, potential contamination)
23. **Sampling Site Graphic and MGRS Corners** –  
 Record location of corners of sampling site and graphic showing site grid with sub-area numbers.  
 If site is a discrete sample site of contamination, show sketch of site and MGRS location of sample
24. **Single Area of Grid Graphic** – Required if sample is part of an area site grid. Sub-area sketch with sub-grid and MGRS locations of composite sample locations.

\*MGRS – Location in Military Grid Reference System (MGRS) from GPS, ten digit grid with grid square identifier (e.g. BQ1234567890)

**APPENDIX 8-3**

**RANDOM NUMBER TABLE**

USACHPPM DRAFT TG-251

	1	2	3	4	5	6	7	8	9	10
1	96268	11860	83699	38631	90045	69696	48572	05917	51905	10052
2	03550	59144	59468	37984	77892	89766	86489	46619	50236	91136
3	22188	81205	99699	84260	19693	36701	43233	62719	53117	71153
4	63759	61429	14043	44095	84746	22018	19014	76781	61086	90216
5	55006	17765	15013	77707	54317	48862	53823	52905	70754	68212
6	81972	45644	12600	01951	72166	52682	37598	11955	73018	23528
7	06344	50136	33122	31794	86723	58037	36065	32190	31367	96007
8	92363	99784	94169	03652	80824	33407	40837	97749	18361	72666
9	96083	16943	89916	55159	62184	86206	09764	20244	88388	98675
10	92993	10747	08985	44999	35785	65036	05933	77378	92339	96151
11	95083	70292	50394	61947	65591	09774	16216	63561	59751	78771
12	77308	60721	96057	86031	83148	34970	30892	53489	44999	18021
13	11913	49624	28519	27311	61586	28576	43092	69971	44220	80410
14	70648	47484	05095	92335	55299	27161	64486	71307	85883	69610
15	92771	99203	37786	81142	44271	36433	31726	74879	89384	76886
16	78816	20975	13043	55921	82774	62745	48338	88348	61211	88074
17	79934	35392	56097	87613	94627	63622	08110	16611	88599	02890
18	64698	83376	87527	36897	17215	74339	69856	43622	22567	11518
19	44212	12995	3581	37618	94851	63020	65348	55857	91742	79508
20	89292	00204	00579	70630	37136	50922	83387	15014	51838	81760
21	08692	87237	87879	01629	72184	33853	95144	67943	19345	03469
22	67927	76855	50702	78555	97442	78809	40575	79714	06201	34576
23	62167	94213	52971	85794	68067	78814	40103	70759	92129	46716
24	45828	45441	74220	84157	23241	49332	23646	09390	13031	51569
25	01164	35307	26526	80335	58090	85871	07205	31749	40571	51755
26	29283	31581	04359	45538	41435	61103	32428	94042	39971	63678
27	19868	49978	81699	84904	50163	22652	07845	71308	00859	87984
28	14292	93587	55960	23159	07370	65065	06580	46285	07884	83928
29	77410	52135	29495	23032	83242	89938	40516	27252	55565	64714
30	36580	6921	35675	81645	60479	71035	99380	59759	42161	93440
31	07780	18093	31258	78156	07871	20369	53977	08534	39433	57216
32	07548	08454	36674	46255	80541	42903	37366	21164	97516	66181
33	22023	60448	69344	44260	90570	01632	21002	24413	04671	05665
34	20827	37210	57797	34660	32510	71558	78228	42304	77197	79168
35	47802	79270	48805	59480	88092	11441	96016	76091	51823	94442
36	76730	86591	18978	25479	77684	88439	34112	26052	57112	91653
37	23439	02903	20935	76297	15290	84688	74002	09467	41111	19194
38	32927	83426	07848	59372	44422	53372	27823	25417	27150	21750
39	51484	05286	77103	47284	00578	88774	15293	50740	07932	87633
40	45142	96804	92834	26886	70002	96641	36008	02239	91563	66423

Source: U.S. Air Force Field Manual 97-1, Bioenvironmental Engineering Sampling, May 1998.

## CHAPTER 9

### RADIATION SAMPLING METHODS AND ANALYTICAL REQUIREMENTS

#### 9.1 GENERAL.

##### 9.1.1 Biological Systems In Humans

Exposure of living organisms to sufficiently large amounts of ionizing radiation can cause harmful biological effects. It may not be the gamma ray itself that causes damage to tissue, but rather the high-energy electrons produced when gamma ray energy is absorbed in the body and harm vital systems of the human body.

##### 9.1.2. Health Effects of Radiation Exposure

Depending on the level of exposure, radiation can pose a health risk. It can adversely affect individuals directly exposed as well as their descendants. Radiation can affect cells of the body, increasing the risk of cancer or harmful genetic mutations that can be passed on to future generations; or, if the dosage is large enough, it can cause massive tissue damage. High radiation exposure can cause severe effects and lead to death within a few days/weeks.

##### 9.1.3. The Biological Effects of Radiation

Radiation causes ionization in the molecules of living cells. These ionizations result in the removal of electrons from the atoms, forming ions or charged atoms. The ions formed can then go on to react with other atoms in the cell, causing damage. For example, when a gamma ray interacts in a cell, the water molecules near the deoxyribonucleic acid (DNA) may be ionized and the ions may react with the DNA strand, causing it to break. In general, a cascade of series of ionization events cause biological damage in humans.

#### 9.2. INSTRUMENTATION.

Human senses cannot detect low levels of ionizing radiation. Therefore, we must rely on specialized equipment to identify sources of radiation so that proper precautions can be taken. However, not every instrument detects all types of radiation; one needs to choose the proper instrumentation for the performance of a specific job. In order to make the right decision, an understanding of the instrumentation is imperative. Radiation intensity (radiation field) and radioactivity measurements may be the two main purposes for using instrumentation in radiation protection. Radiation intensity may be measured with: 1) a direct-reading instrument (portable, mobile or fixed station), or 2) a passive, integrating detection device that is later interpreted (possibly requiring some form of processing). In the case of measuring radioactivity, it is often necessary to concentrate the radioactive material during collection in the field (such as in air sampling) or by processing in the laboratory. In addition to measuring quantity or concentration of radioactivity, it is often important to identify the radionuclides present. For some radionuclides and some media, this can be done directly by instrumental means; for others, it is necessary to chemically separate and concentrate the radionuclide before counting the radioactivity.

##### 9.2.1. Survey meters

Portable survey meters are used for measuring either: 1) levels of radiation intensity, or 2) amounts of radioactive contamination. Some survey meters have a digital counting capability or an integrate mode and, when operated in these modes, they can read an integral quantity for the duration of the

measurements.

### 9.2.2. Survey meters for measuring radiation intensity

Instruments that measure radiation intensity are designed to quantify: 1) radiation flux density, 2) exposure, 3) dose, or 4) dose equivalent (rem meters). Radiation flux density instrumentation measures numbers of particles or photons in a given area per unit time (commonly alpha or beta particles per probe window area, photons interacting within the tube, or neutrons/cm<sup>2</sup> per unit time). Instrumentation for quantifying human external exposure are designed to measure x-ray and gamma radiation. These instruments are read in millirem per hour (mR/hr) or rem per hour (R/hr) (mR or R in the integral mode). An example of a dose quantification instrument is a neutron-measuring instrument that has been developed to give a reading, which is indicative of the dose to some standardized volume such as a hypothetical slab or cylinder of tissue. Instruments that measure dose equivalent are designed to give a reading that is indicative of the dose equivalent to a standard man if he was at the location occupied by the instrument. The instruments may be specific for a particular kind of radiation (such as fast neutron) or they may be applicable to mixtures of radiations (such as for neutrons of all energies or for gamma rays and neutrons).

## 9.3. THE SURVEYING AND SAMPLING PLAN.

### 9.3.1 Purpose

This survey method will allow a surveyor to gather enough data of proper quality to: (1) answer the question, “Is there an immediate external radiological hazard present?” (2) estimate the radiation exposure to personnel in the survey unit, and (3) estimate the variance in the measurement process. A health physicist shall review the survey and its results so that additional recommendations can be made. More detailed survey information is contained in USACHPPM TG 236,A, *Basic Radiological Dose Estimation – A Field Guide (Draft)*, 2001.

The data from this plan will be used to estimate the Radiation Exposure Status (RES) at the end of a given mission or the duration of the mission for a specified Operational Exposure Guidance (OEG). This protocol is based on using the AN/VDR-2 RADIAC meter or the AN/PDR-77 RADIAC kit only.

### 9.3.2. General

This plan will not provide enough information for a detailed health risk assessment, but it will allow a qualified expert to draw preliminary conclusions of the radiological conditions of the survey unit. All procedures are based on the recommendations outlined in Nuclear Regulatory (NUREG)-1575, *Multi-Agency Radiation Survey and Site Investigation Manual*). This sampling protocol is designed to correspond roughly with a scoping survey as described in NUREG-1575. All survey data will be recorded on the supplied sheets, copies, or other format as long as all the information on the sheets in this technical guide is included. Any deviation from the procedures set forth in this protocol must be accompanied by an explanation of the change. Professional judgment is encouraged, but all rationales for changes must be recorded.

For this survey, 1 roentgen (R), 1 rem, and 1 rad of external photon radiation are considered equivalent to 0.01 gray (Gy) or 1 cGy.

### 9.3.3. Instrumentation Use for a Survey

The following requirements must be met for each piece of equipment used for a survey:

1. Field survey meters will be calibrated every 12 months and no instrument shall be used whose calibration has expired, unless no other option exists. If instruments are in need of calibration, use your standard procedures for instrument calibration or maintenance.
2. The survey instruments and accessories shall be operated within their stated humidity and temperature requirements.
3. All survey meters will have operational checks performed on them with an appropriate radioactive check source before beginning a survey and periodically during the survey. The results of the operational checks before and after the survey will be recorded on the data sheets for the survey.
4. All instruments will be operated in ratemeter mode, and all instruments will be held in place for 60 seconds before recording any stationary (static) measurement value on the survey forms.

### 9.3.4. List of Supplies

1. AN/PDR-77 or AN/VDR-2
2. Copy of USACHPPM TG-236A and datasheets
3. Global positioning system (GPS) Unit (optional) and tape measure (optional)
4. Indelible marker
5. Pens
6. Sample Labels (Appendix 9-2)
7. Sampling tool (e.g., trowel or entrenching tool)
8. Twenty-four (24) 1-gallon Ziploc<sup>®</sup> or similar plastic bags; twelve additional bags to account for breakage and extra samples. Other sample containers may be used in coordination with the laboratory.
9. Sealing or other strong tape
10. Distilled water (at least 4 liters)
11. Latex surgeons gloves
12. Leather or gardener's gloves
13. Flags or other land marking items

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Ziploc<sup>®</sup> is a registered trademark of S.C. Johnson & Son, Inc., Racine, Wisconsin.

### 9.3.5. Conducting a Survey

#### 9.3.5.1 Survey Unit Setup

The recommended maximum area for each outdoor survey unit is 10,000 m<sup>2</sup> and for each indoor survey unit the recommended maximum area is 100 m<sup>2</sup> of floor space. The minimum outdoor survey unit area is a rectangle 8 meters long and 6 meters wide, 48 m<sup>2</sup>. The minimum indoor survey unit area is 10 m<sup>2</sup>.

#### 9.3.5.2 Choosing the Survey Unit

The choice of the survey unit or units depends on the overall military operation. The commander may specify an area that needs to be surveyed. In general, a survey unit must enclose an area that does not vary greatly over that area. For example, a group of survey units could be a warehouse, its parking lot, and an adjacent vacant lot. Generally, the parking lot and vacant lot would not be considered at one survey unit. The survey unit must encompass an area that is suspected to have elevated levels of radiation. If the area surrounding a potentially contaminated item is to be surveyed, then the survey unit should be centered on the item; for example, a tank damaged by a depleted uranium penetrator. If desired, an additional survey unit can be added downwind if it is suspected that airborne radioactive materials were released. A single room or a group of similar rooms can be a survey unit. The survey unit should be marked and entry should be restricted to the survey team until the survey is done. Once the survey is done, a decision as to who can enter the area can be made.

The following steps should be followed to setup the survey unit. Refer to the datasheet while following these instructions:

1. Encompass the area to be surveyed with a rectangle.
2. Record GPS/Grid coordinates for the points indicated on the datasheet, if available.
3. Record the length and width of the survey unit on the datasheet.
4. Divide the width into 6 equal blocks.
5. Divide the length into 8 equal blocks.
6. Mark the boundaries of and restrict access to the survey unit, if possible.

Note: The survey unit should be divided into 48 square blocks as shown on the datasheet. A GPS is a very useful aid to finding the location of the survey unit and measurement locations, but a GPS is not necessary to perform the assessment.

## 9.4. BACKGROUND MEASUREMENT(S).

The naturally occurring radiation levels (background) data will be gathered at specified background locations before any survey is begun.

### 9.4.1 Outdoor Background Measurement

An outdoor background location should be an area well outside the survey unit. Dissimilar survey units must have separate and appropriate background measurements. The background location must have no or a very small chance of being contaminated but is all other ways be similar to the survey unit(s). All sampling locations must be noted on a field map. For this assessment, there will be three (3) background measurement locations. The three (3) locations will be taken at least 10 meters from a point in an uncontaminated area at the 0°, 120°, and 240° compass points. A soil sample, an external gamma exposure rate measurement, and an x-ray probe measurement (if the

probe is available) will be taken at each outdoor location. Indoor locations require only external gamma exposure rate measurements.

#### 9.4.2 Indoor Background Measurement

An indoor background location should be a room made from similar construction materials but well away from the survey unit. If possible, avoid rooms that share ventilation ductwork.

### 9.5 EXTERNAL RADIATION SURVEY (OUTDOORS OR INDOORS).

1. The surveyor will record the external exposure ( $\beta\gamma$ -probe) rate at about one meter (about 3 feet) above the ground.
2. If the x-ray probe is available, x-ray readings will be taken about 10 cm (~4 inches) above the ground.
3. Soil samples (outdoors only), x-ray, and  $\beta\gamma$ -probe measurements will be taken in the center of blocks 1-12.
4. Only  $\beta\gamma$ -probe measurements need to be taken in blocks 13 – 24.

### 9.6. PERSONNEL MONITORING PROCEDURES.

Personnel monitoring is required for people who have been in an area with elevated radiation readings as determined by this survey. Usually a hand and foot frisk survey with the Beta-Gamma pancake probe will satisfactorily meet this criteria. The following is adapted U.S. Department of Health and Human Services (DHHS), *Preparedness and Response in Radiation Accidents*. Food and Drug Administration (FDA), CDRH, August 1983.

1. Find an area with low background and little to no contamination.
2. Select the pancake probe or the probe with the end window open for personnel monitoring.
3. Use the headphones or other audio capabilities of the survey meter. It is easier to detect changes in counting rate by listening, and it allows the user to concentrate on the survey not the meter.
4. Note the background on the meter.
5. The person being monitored should stand straight, feet spread apart, arms extended with the palms straight up, and the fingers straight out.
6. Keep the probe window about 2.5 cm (1 inch) from the surface of the body. Try not to touch the person with the probe.
7. Move the probe about 2.5 cm  $s^{-1}$  over the person: start at the head, survey the front of the person, including the inseam, crotch, and armpits.
8. Survey the outline of the body with special attention to the fingertips.
9. Repeat with the arms and hands turned over.
10. Repeat the survey on the back of the person.
11. As a rule of thumb, any area that registers twice the background should be considered contaminated.
12. Take another background reading, and if it is significantly different from the first reading, resurvey the person.

13. The aim of personnel monitoring is to determine with a reasonable certainty if a person is contaminated. In the event that a person is contaminated, decontamination with soap and water as soon as practicable.

#### **9.7. EQUIPMENT SURVEYS.**

An equipment survey is required for an item that may have been in an area with elevated radiation readings as determined by this survey, that may have been damaged by a depleted uranium (DU) penetrator, or contains a broken radioactive commodity. Equipment surveys are judgmental measurements. Because of the complexity and size range of equipment that might be encountered in the field, one generic approach would be too cumbersome to use. For relatively small pieces of equipment, a surface scan will cover the entire surface of the equipment.

1. The ambient background will be measured at 1 meter from the equipment to be surveyed.
2. Verify measured values are in excess of 3 times the background value.
3. If possible, small contaminated items can be bagged and labeled.
4. Larger contaminated items shall be marked as contaminated and shall be cordoned off at a distance of 1 meter.
5. Contaminated items may continue to be used at the discretion of the commander.

#### **9.8. SOIL SAMPLING GUIDANCE.**

Detailed guidance on soil sampling, can be found in Section 8, "Soil Sampling".

#### **9.9. SAMPLE CONTAINMENT AND MANAGEMENT.**

1. All sample shipping shall be coordinated with the lab (see below) in accordance with guidance contained in Section 2.
2. Disposable gloves and splash protective apparel will be worn when applicable.
3. Samples will be packaged in accordance with Section 2.
4. Samplers and sample containers will be received and shipped according to Section 2.

The addresses for the USACHPPM Directorate of Laboratory Sciences-Main are:

By U.S. Mail:

Commander  
USACHPPM  
ATTN: MCHB-TS-LSM (Sample Mgt Lab)  
5158 Blackhawk Road  
APG, MD 21010-5403

By FedEx, UPS, or other commercial carriers:

CDR, USACHPPM  
ATTN: MCHB-TS-LSM (Sample Mgt Lab)  
5158 Blackhawk Road  
Bldg E2100  
APG, MD 21010-5403

#### **9.10. QUALITY ASSURANCE AND QUALITY CONTROL.**

The following steps should be followed to ensure proper quality assurance/quality control (QA/QC) of collected samples and results.

1. Data collection forms and worksheets are provided in the protocols for the surveys.
2. All survey meters will have operational checks performed on them with an appropriate radioactive check source before beginning a survey and periodically during the survey. The results of the operational checks before and after the survey will be recorded on the data sheets.
  - a. If the operational check source readings **are within** 50 percent of the value on the calibration sheet, the survey can continue.
  - b. If the readings **are not within** 50 percent, take another 2 readings. If **both** of these extra readings are within 50 percent of the value on the calibration sheet, continue with the survey. If either of these additional readings **is not within** 50 percent, stop the survey and get a new instrument.
3. One collocated soil sample will be taken within one meter (~3 feet) of the sampling location in block 1 of the survey unit. This soil sample must be labeled as a QC sample.
4. An external exposure rate measurement will be repeated at the end of the survey in block 1 of the survey unit. The meter reading will be recorded as G2 in block 1 of the survey unit.
5. If the x-ray probe is available, a second reading will be recorded as X2 in block 2 of the survey unit.
6. The survey data will be reviewed for anomalies and completeness by the officer-in-charge (OIC) or the noncommissioned officer-in-charge (NCOIC) at the end of each survey.
7. A health physicist will be contacted early in the process.

#### **9.11 LABORATORY ANALYSES.**

All laboratory analyses will be coordinated with USACHPPM, Directorate of Laboratory Services (DLS), Radiologic, Classic, and Clinical Chemistry Division (RCCCD). The following steps should be followed to ensure proper analysis of samples.

1. The initial analyses of the soil samples will be a gross  $\alpha\beta$ -activity measurement (DLS Test Code: 765) and a qualitative gamma spectroscopy measurement (A 100 minute counting interval is recommended; DLS Test Code: 815).
2. The samples will be analyzed in accordance with USACHPPM, RCCCD protocols and procedures to meet the survey plan DQOs.
3. All samples submitted to the RCCCD will be controlled in accordance with the laboratory's chain of custody protocol.

#### **9.12 DATA INTERPRETATION.**

The final interpretation and recommendations will be made with the advice of personnel trained in radiation safety. To interpret the laboratory results, the following information must be available to the radiation safety officer.

1. Survey checklists and Data Sheets (Appendix 9-1).
2. Copies of all paperwork will accompany the samples to the lab.
3. Copies of all paperwork will be sent to USACHPPM-Main, Health Physics Program (HPP).

#### **9.13 DOCUMENT HANDLING.**

Once the data interpretation and communication are done, all the associated paperwork shall be preserved and archived. Tentatively, this archive is planned for the HPP at USACHPPM-Main.

#### **9.14 PERSONNEL DECONTAMINATION.**

Many times when working with or around radioactive materials, despite the best efforts, individuals will get contaminated. In the vast majority of the cases, the contamination is minor. Clothing that is contaminated should be removed and stored in suitable containers (e.g., plastic bags) until either the radioactivity has decayed to an acceptable level or the clothing is washed or disposed of through the appropriate channels. If the skin is contaminated, then decontamination is needed.

There should be a special decontamination location set up near the survey area. To decontaminate a person, you must first locate the areas that are contaminated. The person must be resurveyed carefully and the areas that are contaminated must be noted. Then when decontaminating the person, start with the mildest measures and move to stronger measures if the contamination is difficult to remove. Also, take care that you don't break the skin or cause reddening. This could introduce contamination into the bloodstream.

Keep in mind that during decontamination you want to minimize the spread of contamination. You don't want to get contaminated yourself! For example, wear gloves and coveralls, if needed, and work from the edges of the contaminated area toward the center.

Simple decontamination procedures listed from mildest to strongest are listed below. This is not a comprehensive list—

1. Lifting off with tape.
2. Flushing with water.
3. Washing with soap and warm water.
4. Washing with a mild abrasive soap, soft brush, and warm water.
5. Washing with a detergent.
6. Washing with a complexing agent.
7. Washing with a mild organic acid.

After each decontamination attempt, the area and its surroundings must be resurveyed until the contamination level is acceptable. Also, the area in the decontamination location near the person should be surveyed to ensure that contamination has not spread.

#### **9.15 SURVEY UNITS LESS THAN THE PRESCRIBED MINIMUM AREA.**

If the survey unit is less than 48 m<sup>2</sup> for an outdoor unit or 10 m<sup>2</sup> for an indoor unit, then you will alert a health physicist and initiate an external gamma scan of the area (and an x-ray scan, if the probe is available). For the external gamma exposure rate scan, the  $\beta\gamma$ -probe will be held about 1 meter above the ground (or floor) and the surveyor will walk slowly, about 0.5 m s<sup>-1</sup>. The x-ray probe will be held about 10 cm above the ground for the scanning measurements.

#### **9.16 FIELD ASSESSMENT(S).**

1. Determine the Radiation Exposure Status (RES) category or mission duration to meet the Operational Exposure Guidance (OEG) determined by the commander. See Appendix 9-1.

2. Determine if the Level 1 survey is adequate to estimate the upper limit on the radiation exposure to personnel.

### **9.17 SURVEY SCOPE.**

A radiation survey at this level is designed to answer simple questions in a timely manner with minimal information. The information can be gathered from intelligence data and from the survey itself. What are the external exposure rates both indoors and outdoors? Is contaminated equipment present? Is there historical or intelligence information available? Is the mission duration or the OEG specified?

### **9.18 BOUNDARIES OF THE SURVEY.**

#### 9.18.1 Spatial Boundaries

The recommended maximum area for an outdoor survey is 10,000 m<sup>2</sup> (roughly a little larger than 2 football fields) and 100 m<sup>2</sup> (roughly a 30' x 30' floor area) for each indoor survey unit. These areas were chosen as a compromise between the time and personnel constraints on doing a survey and greatly increasing the chance of missing significant radiological exposures.

For any assessment, more than one type of survey unit may be present; for example, the entire assessment may require a survey of an open field, a paved parking lot, and the interior of a warehouse. Each of these areas would be treated as separate survey units, unless circumstances dictate otherwise. Furthermore, each of these survey units need a matching background survey unit of similar makeup.

#### 9.18.2 Temporal Boundaries

This survey/assessment is designed for missions lasting up to 180 days.

The results of the survey and the conclusions are expected within 24 hours of completing the survey. In reality, the results and conclusions should be available in much less than 24 hours.

#### 9.18.3 Interpreting and Reporting the Results in the Field (See Appendix 9-1)

The field results should be discussed with personnel knowledgeable in radiation protection. The discussions should be made with the primary purpose of relaying the results and recommendations to the commander in a useful manner. The table in the next section is a listing of recommended actions for radiation exposures that result in different RES categories

### **9.19. References**

1. Nuclear Regulatory Commission, (NUREG) 1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), June 2001.
2. U.S. Army Center for Health Promotion and Preventive Medicine TG 236A, *Basic Radiological Dose Estimation – A Field Guide (Draft)*, June 2000.
3. U.S. Army Environmental Health Agency TG 155, *Environmental Sampling Guide*, February 1993.
4. Department of Health and Human Services (DHHS), *Preparedness and Response in Radiation Accidents*. Food and Drug Administration, CDRH, August 1983.



## CHAPTER 9

### RADIATION SAMPLING METHODS AND ANALYTICAL REQUIREMENTS

#### 9.1 GENERAL.

##### 9.1.1 Biological Systems In Humans

Exposure of living organisms to sufficiently large amounts of ionizing radiation can cause harmful biological effects. It may not be the gamma ray itself that causes damage to tissue, but rather the high-energy electrons produced when gamma ray energy is absorbed in the body and harm vital systems of the human body.

##### 9.1.2. Health Effects of Radiation Exposure

Depending on the level of exposure, radiation can pose a health risk. It can adversely affect individuals directly exposed as well as their descendants. Radiation can affect cells of the body, increasing the risk of cancer or harmful genetic mutations that can be passed on to future generations; or, if the dosage is large enough, it can cause massive tissue damage. High radiation exposure can cause severe effects and lead to death within a few days/weeks.

##### 9.1.3. The Biological Effects of Radiation

Radiation causes ionization in the molecules of living cells. These ionizations result in the removal of electrons from the atoms, forming ions or charged atoms. The ions formed can then go on to react with other atoms in the cell, causing damage. For example, when a gamma ray interacts in a cell, the water molecules near the deoxyribonucleic acid (DNA) may be ionized and the ions may react with the DNA strand, causing it to break. In general, a cascade of series of ionization events cause biological damage in humans.

#### 9.2. INSTRUMENTATION.

Human senses cannot detect low levels of ionizing radiation. Therefore, we must rely on specialized equipment to identify sources of radiation so that proper precautions can be taken. However, not every instrument detects all types of radiation; one needs to choose the proper instrumentation for the performance of a specific job. In order to make the right decision, an understanding of the instrumentation is imperative. Radiation intensity (radiation field) and radioactivity measurements may be the two main purposes for using instrumentation in radiation protection. Radiation intensity may be measured with: 1) a direct-reading instrument (portable, mobile or fixed station), or 2) a passive, integrating detection device that is later interpreted (possibly requiring some form of processing). In the case of measuring radioactivity, it is often necessary to concentrate the radioactive material during collection in the field (such as in air sampling) or by processing in the laboratory. In addition to measuring quantity or concentration of radioactivity, it is often important to identify the radionuclides present. For some radionuclides and some media, this can be done directly by instrumental means; for others, it is necessary to chemically separate and concentrate the radionuclide before counting the radioactivity.

##### 9.2.1. Survey meters

Portable survey meters are used for measuring either: 1) levels of radiation intensity, or 2) amounts of radioactive contamination. Some survey meters have a digital counting capability or an integrate mode and, when operated in these modes, they can read an integral quantity for the duration of the

measurements.

### 9.2.2. Survey meters for measuring radiation intensity

Instruments that measure radiation intensity are designed to quantify: 1) radiation flux density, 2) exposure, 3) dose, or 4) dose equivalent (rem meters). Radiation flux density instrumentation measures numbers of particles or photons in a given area per unit time (commonly alpha or beta particles per probe window area, photons interacting within the tube, or neutrons/cm<sup>2</sup> per unit time). Instrumentation for quantifying human external exposure are designed to measure x-ray and gamma radiation. These instruments are read in millirem per hour (mR/hr) or rem per hour (R/hr) (mR or R in the integral mode). An example of a dose quantification instrument is a neutron-measuring instrument that has been developed to give a reading, which is indicative of the dose to some standardized volume such as a hypothetical slab or cylinder of tissue. Instruments that measure dose equivalent are designed to give a reading that is indicative of the dose equivalent to a standard man if he was at the location occupied by the instrument. The instruments may be specific for a particular kind of radiation (such as fast neutron) or they may be applicable to mixtures of radiations (such as for neutrons of all energies or for gamma rays and neutrons).

## **9.3. THE SURVEYING AND SAMPLING PLAN.**

### 9.3.1 Purpose

This survey method will allow a surveyor to gather enough data of proper quality to: (1) answer the question, “Is there an immediate external radiological hazard present?” (2) estimate the radiation exposure to personnel in the survey unit, and (3) estimate the variance in the measurement process. A health physicist shall review the survey and its results so that additional recommendations can be made. More detailed survey information is contained in USACHPPM TG 236,A, *Basic Radiological Dose Estimation – A Field Guide (Draft)*, 2001.

The data from this plan will be used to estimate the Radiation Exposure Status (RES) at the end of a given mission or the duration of the mission for a specified Operational Exposure Guidance (OEG). This protocol is based on using the AN/VDR-2 RADIAC meter or the AN/PDR-77 RADIAC kit only.

### 9.3.2. General

This plan will not provide enough information for a detailed health risk assessment, but it will allow a qualified expert to draw preliminary conclusions of the radiological conditions of the survey unit. All procedures are based on the recommendations outlined in Nuclear Regulatory (NUREG)-1575, *Multi-Agency Radiation Survey and Site Investigation Manual*). This sampling protocol is designed to correspond roughly with a scoping survey as described in NUREG-1575. All survey data will be recorded on the supplied sheets, copies, or other format as long as all the information on the sheets in this technical guide is included. Any deviation from the procedures set forth in this protocol must be accompanied by an explanation of the change. Professional judgment is encouraged, but all rationales for changes must be recorded.

For this survey, 1 roentgen (R), 1 rem, and 1 rad of external photon radiation are considered equivalent to 0.01 gray (Gy) or 1 cGy.

### 9.3.3. Instrumentation Use for a Survey

The following requirements must be met for each piece of equipment used for a survey:

5. Field survey meters will be calibrated every 12 months and no instrument shall be used whose calibration has expired, unless no other option exists. If instruments are in need of calibration, use your standard procedures for instrument calibration or maintenance.
6. The survey instruments and accessories shall be operated within their stated humidity and temperature requirements.
7. All survey meters will have operational checks performed on them with an appropriate radioactive check source before beginning a survey and periodically during the survey. The results of the operational checks before and after the survey will be recorded on the data sheets for the survey.
8. All instruments will be operated in ratemeter mode, and all instruments will be held in place for 60 seconds before recording any stationary (static) measurement value on the survey forms.

### 9.3.4. List of Supplies

14. AN/PDR-77 or AN/VDR-2
15. Copy of USACHPPM TG-236A and datasheets
16. Global positioning system (GPS) Unit (optional) and tape measure (optional)
17. Indelible marker
18. Pens
19. Sample Labels (Appendix 9-2)
20. Sampling tool (e.g., trowel or entrenching tool)
21. Twenty-four (24) 1-gallon Ziploc<sup>®</sup> or similar plastic bags; twelve additional bags to account for breakage and extra samples. Other sample containers may be used in coordination with the laboratory.
22. Sealing or other strong tape
23. Distilled water (at least 4 liters)
24. Latex surgeons gloves
25. Leather or gardener's gloves
26. Flags or other land marking items

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Ziploc<sup>®</sup> is a registered trademark of S.C. Johnson & Son, Inc., Racine, Wisconsin.

### 9.3.5. Conducting a Survey

#### 9.3.5.1 Survey Unit Setup

The recommended maximum area for each outdoor survey unit is 10,000 m<sup>2</sup> and for each indoor survey unit the recommended maximum area is 100 m<sup>2</sup> of floor space. The minimum outdoor survey unit area is a rectangle 8 meters long and 6 meters wide, 48 m<sup>2</sup>. The minimum indoor survey unit area is 10 m<sup>2</sup>.

#### 9.3.5.2 Choosing the Survey Unit

The choice of the survey unit or units depends on the overall military operation. The commander may specify an area that needs to be surveyed. In general, a survey unit must enclose an area that does not vary greatly over that area. For example, a group of survey units could be a warehouse, its parking lot, and an adjacent vacant lot. Generally, the parking lot and vacant lot would not be considered at one survey unit. The survey unit must encompass an area that is suspected to have elevated levels of radiation.. If the area surrounding a potentially contaminated item is to be surveyed, then the survey unit should be centered on the item; for example, a tank damaged by a depleted uranium penetrator. If desired, an additional survey unit can be added downwind if it is suspected that airborne radioactive materials were released. A single room or a group of similar rooms can be a survey unit. The survey unit should be marked and entry should be restricted to the survey team until the survey is done. Once the survey is done, a decision as to who can enter the area can be made.

The following steps should be followed to setup the survey unit. Refer to the datasheet while following these instructions:

7. Encompass the area to be surveyed with a rectangle.
8. Record GPS/Grid coordinates for the points indicated on the datasheet, if available.
9. Record the length and width of the survey unit on the datasheet.
10. Divide the width into 6 equal blocks.
11. Divide the length into 8 equal blocks.
12. Mark the boundaries of and restrict access to the survey unit, if possible.

Note: The survey unit should be divided into 48 square blocks as shown on the datasheet. A GPS is a very useful aid to finding the location of the survey unit and measurement locations, but a GPS is not necessary to perform the assessment.

### **9.4. BACKGROUND MEASUREMENT(S).**

The naturally occurring radiation levels (background) data will be gathered at specified background locations before any survey is begun.

#### 9.5.1 Outdoor Background Measurement

An outdoor background location should be an area well outside the survey unit. Dissimilar survey units must have separate and appropriate background measurements. The background location must have no or a very small chance of being contaminated but is all other ways be similar to the survey unit(s). All sampling locations must be noted on a field map. For this assessment, there will be three (3) background measurement locations. The three (3) locations will be taken at least 10 meters from a point in an uncontaminated area at the 0°, 120°, and 240° compass points. A soil sample, an external gamma exposure rate measurement, and an x-ray probe measurement (if the

probe is available) will be taken at each outdoor location. Indoor locations require only external gamma exposure rate measurements.

#### 9.5.2 Indoor Background Measurement

An indoor background location should be a room made from similar construction materials but well away from the survey unit. If possible, avoid rooms that share ventilation ductwork.

### 9.6 EXTERNAL RADIATION SURVEY (OUTDOORS OR INDOORS).

5. The surveyor will record the external exposure ( $\beta\gamma$ -probe) rate at about one meter (about 3 feet) above the ground.
6. If the x-ray probe is available, x-ray readings will be taken about 10 cm (~4 inches) above the ground.
7. Soil samples (outdoors only), x-ray, and  $\beta\gamma$ -probe measurements will be taken in the center of blocks 1-12.
8. Only  $\beta\gamma$ -probe measurements need to be taken in blocks 13 – 24.

### 9.6. PERSONNEL MONITORING PROCEDURES.

Personnel monitoring is required for people who have been in an area with elevated radiation readings as determined by this survey. Usually a hand and foot frisk survey with the Beta-Gamma pancake probe will satisfactorily meet this criteria. The following is adapted U.S. Department of Health and Human Services (DHHS), *Preparedness and Response in Radiation Accidents*. Food and Drug Administration (FDA), CDRH, August 1983.

14. Find an area with low background and little to no contamination.
15. Select the pancake probe or the probe with the end window open for personnel monitoring.
16. Use the headphones or other audio capabilities of the survey meter. It is easier to detect changes in counting rate by listening, and it allows the user to concentrate on the survey not the meter.
17. Note the background on the meter.
18. The person being monitored should stand straight, feet spread apart, arms extended with the palms straight up, and the fingers straight out.
19. Keep the probe window about 2.5 cm (1 inch) from the surface of the body. Try not to touch the person with the probe.
20. Move the probe about 2.5 cm  $s^{-1}$  over the person: start at the head, survey the front of the person, including the inseam, crotch, and armpits.
21. Survey the outline of the body with special attention to the fingertips.
22. Repeat with the arms and hands turned over.
23. Repeat the survey on the back of the person.
24. As a rule of thumb, any area that registers twice the background should be considered contaminated.
25. Take another background reading, and if it is significantly different from the first reading, resurvey the person.

26. The aim of personnel monitoring is to determine with a reasonable certainty if a person is contaminated. In the event that a person is contaminated, decontamination with soap and water as soon as practicable.

### **9.7. EQUIPMENT SURVEYS.**

An equipment survey is required for an item that may have been in an area with elevated radiation readings as determined by this survey, that may have been damaged by a depleted uranium (DU) penetrator, or contains a broken radioactive commodity. Equipment surveys are judgmental measurements. Because of the complexity and size range of equipment that might be encountered in the field, one generic approach would be too cumbersome to use. For relatively small pieces of equipment, a surface scan will cover the entire surface of the equipment.

6. The ambient background will be measured at 1 meter from the equipment to be surveyed.
7. Verify measured values are in excess of 3 times the background value.
8. If possible, small contaminated items can be bagged and labeled.
9. Larger contaminated items shall be marked as contaminated and shall be cordoned off at a distance of 1 meter.
10. Contaminated items may continue to be used at the discretion of the commander.

### **9.8. SOIL SAMPLING GUIDANCE.**

Detailed guidance on soil sampling, can be found in Section 8, "Soil Sampling".

### **9.9. SAMPLE CONTAINMENT AND MANAGEMENT.**

5. All sample shipping shall be coordinated with the lab (see below) in accordance with guidance contained in Section 2.
6. Disposable gloves and splash protective apparel will be worn when applicable.
7. Samples will be packaged in accordance with Section 2.
8. Samplers and sample containers will be received and shipped according to Section 2.

The addresses for the USACHPPM Directorate of Laboratory Sciences-Main are:

By U.S. Mail:

Commander  
USACHPPM  
ATTN: MCHB-TS-LSM (Sample Mgt Lab)  
5158 Blackhawk Road  
APG, MD 21010-5403

By FedEx, UPS, or other commercial carriers:

CDR, USACHPPM  
ATTN: MCHB-TS-LSM (Sample Mgt Lab)  
5158 Blackhawk Road  
Bldg E2100  
APG, MD 21010-5403

### **9.10. QUALITY ASSURANCE AND QUALITY CONTROL.**

The following steps should be followed to ensure proper quality assurance/quality control (QA/QC) of collected samples and results.

8. Data collection forms and worksheets are provided in the protocols for the surveys.
9. All survey meters will have operational checks performed on them with an appropriate radioactive check source before beginning a survey and periodically during the survey. The results of the operational checks before and after the survey will be recorded on the data sheets.
  - a. If the operational check source readings **are within** 50 percent of the value on the calibration sheet, the survey can continue.
  - b. If the readings **are not within** 50 percent, take another 2 readings. If **both** of these extra readings are within 50 percent of the value on the calibration sheet, continue with the survey. If either of these additional readings **is not within** 50 percent, stop the survey and get a new instrument.
10. One collocated soil sample will be taken within one meter (~3 feet) of the sampling location in block 1 of the survey unit. This soil sample must be labeled as a QC sample.
11. An external exposure rate measurement will be repeated at the end of the survey in block 1 of the survey unit. The meter reading will be recorded as G2 in block 1 of the survey unit.
12. If the x-ray probe is available, a second reading will be recorded as X2 in block 2 of the survey unit.
13. The survey data will be reviewed for anomalies and completeness by the officer-in-charge (OIC) or the noncommissioned officer-in-charge (NCOIC) at the end of each survey.
14. A health physicist will be contacted early in the process.

#### **9.19 LABORATORY ANALYSES.**

All laboratory analyses will be coordinated with USACHPPM, Directorate of Laboratory Services (DLS), Radiologic, Classic, and Clinical Chemistry Division (RCCCD). The following steps should be followed to ensure proper analysis of samples.

4. The initial analyses of the soil samples will be a gross  $\alpha\beta$ -activity measurement (DLS Test Code: 765) and a qualitative gamma spectroscopy measurement (A 100 minute counting interval is recommended; DLS Test Code: 815).
5. The samples will be analyzed in accordance with USACHPPM, RCCCD protocols and procedures to meet the survey plan DQOs.
6. All samples submitted to the RCCCD will be controlled in accordance with the laboratory's chain of custody protocol.

#### **9.20 DATA INTERPRETATION.**

The final interpretation and recommendations will be made with the advice of personnel trained in radiation safety. To interpret the laboratory results, the following information must be available to the radiation safety officer.

4. Survey checklists and Data Sheets (Appendix 9-1).
5. Copies of all paperwork will accompany the samples to the lab.
6. Copies of all paperwork will be sent to USACHPPM-Main, Health Physics Program (HPP).

#### **9.21 DOCUMENT HANDLING.**

Once the data interpretation and communication are done, all the associated paperwork shall be preserved and archived. Tentatively, this archive is planned for the HPP at USACHPPM-Main.

### **9.22 PERSONNEL DECONTAMINATION.**

Many times when working with or around radioactive materials, despite the best efforts, individuals will get contaminated. In the vast majority of the cases, the contamination is minor. Clothing that is contaminated should be removed and stored in suitable containers (e.g., plastic bags) until either the radioactivity has decayed to an acceptable level or the clothing is washed or disposed of through the appropriate channels. If the skin is contaminated, then decontamination is needed.

There should be a special decontamination location set up near the survey area. To decontaminate a person, you must first locate the areas that are contaminated. The person must be resurveyed carefully and the areas that are contaminated must be noted. Then when decontaminating the person, start with the mildest measures and move to stronger measures if the contamination is difficult to remove. Also, take care that you don't break the skin or cause reddening. This could introduce contamination into the bloodstream.

Keep in mind that during decontamination you want to minimize the spread of contamination. You don't want to get contaminated yourself! For example, wear gloves and coveralls, if needed, and work from the edges of the contaminated area toward the center.

Simple decontamination procedures listed from mildest to strongest are listed below. This is not a comprehensive list—

8. Lifting off with tape.
9. Flushing with water.
10. Washing with soap and warm water.
11. Washing with a mild abrasive soap, soft brush, and warm water.
12. Washing with a detergent.
13. Washing with a complexing agent.
14. Washing with a mild organic acid.

After each decontamination attempt, the area and its surroundings must be resurveyed until the contamination level is acceptable. Also, the area in the decontamination location near the person should be surveyed to ensure that contamination has not spread.

### **9.23 SURVEY UNITS LESS THAN THE PRESCRIBED MINIMUM AREA.**

If the survey unit is less than 48 m<sup>2</sup> for an outdoor unit or 10 m<sup>2</sup> for an indoor unit, then you will alert a health physicist and initiate an external gamma scan of the area (and an x-ray scan, if the probe is available). For the external gamma exposure rate scan, the  $\beta\gamma$ -probe will be held about 1 meter above the ground (or floor) and the surveyor will walk slowly, about 0.5 m s<sup>-1</sup>. The x-ray probe will be held about 10 cm above the ground for the scanning measurements.

### **9.24 FIELD ASSESSMENT(S).**

3. Determine the Radiation Exposure Status (RES) category or mission duration to meet the Operational Exposure Guidance (OEG) determined by the commander. See Appendix 9-1.

4. Determine if the Level 1 survey is adequate to estimate the upper limit on the radiation exposure to personnel.

### **9.25 SURVEY SCOPE.**

A radiation survey at this level is designed to answer simple questions in a timely manner with minimal information. The information can be gathered from intelligence data and from the survey itself. What are the external exposure rates both indoors and outdoors? Is contaminated equipment present? Is there historical or intelligence information available? Is the mission duration or the OEG specified?

### **9.26 BOUNDARIES OF THE SURVEY.**

#### 9.26.1 Spatial Boundaries

The recommended maximum area for an outdoor survey is 10,000 m<sup>2</sup> (roughly a little larger than 2 football fields) and 100 m<sup>2</sup> (roughly a 30' x 30' floor area) for each indoor survey unit. These areas were chosen as a compromise between the time and personnel constraints on doing a survey and greatly increasing the chance of missing significant radiological exposures.

For any assessment, more than one type of survey unit may be present; for example, the entire assessment may require a survey of an open field, a paved parking lot, and the interior of a warehouse. Each of these areas would be treated as separate survey units, unless circumstances dictate otherwise. Furthermore, each of these survey units need a matching background survey unit of similar makeup.

#### 9.26.2 Temporal Boundaries

This survey/assessment is designed for missions lasting up to 180 days.

The results of the survey and the conclusions are expected within 24 hours of completing the survey. In reality, the results and conclusions should be available in much less than 24 hours.

#### 9.26.3 Interpreting and Reporting the Results in the Field (See Appendix 9-1)

The field results should be discussed with personnel knowledgeable in radiation protection. The discussions should be made with the primary purpose of relaying the results and recommendations to the commander in a useful manner. The table in the next section is a listing of recommended actions for radiation exposures that result in different RES categories

### **9.20. References**

5. Nuclear Regulatory Commission, (NUREG) 1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), June 2001.
6. U.S. Army Center for Health Promotion and Preventive Medicine TG 236A, *Basic Radiological Dose Estimation – A Field Guide (Draft)*, June 2000.
7. U.S. Army Environmental Health Agency TG 155, *Environmental Sampling Guide*, February 1993.
8. Department of Health and Human Services (DHHS), *Preparedness and Response in Radiation Accidents*. Food and Drug Administration, CDRH, August 1983.



**Appendix 9-2**  
**Sample Labels**

Field ID#:  
Project #:  
Site Name:  
Collector's Initials:  
Project Officer:  
Collection Date/Time:  
DLS Analyses Codes: 765, 815

Field ID#:  
Project #:  
Site Name:  
Collector's Initials:  
Project Officer:  
Collection Date/Time:  
DLS Analyses Codes: 765, 815

Field ID#:  
Project #:  
Site Name:  
Collector's Initials:  
Project Officer:  
Collection Date/Time:  
DLS Analyses Codes: 765, 815

Field ID#:  
Project #:  
Site Name:  
Collector's Initials:  
Project Officer:  
Collection Date/Time:  
DLS Analyses Codes: 765, 815

Field ID#:  
Project #:  
Site Name:  
Collector's Initials:  
Project Officer:  
Collection Date/Time:  
DLS Analyses Codes: 765, 815

Field ID#:  
Project #:  
Site Name:  
Collector's Initials:  
Project Officer:  
Collection Date/Time:  
DLS Analyses Codes: 765, 815

Field ID#:  
Project #:  
Site Name:  
Collector's Initials:  
Project Officer:  
Collection Date/Time:  
DLS Analyses Codes: 765, 815

Field ID#:  
Project #:  
Site Name:  
Collector's Initials:  
Project Officer:  
Collection Date/Time:  
DLS Analyses Codes: 765, 815

Field ID#:  
Project #:  
Site Name:  
Collector's Initials:  
Project Officer:  
Collection Date/Time:  
DLS Analyses Codes: 765, 815

Field ID#:  
Project #:  
Site Name:  
Collector's Initials:  
Project Officer:  
Collection Date/Time:  
DLS Analyses Codes: 765, 815

**Appendix 9-3**  
**Summary of the AN/PDR-77 and the VDR-2**  
**RADIAC Meters**

**9-3.1 Summary of the AN/PDR-77 and its uses**

The AN/PDR-77 Radiac Set is a set of portable radiation detection equipment for detecting alpha, beta, x, and gamma radiation. The basic instrumentation includes: a scaler/ratemeter, an alpha scintillator (ZnS), a [energy compensated] pair of GM tubes, and an x-ray detector (a thin NaI detector) . The accessory kit (RPO kit) contains a pancake GM tube and a “μR meter” (1” x 1.5” NaI) detector.

The scaler/ratemeter can detect the probe attached and automatically sets the correct operating characteristics. Because each probe is calibrated with a particular unit, only under extreme circumstances should a probe be used with a unit other than the one it was calibrated with. The control unit is a digital read-out meter that is self-scaling. This meter automatically recognizes the probe attached and adjusts the read-out units and calibration parameters applicable for each probe. The meter uses three 9V batteries as a power source<sup>1</sup>. Tabel 9-3-1 lists the front panel components of this meter and their respective functions.

**Table 9-3-1. Front panel controls of the AN/PDR-77 scaler/ratemeter**

Panel controls from left to right	Function
PWR (switch)	Toggle switch turns power on (up) and off (down).
CLR/TEST <input type="checkbox"/> (push button)	If depressed and held, it activates the operating self-test. It changes settings when used with other buttons.
UPDATE TIME <input type="checkbox"/> (push button)	Pressing this button will display the count time interval. Display will show either a 1" or 2" indicating display update time; reading is displayed every second or every 2 seconds.  Holding this button and depressing the CLR/TEST button will change and update the time.
BKND SUB	This button also subtracts background from indicated display readings. Depressing while turning the instrument on will initiate a background count that will be subtracted from all readings until the instrument is turned off.
ALARM (push button)	This button is used in setting alarm set points. Depressing while the instrument is on will display the current alarm setting. Changing the setting is done by depressing and holding this ALARM button and depressing the CLR/TEST button simultaneously. When display begins to flash, release both buttons. If the CLR/TEST button is depressed again the decimal point, k and arrows will begin to flash. If the CLR/TEST button is depressed again, the first digit will begin to flash. This value can now be increased by depressing the ALARM button. Once the desired value for the first digit is obtained, one can depress and release the CLR/TEST button. This will activate the second digit, which can now be changed by depressing the alarm button. The process can continue until the desired alarm value is reached. Once finished, one can depress the CLR/TEST button to return the instrument to the ratemeter mode.

<sup>1</sup> The typical lifetime of these batteries is approximately 100 hours. After the low-battery warning is triggered, there are approximately 5 operational hours left.

Panel controls from left to right	Function
SCALER	<p>The scaler accumulates the total counts for a predetermined time. By depressing this button while turning the instrument on, one will access the scaler mode. This mode allows for count time from 0.1 to 20.9 minutes or will allow for a continuous count until it is manually terminated. Pressing and holding the CLR/TEST button clears the previous reading and begins a new count sequence. To view the preset count time one needs to depress and hold the ALARM button. To change the preset count time, one needs to press and release the CLR/TEST button while depressing the SCALER button. This adjusts the minute value. Then, one needs to press and release the UPDATE TIME button while depressing the SCALER button. This adjusts the tenths of a minute value.</p> <p>By setting the time to 0.0 value, the instrument will set a continuous count time that must be stopped manually.</p> <p>By depressing the SCALER button during a scaler count the instrument will display the preset count time. If pressed while depressing the UPDATE TIME button, it will display the elapsed count time.</p>
FILTER (push button)	<p>The filter converts indicated readings to average readings. By depressing this button while the instrument is on, it will display the filter status. A display of 1" indicates that the filter is active while a display of 2" indicates the filter is off. The filter in the active position will display average readings while the filter in the off position will display raw readings.</p> <p>For all probes except the alpha probe, it is recommend to have the filter in the <input type="checkbox"/> active <input type="checkbox"/> position. To change its status, one needs to depress and release the CLR/TEST button while holding down the FILTER button.</p>
<input type="checkbox"/> SET <input type="checkbox"/> or "AGE"	<p>This is only used with the x-ray probe in the uCi/m<sup>2</sup> mode. Depressing this button and holding it while turning on the instrument will allow the operator to view and change the weapon age data. After instrument is on, a 01" is displayed and a flashing digit follows it. This digit is the tens place of the weapons age. Successively pressing the AGE button will change the digit from 0 - 6. Pressing the CLR/TEST button will display a 02" and a flashing digit representing the ones place of the weapons age. Pressing CLR/TEST button again will display a 03" and a flashing digit that represents the tenths place of the weapons age. The only acceptable choices here are a 0 or a 5. All ages should be rounded to the nearest of a year. Once age is set, pressing CLR/TEST will place the instrument back into the ratemeter mode.</p>
LIGHT (switch)	<p>This is an on/off toggle switch that turns display light on or off. The light intensity is not very bright; in daylight conditions the light may not be visible. The light should only be left on when needed as it drastically increases the battery use.</p>

Panel controls from left to right	Function
<p>CHIRP/ALARM (switch)</p>	<p>This switch is used to change audible settings for the instrument.</p> <p>In the CHIRP (up/top) position the instrument will make a chirping sound indicative of the count rate.</p> <p>In the VIS (center) position all meter functions must be visualized on the front panel. Both CHIRP and Audible alarm are disabled.</p> <p>In the AUD/VIS (down/bottom) position the trend lights are illuminated and the audible and visual indicator alarms operate when alarm set point is exceeded. This signal will automatically shut off when the reading drops below the alarm value.</p>
<p>TREND (lights)</p>	<p>These are dual-purpose trend lights located on each side of the word TREND. They illuminate when a statistically significant change in the count rate has occurred. The light on the left will illuminate if the trend is downward and the light on the right will illuminate if the trend is upward.</p>

**AN/PDR-77 instrument selection**

Radionuclide	Search	Large Area Survey	Shipping Container Survey	Hotline Monitoring
<sup>63</sup> Ni	β	β	Must do a wipe test	β
<sup>99</sup> Tc	β	β	β	β
<sup>90</sup> Sr/ <sup>90</sup> Y	β	β	β	β
<sup>239</sup> Pu	X-ray	X-ray	α	α
<sup>241</sup> Am	X-ray	X-ray	α	α
DU	X-ray	X-ray	β	β
<sup>137</sup> Cs	μR	μR	β/γ	μR
<sup>60</sup> Co	μR	μR	β/γ	μR
Where: α=	Alpha (ZnS) probe (ADK-77-α);	β/γ =	Beta/Gamma probe (GM/VDR probe);	
β =	Beta pancake probe (RPO-β);	μR =	micro-R probe (NaI) (RPO-NaI); and,	
		X-ray =	5" low energy x-ray probe.	

**9-3.1.1 β/γ probe (GM/VDR-2)**

Routine external radiation surveys can be appropriately done using the β/γ probe. This probe is to be used for external dose rate measurements and locating sources of radiation. According to the draft User’s Guide, “for routine surveying, the best accuracy in the ratemeter mode is obtained in the filtered mode with a 2 second update time.” The filter takes the count rate from the current update time and averages it over the previous 32 update periods. In the unfiltered mode, the counting rate determined over the current update period is displayed with no averaging over previous update periods.

In effect, filtered data displays a running average of the past 32 measurements. This averaging smoothes out the statistical fluctuations in the dose rate data, but it also smoothes out real fluctuations. It is similar to choosing a longer time constant on an analog meter. For routine external gamma ray surveys, filtering is fine, but a soldier may miss a small hot spot of radioactive material in filtered mode. With proper training either mode can be used well.

The β/γ probe has an end shield that can be lifted for beta dose measurements, but according to the Production Qualification Test report (PQT), this capability is not accurate. Furthermore, the requirement that the detector be able to quantify beta dose has been dropped by the chemical school. However, if needed, the end shield can be lifted for beta surface contamination surveys. If even more sensitivity is needed, then the thick end window (under the moveable shield) can be removed for contamination surveys. In this case, the user must then be extremely careful not to break the very thin window of the GM tube itself. Figures 3.6 and 3.7 are a picture of the beta/gamma probe and a representation of its components respectively.

**9-3.1.2 Alpha Probe**

The AN/PDR-77 alpha probe is a 100 cm<sup>2</sup> zinc sulfide (ZnS) scintillation detector. The probe has a scintillator air coupled to a photomultiplier tube (PMT), which is protected from light by a two-

layer aluminized Mylar window. The probe can have read outs in CPM,  $\mu\text{Ci m}^{-2}$ , or DPM  $100 \text{ cm}^{-2}$ . A typical minimum detectable activity (MDA) for the alpha probe is approximately 15 dpm.

The user’s manual states that the  $2\pi$  efficiency of the alpha probe corresponds to about 42 percent; however it is important to notice that the data in the PQT reflects that the average efficiency for its 10 tested probes was about 46%, with a range of 38 percent to 51 percent. The alpha probe can be used to determine and assess the extent of alpha contamination. Being a hand held device, however, makes large area surveys impossible. This probe’s usefulness is limited to personnel and equipment surveys and can be also used for counting filters for suspected alpha contamination.

**9-3.1.3 The X-ray Probe**

The X-ray probe is a large area thin NaI crystal set up with 2 energy windows designed to detect x-rays emitted by  $^{241}\text{Am}$ . As such, it is designed for Pu detection, and weapons grade  $^{239}\text{Pu}$  in particular. As an added benefit, the probe can detect the x-rays and gamma rays emitted by U. The x-ray probe can be used as a survey meter to detect the presence of U, Pu, or any photon emitting isotope.

The x-ray probe has a 5” x 0.25” sodium iodide scintillation crystal and a 2” PMT. Its sensitivity is reported to be approximately  $1\mu\text{Ci/m}^2$  for  $^{239}\text{Pu}$ . The probe was designed to be used at nuclear weapon accident scenarios. Therefore, the conversion from counting rate to activity per unit area is for use with weapons grade Pu and requires knowing the age of the weapon. Table 9-3-3 includes the active energy window for each energy setting for the x-ray probe.

**9-3.1.4 Pancake Probe**

The pancake probe is a GM detector with a  $2 \text{ mg cm}^{-2}$  thick window. This window effectively blocks all beta particles that reach the window with energies less than about 35 keV and alpha particles of about 4 MeV. Typical beta efficiencies as taken from the User’s Guide are in the table 9-3-2.

**Table 9-3-3. Typical pancake probe efficiencies**

Nuclide	Maximum $\beta$ Energy (keV)	Average $\beta$ Energy (keV)	$2\pi$ Efficiency (%)
$^3\text{H}$	18.6	5.7	-
$^{63}\text{Ni}$	66	17	0.03
$^{14}\text{C}$	156	49	0.6
$^{99}\text{Tc}$	294	85	24.0
$^{90}\text{Sr}/^{90}\text{Y}$	546 / 2300	196 / 935	40.5

Protactinium-234m, a radioactive decay product of  $^{234}\text{Th}$  in the  $^{238}\text{U}$  decay series, emits a 2.28 MeV (maximum energy)  $\beta$  quite close in energy to  $^{90}\text{Y}$ . It takes about 8 months for equilibrium between  $^{238}\text{U}$  and its immediate progeny. Therefore, the pancake probe should have no difficulty in detecting DU and can be recommended as the best choice for its detection. Monitoring for low energy beta emitters such as  $^3\text{H}$  and  $^{63}\text{Ni}$  require more sophisticated instrumentation and methods.

The pancake probe reported gamma sensitivity for  $^{137}\text{Cs}$  is 2,200 cpm/mr/hr. Under most circumstances, the  $\beta$ -pancake probe will be adequate for contamination surveys, but under no circumstances should it be used for external dose rate measurements.

### **9-3.1.5 $\mu\text{R}$ probe**

The microR ( $\mu\text{R}$ ) probe is included in the radiation protection officer extension kit only. This probe has a 1" x 1.5" sodium iodine (NaI) crystal with a 1" PMT. Although the probe can be used for external gamma dose rate measurements, the response is very dependent on photon energy and this dependence must be taken into account for accurate dose estimates. That is, the user must know the energy to be able to convert cpm to  $\mu\text{R}/\text{hr}$ . The sensitivity of this detector to  $^{137}\text{Cs}$  is approximately 122 cpm/ $\mu\text{rad}/\text{hr}$ . The detector is about 20 times more efficient at 63 keV than at 662 keV. Because of its high sensitivity, the  $\mu\text{R}$  probe can be used as a radiation detector (not a dose meter) to search for radiation sources.

### **9-3.2 AN/PDR-77 preferred uses and disadvantages**

The AN/PDR usage preference is listed below:

1. For basic external radiation surveys the  $\beta/\gamma$  probe is adequate. The  $\beta/\gamma$  probe comes calibrated by manufacturer, so that these instruments should be checked against known radiation fields.

The ACE directive requires all radiological dose rate monitors to be able to measure  $0.1 \text{ mR h}^{-1}$  and the radiological hazard area as  $0.2 \text{ mR h}^{-1}$ . The sensitivity of the low range  $\beta/\gamma$  probe is about  $30 \text{ c s}^{-1} \text{ mR}^{-1} \text{ h}$ ; therefore, for  $0.1 \text{ mR h}^{-1}$  the corresponding counting rate is about 180 counts per minute. This counting rate would result in an uncertainty of about 10 percent for a one-minute count. According to the PQT, the best engineering judgment is that the probes are accurate to within 20 percent. However, at low levels the precision is poor.

2. For basic surface contamination surveys, the  $\beta$ -pancake probe and alpha probe are adequate. According to the AN/PDR-77 draft User's Manual, the pancake probe was determined to be the best probe for measuring DU. The response of this probe to alpha, beta, and gamma radiation of various energies from point and extended sources should be evaluated. Estimates of the background counting rates and variances should be made so that minimum detectable activities can be estimated.

The presence of alpha contamination can be determined with the pancake probe by putting a piece of thin cardboard between the source and the detector. However, the amount of alpha contamination cannot be quantified, for this you need the alpha probe. The alpha probe should be calibrated for both point and extended sources of contamination. Estimates of the background counting rates and variances should be made so that minimum detectable activities can be calculated.

3. For large area surveys, especially for Pu and U, the x-ray detector is the detector of choice.
4. For alpha contamination surveys over equipment or personnel, the alpha probe is the probe of choice.

It is just as important to know the preferred uses of the AN/PDR-77 as its disadvantages when chosen as a radiation field instrument. The following are some of the disadvantages that can be related to the AN/PDR-77 and its capability for usage in the field:

1. The AN/PDR-77 and RPO kit do not have neutron measuring capabilities
2. There is no accurate beta dose rate measuring capability; and,
3. Environmental external dose rates are expected to be imprecise and difficult to Measure.
4. The documentation surrounding the AN/PDR-77 often uses CPM as an activity unit. The use of CPM as an unit of activity should be avoided.

**9-3.3 Arrival Checkout**

Upon arrival of a calibrated AN/PDR-77 unit, it is recommended to collect the information in the following form:

**Arrival Checkout and Preoperational Test**

Date: \_\_\_\_\_

Time: \_\_\_\_\_

Alpha Probe SN: \_\_\_\_\_

Beta/ Gamma Probe SN: \_\_\_\_\_

X-ray Probe SN: \_\_\_\_\_

AN/PDR Radiac SN: \_\_\_\_\_

Checkout performed by: \_\_\_\_\_

**AN/PDR-77**

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>

Carrying Case Inspection: Is the case free of obvious damage and is the case in proper working order?

All probes present?

Radiac Meter Inspection: Is the meter free of obvious damage?

Alpha Probe Inspection: Is the probe free of obvious damage?

Beta/Gamma Probe Inspection: Is the probe free of obvious damage?

X-ray Probe Inspection: Is the probe free of obvious damage?

**RPO Kit**

Pancake Probe SN: \_\_\_\_\_

“micro R” Probe SN: \_\_\_\_\_

Yes	No
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

Are the pancake probe and “micro R” probe present?

Pancake Probe Inspection: Is the probe free of obvious damage?

“micro R” Probe Inspection: Is the probe free of obvious damage?

**Preoperational Test**

9-3-9

If the unit passes the preoperational test in the Technical Manual, the unit is ready for use.

If the unit fails the test, then notify your supervisor.

**9-3.6 References**

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2. USACHPPM TG No. 155, *Environmental Sampling Guide*.
3. USACHPPM TG No. 214, *DLS Customer Service Manual*.
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5. USACHPPM TG No.238, *Radiological sources of Potential Exposure and /or Contamination*.
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