FIELD SAMPLING HAZARDS

1.0 INTRODUCTION

Field inspection and sampling represent one of the largest responsibilities of field personnel. Personnel who perform these activities will be confronted with many different types of work environments, each with its own associated hazards. Although some of these hazards will be unique to a given site, many hazards are common to a particular type of site (e.g., water treatment plants or mines) or to field work in general.

Learning Objective
At the end of this module, you will be able to:

- Identify the hazards associated with different types of inspections and samplings
- Provide information on how to reduce the risks of those hazards.

2.0 HAZARDS OF THE SAMPLING ENVIRONMENT

Hazards of the sampling environment are those created by everyday operating procedures and the sampling location.

2.1 Hazards Created by Everyday Operating Procedures

Examples of hazards created by everyday operating procedures are as follows:

- Vehicle operation
- Noise
- Thermal hazards
- Flammable materials
- Toxic materials.

Refer to the following modules for detailed information on these hazards: “Vehicle Safety;” “Occupational Noise;” and “Chemical Hazards and Reactions.”

2.2 Hazards Created by the Sampling Location

Examples of hazards created by the sampling location are as follows:

- Significant height
- Weather conditions
- Higher exposures to chemical and thermal hazards
- Remote areas
- Natural hazards.

Refer to “Natural Hazards” for more detailed information concerning these hazards.

3.0 HAZARDS OF THE SAMPLING PROCESS

Hazards of the sampling process are those created by the equipment, procedures, and materials used to collect the samples.

3.1 Sampling Equipment

Preventing injuries caused by using field sampling equipment (or damage to the equipment) may be complicated by the fact that field equipment can be specialized and less likely to have been evaluated for safety hazards than if it were a widely used consumer product.

Field sampling equipment may have unusual design and operating features, and there may be no established written procedures for safe operation of the equipment.

Equipment to collect and contain hazardous samples should be:

- Disposable or easily decontaminated
- Inexpensive
- Easy to operate
- Non-reactive
- Safe to use.

Because hazardous substances could be complex mixtures of semisolids, liquids, or solids, the viscosity, corrosivity, volatility, explosiveness, and flammability could vary greatly.

Table 1 presents a summary of sampling equipment for hazardous materials.

Table 1: Sampling Equipment for Hazardous Materials

SAMPLER	APPLICATIONS	LIMITATIONS	POTENTIAL HAZARDS
Open-tube/ COLIWASA	Liquids, slurries	Not for containers over 1.5 m (5 ft) deep	Single hand use, contamination, breakage of glass, splash, drum hazards
Plastic	Not for materials: nitrobenzene, methyformaldehydemesityl oxide, tetrahydrofuran, or many common solvents such as acetone		
Glass	Not for materials containing hydrofluoric acid and concentrated alkali solutions		

	COLIWASA may be difficult to decontaminate and may cause cross-contamination of samples		
Pond (dip) sampler	Liquids, sludges	Not for sampling beyond 3.5 m (11.5 ft)	Single or two hand use, utilized near water, splash, contamination, incompatibility
Manual pump	Liquids	Requires large amounts of disposable tubing that must be compatible with material	Single or two hand use, splash, contamination, incompatibility
Weighted bottle samples	Liquids	Difficult to use with very viscous liquids. Exterior of sample bottle exposed to hazardous materials	Single or two hand use, splash, contamination, incompatibility
Gain sampler	Granular solids	Limited application for sampling moist and sticky solids with a diameter of 0.6 cm (1/4 in)	Single hand use, contamination, incompatibility
Sampling trier	Solids	Possible difficulty in retaining core sample of very dry granular materials during sampling	Single hand use, contamination, incompatibility
Trowel/scoop/spoon	Solids, soil surface	Not for sampling deeper than 8 cm (3 in). Difficult to obtain reproducible mass of samples	Single hand use, contamination, incompatibility
Waste pile	Loose solids	Not for sampling solid wastes with dimensions greater than half the diameter of the sampling tube	Single hand use, contamination, incompatibility
Soli auger (manual)	Soil deeper than 102-126 cm (3-4 in)	Does not collect undisturbed core sample	Two hand use, backstrain, contamination

3.1.1 Solids

Following are examples of sampling equipment used to collect solids:

- Grain sampler
- Sampling trier
- Waste pile sampler
- Trowel/scoop/spoon
- Soil auger (manual).

3.1.2 Liquids

Following are examples of sampling equipment for liquids:

- Open-tube/drum sampler
- Composite liquid waste sampler (COLIWASA)
- Pond (Dip) sampler
- Manual pumps
- Weighted bottle sampler.

3.1.3 General Safety Considerations

Following are some safety considerations for sampling equipment use:

- The manufacturers of sampling equipment usually provide detailed instructions as to procedures for safe setup and operation. It should become common practice to thoroughly read these instructions before attempting to use the equipment.

- Before going into the field, field personnel should familiarize themselves with the operation of sampling equipment and should perform routine checks and calibration, if necessary, to ensure that the equipment is working properly.

- Personnel should also practice with the equipment prior to use, utilizing the designated level of PPE.

- Where significant hazards are associated with a particular instrument, they should be noted on the outside of the equipment and/or carrying cases.

- When choosing sampling equipment, it is essential to know the type of hazardous environment in which it will be used.

Other potential hazards to be evaluated during sampling equipment use include:

- **Mechanical Hazards**. Moving parts may present mechanical hazards, with a potential for crushing, cutting, burning, bruising, or severing body parts. For instance, moving parts on drill rigs can throw rocks and/or debris. Safety glasses should be used around drills, particularly when holes are being "started."

- **Lifting Objects**. Proper lifting techniques can prevent painful back injuries. Remember to keep your back straight, lift with your legs, and keep the load close to the body. When moving a lifted load, turn with your whole body, starting with your feet, and do not turn with the waist.

- **Weight and Momentum**. This must also be evaluated, particularly while using heavy objects. For example, once a full drum is put in motion, it is difficult to stop. Never place your body beneath elevated equipment or machinery, particularly your hands

and feet. In addition, wheel chocks should be used when parking on inclines. Heavy equipment should not be placed on elevated areas that pose a fall hazard.

- **Climbing**. When climbing is necessary, look closely at the condition of ladders and stairs before using them. Ensure that they will carry your weight and whether any precautions are necessary. Remember that three points of contact with your feet and hands while climbing ladders is the safest method.

- **Sharp Edges**. Care must be exercised when working with sharp edges. Broken glass or tools can easily cut the skin and sometimes even Kevlar-type (cut-resistant) gloves. Metallic 55-gallon drums are notorious for having "burrs" (sharp edges) around the lids. Gloves should be worn whenever handling them.

- **Electrical Hazards**. Electrically powered equipment should be used with caution. Be aware if the power cord or electrical insulation is damaged. Avoid contact with any surfaces that may be "hot" or energized. Do not use three-pronged (grounded) electrical plugs with a two-pronged (not grounded) circuit. Lastly, ducting and/or gas streams need to be evaluated when testing static or velocity pressures with a "Pitot" tube. Electrical charges may accumulate (especially in fiberglass ducting) and shock you (electrical discharge). This can be particularly troublesome when climbing or in potentially explosive atmospheres.

3.2 Sampling Materials

Hazardous chemicals are frequently used in field sampling activities. Some chemicals may be used as:

- Preservatives for samples that will be analyzed in the laboratory (e.g., acids)
- Analytical reagents for field testing (e.g., standards)
- For cleaning or decontaminating sample containers or sample equipment.

The health and safety hazards of chemicals or solvents to be used for field sampling should be identified before they are taken into the field, so that they can be transported and used safely and so that the waste can be disposed of properly. MSDSs for hazardous chemicals should always be brought to the job site. Whenever possible, drop ship sampling chemicals to the job site.

3.2.1 Compressed Gases

Compressed gas cylinders are frequently used for calibrating and operating analytical equipment. In addition, self-contained breathing apparatus (SCBA) air tanks could be brought to the field. These tanks can present a multitude of hazards:

- Empty tanks can still be heavy and [due to their elongated shape], easily tipped over.
- Never move or transport a cylinder without removing any regulators and ensuring that the protective threaded cap or top is in place.

- When transporting the cylinder or when setting the tank up for use, securely chain or fasten the cylinder in an upright position to prevent shifting or falling over.
- Always check cylinders for pitting, corrosion, and rusting.
- Never add adaptors or other gear to a regulator to make equipment fit.
- Never use oil or petroleum products on fittings.
- The direction of the threads on tanks is often reversed from the normal directions used in common equipment.
- Always ensure that cylinders are properly labeled and secured prior to shipment. Ensure that shipping papers are properly completed, placards are provided (if needed), and personnel mobilizing cylinders to the field are DOT trained.

3.2.2 Reagents

Sampling procedures often require the use of chemical reagents. Safety considerations for use of chemical reagents include:

- Reagent bottles should be packed in absorbent, cushioning material to prevent bumping and leakage.
- Labels for reagents should be made of indelible material and care should be taken to separate incompatible chemicals.
- Standard Operating Procedures outlining test procedures as well as sampling hazards and chemical incompatibilities should be included with testing chemicals.
- MSDSs should always be available.
- Shipping papers should be completed.
- Once onsite, reagents should be properly stored (e.g., in a flammable storage cabinet).

3.3 Sample Collection and Packaging

Sampling is the physical collection of a representative portion of the environment. To be representative, a sample must be collected and handled by means that will preserve its original physical form and chemical composition, as well as prevent contamination or changes in concentration of the materials to be analyzed.

Samples are taken to determine the following:

- Compliance with existing regulations
- Presence or absence of a particular compound
- Extent of dispersion
- Effectiveness of decontamination
- Suitability for recovery or recycling
- Adequacy of worker protection
- Potential public health hazard
- Compatibility of the materials in question.

It is important to determine the specific purpose of collecting the sample because it will dictate many of the subsequent choices of:

- Methodology
- Sampling sites
- Types and numbers of samples required
- Proper sample containers.

The following factors must also be taken into consideration because they can influence the sampling plan development process:

- Topographic, geologic, and hydrologic characteristics of the site
- Meteorologic conditions
- Flora and fauna of the area
- Geographic and demographic information
- Physical properties and hazardous characteristics of material involved.

The sampling plan should also address health and safety concerns of the sampling effort.

27.3.3.1 Sampling Team (Buddy System)

The sampling team (two or more), which is an essential safety feature of the sampling regime, should operate using the buddy system. This involves:

- Walking side by side
- Maintaining visual contact
- Periodically checking each other's protective equipment
- Maintaining open communications (e.g., direct verbal, two-way radio).

3.3.2 Collection Methodology

The collection of representative hazardous or environmental samples can be accomplished by taking either of the following types of samples:

- Grab
- Composite (Batch).

The locations of sampling sites are influenced by the objectives of the study. Exact locations should be chosen considering the factors that can influence the concentrations and the dispersion of the material of concern. Occasionally, a sampling scheme incorporating both judgement and random sampling is used.

The appropriate number of samples to be collected at a particular site or incident is dependent upon a variety of factors, including:

- The degree of accuracy desired
- The spatial and temporal variability of the media to be sampled
- The cost of collecting and analyzing the samples.

The laboratory analyzing the samples should be consulted before the samples are collected to ensure that the laboratory's analytical needs are met and that the appropriate number and types of samples are taken for a good quality assurance/quality control (QA/QC) program.

The analyses to be done may require specific sample handling and preservation procedures and also may require specific sample container types, volumes, and numbers.

The following types of samples are commonly taken to maintain an adequate quality assurance program in such instances:

- Duplicate samples
- Split samples
- Spiked samples
- Reproducible check
- Blank samples.

At present, there are numerous accepted standardized methods for collecting environmental samples.

The main safety concerns associated with collecting samples include:

- Splashes
- Containment
- Incompatibilities
- PPE failure
- Broken sample containers.

Other safety concerns relate to the field sampling operation and the site access method such as:

- Excavations or test pits - confined space
- Smoke stack - cherry picker
- Lagoons, rivers, creeks - boats, barges
- Drill rigs - plywood access walkouts.

3.3.3 Documentation and Chain-of-Custody

All information pertinent to field activities, including sampling, must be recorded in various forms:

- Logbooks
- Sample tags
- Photographs.

Proper documentation and document control are crucial to enforcement actions, because the government's case in a formal hearing or criminal prosecution often hinges on evidence gathered by others.

The purpose of document control is to assure that all documents for a specific project are accounted for when the project is completed. Accountable documents include items such as:

- Logbooks
- Field data records
- Correspondence
- Sample tags
- Graphs
- Chain-of-custody records
- Analytical records
- Photos.

Each document should bear a serial number and should be listed, with the number, in a project document inventory assembled at the project's completion. Waterproof ink must be used in recording all data in documents bearing serial numbers.

3.3.4 Sample Packaging Requirements

Samples collected at a site should be classified as either environmental or hazardous material (or waste) samples.

A distinction must be made between the two types of samples in order to:
- Determine appropriate procedures for transportation of samples
- Protect the health and safety of laboratory personnel receiving the samples.

3.3.5 Decontamination of Containers and Equipment

When it is necessary to re-use containers or equipment for sampling, decontamination procedures must be considered to prevent cross-contamination. When reuse is necessary, then procedures for cleaning should be provided in the SOP and approved by QA/QC staff. The following general guidelines represent good decontamination procedures which, when used, will aid in precluding cross contamination of samples. After use, equipment must be washed with warm detergent solution, rinsed several times with tap water, rinsed with distilled water, and drained of excess water. Equipment must then be air dried; dried with a stream of warm, dry air; or wiped dry. Samplers used on petroleum products and oil residues may first have to be wiped with absorbent cloth to eliminate the residues. The equipment should then be rinsed with an organic solvent (e.g., hexane), washed with detergent solution, and rinsed with water.

4.0 PERSONAL PROTECTIVE AND EMERGENCY EQUIPMENT

Personal protective and emergency equipment should be selected based on the hazards that are known or suspected to be on site. The following sections discuss each topic and give examples of equipment commonly used.

4.1 Personal Protective Equipment Selection

Depending on the particular hazardous characteristics of the site, the protective clothing may range from Level D (minimal/no protection) to Level A (fully encapsulating suits with SCBA).

The overall goal of protective clothing selection for sampling is to provide sufficient protection to the:

- Eyes
- Skin (hands, feet, and body)
- Respiratory system.

The same type of protective clothing cannot be used for all situations. It is essential that qualified individuals who are familiar with the effects of chemicals on protective equipment be involved in the selection before the actual sampling. For more information on personal protective equipment and respiratory protection, refer to "Biological Safety" and "Bloodborne Pathogens," respectively.

4.2 Emergency Equipment Selection

Emergency equipment selected for field sampling and inspection will depend on the types of activities being performed on-site and expected hazards. The following are examples of equipment that should be selected:

- Fire extinguisher
- First Aid/Bloodborne Pathogen (BBP) Kit.

5.0 EMERGENCY PROCEDURES

In the event of an emergency during field activities, follow the direction of the on-site health and safety representative or procedures included in the health and safety plan.

6.0 SUMMARY

This module has presented information on field sampling and inspection hazards that EPA personnel may encounter. The hazards are broken down into those created by the work environment and those created by the equipment and procedures used to collect the

samples. A description of common sampling procedures was provided along with safety and emergency equipment recommendations.

Key concepts presented in this module are:

- Examples of hazards created by everyday operating procedures are as follows:
  - Vehicle operation
  - Noise
  - Thermal hazards
  - Flammable materials
  - Toxic materials.

- Examples of hazards created by the sampling location are as follows:
  - Significant height
  - Weather conditions
  - Higher exposures to chemical and thermal hazards
  - Remote areas
  - Natural hazards.

- Equipment to collect and contain hazardous samples should be:
  - Disposable or easily decontaminated
  - Inexpensive
  - Easy to operate
  - Nonreactive
  - Safe to use.

- The manufacturers of sampling equipment usually provide detailed instructions as to procedures for safe set-up and operation. It should become common practice to thoroughly read these instructions before attempting to use the equipment.

- Hazardous chemicals are frequently used in field sampling activities. Some chemicals may be used as:
  - Preservatives for samples that will be analyzed in the laboratory (e.g., acids)
  - Analytical reagents for field testing (e.g., standards)
  - For cleaning or decontaminating sample containers or sample equipment.

- MSDSs for hazardous chemicals should always be brought to the job site.

- A sample must be collected and handled by means that will not only preserve its original physical form and chemical composition, but also prevent contamination or changes in concentration of the materials to be analyzed.

- The following factors must also be taken into consideration because they can influence the sampling plan development process:
  - Topographic, geologic, and hydrologic characteristics of the site
  - Meteorologic conditions

- Flora and fauna of the area
- Geographic and demographic information
- Physical properties and hazardous characteristics of material involved

The sampling plan should also address health and safety concerns of the sampling effort.

- The sampling team (two or more) is an essential safety feature of the sampling regime, and should operate using the buddy system.

- The following types of samples are commonly taken to maintain an adequate quality assurance program in such instances:
  - Duplicate samples
  - Split samples
  - Spiked samples
  - Reproducible check
  - Blank samples.

- The safety concerns associated with collecting samples include:
  - Splashes
  - Containment
  - Incompatibilities
  - PPE failure
  - Broken sample containers
  - Excavations or test pits - confined space
  - Smoke stack - cherry picker
  - Lagoons, rivers, creeks - boats, barges
  - Drill rigs - plywood access walkouts.

- Samples collected at a site should be classified as either environmental or hazardous material (or waste) samples. A distinction must be made between the two types of samples in order to:
  - Determine appropriate procedures for transportation of samples
  - Protect the health and safety of laboratory personnel receiving the samples.

- All sampling equipment must be clean before use. Improper cleaning of sampling equipment will cause cross contamination of samples.

- The type of personal protective equipment will be dependent on the particular hazardous characteristics of the site. The overall goal of protective clothing selection for sampling is to provide sufficient protection to the:
  - Eyes
  - Skin (hands, feet, body)
  - Respiratory system.

- In the event of an emergency during field activities, follow the direction of the on-site health and safety representative or procedures included in the health and safety plan.

Measures you can take when dealing with hazardous substances include:

- Understand the potential hazards that may be present from everyday operating procedures and created by the sampling location.

- Ensure that you follow the general safety considerations for sampling equipment:
  - Read the manufacturer's instructions before attempting to use the equipment.
  - Familiarize yourself and practice with the operation of the equipment.
  - Verify that the significant hazards of the equipment should be noted on the instrument or its case.
  - Know the type of hazardous environment in which the equipment will be used.

- Be aware of the hazards associated with the sampling materials (e.g., compressed gases, reagents).

- Use a buddy system when executing a sampling plan.

- Classify all samples as either environmental or hazardous material (or waste) for proper handling and disposal.

- Properly decontaminate all sampling equipment after each use.

- Use the appropriate personal protective equipment when conducting your sampling (e.g., goggles, gloves, tyvek suits, and respirators).

- Understand the emergency procedures included in the site health and safety plan.

EXERCISE

Choose the best answer for the following:

1. _____ Hazards created by everyday operating procedures include:

   A. Noise
   B. Thermal hazards
   C. Toxic materials
   D. All of the above

2. _____ Hazards created by the sampling location include all but the following:

   A. Natural hazards
   B. Weather
   C. Height
   D. None of the above

3. _____ Equipment used to contain hazardous samples should be all but the following:

   A. Expensive
   B. Easy to operate
   C. Nonreactive
   D. Safe to use

4. _____ Equipment used to collect solid samples includes:

   A. Open-tube
   B. Sampling trier
   C. Weighted bottle
   D. None of the above

5. _____ Equipment used to collect liquid samples includes:

   A. Open-tube
   B. Waste pile
   C. Sampling trier
   D. Trowel

6. _____ When choosing sampling equipment, it is essential to know the type of hazardous environment in which it will be used.

7. _____ Chemicals used in field sampling activities may include preservatives, reagents, and cleaners.

8. _____ Never move a compressed gas cylinder without ensuring that any regulators are in place.

9. _____ Chemical reagent bottles should be packed in absorbent.

10. _____ Sampling is performed to determine the adequacy of worker protection.

11. _____ The buddy system is an essential safety feature of the sampling regime.

12. _____ The main safety concerns associated with collecting samples include splashes, contamination, and PPE failure.

13. _____ Sampling to be conducted at excavations may be hazardous due to potential confined space entry.

14. _____ All samplers are assumed to be clean before use.

15. _____ The protective clothing used is usually Level D.

EXERCISE KEY

Choose the best answer for the following:

1. _____ Hazards created by everyday operating procedures include:

   A. Noise
   B. Thermal hazards
   C. Toxic materials
   D. All of the above

2. _____ Hazards created by the sampling location include all but the following:

   A. Natural hazards
   B. Weather
   C. Height
   D. None of the above

3. _____ Equipment used to contain hazardous samples should be all but the following:

   A. Expensive
   B. Easy to operate
   C. Nonreactive
   D. Safe to use

4. _____ Equipment used to collect solid samples includes:

   A. Open-tube
   B. Sampling trier
   C. Weighted bottle
   D. None of the above

5. _____ Equipment used to collect liquid samples includes:

   A. Open-tube
   B. Waste pile
   C. Sampling trier
   D. Trowel

6. ***T*** When choosing sampling equipment, it is essential to know the type of hazardous environment in which it will be used.

7. ***T*** Chemicals used in field sampling activities may include preservatives, reagents and cleaners.

8. ***F*** Never move a compressed gas cylinder without ensuring that any regulators are in place.

9. ***T*** Chemical reagent bottles should be packed in absorbent.

10. ***T*** Sampling is performed to determine the adequacy of worker protection.

11. ***T*** The buddy system is an essential safety feature of the sampling regime.

12. ***T*** The main safety concerns associated with collecting samples include splashes, contamination, and PPE failure.

13. ***T*** Sampling to be conducted at excavations may be hazardous due to potential confined space entry.

14. ***F*** All samplers are assumed to be clean before use.

15. ***F*** The protective clothing used is usually Level D.