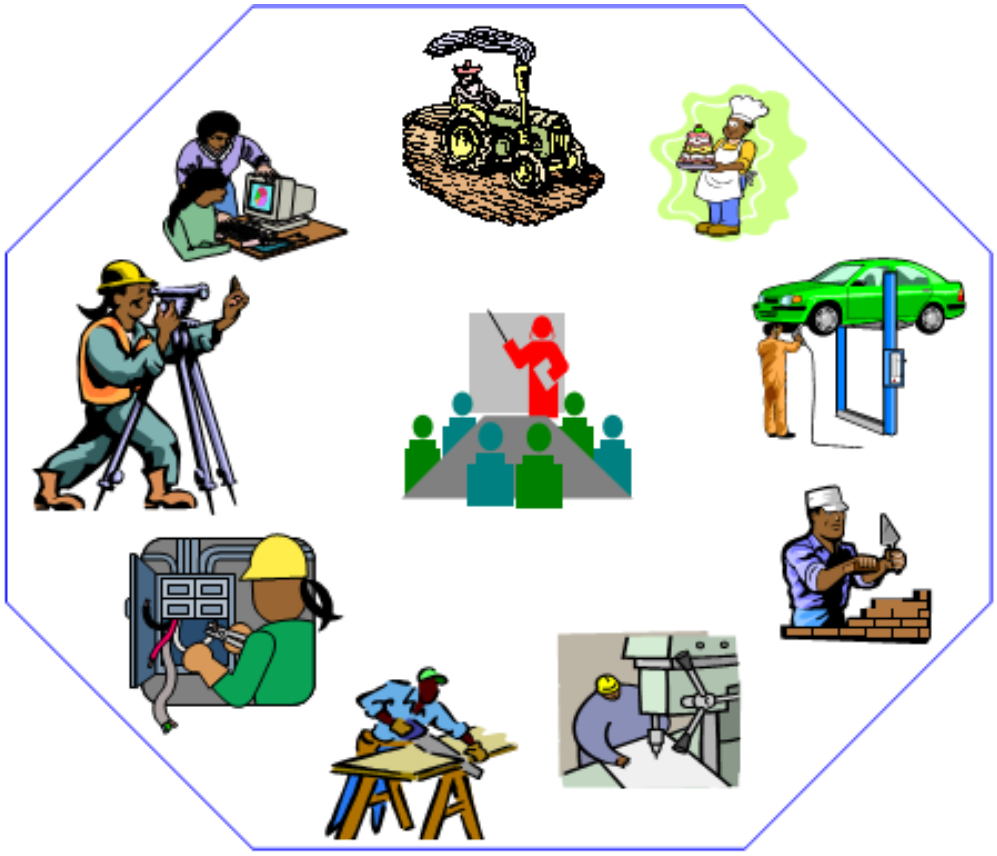
Surface Mining Level-II

Based on December 2018, Version 2 OS and April. 2021, V1 Curriculum



Module Title: - Take Environmental and Operational sample

LG Code: MINSMN2 M011LO (1-5) LG(40-44)

TTLM Code:MINSMN2 TTLM 0421v1

Adama Ethiopia

April,2021

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LG #32	LO #1-Plan and prepare

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Accessing, interpreting and applying compliance documentation of collection of mine sample
- Confirming the purpose, priority and scope of the sample request or plan
- Carrying out coordination
- Identifying and reviewing mining site hazards procedure
- Using and document Procedures to ensure representative sampling as per work requirements
- Confirming quantity, location , sample fraction, and time of sampling and types of samples
- Preparing required sampling tools and equipment as per work requirements

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Access, interpret and apply Compliance documentation relevant to the collection of mine samples
- Confirm The purpose, priority and scope of the sample request or plan
- Liaise with relevant personnel to arrange site access and all necessary permits
- identify and review mining Site safety hazards procedures in accordance with WHS requirements
- Use and document Procedures to ensure representative sampling as per work requirements
- Quantity, location (including sampling depth), sample fraction, and time of sampling and types of samples to be collected are confirmed
- Prepare required sampling tools and equipment as per work requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
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Information Sheet 1-Accessing, interpreting and applying compliance documentation of collection of mine sample

1.1.Introduction

Compliance documentation is the documents that must be completed in a job. These documents are required to show that the workplace is following the established laws, set practices and standards that must be in place.

It is not about you might complete; it is not about you'll finish them later; it is not about you'll work on if you have time! Compliance documents are documents that must be read and followed and in some cases completed by you.

In workplaces where there are inherent dangers around you, if you do not follow the rules you can expect to be looking for another line of work! Some of documents or information's of Compliance documentation:

- company guidelines and specifications
- Ethiopian standards (mineral exploration standards)
- Control of Substances Hazardous to Health Regulations
- Equal Employment Opportunity and Disability Discrimination legislation
- Records, reports, observations and verbal responses required to verify
- compliance with standards by a facility or program.

1.2. Accessing compliance documentation

Accessing compliance documentation is a means of approaching, entering, exiting, communicating with, or making use of different kinds of documents or information related to the work to be performed.

1.3. Interpreting compliance documentation

Interpreting compliance documentation is explain the meaning of (information or actions) collected and accessed

1.4. Applying compliance documentation

Applying compliance documentation is to make use of the above mentioned Accessing and interpreting specific documents or information for a practical purpose.

Self-check 1	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Short Answer Questions

1. What is compliance documentation?(2pts)

2. What is the purpose of understanding compliance documentation?(2pts)

Note: **Satisfactory rating - 3points** **Unsatisfactory - below 3 points**

Score = _____

Rating: _____

Information Sheet 2-Confirming the purpose, priority and scope of the sample request or plan

2.1. Understanding Sampling Techniques

There are a lot of differences between the operations of successful mining companies and ones that become financial failures, but one of the consistent key differences between them is their sampling programs. One is reminded of the old saying about the three most important things to remember about investing in real estate—they are location, location, and location. For mining it is similar, and perhaps the three most important things in designing a successful mining project are sampling, sampling, sampling.

No mineral deposit is uniformly rich; in fact, most are extremely variable. If the property is a good one, some spots may be rich; some will be lower grade but still rich enough to be profitable; but many will be too low-grade to work profitably. When rock is too low-grade to make money, it is waste and should not be processed. Large operators spend huge amounts of money on sampling. They have a good idea before mining begins how much waste and how much ore they have. Successful mining companies know that the investment necessary for a good sampling program is well worth the time and dollars expended. Far too often small operators, in a mistaken attempt to reduce costs, conduct little or no sampling before beginning to mine.

2.2. Need of sampling

- Exploration stage to locate economic mineral deposits, drill targets.
- Development stage to determine reserves.
- Production stage to maintain grade control.
- Environmental monitoring, compliance.
- To predict, model, and remediate ARD and other drainage problems associated with mine sites.

- To determine how well the predictive models work and how effective the remediation methods are

2.3. **Sampling plan should include**:

- Introduction and objectives
- Scope
- Sampling matrix and sampling site
- Method of sampling
- Administrative arrangements – health, safety and security provisions
- Preliminary site inspection
- Sampling equipment
- Containers, preservatives, holding times and shipping and additional information

2.4. Safety considerations

Sampling related safety consideration should be brought into the planning process from the beginning, especially for the following:

- Personal protective equipment
- Fall protection equipment
- Specialized air monitoring equipment for hazardous environments, and
- Specialized equipment for handling potentially harmful substances.

2.5. Purpose of sample plan

To develop sample protocols:

- Collection techniques
- Sample collection
- Observational field data
- Modify sampling plan and deviations
- Opportunistic sampling
- Contamination
- Handling/transport

- Preservation and storage (from field to laboratory)
- Sample pre-treatment in the laboratory
- Filtration
- Sample preparation
- Sample separation
- Archival/storage
- Analytical procedures and techniques

Self-Check – 2	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. List the purpose of sample plan(3pts)

2. Describe the safety consideration while conducting mine sampling(3pts)

3. What is sampling mean?(2pt)

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

Score = _____

Rating: _____

Information Sheet 3- Carry out coordination

3.1. Introduction

Coordination is: „the act of coordinating, making different people or things work together for a goal or effect", or „the regulation of diverse elements into an integrated and harmonious operation". The management of a modem enterprise is based on the principle of specialization or division of labour. jobs are broken down into single respective tasks and are entrusted to individuals either working in the same department or in different departments of them enterprise. But the mere application of the principle of specialization does not enable an organization to attain the desired results. With jobs specialized and divided among units, coordination becomes necessary.

3.2. **Need for coordination**:

Good cooperation attacks problems as they arise; excellent coordination anticipates them and prevents their occurrence. Mary Parker Fouett states that coordination can be more easily achieved by direct personal contact among the responsible people concerned. By direct personal contact, ideas, ideals, goals, views, can be discussed and misunderstandings if any, can be clarified much more efficiently than by any other method.

3.3. Field Coordinator

A field coordinator oversees the operation and execution of site work activities. When scheduling field sampling techniques, a field coordinator makes sure that the appropriate techniques, equipment, and materials are on hand to complete work on time and according to standard operating procedure (SOP). By interfacing with field workers, libratory, and others field coordinators ensure the smooth operation of field activities, including field safety and work quality. Field coordinators often split their time between the office and field locations.

3.3.1. Field Coordinator Duties and Responsibilities

Field coordinators typically carry out the following duties:

Schedule Work: Creating and managing work schedules is a core responsibility for field coordinators and may include organizing routes for individual field visits or scheduling long-term projects that involve numerous contractors and subcontractors.

Perform Inspections: Prior to the start of work, field coordinators may visit project sites to verify the work to be performed. Once work has commenced, they sometimes remain at the job site or frequently visit to ensure sufficient staffing levels, on-time delivery of materials, and the overall quality and performance of work according to project specifications.

Manage Safety: A critical element of field service activities is the safety of all workers. Field coordinators ensure compliance with OSHA and other safety regulations. This includes inspecting protective work gear and other equipment used by field workers, coordinating safety training, performing accident investigations, and compiling safety reports.

Communicate with laboratory: Field coordinators interact with laboratory and receive feedback regarding the quality of work performed by field workers.

Create Reports: Field coordinators are responsible for the timely completion of work orders and field progress reports. They may also generate project reports summarizing field worker hours, service technician utilization rates, and productivity metrics.

Self-Check – 3	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What is coordination?(3)
2. List Field coordinator duties(5)

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

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Score = _____

Rating: _____

Information Sheet 4-Identifying and reviewing mining site hazards procedure

4.1. Introduction

Hazard

Hazard is a situation that poses a level of threat to life, health, property or environment.

Hazard Identification

Hazard identification is to identify and develop a list of hazards for each job in the organization that are reasonably likely to expose people to injury, illness or disease if not effectively controlled

Employers shall ensure that hazard assessments are conducted for mineral exploration work activities. The goal of the hazard assessment is to identify the hazard and determine the significance of the risk. A hazard assessment is best conducted by a team of individuals who consider the work activities, processes, and equipment utilized.

Following are some of the important terminologies involved in hazard identification and risk analysis:

- **Harm**: Physical injury or damage to the health of peoples either directly or indirectly as a result of damage to property or to the environment.
- **Hazard:** Hazard is a situation that poses a level of threat to life, health, property or environment. Most hazards are dormant with only a theoretical risk of harm however once a hazard becomes active it can create emergency situation.
- **Accident:** An accident is a specific, unidentifiable, unexpected, unusual and unintended eternal action which occurs in a particular time and place with no apparent and deliberate cause but with marked effect.
- **Protective measure**: The combination of risk reduction strategies taken to achieve at least the tolerable risk. Protective measures include risk reduction by inherent safety, protective devices, and personal protective equipment, information for use and installation and training.
- **Severity**: Severity is used for the degree of something undesirable.

- **Different** Forms of Injury
- **Serious Bodily Injury** means any injury which involves the permanent loss of any part or section of the body or the permanent loss of sight or hearing or any permanent physical incapability or the facture of any bone or one or more joint or bone of any phalanges of hand or foot.
- **Reportable Injury** means any injury other than any serious bodily injury, which involves the enforced absence of injured person from work for a period of 72 hours or more.
- **Minor Injury** means any injury which results in enforced absence from work of the person exceeding 24hrs and less than 72 hours.

4.2. Hazard Assesment

The purpose of hazard assessment is to identify and develop a list of hazards for each job in the organization that are reasonably likely to expose people to injury, illness or disease if not effectively controlled.

Risk Assessment

Risk assessment is the process used to determine the likelihood that people exposed to injury, illness or disease in the workplace arising from any situation identified during the hazard identification process prior to consideration or implementation of control measures. Risk occurs when a person is exposed to a hazard. Risk is the likelihood that exposure to a hazard will lead to injury or health issues. It is a measure of probability and potential severity of harm or loss.

Risk Control

Risk control is the process used to identify, develop, implement and continually review all practicable measures for eliminating or reducing the likelihood of an injury, illness or diseases in the workplace.

Implementation of risk controls

All hazards that have been assessed should be dealt in order of priority in one or more of the following hierarchy of controls

Table 1.1. Hazard assessment control system

No	**Control**	Example
1	Eliminate	Removing the hazard, e.g. taking a hazardous piece of equipment out of service.
2	Substitute	Replacing a hazardous substance or process with a less hazardous one, e.g. substituting a hazardous substance with a non-hazardous substance.
3	Isolation	Isolating the hazard from the person at risk, e.g. using a guard or barrier.
4	Engineering	Redesign a process or a piece of equipment to make it less hazardous.
5	Administrative	Adopting safe work practices or providing appropriate training, instruction or information.
6	Personal Protective Equipment	The use of personal protective equipment could include using gloves, glasses, earmuffs, aprons, safety footwear, and dust masks.

Self-Check – 4	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

Define the following:

A. Harm:

B. Hazard

C. Accident

D. Hazard Control

E. PPE

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet 5-Use and document Procedures to ensure representative sampling as per work requirements

5.1. Field sample procedure

The field sampling procedures should be part of the Sampling Plan that describes required sample preservation, proper containers, correct sample container cleaning procedures, sample holding times from collection to analysis and sample shipping and storage conditions. The Plan should also provide copies of appropriate chain of custody forms.

Sampling Handling, After Collection

This portion of the SOP should specify how samples are processed and handled after collection. Details relevant to the integrity, validity and documentation of the sample after collection should be covered. These procedures should already have been determined, but the SOP describes how they will be implemented. Key information to convey in this section includes:

- How the sample will be labeled and sealed?
- What information should be recorded in sampling field notes?
- How the sample will be preserved and transported?.
- How chain-of-custody is maintained and documented?

  Steps need to be taken prior to beginning the sampling process. When preparing for a sampling event, the following key considerations should be addressed:

Notify the lab performing the analyses and schedule the sampling event.

- Assemble and/or clean sampling implements.
- Assemble and/or clean sample containers.
- Assemble and prepare any sample handling equipment (coolers, labels, notebooks, custody forms, markers).
- Checklists are very useful in this portion of the SOP.

Table. 1 Soil sample Equipment check list

Protective gear	Sample	Sampler	Cleaning	labeling	Transporting

	container		**equp**		**and Preservation**
Disposable gloves (such as nitrile or latex)	Bucket (accumulate and mix grab samples)	Scoop	Disposable towels	Labels for sample containers	Sample containers

Self-Check – 5	Written test

Directions:

Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Short Answer Questions

1. List some of sample handling of procedure ?(3)

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Information sheet 6- Confirming quantity, location, fraction, time and types of samples

6.1. Sampling

Description of the location, number of units and/or quantity of material that should be collected, and associated acceptance criteria. Going on-site and collecting a sample without first planning how to do so, may result in a meaningless, contaminated, or unrepresentative sample.

To meet the objectives of legal sampling and ensure success of the whole procedure thorough planning is crucial. The planning process of sampling procedure begins with a preparation of a detailed sampling plan from organizational SOP. The following questions and answers should be addressed during preparation of the sampling plan:

- What type of sample matrix? (solid: soil, sludge, rock) (liquid: water) (gas: dust)
- What type of sampling method? (grab or composite)
- Where will the samples be collected? (based on SOP sampling point)
- When the sample collected? (sampling time)
- What is the sample volume?(sample quantity)
- How is sample going to be collected? (sampler)

When does the sample need to be collected and analyzed?(Sampling timing)

6.2. Water Sampling timing

Time the sampling trip such that it is possible to collect a representative water sample from the designated sampling point. Take into account factors such as the weather, tides, currents, geography etc.

Water Sampling point: For rivers, the primary sampling point is in the surface water layer (0-5 cm from the surface) at the centre of the main flow. For lakes and the ocean, the sampling point will be selected after taking into consideration such factors as geography, whether there are freshwater (rivers or streams) or wastewater inflows, depth, tides, currents etc.

For underground water, the sampling site or sites will be selected after taking into consideration such factors as water flow and geological structure (hydrogeology), and also site conditions such as factories or land use, and avoiding bias so as to be able to understand the whole area's underground water.

Sediment

Sampling timing: If only sediment is to be sampled, time the sampling trip such that it is possible to collect a representative sample from the designated sampling point taking into account factors such as the weather, tides, currents, geography etc. If sediment sampling is linked to a study of the overlying water, then collect the sediment sample at the same time as the water samples.

Sampling point: In rivers, the sampling point will be (a) the point where water samples are taken if the sediment study is linked to a water quality study, or (b) if only sediment is being studied, that part of the river where sedimentation is occurring (the places in the river where sediment is being deposited such as the outside of bends).

Figure 1. Sediment sample

Soil

Sampling timing: There are fewer restrictions on when soil samples may be collected. However, one should still time the sampling trip so that it is possible to collect a representative soil sample from the designated sampling point. Take into account factors such as the weather, season, geography etc.

Sampling point: The sampling point will be selected after taking into consideration such factors as local geography, soil vegetation coverage, whether there are freshwater or wastewater channels or subsurface drains, etc.

Self-Check – 6	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What do you understand about the following concept(2 pt each)

a. Sampling point

b. Sampling time

c. Sediment sample

d. Soil sample

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

Score = _____

Rating: _____

Information Sheet 7- Preparing required sampling tools and equipments

7.1. Introduction

Samplling tools and equipment

Collection of air, liquid or solid surface mine samples often require various types of sampling tools and equipment to compliment specific situations encountered in the field. Selection and preparation of sampling tools and equipment is based on the sample type, matrix, and physical location of the sample point and other site-specific conditions.

Equipment Selection

All equipment that is used to collect and prepare field samples must be prepared so that it does not contaminate or react with the material being sampled. Contamination can arise if equipment is improperly cleaned or is made of materials that are released into the sample.

7.2.Tools and equipment of sample selection

Sampler

This content lists and describes commonly used samplers, their application, and a brief description of how to use them.

Water sampler Surface water sampling includes collection of samples from lakes, ponds, streams, and rivers

Pond Sampler

The commercially available pond sampler (Figure below) is used to collect liquid waste samples from disposal ponds, pits, lagoons, and similar reservoirs. The pond sampler

may consist of an adjustable clamp attached to the end of a two or three piece telescoping aluminum tube that serves as the handle.

Weighted containers

For taking samples from large tanks and storage vessels, a container in a weighted carrier can be used. The container is designed such that it can be opened at the required depth. Marks on the cord used for lowering the container can be used to determine when the correct sampling depth has been reached. A typical weighted container is shown in Figure below.

Syringe Sampler

Syringe samplers are specialized devices designed to capture and preserve in-situ ground water conditions by precluding sample aeration and pressure changes from sample degassing (escape of VOCs) or out gassing (escape of inorganic gases).

Swing Jar Sampler

The swing jar sampler (Figure below) is a surface sampler that may be used to collect liquids, powders, or small solids at a distance of up to 12 feet..

Solid sampler

Scoop/Trowel

The trowel or scoop can be used to collect surface soil samples. They can also be used for homogenizing soil or for collecting a variety of other solid waste samples.

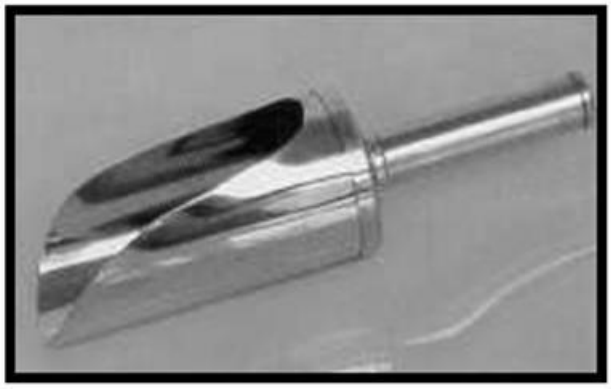
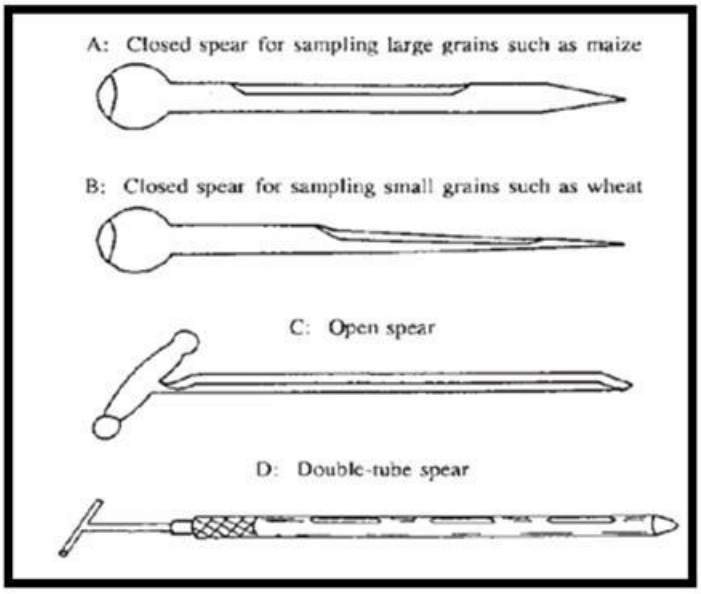


Fig Scoop/towel

Simple bag-sampling spears

Simple bag-sampling spears are the most commonly used instruments for taking samples from bags, because they are relatively cheap, simple and quick. Sampling spears generally have a maximum external diameter of about 12 mm, but can be up to 25 mm in diameter. To obtain a good cross-sectional sample, the spear should be 40–45 cm in length. The tapered type of sampling spear penetrates bags easily.



Bucket Auger

The bucket auger consists of a stainless steel cylindrical body with sharpened spiral blades on the bottom and a framework above allowing for extension rod and T-handle attachments. When the tool is rotated clockwise by its T-handle, it advances downward as it cuts into the soil and moves loosened soil upward where it is captured in the cylindrical body.

Fig bucket auger

Continuous flight auger borings: As the name implies, continuous flight augers have the auger flights continuous along the entire length of the auger. As shown in Figure below, there are two types of continuous flight augers: solid stem and hollow stem. For both of these type augers the drill cuttings are returned to the ground surface via the auger flights. The solid stem auger must be removed from the borehole to allow access to the hole for insertion of sampling or testing devices. Because the auger must be periodically removed from the borehole, a solid stem auger is not appropriate in sands and soft soils or in soil deposits where groundwater is close to the surface. A hollow-stem auger has a circular hollow core that allows for sampling through the center of the auger. As shown in Figure below c, hollow-stem augers come in a variety of diameters.

Sediment Core Samplers: Sediment corers differ from benthic grab samplers by their ability to retain the integrity of sediment horizons with minimal disturbance. This allows

for discrete sampling of horizons or zones of interest. They are also capable of collecting samples at greater depths than grab samplers.

Barrel augers: Barrel-type augers may be used with drill rigs to obtain disturbed samples of most cohesive soils above and below the water table.

Diamond cutter: an electrically powered diamond cutter for professional use in the construction industry. It is designed for cutting mineral materials with diamond discs without use of water.

Soil Coring Device

The soil-coring device consists of a stainless steel, machined split-cylinder with threaded ends, cutting shoe and end cap with a slide hammer used for advancement into the soil. The cutting shoe and end caps of the corer are also constructed of stainless steel. Use of a plastic collection tube and soil-retaining basket is optional. Once the desired depth is reached, the slide hammer can be used to assist in pulling back the device.

Split Core Sampler

The Split Core Sampler (Figure below) what separates this device from other core samplers is the ability to open the core longitudinally. This eliminates any complications that may arise when extruding sample from fixed core barrels. Joining like sections together end to end can extend the length of this core sampler up to 48 inches.

Sub sampler equipments

Sample Splitters

These are often called riffle or chute splitters, and a typical splitter is shown in Figure below. These consist of a series of chutes that run in alternating directions, so that

when material is poured into the top of the splitter, it flows through the chutes and is randomly divided into two equal-sized fractions.

Rotary Riffle splitter

The rotary, or spinning, riffle is the best method to use for dividing material into representative samples.

Rotary riffle splitter; Material is split into multiple samples in a single operation. In the example shown, the material is split into 12 identical fractions, which allows easy division of the bulk material into halves, thirds, quarters, sixths, or twelfths.

Sampling sieve: used for screening

Size reduction

Blake Jaw Crusher: It has its moving jaw pivoted at the top. It is classified on the basis of single or double toggle type. A jaw crusher has 2 jaws said to form a V-shaped at the top through which feed is admitted. One of the jaw is fixed in to the main frame and other is movable. The crushing faces are usually made of hard field Mn steel (12-14%Mn, 1%C). The jaw crusher speed varies from 100-400RPM.

Gape: It is the distance between jaw plates at the fixed opening end.

Set: The distance between the jaw plates in the discharge end.

Self-Check – 7	Written test

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

Define the function of sampling Equipments

a. Diamond cutter

b. Split Core Sampler

c. Sample Splitters

d. Bucket Auger

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

Score = _____

Rating: _____

LG #41	LO #2- Conduct sample collection

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Collecting samples
- Preserving sample integrity
- Labeling and placing samples in suitable containers
- Storing and transporting samples
- Identifying and recording characteristics of sampling environment
- Maintaining sampling equipment in a clean and safe working condition

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Collecting samples
- Preserving sample integrity
- Labeling and placing samples in suitable containers
- Storing and transporting samples
- Identifying and recording characteristics of sampling environment
- Maintaining sampling equipment in a clean and safe working condition

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Information Sheet 1- Collecting samples

1.1. Sample

Sampling involves the selection of a number of study units (e.g. Soil in the study of mineral) from a defined study population (e.g. soil, water, sediment, rock). The population is too large for us to consider collecting information from all its members. Instead we select a sample of individuals hoping that the sample is representative of the population.

Types of sample matrix:

- Water; groundwater (wells), surface water (streams, rivers, lakes and reservoirs), effluents
- Solids; sediments, soils, sludge, minerals
- Gases; atmospheric particles and gases
- Hazardous waste
- Radioactive waste

Sampling method

There are three sampling approaches:

Random sampling: First, we divide the target population into equal units then Select the required number of sampling units, using a “lottery” method or a table of random numbers.

Systematic Sampling: Individuals are chosen at regular intervals (for example, every 5th, 10th, etc.) For example, a systematic sample is to be selected from 1000 students of a school. The sample size is decided to be 100. The sampling fraction is: 100/1000 = 1/10. The number of the first student to be included in the sample is chosen randomly by picking one out of the first ten pieces of paper, numbered 1 to 10. If number 5 is picked, every tenth student will be included in the sample, starting with student number 5.

Judgmental: is selective sampling, the opposite of random sampling in which we use prior information about the target population to help guide our selection of samples. The random and systematic approaches are used in routine sampling, whereas the judgmental sampling is often the method of choice for regulatory and emergency response sampling.

Types of sampling

Samples can be either grab or composite samples.

Grab sample: A grab sample is a discrete sample which is collected at a specific location at a certain point in time. If the environmental medium varies spatially or temporally, then a single grab sample is not representative and more samples need to be collected.

Composite sample: A composite sample is made by thoroughly mixing several grab samples. The whole composite may be measured or random samples from the composites may be withdrawn and measured.

1.2. Sampling procedure

Your description of sampling procedures should outline the actual procedures that will be employed before, during, and after the collection of a sample.

Procedures for collecting samples

What to collect (solid, liquid, gas)

Selection of sample locations

Frequency of sampling

Size of the sample (mass/volume required)

Number of sample units in each sampling site

Selection of sampling devices, containers and their cleaning requirements

Type of sample (discrete, composite, multilevel or passive)

Safety: An important component of any sampling plan, process, or event is the procedures developed and implemented to protect sampling personnel from the potential hazards.

Equipment Checklist: Having the necessary equipment clean and in good working order prior to arriving at the sampling site saves time and frustration and is more likely to result in consistent sampling procedures.

Sampling Handling, After Collection

This portion of the SOP should specify how samples are processed and handled after collection. Details relevant to the integrity, validity and documentation of the sample after collection should be covered. These procedures should already have been determined, but the SOP describes how they will be implemented. Key information to convey in this section includes:

How the sample will be labeled and sealed.

What information should be recorded in sampling field notes.

How the sample will be preserved and transported.

How chain-of-custody is maintained and documented.

1.3. Soil Sampling

The method and procedure for obtaining soil samples vary according to the purpose of sampling.

Sampling method

Grid Soil Sampling Methods

Grid soil sampling subdivides a field into an arrangement of cells (usually squares) and a sample is taken from each of these cells. These include regular systematic point, staggered start point, systematic unaligned point, and random composite cell

Point Methods

Regular systematic sampling: (sometimes called cell center sampling) takes one sample from the center of each grid cell. (Figure below) shows an example of a regular systematic sampling schema.

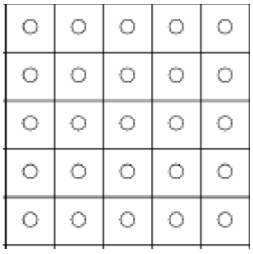


Figure 4 Regular systematic sampling

Systematic unaligned sampling: (or sometimes called systematic random sampling), GIS software is used to create a random sample location in each grid cell.

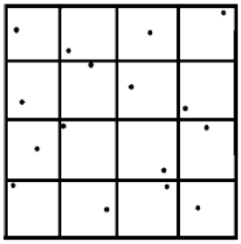
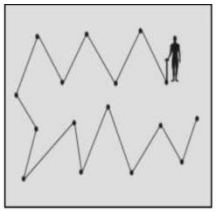


Figure 5 Systematic unaligned sampling

Random Composite Cell Sampling Method

Random composite cell sampling (or grid-cell sampling as it is sometimes called) is accomplished when soil probes are taken from random locations within a grid cell, and one composite sample is created from these probes. (Figure below) shows one cell of a grid with the random composite cell sampling method.



Example of Sample collection procedures

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

Example of sample collecting using diamond saw

Fig 7 Sample collection

Table 2.Sampling techniques

Sample type	Ample method	definition	Photo
linear	Chip	Individual punctual chip specimens collected in a discontinuous fashion aggregated to form a sample	
	Chip-channel	Series of continuous chips aggregated to form a sample	

			
	Channel	Consistent volume cut across sample zone, can be hand or diamond saw cut	
	Panel	Large and/or multiple chip or chip-channel samples	
Broken rock	Grab	Hand “grab” of sample from a rock pile	
Drill hole	Blast hole/sludge Chippings over a given length recovered up the outside of the drill string		

Self-Check – 1	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Define the following term

1. Composite sample
2. Grab
3. What is sampling?

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

Score = _____

Rating: _____

.

Answer sheet

Test I

1._____

2. _____

Information Sheet 2- Preserving sample integrity

2.1. Holding time

Holding time is the maximum time allowed between collection and the moment when sample preparation or analysis on that sample must begin. Turnaround time in addition is the length of time it takes from when a sample is received by the laboratory to the time when a result of analysis is issued.

Correct handling of sample and prompt delivery is essential in order to obtain the best quality of analytical results. The sample should be delivered to the laboratory immediately after collection and analysis should start as soon as possible to ensure the results are representative. Samples begin to change as soon as they are removed from their environment. In a case when the holding times are exceeded the samples should be flagged in the laboratory analytical report.

2.1.1. Sample preservation

The sample must be representative of the environment. Both physical and chemical processes may be involved in changing the composition of a sample after it is collected. Common physical processes which may degrade a sample are volatilization, diffusion, and adsorption. Possible chemical changes include photochemical reaction, oxidation and microbial degradation.

The collected sample is invariably exposed to conditions very different from the original source. For example, if a ground water sample is exposed to sunlight after it is collected; photochemical reactions may degrade some of the analytes of interest. Samples often must be preserved in some way, to keep them stable until the analysis is completed.

The purpose of sample preservation is to minimize any degradation until the samples can be analyzed. Complete preservation of samples is practically impossible because complete stability for every constituent can never be achieved. Sample that cannot be

delivered to the laboratory within 2 hours must be preserved to minimize changes in samples that begin immediately after collection. It is the field sampler's responsibility to preserve and store the samples until delivered to the laboratory.

2.1.2. **Sample Preservation(solid)**

Without preservation, a solid sample may undergo a change in composition due to the loss of volatile material, biodegradation, and chemical reactivity (particularly redox reactions). Storing samples at lower temperatures makes them less prone to biodegradation and to the loss of volatile material, but fracturing of solids and phase separations may present problems. To mini¬mize the loss of volatiles, the sample container is filled completely, eliminat¬ing a headspace where gases collect. Samples that have not been exposed to O2 are particularly susceptible to oxidation reactions. For example, the contact of air with anaerobic sediments must be prevented.

nufacturing processes have many factors that influence their success, and in each, the possibility of variation is introduced. The specific types of variation depend on what is being manufactured -- for example, an adhesive is affected by factors unlike those that affect a machine. In general, however, the outcome-specific factors fit into five major areas.

recommended sampling containers, preservation requirements, and holding times for soil samples

Contaminant	Container[1] Preservation[2]	Holding time[3]
Acidity	P, G	14 days
Alkalinity	P, G	14 days
Ammonia	P, G	28 days
Sulfate	P, G	28 days
Sulfide	P, G	28 days
Sulfite	P, G	48 hours
Nitrate	P, G	48 hours
Nitrate-Nitrite	P, G	28 days
Nitrite	P, G	48 hours
Oil and grease	G	28 days
Organic carbon	P, G	28 days
Metals		
Chromium VI	P, G	48 hours
Mercury	P, G	28 days
Other metals	P, G	6 months
Cyanide	P, G	28 days

recommended sampling containers, preservation requirements, and holding times for soil samples (continued)

Contaminant	Container[1] Preservation[2]	Holding time[3]
Purgeables		
Halocarbons and aromatics	G, Teflon®-lined septum	14 days
Acrolein and acrylonitrate	G, Teflon®-lined septum	3 days
Orthophosphate	P, G	48 hours
Pesticides	G, Teflon®-lined cap	7 days until extraction
		30 days after extraction
Phenols	G	28 days
Phosphorus	G	48 hours
Phosphorus, total	P, G	28 days
Chlorinated organic compounds	G, Teflon®-lined cap	7 days

[1] P = polyethylene, G = glass.
[2] All samples are cooled to 4 °C. Preservation is performed immediately upon collection. For composites, each aliquot preserved at collection. When impossible to preserve each aliquot, samples may be preserved by maintaining 4 °C until compositing and sample splitting is completed.
[3] Samples are analyzed as soon as possible. Times listed are maximum holding if analysis is to be valid.

Source: Description and Sampling of Contaminated Soils.

Self-Check – 2	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test 1. Define the following

1. Sample preservation
2. Holding time

Test II: Write true if the statement is correct and false if the statement is incorrect

1. We can preserve acidic soil sample more than 14 days without preservation mechanism. (2pts)

2. Sample preservation is a great effect in sample test result. (2pts)

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

Score = _____

Rating: _____

Answer sheet

Test I

1._____

2. _____

Test II

1._____

2._____

Information Sheet 3- Placing and Labeling samples

3.1. Sample labling

Once sample is collected, the containers should immediately be properly sealed and labeled. A legal custody seal is applied over the top of the lid and down the side of the container showing the identification number of sample and the field sampler's signature. To prevent container mix-up each sample container must also be labeled with waterproof, permanent, adhesive, polyester labels or equivalent.

Why Properly Label Samples?

- Reduces risk of contamination
- Reduces injury to self and others
- Maintains clean and organized working environment
- Avoids loss or damage to valuable samples
- Maintains integrity of research being conducted
- Labeling Samples guide:
- Use appropriate label written with non bleed ink or printed from a printer
- Use legible hand writing in a universal language understood by everybody in your lab
- Use clear tape to protect label
- Label without obstructing view of sample contents
- Place label evenly

dentifying equipment variation is one of the essential elements of a quality management system. Identifying equipment variation in the processing area is necessary to ensure accurate, reliable, and timely testing. The benefits of Identifying equipment variation program are many:

- Helps to maintain a high level of equipment performance;
- Reduces variation equipment, and improves the technologist's confidence in the accuracy of testing results;

- Lowers repair costs, as fewer repairs will be needed for a well-maintained instrument;
- Lengthens instrument life;
- Reduces interruption of services due to breakdowns and failures;
- Increases safety for workers;
- Produces greater customer satisfaction.

3.2. Sampling containers

The size and type of sample to be taken will determine the type of sample container required.

For volatile organic compounds, use clear or brown bottles or vials with screw caps or stoppers lined with tetrafluoroethene resin films, or similar products, which can be closed to provide a gas-tight seal.

For semi-volatile or non-volatile organic compounds, use clear or brown glass jars with a stoppers or Teflon lined screw caps.

For inorganic compounds such as heavy metals, use polyethylene or glass containers.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. Describe sample labeling guides
2. What is the importance of sample labling?

Note: Satisfactory rating - 3points Unsatisfactory - below 3 points

Score = _____

Rating: _____

Information Sheet 4- Storing and transporting samples

4.1. Sample Handling

After collecting samples, it is important to properly store samples to prevent contamination. Typically, most laboratories prefer to prepare samples in their lab. This means that you can often send samples directly to the laboratory without doing any processing yourself. Some laboratories require samples to be submitted in specific sample bags or containers. Check with your chosen laboratory for specific information on its requirements for handling and packaging samples.

4.2. Storing samples

If you are not sending samples directly to the laboratory, consider storing samples in the refrigerator or freezer to minimize the chance of mold forming in the sample bag.

Sample Volumes, Bottles, Preservatives and Holding Times for Soil Samples

PARAMETER	CONTAINER TYPE, NUMBER and SUGGESTED VOLUME	PRESERVATION	MAX HOLDING TIME UNTIL EXTRACTION (from date of collection)	MAX HOLDING TIME UNTIL ANALYSIS (from date of collection)
Volatile Organics	1 x 100 mL glass jar with Teflon-lined cap	Cool to ≤ 4°C (No headspace)	N/A	7 days (from date of collection) *
Semi Volatiles	1 x 250 mL glass jar with Teflon-lined cap	Cool to ≤ 4°C	14 days	40 days
Petroleum Hydrocarbons by GC	1 x 250 mL glass jar with Teflon-lined cap	Cool to ≤ 4°C	3 days	14 days *
Total Lead	1 x 250 mL glass jar with Teflon-lined cap	Cool to ≤ 4°C	N/A	6 months
Organic Lead	1 x 500 mL glass jar with Teflon-lined cap	Cool to ≤ 4°C	14 days	14 days *
TCLP (for volatiles)	1 x 500 mL glass jar with Teflon-lined cap	Cool to ≤ 4°C (No headspace)	7 days	N/A
TCLP (for semi-volatiles and metals)	1 x 500 mL glass jar with Teflon-lined cap	Cool to ≤ 4°C	Organics: 14 days Metals: 6 months	N/A
* These samples should be shipped within 24 hours of collection.				

Sample transportation

Shipment of samples is time critical to ensure their integrity. The field sampler is responsible for preserving and storing the samples until they are delivered to the laboratory. After collection all samples should be handled as little as possible. They

should be put on ice for transport to laboratory but never frozen. Each collected sample stored in the cooler should have its own Field Sampling Data Sheet that must accompany the sample at all times. The Field Sampling Data Sheet should be placed in a waterproof bag, sealed and taped under the lid of the cooler along with the samples to which it applies.

The packages should be sealed with custody seal tape so the recipient can tell if the package has been tampered with. This seal should not be broken until the samples arrive at the laboratory and are checked in by laboratory staff. The seal label should include:

- Shipping and receiving facility name,
- Sampler's name,
- Date the container is sealed for shipment, and It should read "Chain of Custody Sample Authorization Required to Open".

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions

1. What is sample handling and sample transporting? (4pts)

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

Score = _____

Rating: _____

Information Sheet 5- Identifying and recording characteristics of sampling environment

5.1. Sample Identification

The sample must first be properly and uniquely identified. Sample identification entails establishing a scheme which ensures that each sample is identified in such a way that one sample cannot be mistaken for another.

5.2. Sampling Records

Records of sampling and sampler must be kept current and accessible for review.

Records must include:

- date and time of all sampling activity including grab and toxicity samples and performance check samples for analyzers, etc;
- temperature stability records;
- sample identification, e.g., wastewater stream, control point etc.;
- sample collection method, e.g., autos ampler, 24 hour composite, grab, etc.;
- identification of sampling staff;
- malfunctions and corrective action taken;
- maintenance log including frequency and type of maintenance performed, e.g., tubing changes, cleaning, reprogramming, programmer repairs etc.;

Labels must be filled out immediately after the sample is collected to ensure that containers are not later misidentified. Indelible ink must be used on all labels, and the writing must be legible. For samples which require preservation, the sample labels must have a space on the label reserved for noting the preservative added, or other treatments, such as filtering, compositing, etc.

Once sample is collected, the containers should immediately be properly sealed and labelled. A legal custody seal is applied over the top of the lid and down the side of the container showing the identification number of sample and the field sampler's signature. To prevent container mix-up each sample container must also be labeled with

waterproof, permanent, adhesive, polyester labels or equivalent. Different labeling systems can be used, such as:

Pre-printed and two-part labels with corresponding unique numbers. One part of the label is attached on the container and the other one is kept for the sampling documentation,

Another way of labeling is to etch the container with a glass etcher. The etchings should be marked directly into glass, forming a permanent record,

Evidentiary labels that match container identification numbers on three separate stickers can also be used. In such a case, one of the stickers is used to seal the lid of the sample container (the lid cannot be removed without damaging the seal), one is put on the sample container and the last is placed in the Field Sampling Data Sheet along with the sampler's notes for the sampling event.

Proper labeling of samples is also important for quality assurance purposes. Information on the labels provides uniformity of sample records assists the sampler and helps ensure that vital information is not omitted. The label could contain, but is not limited to the following information:

- Container identification number,
- Sampling date and time,
- Sampling location
- Field sampler's name
- Name of the witness (es).

In a case the sample label is lost or was never prepared, a written statement should be made detailing the sample collection and transportation from the field to the laboratory, description of the known chain of custody data and references to any sample associated entries.

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

1. Sampler
2. Field log
3. Dispose waste

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

Score = _____

Rating:

Information Sheet 6- Maintaining sampling equipment's in a clean and safe working condition

6.1. Implementing an Equipment Maintenance Program

6.1.1. Preventive maintenance

Preventive maintenance is A program of routine actions such as cleaning, lubrication, adjusting, or testing to keep equipment ready for use. Manufacturers generally recommend a set of equipment maintenance tasks that should be performed at regular intervals: daily, weekly, monthly, or yearly. Following these recommendations will ensure that the equipment performs at maximum efficiency and will increase the lifespan of the equipment.

Always operate equipment safely.

Be thoroughly familiar with requirements for equipment operation and maintenance.

Be aware of the limitations as well as applications of the equipment with respect to your field site.

Maintain and test equipment on a regular schedule.

Key points for Maintenance of sampling Equipments

Maintain Tools and Identify when equipment requires maintenance.

- Regularly check all equipment
- Recognize and report unsafe equipment
- Identify and be aware of scheduled maintenance
- Be aware of manufacturer's instructions
- Use safety equipment and guards as instructed
- Report all equipment issues with supervisors

6.2. CLEANLINESS

Cleanliness is a high priority. To prevent contamination all sampling containers and equipment must be kept clean and in a good condition, fit to be used at all times. Pre-cleaned sample containers can be purchased from commercial suppliers and used for sampling, only under condition that the laboratory is familiar with its cleaning protocol.

cleaning of field equipment

The equipment or its parts that come into contact with the sample should be cleaned to avoid cross-contamination. The cleaning should be done before going into the field whenever possible.

Prior to the trip all visible particulate matter and other residue should be removed by washing the equipment accessible surfaces with phosphate-free laboratory grade detergent and hot water. A steam or high-pressure water washer can be used if possible to remove dirt or residue from the sampling equipment. In any case, an approved laboratory cleaning methodology for analyte of interest must be followed.

While in the field, if washing is needed, the sampling equipment should be scrubbed with detergent to remove all visible particulate matter and other residue, rinsed several times with tap water and than few more times with de-ionized water to remove detergent.

- Store tools and equipment
- Choose Correct conditions to store tools
- Store in an appropriate safe location in accordance to the correct conditions
- Store safely when transporting
- Consider the environment when cleaning equipment.
- Contaminants into waterways
- Wastage of water
- Recycling

Maintenance plan

A maintenance plan will include preventive maintenance procedures as well as provision for inventory, troubleshooting, and repair of equipment. When implementing an equipment maintenance program, some of the initial steps will include what follows.

- Assign responsibility for providing oversight.
- Develop written procedures for maintaining equipment, including routine maintenance plans for each piece of equipment. The plan should specify the frequency with which all maintenance tasks should be performed.

Develop the format for records, create logs and forms, and establish the processes to maintain records.

Equipment inventory

The laboratory should keep an inventory log of all equipment in the laboratory.

The log should be updated with information on new equipment, as it is added, and include documentation of when old equipment is retired. For each piece of equipment, the equipment inventory log should have a record of:

instrument type, make and model number, and serial number of the instrument, so that any problems can be discussed with the manufacturer;

date the equipment was purchased, and whether it was purchased new, used, or reconditioned;

Manufacturer/vendor contact information;

presence or absence of documentation, spare parts, and maintenance contract;

warranty's expiration date;

During the inventory, the condition of the equipment should be documented as:

Functional

partially functional, or

Non-functional. Equipment that is not functioning needs to be evaluated as to whether or not it can be repaired. Non-repairable equipment should be retired, and work should be scheduled for equipment needing repair.

Inventory of spare parts

To ensure that the laboratory does not run out of spare parts, an inventory record of those used most frequently should be kept for each piece of equipment. The record should include:

part name and number;

average use of the part, and the minimum to keep on hand;

cost;

date when the part is placed into storage, and when it is used (in and out stock log);

Quantity of each part remaining in inventory.

Equipment Maintenance Documentation

Equipment documents and records are an essential part of the quality system. Each major piece of equipment will have its own equipment maintenance document. Smaller, commonly used equipment such as centrifuges and pipettes may be managed with an equipment maintenance document or manual that deals with all such equipment in the laboratory. An equipment maintenance document should include:

Step-by-step instructions for routine maintenance, including frequency of performance, and how to keep records of performance; instructions for carrying out function checks, frequency of performance, and how to record the results;

directions for calibrating the instrument;

- guide for troubleshooting;
- any required manufacturer's service and repair;
- List of any specific items needed for use and maintenance, such as spare parts.
- date problem occurred, and when equipment was removed from service;
- reason for breakdown or failure;
- corrective action taken; including a note about any service provided by the manufacturer;

Self-Check – 6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Define the following terms (2 pts each)

1. maintenance
2. preventive maintenance

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

Score = _____

Rating: _____

Operation sheet 1 Gold in river sampling technique

How to test for gold in rivers:

1. look for a site in the river where gold should occur.
2. Using a spade, dig a sample from the area made up from 4-5 different spots.
3. Put the sample into a basin. Remove any large stones.
4. Pan the sample:
5. If you see many specs of gold, then this is a good place to mine!
6. If you don't see any gold, or only a few specs of very small gold, try testing another location. You may want to go farther upstream (in the direction where water is coming from).You can also use this method to help you find the rock source of the gold carried along in the river.

Lap Test 1

Using all necessarly steps show how to find gold in river steam sediment

_____
_____
_____
_____

LG #42	LO #3- Prepare samples

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Verifying, Checking, documenting sample and sampling equipment
- Performing sample preparation
- Containing loss of material and Protecting samples against contamination
- Recovering and cleaning samples
- Storing or disposing residues and samples

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Verify, Checke, document sample and sampling equipment
- Performe sample preparation
- Containe loss of material and Protecte samples against contamination
- Recover and clean samples
- Store or dispose residues and samples

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information Sheet 1- Verifying, Checking, documenting sample and sampling equipment

1.1. Sampling record

The type of data recorded will depend on the collection. Written record of the sampling operations carried out on a particular material for a defined purpose. The sampling record should contain the batch number, date and place of sampling, reference to the sampling protocol used, a description of the containers and of the materials sampled, notes on possible abnormalities, together with any other relevant observations, and the name and signature of the inspector.

1.2. Documentation

Documentation of sample collection efforts is important, Also, the interpretation of analytical results can be facilitated by an understanding of the conditions under which samples were collected. Most frequently, however, sample documentation in the form of field notes and sample labels verifies that samples were collected according to established SOPs.

1.3. Field Records

Field notes or logbooks that document a sampling event should include the following:

- Sample identification
- Sample location (sampling point)
- Type of sample (composite or grab, number of grab samples and, for continuous processes, the interval between grab samples; for composite samples, the number of grab samples collected and their relative weighting)
- Sampling equipment and a brief description of sampling procedure
- Date and time of collection
- Weather conditions

1.4. Sample Labeling

After a sample is collected, it is placed into a container or containers that are compatible with the intended analyses. Sample collection sheets or chain-of-custody sheets are

used to identify samples for analysis in the lab. However, sample containers themselves must be labeled to correspond to the information recorded on the custody sheet. Also, it is advisable that the sample containers be labeled in a manner that clearly identifies the sample without referring to the custody sheet. The following information should be included on container labels:

Sample identification

- Date and time of collection
- Sample type (grab or composite)
- Sample location
- Person collecting sample
- Preservative

1.5. Equipment Preparation and Cleaning

Before using sampling equipment for the first time and after every use, it must be thoroughly cleaned. Cleaning procedures may differ slightly, depending on the type of sampling equipment and the analysis to be performed.

Below is a generalized cleaning procedure that can be used to prepare sampling equipment between sampling events:

- Clean equipment with warm tap water to remove the majority of solids.
- Using a brush and standard low-phosphate lab detergent, scrub the equipment to remove all residues.
- After scrubbing, triple rinse the equipment with tap water.
- For the final rinse, triple rinse with deionized water.

Cleaning equipment:

- Disposable towels
- Soap, such as a low-phosphate laboratory detergent
- Scrub brush
- Rinse water
- Deionized water
- Tarp or plastic sheets

- Foil or other protective wrap

Equipments	preparation
Crusher: breaking large pieces of solid material into small lumps .	Check: function Oil, greas, clean and others
Grinder: grinders-grinders reduce crushed feed to powder Ball mill	Check, function, Oil,greas, clean
Splitter: After crushing, a smaller portion of the crushed material is split or selected for pulverizing.	Clean
sieve **Size of the Screen:** It is the distance between two consecutive wires.	clean
Coning & Quartering Coning and Quartering consists of manually flattening out a heap of material and dividing it into quarters.	

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I short answer

1. List Cleaning equipment for sampling equipments(3)
2. List the information sample container labels(3)

Note: Satisfactory rating - 4 points Unsatisfactory - below 4 points

Score = _____

Rating: _____

Information Sheet 2-Performing sample preparation

2.1. SAMPLE PREPARATION

Unlike gases and liquids, which generally require little sample preparation, a solid sample usually needs some processing before analysis. Sample preparation includes crushing, grinding, splitting, sieving, coning and quartering process to reduce the sample into a form suitable for chemical analysis.

Reducing Particle Size (comminution)

A reduction in particle size is accomplished by a combination of crushing and grinding the gross sample. A variety of tools are used depending on the particle's size and hardness. Large particles are crushed using jaw crushers capable of reducing particles to diameters of a few millimeters. Ball mills, disk mills, and mortars and pestles are used to further reduce particle size

Blake Jaw Crusher: A jaw crusher has 2 jaws said to form a V-shaped at the top through which feed is admitted. One of the jaws is fixed in to the main frame and other is movable.

Roll crusher: Roll crusher consists of pair of heavy cylindrical rolls revolving towards each other

Splitting

After crushing, a smaller portion of the crushed material is split or selected for pulverizing. If due care is not taken, splitting during sample preparation can result in a sub-sample that is not representative of the primary sample.

Sub Sample preparation methods

- Coning and Quartering
- Sample Splitters

These are often called riffle or chute splitters, and a typical splitter is shown in Figure below. These consist of a series of chutes that run in alternating directions, so that when material is poured into the top of the splitter, it flows through the chutes and is randomly divided into two equal-sized fractions.

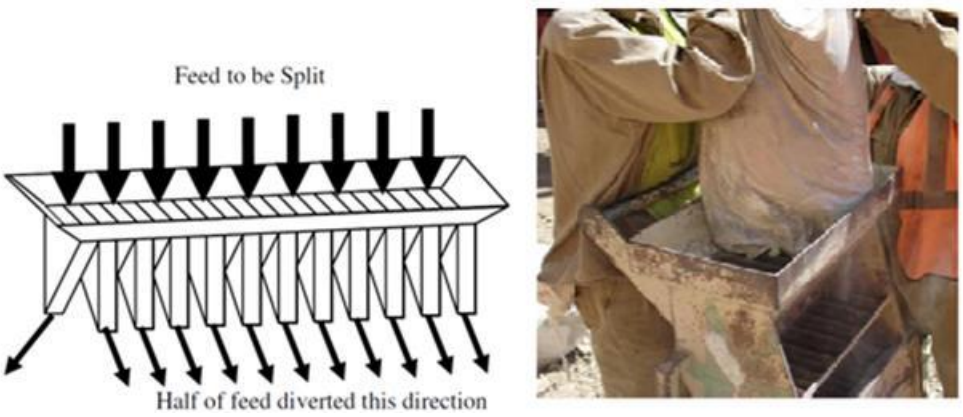


Figure 8.samplespliter

Magnetic Separator

It is a technique which is used to separate the mineral particles from gangue particles on the basis of its magnetic properties. Actually there are three types of magnetic materials,

1. Ferro magnetic – strong magnetic field
2. Para magnetic – weak magnetic field
3. Dia magnetic – no magnetic field
4. Shut down the process

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I Define the following

1. Sample splitter
2. Magnetic separator
3. Rotary riffle

Note: Satisfactory rating - 3points Unsatisfactory - below 3 points

Score = _____

Rating: _____

Information Sheet 3-Containing loss of material and Protecting samples against contamination

3.1. Containing loss of sample

General procedures for preparing solid samples (such as drying, obtaining a constant weight, grinding, sieving, mixing, and sub sampling), considerations should be taken to minimize sample losses and to prevent contamination. for sample preparation to avoid sample loss and sample contamination. Due to the physical nature of the matrix, sample preparation for solids requires the most attention.

Potential Sample Losses During Preparation Materials may be lost from a sample during laboratory preparation. The following sections discuss the potential types of losses and the methods used to control them.

Losses as Dust or Particulates: When a sample is dryashed, a fine residue (ash) is often formed. The small particles in the residue are resuspended readily by any air flow over the sample. Air flows are generated by changes in temperature (e.g., opening the furnace while it is hot) or by passing a stream of gas over the sample during heating to assist in combustion.

These losses are minimized by: ashing samples at as low a temperature as possible, gradually increasing and decreasing the temperature during the ashing process, using a slow gas-flow rate, and never opening the door of a hot furnace. If single samples are heated in a tube furnace with a flow of gas over the sample, a plug of glass or quartz wool can be used to collect particulates or an absorption vessel can be used to collect volatile materials. At a minimum, all ash or finely ground samples should be covered before they are moved.

Solid samples are often ground to a fine particle size before they are fused or wet ashed to increase the surface area and speed up the reaction between the sample and the fluxing agent or acid . Since solid samples are frequently heterogeneous, a source of error arises from the difference in hardness among the sample components. The softer

materials are converted to smaller particles more rapidly than the harder ones, and therefore, any loss in the form of dust during the grinding process will alter the composition of the sample. The finely ground particles are also susceptible to resuspension.

Samples may be moistened carefully with a small amount of water before adding other reagents. Reagents should be added slowly to prevent losses as spray due to reactions between the sample and the reagents.

Losses Through Volatilization Some radionuclides are volatile under specific conditions (e.g., heat, grinding, strong oxidizers), and care should be taken to identify samples requiring analysis for these radionuclides. Special preparation procedures should be used to prevent the volatilization of the radionuclide of interest.

The loss of volatile elements during heating is minimized by heating without exceeding the boiling point of the volatile compound. Ashing aids can reduce losses by converting the sample into less volatile compounds. These reduce losses but can contaminate samples. During the wet ashing process, losses of volatile elements can be minimized by using a reflux condenser. If the solution needs to be evaporated, the reflux solution can be collected separately. Volatilization losses can be prevented when reactions are carried out in a properly constructed sealed vessel.

Field Spikes

Field spikes are samples collected in the field and spiked with compounds of interest or related compounds. These samples are used to check on the potential for loss of analyte on shipping and for recovery of analytes from a particular medium. The field spike is prepared by adding a known amount of the spiking material to a known amount of the matrix and mixing thoroughly prior to closing and sealing the sample container. Field spikes are normally not required but may be desired where preservation techniques are in question and the integrity of analytes at the laboratory is not known, when there is a question concerning matrix effects, and when the results from the analytical laboratory for a particular analyte or class of analytes are in question.

Field spikes should be submitted blind to the laboratory in the same manner as outlined for the split samples. These samples should be carried through all stages of the sampling and sample handling process as the actual study samples to ensure that they truly indicate the integrity of the samples collected.

Sample contamination

The possibility of a sample contamination is always present. A contaminated sample is considered useless and contamination between containers, tools and equipment could become a big issue during sample preparation. Samples that do not require the addition of preservative must be kept tightly capped and out of contact with anything that may cause contamination.

Possible sources of contamination include:

Cross-contamination: is the contamination of one sample by another sample that is being processed concurrently or that was processed prior to the current sample leaving a residue on the equipment being used. Simply keeping samples covered whenever practical is one technique to minimize cross-contamination.

Airborne; airborne contamination is most likely to occur when grinding or pulverizing solid samples. Very small particles (~10 µm) may be produced, suspended in air, and transported in the air before settling onto a surface. Therefore, the grinding or pulverizing of solid samples or the handling of samples that could produce airborne contamination should be carried out under a laboratory hood or ventilated enclosure designed to prevent dispersal or deposition in the laboratory of contaminated air particulates.

Equipment; Samples may be contaminated by:

- Inappropriate containers or equipment,
- Dirty container caps,
- Containers that have not been properly cleaned,
- Loosely or improperly capped containers,
- Contaminated preservatives,
- Cross-contamination introduced by sampling equipment,

- Exposure to open air, which may contain various vapours,
- Poor sampling techniques.

As preventive measures,

Samples should not be stored in containers whose origin is not known to the field sampler.

The sample containers should be sealed tightly and stored in clean areas.

Sampling containers and other sampling equipment should never be stored near solvents, gasoline, or other volatile substances that might cause contamination.

Sampling equipment should remain in wrapping material until it is used in the field. It must be decontaminated according the appropriate protocol when transferred between sampling sites.

Disposable gloves should be worn at all times when handling preservative, sample containers and sampling equipment.

Cleanliness: Cleanliness is a high priority. To prevent contamination all sampling containers and equipment must be kept clean and in a good condition, fit to be used at all times. Only under condition that the laboratory is familiar with its cleaning protocol.

Self-Check – 3	Written test

Name…… ID……. Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

I. Define the following terms

1. Sample contamination
2. List source of sample contamination
3. Loss of materials
4. Field spikes

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

Score = _____

Rating: _____

Operation Sheet 4– Recovering and cleaning samples

4.1. Cleaning samples

Exclusion of material by size and composition

During solid preparation, some particles may be identified in the sample that is not a part of the matrix. Examples of such particles are rocks and pebbles or fragments of glass and plastic. Depending on the specific procedures given in the planning documents on the constitution of the sample taken, sample that are not a part of the matrix can be removed and analyzed separately if desired. The sample should be weighed before and after any material is removed. Other materials that are not a part of the required matrix can also be removed and analyzed separately. If analysis of the material removed is necessary, applicable SOPs should be used to prepare the material for analysis.

exclusion of organic material

Leaves, twigs, and grass can easily be collected inadvertently along with samples of soil or sediment. Because these are not usually intended for analysis, they are often removed and stored for future analysis, if necessary. The material removed should be identified, if possible, and weighed.

- Percent recovery

Percent recovery describes the capability of the method to recover a known amount of analyte added to a sample. This is the most realistic and useful term to be applied to the daily quality control of the analytical performance. Spike the sample with a known quantity of the analyte such that the combined added and suspected natural concentration of the analyte is within the working range of the method. The longer the residence time of the spiked analyte before extraction or digestion, the closer is the simulation in recovering the analyte from the natural sample. Calculate the percent recovery as follows.

% Recovery = ((c-a)/b)x100

where: a = natural concentration of analyte determined in the sample

b = concentration of analyte added to the sample

c = concentration of analyte determined in the spiked sample.

Note: If a is known beforehand, c should be approximately twice a, or b should be approximately equal to a.

In general, at least 80 % recovery should be achievable from a reference method. Lower recoveries may be expected for low concentrations of analytes.

4.2. Recovering

After core loss zones have been identified, the actual amount of recovery made during each drilling segment should be made. Recovery is expressed as the percentage of actual core return, as compared to the actual depth drilled. To get a valid figure for recovery, both the distance cored and the core length must be carefully measured and not be left to casual driller observations. The percentage recovery can be calculated using the following equation:

Self check 4	Writen test

Name…… ID…… Date……

I. Define the following

1. Sample recovering

2. sample cleaning

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Score = _____

Rating: _____

Operation Sheet 5–Storing or disposing residues and samples based on OHS and environmental guidelines

5.1. Introduction

Each of the ore-mining and-processing steps can generate mining wastes. This waste generally has different physical and chemical properties, resulting in different potential environmental impacts. Residual wastes which cannot be used by any means should be disposed properly.

5.2. Disposal of Materials by using 3R

To reduce waste problems in future, reduction in waste generation and re-use of old products and possible reduction at the consumption level include better buying habits and cutting down on the use of disposable products and packaging. The following 3R are mostly used in waste prevention methods

Reduce: Buy only what you need because a better way to reduce waste is by not creating it.

Reuse: If you have to acquire goods, try getting used ones or obtaining substitutes.

Recycle: When discarding your waste, find ways to recycle it instead of letting it go to landfill.

Solid Waste from Mines

Waste rock and tailing, no matter which kind of development program was utilized in a mine, are the upper most solid waste in the duration of exploitation of mineral resource. The discharging of waste rock and tailings has large portion of mine land use and higher safety requirements. Simultaneously, it also brings great destruction to the mine area environment.

Waste rock: – Waste rock is one of the maximum solid wastes occurred in the mining industry. In order to extract ore, large amount of rock is stripped or excavated and transported to the waste-rock dump.

Tailings-: Tailings are the major solid wastes produced in the process of mineral beneficiation. In order to extract usable minerals, ore was crushed and milled to

appropriate size, then, the usable minerals were separate from unusable minerals via different beneficiating methods

5.3. Reclamation of Solid Wastes

Utilization of waste rock for construction

Waste rock results from stripping in an open-pit or excavation of an underground mine. Usually, according to the difference utilities of waste rock, it could be used directly or dressed to various sizes for using.

The following embodies utilization methods of waste rock:

- A very good material for construction of roads. The coarser size waste rock can be used for Sub grade building and the fine size for road surface paving;
- A very good material for construction of dams;
- A very good material for beneficiating coarse and fine aggregate of concrete;
- It could be used for making construction bricks when beneficiated to suitable size; and To backfill the mined out area, subsidence area and other area needed to be filled.

5.4. Utilization of tailings for construction

The usages of tailings as construction material are described as following:

- Used for making wall bricks and floor tiles for construction;
- Used for filling depressions, the mined out area or subsidence area;
- Used for improving of the soil; and
- Separating out coarser size for fine aggregate of concrete and building sand usage.

Recycling usable minerals: With the development of mineral processing technology, it becomes possible that the usable minerals in tailings could be recycled.

Backfill mined out area: Waste rock and tailings could also be used in the backfill mined area of a mine in transition from open-pit to underground mining. Backfill the mined area is not only significant to the environmental restoring and improving the mining condition, but also a good idea of disposal method on solid waste from mines.

Regeneration of ground vegetation: The investigation result shows that vegetation planted on the surface of iron tailings was not only propitious to tranquilizing and reducing soil erosion but also enhancing growth of vegetation.

Producing glass or fertilizer: According to the varieties of mineral composition in tailings of different mine, tailings could be used to produce glass or fertilizer

Self check 5	Writen test

Name…… ID…… Date……

Part 1. Short answer

What is the meaning of the following terms

1. Recyle
2. landfill
3. Reuse
4. Reduce
5. Waste
6. Hazard

Note: **Satisfactory rating - 4points** **Unsatisfactory - below 4 points**

Score = _____

Rating: _____

LG #43	LO #4- Prepare samples for dispatch

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Labeling, storing and transporting samples to maintain integrity of sample
- Using appropriate reference materials, standards and controls
- Protecting samples against contamination
- Documenting and filing any change to preparation methods
- Forwarding samples for analysis
- Storing, testing and disposing samples

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Labele, store and transporte samples to maintain integrity of sample
- Use appropriate reference materials, standards and controls
- Protecte samples against contamination
- Documente and file any change to preparation methods
- Forward samples for analysis
- Store, teste and dispose samples

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Operation Sheet 1-Labeling, storing and transporting samples to maintain integrity of sample

1.1. Holding time

Holding time is the maximum time allowed between collection and the moment when sample preparation or analysis on that sample must begin. Turnaround time in addition is the length of time it takes from when a sample is received by the laboratory to the time when a result of analysis is issued. Correct handling of sample and prompt delivery is essential in order to obtain the best quality of analytical results.

1.2. Transport and storage of samples

Procedures for handling the sample during transport will depend on the nature of the sample matrix and the target analytes. After removing a sample from its target population, its chemical composi¬tion may change as a result of chemical, biological, or physical processes. To prevent a change in composition, samples are preserved by controlling the solution's pH and temperature, by limiting its exposure to light or to the atmosphere, or by adding a chemical preservative. After preserving a sample, it may be safely stored for later analysis. The maximum holding time between preservation and analysis depends on the analyte'sstabil¬ity and the effectiveness of sample preservation.

As preventive measures, samples should not be stored in containers whose origin is not known to the field sampler. The sample containers should be sealed tightly and stored in clean areas. Sampling containers and other sampling equipment should never be stored near solvents, gasoline, or other volatile substances that might cause contamination.

1.3. Sample labeling

The sample collection process should be co-ordinated with the laboratory. Analysts need to know how many samples will be arriving, the approximate time of arrival and the analyses that are to be carried out, so that appropriate quantities of reagent

chemicals can be prepared. Each sample container must be provided with an identification label on which the following information is legibly and indelibly written:

- Name of the study.
- Sample station identification and/or number.
- Sampling depth.
- Date and time of sampling.
- Name of the individual who collected the sample.
- Brief details of weather and any unusual conditions prevailing at the time of sampling.
- Record of any stabilizing preservative treatment.
- Results of any measurements completed in the field.

Self check 1	Writen test

Name…… ID…… Date……

Part 1. Short answer

Define the following(6pts)

1. Sample labeling
2. Sample storing
3. Sample handling

Note: **Satisfactory rating - 4points** **Unsatisfactory - below 4 points**

Score = _____

Rating: _____

Operation Sheet 2-Using appropriate reference materials, standards and controls

2.1. Reference material

Reference materials: are used to assess a measurement method. More specifically, reference materials are used to assess the accuracy (bias) of the measurement process.

- References
- Information sources,
- Sampling media background,
- Sampling protocols and procedures,
- Sampling tests and equipment protocols,
- Laboratory certifications.

2.2. QUALITY ASSURANCE /QUALITY CONTROL PROGRAM

Quality Assurance (QA)/Quality Control (QC) is a program designed by the laboratory that specifies the methods and procedures required to produce measurement-based, technically valid, legally defensible and known quality information. The QA/QC activities are designed to evaluate precision and accuracy of the sample collection and analysis and to ensure that any problems that may occur are quickly identified and rectified.

The QA/QC Program has two components:

2.2.1. Quality Assurance (QA): describes the overall measures that a laboratory uses to ensure the quality of its operations. It is designed to evaluate the precision and accuracy of the sample collection, laboratory analysis and potential sources of contamination encountered during sample collection and delivery to the laboratory.

2.2.2. Quality Control (QC): is part of the overall QA. It consists of operational techniques and activities that are used to fulfil requirements for quality. An effective QA/QC Program is essential for any laboratory seeking accreditation according to ISO/IEC 17025 Standard and CALA accreditation program.

2.3. QUALITY ASSURANCE MANUAL

The QA/QC Program should be defined in a written document called Quality Assurance (QA) Manual as a top tier of the document hierarchy. The manual should describe the approaches to achieve quality data and address any differences in handling between process control samples, compliance samples and samples headed to court. It should also include policy statements describing the intent and goal of the laboratory to conform to ISO/IEC 17025 Standard requirements. The quality policy statement should be written by senior management. The QA Manual which is to be reviewed and updated regularly should include the following topics:

- Laboratory organization and responsibility,
- Field sampling procedures,
- Laboratory sample handling procedures,
- Standard Operating Procedures for each analytical method used,
- Quality control procedures,
- Data reduction, validation, and verification,
- Preventative maintenance procedures,
- Laboratory audits,
- Corrective actions,
- Recordkeeping procedures,
- Proficiency testing.

Self check-2	Writen test

I. Define the following(2pts each)

1. Quality control

2. Quality assurance

3. Reference materials and example

Note: **Satisfactory rating – 5points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 3- Protecting samples against contamination

3.1. Introduction

The possibility of a sample contamination is always present. A contaminated sample is considered useless and contamination between containers, tools and equipment could become a big issue during sampling. Samples that do not require the addition of preservative must be kept tightly capped and out of contact with anything that may cause contamination. Samples may be contaminated by:

- Inappropriate containers or equipment,
- Dirty container caps,
- Containers that have not been properly cleaned,
- Loosely or improperly capped containers,
- Contaminated preservatives,
- Cross-contamination introduced by sampling equipment,
- Exposure to open air, which may contain various vapors,
- Sloppy sampling techniques.

Procedures can be established to minimize the potential for contamination. This may include:

- work practices that minimize contact with potential contaminants;
- using remote sampling techniques;
- covering monitoring and sampling equipment with plastic, aluminum foil, or other protective material;
- watering down dusty areas;
- avoiding laying down equipment in areas of obvious contamination;
- use of disposable sampling equipment.

3.2. Decontamination Methods

All samples and equipment leaving the contaminated area of a site must be decontaminated to remove any contamination that may have adhered to equipment. Various decontamination methods will remove contaminants by:

- physical action
- Chemical complexion to inactivate contaminants by neutralization, chemical reaction, disinfection, or sterilization.

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

Abrasive Cleaning Methods

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

- **Mechanical**

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

- **Air Blasting**

Air blasting equipment uses compressed air to force abrasive material through a nozzle at high velocities. The distance between nozzle and surface cleaned, air pressure, time of application, and angle at which the abrasive strikes the surface will dictate cleaning efficiency.

- **Wet Blasting**

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

- **Non-Abrasive Cleaning Methods**

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

- **Low-Pressure Water**

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

- **High-Pressure Water**

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

- **Rinsing**

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

- **Damp Cloth Removal**

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

- **Disinfection/Sterilization**

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

Self Check 3- Writen test

Part 1. Short Answer

1. How do we Protect soil samples against contamination?(3Pts)
2. List the possible source of contamination.(3 Pts)

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

Score = _____

Rating: _____

Information sheet 4-Documenting and filling any change to preparation method

4.1. Site recordings

Proper documentation of all site activities is an integral part of sampling and field investigation. In a written form, the field sampler keeps accurate notes as an inclusive documentation of sampling operations including field data, observations, field equipment, sample handling and chain of custody forms. All notes should be made at the time or as soon as possible thereafter. Whenever possible, the notes should be written in waterproof ink and kept by one person.

The chain of custody Field Sampling Data Sheet (also Field Logbook or Sample Journal) in which all field measurements should be entered directly while in the field is mandatory in the legal sampling procedure. The field sampler must note all unusual occurrences (e.g. unusual colour or odor, surface films) and any deviations from standard protocols (e.g. sample is taken from a different location due to safety or access considerations or sampling procedures differ from the set protocol). Preservation of the sample consistent with the type of analysis that will be performed as well as additional samples, if collected, and for what purposes should also be recorded.

Calibration, cleaning, repair log for on-line analyzers; sample condition; this may include the presence of slush and/or ice chips during the winter any other relevant information. Any sampling malfunctions/problems which may impact sample analysis must be communicated to the laboratories performing the analysis.

4.2. Chain of Custody Procedures

The purpose of chain of custody (COC) procedures is to permit traceability from the time samples are collected until all data has been generated. The procedures are intended to document sample possession from the time of collection and disposal. This practice provides documentation during each step, that is, during shipping, storage, and during the process of analysis. A COC is necessary if there is any possibility that analytical data or conclusions based upon analytical data will be used in litigation. This possibility is assumed to exist on every FDGTI project. Therefore sampling COC

procedures must be followed during every sampling event, and the information contained on the COC must accurately represent the sample collection information and the associated analytical requests.

4.3. Sampling record

Written record of the sampling operations carried out on a particular material for a defined purpose. The sampling record should contain the batch number, date and place of sampling, reference to the sampling protocol used, a description of the containers and of the materials sampled, notes on possible abnormalities, together with any other relevant observations, and the name and signature of the inspector.

4.4. Field Notes importance

- Not writing down your observations could result in missed data being recorded and lead to inaccurate conclusions about the rocks being studied.
- Field notes allow you to write down descriptions of fossils, minerals, or rocks while they are being collected. This saves time
- Sketches are also helpful in interpreting geologic events. Field notes can be a legal document, and must be saved for future reference.
- Record date, time, location, who, weather, Describe locality, Sketch, Photographs Location, Direction, Description , Other notes, comments, future work
- Collect samples Date, Location, Photograph, Description, Purpose of sampling

Field log: Information recorded in the Field Log Book should include, but is not limited to:

- Name and address of site,
- Name and address of field contacts on site ,
- Date and time of arrival at, and departure from the site ,
- Purpose of sampling ,
- Site information ,
- References (site drawings, photographs) ,
- Description of sampling point , Method of sample collection ,Record of where samples were taken.

Self check-4	Writen test

I. Define the following

1. Sample documentation activities
2. Chain of custody

Note: **Satisfactory rating - 3points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 5- Forwarding samples for analysis

5.1. Sample Packaging

The CoC record should accompany all sample shipments. Custody seals should be signed and dated at the time of use. Sample shipping containers should be sealed in as many places as necessary to ensure that the container cannot be opened without breaking a custody seal. Tape should be placed over the seals to ensure that seals are not accidentally broken during shipment. If the sampler transports the samples to the laboratory without sample shipment, custody seals are not required.

5.2. Transfer of Custody

When transferring the possession of samples from the field sampler to a transporter or to the laboratory, the sampler should sign, date, and note the time as “relinquished by” on the CoC record. The receiver should also sign, date, and note the time as “received by” on the CoC record. The date and time of the receiver and relinquisher should be the same.

5.3. Laboratory Custody Procedures

A designated sample custodian should accept custody of the shipped samples and verify that the sample identification number matches the CoC record. Pertinent information about shipment, pickup, and courier should be entered in the “Remarks” section. The temperature of the temperature blanks at the time of receiving should be noted on the CoC record.

Self check 5	Writen Test

I. Define the following

1. Sample packaging_____

_____

2. Field custody_____

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Information 6 Storing, testing and disposing of samples

6.1. Sample containers

The size and type of sample to be taken will determine the type of sample container required.

- For volatile organic compounds, use bottles or vials with Teflon lined screw caps or stoppers which can be closed to provide a gas-tight seal.
- For semi-volatile or non-volatile organic compounds, use glass jars with a stoppers or Teflon lined screw caps.
- For inorganic compounds such as heavy metals, use polyethylene or glass containers.

6.2. Storing

Rock and Concrete Core Samples obtained in the field should be handled in a manner that meets the needs and purpose of the exploration program, site conditions and the available mode(s) of transportation. For example, freezing conditions in the winter or direct sunlight and heat in the summer may have detrimental effects on the samples for use in specific tests. Therefore, a plan that is carefully thought out (including technical and common sense issues) and implemented is needed to handle the samples from the time they are retrieved to when they are delivered to the various users of the samples.

Figure below, Small scale example of a sample covered with plastic wrap and then enclosed by two clear plastic half rounds and plastic caps and all open joints between the caps and half rounds sealed with clear, non-porous tape that is not affected by moisture. Any open space between the ends of the sample space inside the half rounds may need to be filled to prevent moisture and/or mechanical damage to the sample too.

Figure 9 Sample container

Self check 6- Writen test

Short answer

1. What is sample container?
2. What conditions necessarily to be addressed in storing sample?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Score = _____

Rating: _____

LG #44	LO #5- Maintain a safe work environment

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Using established work practices and personal protective equipment
- Minimizing environmental impacts of sampling and generation of waste
- Disposing wastes

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Use established work practices and personal protective equipment to ensure personal safety and that of others
- Minimize environmental impacts of sampling and generation of waste
- Dispose All wastes of in accordance with enterprise procedures

Learning Instructions:

6. Read the specific objectives of this Learning Guide.
7. Follow the instructions described below.
8. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
9. Accomplish the “Self-checks” which are placed following all information sheets.
10. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Operation Sheet 1-Using established work practice and personal protective equipment

1.1. Introduction

Surface mine means an excavation in the earth conducted above ground (open-pit mine) for the purpose of opening-up, proving or producing any mineral from a natural deposit. It includes all facilities belonging to or used in connection with the mine.

Mining authority: means a government institution that is responsible for all or any part of occupational safety and health in mining.

Mine operator: means any individual or organization who operates, controls or supervises a mine, as an owner or lessee.

Hazard: means the potential to cause injury or damage to the health of people.

Risk means the likelihood that something will occur causing injury or damage to the health of people.

1.2. Requirements for employment in surface mines

Work in a surface mine often has to be performed in a hostile and dangerous environment. It can be made safe and productive by continual human effort. Such efforts cannot succeed unless all workers have certain skills and a good knowledge of possible hazards and risks.

It is there f o re vital to have competent and experienced persons who should be constantly on the site of the mine to supervise and control the operations and carry out regular inspections. Each newly recruited mineworker should receive instructions, guidance and supervision in their respective work from the supervisor and adequate on-the-job training before being starting work. This instruction should include:

- Introduction to the working environment.
- Health and safety aspects of the task to be assigned.
- Hazard recognition and avoidance.
- Hazards relating to explosives.
- Ground control and working in areas of high walls.

- Hazards of machinery and equipment.
- Basic knowledge of first aid.

1.3. Obligations of mineworkers

No mineworker should take any action at work which could cause danger to other workers, damage to mining equipment or obstruct production. Every worker should fully comply with rules or instructions issued by the mine operator and should make proper use of and take reasonable care of any personal equipment provided for his protection.

Action to prevent danger: Every mineworker while at work should:

- Take reasonable care for the safety and health of himself or herself and of other persons who may be affected by their acts or omissions.
- Comply with instructions given for his own safety and health and those of others.
- Report immediately to the supervisor any situation which he or she considers hazardous and which he or she cannot correct them.
- If this measure cannot be taken, the mineworker should immediately warn all workers who could be in danger.
- Report any accident, injury or dangerous occurrence which arises in the course of or in connection with work.
- Standard working procedures (SWPs) provide information to assist workers to perform tasks safely. They include:
- describing how the work is carried out
- identifying the work activities assessed as having safety or environmental risks
- stating what the safety and environmental risks are
- describing the control measures that will be applied to the work activities
- describing how measures will be implemented to undertake the work in a safe and environmentally sound manner
- outlines the legislation, standards and codes to be complied with and
- Describing the equipment used in the work, the qualifications of the personnel undertaking the work and the training required to undertake the work in a safe manner.

- Personal Protective Equipment (PPE)

All personal protective equipment is to be selected based upon the hazards identified during the risk assessment process of the activity to be undertaken. Personal Protective Equipment shall be fitted properly, be comfortable and provide the proper protection to the wearer. PPE that is not properly fitted to the individual worker is a hazard and will not provide the desired level of protection.

Face and Eye Protection Use when handling with hazardous chemicals; rock-cutting equipment etc.)	
Hearing Protection Noise level assessments must be conducted to determine the level of hearing protection required (s. 68 (2) of the OHS Regulations). Noise exposure to more than 85 dB over an eight hour period is not permissible and prolonged exposure may permanently damage a worker's hearing	
Protective Headgear When on drill sites and mine sites, approved CSA Type II hard hats shall be worn. A comfortable fit is necessary. Painting, piercing, or altering a hard hat can weaken it and is not permitted.	 Helmet

Gloves Gloves protect the hands from temperature extremes, corrosive materials, chemicals and cuts and scrapes. Gloves must properly fit the wearer so as not to create additional hazards.	
Footwear Safety footwear is designed to protect a worker's feet against injuries such as impact, compression, and puncture (s.80 (1) of the OHS Regulations).	
Respiratory Protection Various fumes and dusts may be produced and may have detrimental effects when inhaled. The proper respiratory protection equipment is chosen based on the hazard.	

Self check 1-

I. Define the following

1. Hazard_____
2. Risk assessment _____
3. PPE_____
4. OHS_____

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Score = _____

Rating: _____

Information sheet 2-Minimizing environmental impacts of sampling and generation of waste

2.1. Definition of key concepts

Environment: according to Marie-Louise Larsson, the legal definition of 'environment' must include: a) ecosystems and their constituent parts; b) all natural and physical resources; and c) the social, economic, aesthetic, and cultural conditions which affect the environment or which are affected by changes to the environment. (Marie-Louise Larsson, 2010)

Environmental Impact: The degree of change in an environment resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organization's activities or may be indirectly caused by them. (EPA, 2000)

Environmental impacts (operational sampling)

Mining and mining waste can affect the environment in a number of ways: physical properties, chemical and mineralogical composition or reaction, its volume and area covered, as well as the waste disposal methods employed. Some common impacts include:

- Disturbance of surface matter resulting in increased erosion risk;
- Contamination of site, ground water and environs caused by:
- Release of toxic elements used in mining, and
- Release of toxic by-products of mining;
- Air pollution from gaseous emissions;
- Loss of flora and fauna; and
- Increased risk of accidents.

2.2. Surface exploration

Airborne and ground-based geochemical, and geophysical surveys, line cutting, stripping, and trenching, road/trail building and or helicopter transport, bulk sampling are the main activities of exploration. Environmental impacts of surface exploration (sampling) are:

- Trail/road and trenching related erosion, Tree clearing during construction of paths of field trucks, Habitat disruption, Noise pollution, Landscape distraction
- Digging, trenching and excavation, quarrying, and use of explosives, Camp garbage
- Dissemination of diseases in the human, animal or vegetation populations with the moving vehicles and workers;
- Camp sites impact due to production of waste, used engine oil, packing garbage
- Mitigation of surface exploration impact
- Refilling pits and trenches to their initial situation.
- Minimize vegetation clearing along seismic lines
- By curving survey profiles around prominent trees,
- Using explosives instead of vibrosis,
- Limiting the radius of explosive effect on aquifers,
- Minimizing clearing trees at comp sites

3.1.2. Wastes

Mines generate large volumes of waste. Structures such as waste dumps, tailing impoundments /dams, and containment facilities should be planned, designed, and operated such that geotechnical risks and environmental impacts are appropriately assessed and managed throughout the entire mine cycle.

Solid wastes may be generated in any phase of the mine cycle. The most significant waste generating mining activities will likely occur during the operational phases, which require the movement of large amounts overburden and creation of rock waste and tailings. Other types of solid wastes, depending on the type of mining undertaken, may include leach pad waste, workshop scrap, household and non-process-related industrial waste, as wells as waste oils, chemicals, and other potentially hazardous wastes.

Waste Rock Dumps: Depending on the stripping ratio (in open pit mines), large quantities of overburden or waste rock often need to be removed to expose the mineral to be mined. The overburden and waste rock is often disposed of in constructed waste rock dumps.

Tailings: Tailings vary according to site constraints and the nature / type of the tailings. Potential environmental impacts may include groundwater and surface water contamination due to the generation of acid rock drainage (ARD) and metals leaching (ML) containing runoff / leachate, sedimentation of drainage networks, dust generation and the creation of potential geotechnical hazards associated with the selected management option. Tailings management strategies should consider how tailings will be handled and disposed of during operation, in addition to permanent storage after decommissioning.

- **generation of wastes**

Waste occurs in several stages of the mining process and throughout the life of the mine, from the first exploration drilling project to the last processed material before mine closure. Several types of waste are generated in a mine, but three types stand out with the largest volume: waste rock, tailings and mine water. In some cases, the mine uses certain chemicals such as cyanide in the processing stage. These chemicals often account for a small volume of the total waste, but can pose a large risk due to their high toxicity. Below follows a summary of the most important types of waste from mines.

- **Waste rock**

Waste rock is the rock that is excavated to reach the ore. The amount of waste rock that needs to be removed depends on the geometry and location of the ore body, along with the mining method used and the composition and stability of the rocks. The ratio between waste rock and ore production is called the stripping ratio. For example, a stripping ratio of 2:1 means that 2 tons of waste rock needs to be mined to mine 1 ton of ore. Generally, an open pit mine has a higher stripping ratio than an underground mine.

Waste rock is often stored close to the mine to minimize transports. The waste rock is deposited in piles or heaps.

The composition of the waste rock controls what elements can be released to the environment. Some elements are highly toxic even in small concentrations, for example mercury or some compounds of nitrogen such as ammonia, while other elements are less toxic but pose a threat in higher concentrations, for example zinc and copper. There are often different types of waste rock within a mine, some might be more harmful than others. One effective way of working with waste rock management is separation of different types of waste rock.

When water and air starts to break down the waste rock, called weathering, the elements can be released to the environment. A large block of rock weathers slowly as it has a low surface area while smaller pieces create higher surface areas, making them more susceptible to weathering.

Sulphide minerals are easily weathered in contact with oxygen. When supplied minerals break down, they can produce acid water. The acid water further speeds up the weathering of the minerals, called chemical weathering. The result is an acid water with high metal content, called acid rock drainage (ARD) or acid mine drainage (AMD) when in association with mines. When separating waste rock, the terms potentially acid generating rock (PAG, or acid forming rock, PAF) and non-acid generating rock (NAG, or non-acid forming rock, NAF) are often used.

- **Tailings**

As the ore gets processed and the valuable minerals get separated, fine-grained mineral sand remains as waste, called tailings. The amount of tailings that remain is controlled by what grade the ore is, meaning the percentage of valuable minerals in the ore. For example, if the grade of an ore is 1 percent copper, 99 percent of the total ore would be deposited as tailings. Iron ores generally have higher grades than supplied or gold ores, often going over 50 per cent or more. Less tailings are therefore generally produced in iron ore projects.

After separating the valuable minerals, the tailings are often pumped in a slurry through pipes to be deposited in a tailings storage facility (TSF) (also called tailings management facility, TMF). The pipes are equipped with spigots in several different places around the TSF to evenly distribute the tailings. The TSF is built especially for storage of the tailings and is designed for the location and the geology

Self check 2- Writen test

I. Define the following

1. Disposing wastes_____
2. Surface exploration _____
3. Wastes_____

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 3-Disposing wastes

3.1. Despose

The generated waste must be properly collected and stored, paying close attention to labeling, segregating according to chemical compatibility, and accumulating in a well-ventilated location. This location should be well labeled.

3.2. Waste Collection and Storage

- When generating or managing any chemical waste, appropriate personal protective equipment (PPE) must be worn, and engineering controls should be implemented as necessary.
- Collect and store chemical waste at or near the point of generation in a designated satellite accumulation area. This accumulation area should be well marked for easy identification.
- Chemical waste must be stored in compatible containers with closed and properly fitted caps.
- Waste containers must be labeled mentioning chemical compositions, the accumulation start date, and hazard warnings as appropriate. The institute's EHS office typically provides these required labels.
- Incompatible waste types should not be mixed and should be kept separate in order to avoid any reaction, heat generation, and/or gas evolution.
- Waste containers should be stored in secondary containers in a ventilated, cool, and dry area.
- In the central accumulation area, waste containers should be grounded to avoid fire and explosion hazards.
- Trained laboratory researchers who are most familiar with the waste generated should work with EHS to ensure proper waste management.

Self check 3- Writen test

I. Define the following

1. 5s_____
2. Types of waste _____
3. Dispose waste _____

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Score = _____

Rating: _____

Reference Materials

Book:

1. Sample collection manual, New York state department of environmental conservation, division of water, 1989.
2. gy, p.m. sampling of particulate materials: theory and practice; Elsevier: Amsterdam, the Netherlands, 1982;
3. Sample spiking and recovery calculation
4. USGS Safety and Health for Field Operations Handbook 445-3-H
5. http://www.usgs.gov/usgs-manual/handbook/hb/445-3-h.pdf
6. Environment compliance report dams at nsw mines
7. Gold technical training manual (federal democratic republic of Ethiopia ministry of mines, petroleum and natural gas federal November 2016)

WEB ADDRESSES

1. Soil sampling and methods of analysis (http://www.crcpress.com)

AKNOWLEDGEMENT

We would like to express our appreciation to the TVET instructors and experts of regional TVET bureau, TVET College, and Minister of mines Ethiopian geological survey and federal small and medium manufacturing promotion authority Federal Technical and Vocational Education and Training Agency (FTVETA) who made the development of this learning module with required standards and quality possible.

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