Mineral Resources Infrastructure Work

Level I

Learning Guide - 50

Unit of Competence: Operate Laboratory Machine and Equipment

Module Title: Operate Laboratory Machine and Equipment

LG Code: MIN MRI1 M14 0519 lo1-LG-50

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LO1. Plan and prepare

Instruction Sheet	Learning Guide 50

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

- Organizational policies and procedures in planning and preparation
- Environmental protection requirements
- Accessing, interpreting and applying relevant compliance documentation
- Obtaining, confirming and applying work instructions
- Obtaining, confirming and applying the site safety plan and Safety requirements
- Selecting Plant, tools and equipment
- Characterization of basic soil types
- Identifying, confirming and applying project environmental management plan
- Materials Safety Data Sheets (MSDS)and materials handling methods
- Job Safety Analysis (JSA)

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- access, interpretand apply compliance documentation relevant to operate laboratory machine and equipment.
- obtain, confirm and apply work instructions for the allotted task
- obtain, confirm and apply the site safety plan and organizational policies and procedures to the allotted task with safety requirements
- SelectPlant, tools and equipment to carry out tasks consistent with the requirements of the job
- confirm and apply The project environmental management plan to the allotted task with environmental protection requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 7.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” in page -.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Organizational policies and procedures in planning and preparation

1. **Concept of organizational policies and procedures**

Organizational policies and procedures establish the rules of conduct within an organization, outlining the responsibilities of both employees and employers. Organizational policies and procedures are in place to protect the rights of workers as well as the business interests of employers. Depending on the needs of the organization, various policies and procedures establish rules regarding employee conduct, attendance, dress code, privacy and other areas related to the terms and conditions of employment.

Employee Conduct Policies

An employee conduct policy establishes the duties and responsibilities each employee must adhere to as a condition of employment. Conduct policies are in place as a guideline for appropriate employee behavior, and they outline things such as proper dress code, workplace safety procedures, harassment policies and policies regarding computer and Internet usage. Such policies also outline the procedures employers may utilize to discipline inappropriate behavior, including warnings or employee termination.

Companies are increasingly paying attention to bullying behavior as a serious issue and beginning to adopt policies in this area as well.

Equal Opportunity Policies

Equal opportunity laws are rules that promote fair treatment in the workplace. Most organizations implement equal opportunity policies – anti-discrimination and affirmative action policies, for example – to encourage unprejudiced behavior within the workplace.

Attendance and Time off Policies

Attendance policies set rules and guidelines surrounding employee adherence to work schedules. Attendance policies define how employees may schedule time off or notify superiors of an absence or late arrival. This policy also sets forth the consequences for failing to adhere to a schedule. For example, employers may allow only a certain number of absences within a specified time frame. The attendance policy discusses the disciplinary action employees face if they miss more days than the company allows.

Substance Abuse Policies

Many companies have substance abuse policies that prohibit the use of drugs, alcohol and tobacco products during work hours, on company property or during company functions. These policies often outline smoking procedures employees must follow if allowed to smoke on business premises. Substance abuse policies also discuss the testing procedures for suspected drug and alcohol abuse.

Workplace Security Policies

Policies on security are in place to protect not only the people in an organization, but the physical and intellectual property as well. Policies may cover entrance to a facility, such as the use of ID cards and the procedures for signing in a guest. Equipment such as a company laptop or smartphone may need to be signed out.

2. Planning and preparing work

Planning and organizing work is a necessary part of an efficient and safe workplace. When a job is planned, it will have a better chance of running smoothly. You will regularly receive instructions on the jobs you need to perform.

The main elements of planning and organizing a job include:

- The tasks;
- Who is involved?
- The resources you will need to complete them;
- How long each task should take; and,
- Other information such as safety and advice for task completion.

Planning will assist you to achieve required outcomes and avoid work downtime. Planning and organizing work is the key to ensuring a safe, efficient and effective work output. If you are disorganized, chances are you will feel overwhelmed by your work. Time management is fundamental to organization.

It involves:

- Looking at the task to be completed;
- Working out the time it will take;
- Deciding on the type of equipment and materials to use;
- Delegating parts of tasks / services to others; and,
- Allowing for any possible problems or risks that might occur

Clear purpose

- In any job you must have a clear idea of what you are setting out to achieve.
- Get your priorities clear in your mind and if necessary write them down so you can carry them out easily. When being told what to do, just remember it is...

Setting Priorities

One of the first things you must do when given a work instruction is to be clear about what is required as the outcome. Once you know what you are expected to achieve you can work backwards and plan how to get it done!

As you look 'backwards' at the job, you need to think about what stages or small tasks (often called sub-tasks) need to occur to get the job done.

As you think of the sub-tasks you need to also consider in order or sequence you will complete these in. If you get the sub-tasks right but the order to do them in wrong, the job outcome will not be there! If you miss a sub-task, but get the order right for the ones you have, you'll still get the job wrong.

So, think carefully about what needs to be done in the smallest task possible to complete the job. Now arrange these sub-tasks in the correct sequence to achieve the results you and the boss want.

Self-Check -1	Written Test

Directions:what is Organizational policies and procedures? And how it can apply on lab equipment operation?

1. List out the main elements of planning and organizing for a job. (5 points)
2. Briefly explain the advantage of **Setting Priorities for a given work.** (3points)

Activity: Replacing a tap washer

You have been asked to replace a tap washer on a leaking tap within the work site. There are a number of sub-tasks that make up this job. Arrange the task in priority order as part of the planning for this job.

- Check new washer is seating correctly.
- Remove tap head.
- Replace washer assembly.
- Identify when it is the best time to turn off the water.
- Arrange to have the correct tools and the spare parts necessary for the job.

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Environmental protection requirements

3. Environmental protection

Environmental protection is the practice of protecting the natural environment by individuals, organizations and governments. Its objectives are to conserve natural resources and the existing natural environment and, where possible, to repair damage and reverse trends.

What is Environmental Law?

Humanity has been aware of its environment far longer than there have been laws to protect environments. Environmental law, or sometimes known as environmental and natural resources law, is a term used to explain regulations, statutes, local, national and international legislation, and treaties designed to protect the environment from damage and to explain the legal consequences of such damage towards governments or private entities or individuals. As we will explain in the next section, it covers many areas, all with the same purpose already described here. However, the term "environmental law" does not just cover government legislation. It can also describe a desire by businesses and other organizations, and their regulators to work towards improving ethical principles by setting regulation and industry standards for operating licenses. These are not "laws" per se but act as such within a regulatory framework. It can also apply a method of land management on a kind of understanding of acting responsibly and ethically.

Similarly, impact assessment is not always legally required, but the permission to develop, construct, modify or engineer can often be refused if one is not carried out. These are voluntary regulations rather than law conducted for the good of the environment and the local population. For various reasons, environmental law has always been a flashpoint of controversy. Debates often center on cost, the necessity of such regulations, and the age-old friction between government regulation and encouraging the market to self-regulate and do the right thing for the good of everyone. For example, the ongoing debate over the impact of certain pesticides in agriculture, greenhouse gas emissions are often a battle between the science and industry's attempts to muddy the science and government lobbying to roll back legislation. The other side of the debate is that current industry regulations and legislation are insufficient. Both sides regularly hold conferences to discuss aspects of environmental law and how they should go about getting them changed in their favor.

Whichever way we look at it, environmental law affects all of us - individual health, business activity, geographical sustainability, and the importance of preserving those for the future generations and economy.

Lab waste

Through the course of the lab operation there will be waste will be generated that can be harmful for the environmental. Laboratory waste is waste that is generated from laboratories in industry.In order to contain such problems government and organization place a set of requirements for proper disposal of such waste

The Environmental Policy of Ethiopia

The Environmental Policy of Ethiopia (1997) is the overarching policy for the environment and natural resource management in Ethiopia. It was developed to address an identified gap in the policy framework. The importance of sustainable development was recognised in national policy and laws however there was no overall comprehensive policy formulation to address the cross-sectoral and sectoral issues that concern the environment and natural resource management. The Environmental Policy addresses this by setting out specific policy directives for different sectors concerning the environment and natural resource management.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What kind of chemical can be drained using excessive water?
2. Why do environmental protection law encourage recycling in waste disposal ?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Accessing, interpreting and applying relevant compliance documentation

1. Compliance documentation (Accessing, interpreting and applying)

Compliance documentation are 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.

Hence, Compliance documentation" means specific documents or information including records, reports, observations and verbal responses required to verify compliance with standards by a facility or program.

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

Failing to follow and work correctly with compliance documents may lead you to lose your job. 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.

Examples of compliance documents

Compliance documents that you carry in a person sense would be a driver's license and an Adult Proof of Age Card.

On the next two pages are two types of workplace compliance documents.

The first one in purple is a pre-start inspection checklist for dump trucks and other heavy equipment. The second one (dark) is a light vehicle inspection form - this would be used on utes, four wheel drives, etc. Investigate both forms.

2. Legislation

Legislation are the formal rules and laws set by governments.

The following regulations, procedures, standards and safety considerations may apply to planning and organize your work activities:

- Mining Act and Regulations
- Environmental Protection Act
- Equal Employment Opportunity and Disability Discrimination legislation
- Employment and workplace relations legislation
- Duty of care
- Code of Practice
- Occupational Health and Safety legislation
- Ethiopian Standards
- Manufacturer's specifications and recommendations
- Site specific regulations and procedures

What is the difference between an Act and a Regulation?

An Act is passed by Parliament and provides the ***framework*** which deals with administration, management, inspection, areas of responsibility, duties and penalties, i.e. for Ministers, Inspectors, Mine Managers. Acts are LAW.

Regulations are an Act passed by Parliament and details the specific elements, such as regulations concerning the use and operation of mobile lighting plant, the levels of a specific chemical that can be found in the air within a mine, etc. They are the ***minimum standard*** to be complied with. Regulations are also law.

3. Common law

Common law is the set of laws that are formed, not from government (i.e. statute law), but from past judgments in courts and judicial decisions. The major common law that affects us all is that about individual obligation.

Every person owes an obligation. To discharge their obligation, each person must act in a manner, which shows consideration to other people and property, i.e. to act in a manner, which a reasonable person (with such training/and or experience) would consider fair, just and safe.

If you act negligently in an inadvertent manner, i.e. you do not think about how you act or the consequences, you will be liable. If you act negligently in a reckless or wilful manner, i.e. you deliberately decide to act in a manner, which is likely or calculated to cause damage/loss, you will be liable, and may be charged with a crime in certain circumstances (insurance does not cover you for such acts).

4.4. Employment conditions

Your employment conditions are set by the award that is used in your industry. The award outlines your hours of work, pay rates, leave entitlements, allowances, etc. Your position description will also outline what your employer's expectations are of you.

These are valuable sources of information during the planning phase of a work task ensure that you are working within your parameters of your obligations

5. Duties of workers

Through the awards, regulations and other forms of law broad expectations or duties of workers have been set. Any worker however regardless of the industry they work in or where they are working, has a common set of duties:

- Take reasonable care for his or her own health and safety.
- Take reasonable care that his or her acts or omissions do not adversely affect the health and safety of other persons.
- Comply so far as the worker is reasonably able, with any reasonable instruction that is given by the person conducting the business or undertaking to allow the person to comply with the relevant legislation.
- Co-operate with any reasonable policy or procedure of the person conducting the business or undertaking relating to health or safety at the workplace that has been notified to workers.
- Identify and report risks and hazards.
- Use or wear appropriate personal protective equipment.
- Not intentionally misuse or cause damage to equipment.

6. Being accountable

Accountability is defined as ‘‘being responsible to somebody or for something’’.

In a work sense, accountability is about being true to your word and meeting all of your responsibilities. It is also about being true to yourself and your personal expectations of doing a good job.

Accountability is an individual value. Real accountability cannot be forced; it must be voluntary. Your accountability is really up to you, but you will be judged by other workers and the bosses on how you demonstrate your accountability.

There are three elements to personal accountability:

7. Honesty

Be honest with yourself about your reasons and motivations for your actions.

Be clear about the consequences and accept them graciously.

Try this: Carefully listen to everything you say for one day. How many times do you lie or fudge the truth? This exercise in honesty can be difficult, but the results are surprising. We tell white lies a lot to make ourselves and others feel better. Try developing other skills, like tact and diplomacy, so that you can be honest but still be polite and kind.

8. Responsibility

Once you have gotten a handle on being accountable to yourself, begin accepting responsibility when and where it is deserved. At the same time, do not be afraid to assign responsibility if it truly belongs to someone else.

It can be hard to take the high road and be accountable for your actions, particularly if others around you don't choose the same path. It is not your place to preach or judge others, but you should act assertively and ask that they take responsibility for their actions.

9. Assertiveness

Assertiveness is a word we tend to use without really understanding what it means. We sometimes picture assertive people as being inconsiderate and very demanding. Rather, assertive people express their feelings, needs, and opinions in a forthright manner. However, they are not abrasive; that is the hallmark of the aggressive person.

Assertiveness is behavior that allows a person to express honest feelings in a straightforward way and to exercise personal rights without changing the rights of others. Assertive people feel positive about themselves and others. They are willing to give others a chance to be reasonable before using less positive tactics. They want to openly discuss problems based on facts and needs. Assertion is based on respect for you and respect for the other person.

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Discus what compliance documentation is? (4 points)
2. Discuss briefly the consequences of failing to follow and work correctly with compliance documents. (2 points)
3. What is the current legislation that covers the environmental protection within your state or territory?(2 points)
4. What is meant by the term 'obligation'?(2 points)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet- 4	Obtaining, confirming and applying work instructions

1. work instructions

A work instruction is a tool provided to help someone to do a job correctly. This simple statement implies that the purpose of the work instruction is quality and that the target user is the worker. Unfortunately, in many workplaces, today's work instructions have little connection with this fundamental focus. Factories have encumbered work instructions with content that has been added to satisfy auditors, lawyers, engineers, accountants and yes, even quality managers. We've piled on so much extraneous material that we've lost sight of the intended purpose of work instructions. General, A Work Instruction is a document that provides specific instructions to carry out an Activity. A Work Instruction is a step by step guide to perform a single instruction. A Work Instruction contains more detail than a Procedure and is only created if detailed step-by-step instructions are needed.

When planning any work you must take into account your duty of care obligations and the policy and procedures of your workplace.You must make sure your conduct is safe and does not place others at risk.The task requirements will be outlined in your work instructions for that job. Generally these instructions will be provided by your immediate supervisor, the team leader, site manager or other person in direct authority.

What's the difference between Policies, Procedures, Processes, and Work Instructions? If you find these documents slightly confusing, this tutorial will help explain the difference. First, let's start by defining what is a work instruction and where it's used. It's not easy to tell the difference as there is no official definition for Work Instructions. While the ISO has defined Procedures and Processes very clearly, it doesn't define what is a Work Instructions, which gives rise to some of the confusion.

Definition of a Work Instruction

Here are some definitions from the web. Some are from 'authorized' sources. Other are from ITIL, QA and SOP forums.

A DOCUMENT DESCRIBING SPECIFIC ACTIVITIES AND TASKS WITHIN THE ORGANIZATION. IT CONTAINS THE GREATEST AMOUNT OF DETAIL.

AS A COMPONENT OF A PROCESS, "DEFINES HOW ONE OR MORE ACTIVITIES IN A PROCEDURE SHOULD BE EXECUTED IN DETAIL, USING TECHNOLOGY OR OTHER RESOURCES. A WRITTEN DESCRIPTION OR INSTRUCTION COVERING EACH SIMPLE DETAILED STEP.

ITIL & Work Instructions

ITIL, which is used to manage service and support services, defines it as:

Work Instruction (ITILv3): A detailed set of instructions that describe exactly how a low-level activity must be carried out. For example, describing precisely how a Request For Change record is created in the Change Management software support tool.

Hierarchy of Procedural Documents

Another way to look at this is to consider all procedure documents, from SOPs to Work Instructions, as part of a pyramid.

- Work Instructions are the ‘‘how you address satisfying the SOP’’ documents.
- Standards state that you must have a documented procedure for conducting audits.
- SOPs/Procedures outlines how/when audits will be performed. Work Instructions go one level down and show the exact steps required to train the auditors, prepare the documents etc.

Difference Between Work Instructions and Procedures

Another way of looking at Work Instructions v Procedures is that:

Procedures describe:

- What is the activity is
- Who performs it
- When it is performed

Work instructions describe:

- How the activity is performed.

Example: You are to work on pipes running beside a mine access road. You need to cordon off an area where you will be working. You need to put up signs and barrier fences to warn others about the type of work being done.

Forms of instruction

Work instructions can be received by you or your work team in several different ways. The most common ways of receiving work instructions in a mining or construction workplace are:

Written documentation

A written document means a document with text that provides information on an official work related matter. It may include reports, memos, letters, manuals, service standards and directives.

Verbal instructions

Verbal instructions are the instructions, directions and orders that are given to you through voice, i.e. the boss tells you what to do!

Team meetings

A team meeting is when the members of your work team are gathered together to receive instructions about the work tasks, report back on the team's progress on various jobs and to learn about what is happening in the immediate future on the work site.

Plans / specifications

All the drawings and documents detailing a job including the construction, mechanical and electrical drawings as well as a list of all the materials required. It would also include written instructions to the builder for materials, workers or team leader.

What's in a work instruction?

Work instructions should provide employees with the following basic information:

- The purpose of the job
- The work activity to be done and sequence of tasks
- Hazard assessment
- Emergency requirements
- PPE requirements
- Time frames
- Priorities

Self-Check -4	Written Test

Directions:what is the difference between procedure and work instruction?

1. List at least four forms of instruction and discuss for each. (4 points)
2. List some basic information that work instruction should provide to employee. (4 points)

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Obtaining, confirming and applying the site safety plan and Safety requirements

1. Laboratory Safety Plans

‘‘Laboratory Safety Plans’’ for individual laboratories are required by the Occupational Safetyand Health Administration (OSHA) regulation, ‘‘Occupational Exposures to Hazardous Chemicals in Laboratories,’’ commonly referred to as the OSHA Laboratory Standard. This standard requires a written plan that sets forth procedures, equipment, personal protective equipment and work practices capable of protecting employees from health hazards presented by the chemicals used in the laboratory. At typical laboratory the complete lab safety plan consists of two components:

- The Laboratory Safety Manual, which covers general safety procedures for organization laboratories,
- And a ‘‘Laboratory Safety Plan’’ prepared by the Principal Investigator to address hazards and precautions specific to a given laboratory.

The ‘‘Laboratory Safety Plan’’

- identifies the hazards in the laboratory
- describes specific handling procedures and precautions for special hazards
- outlines emergency safety procedures in the event of a fire or chemical spill

The ‘‘Laboratory Safety Manual’’ and ‘‘Laboratory Safety Plan’’ must be available to all employees in the laboratory; **the contents of these documents must be discussed with each employee when he or she begins working in a laboratory andannually thereafter.**

The ‘‘Laboratory Safety Plan’’ is divided into sections, each of which deal with a particular aspect of laboratory safety, including hazardous materials, radioactive materials, x-ray equipment, lasers, and chemical hazards.

Instructions for the preparation of ‘‘Laboratory Safety Plans’’ are found in the followinglink of the ‘‘Laboratory Safety Manual‘‘.

View a sample laboratory floor plan.

https://ehs.unc.edu/lab/lsp/#targetText=This%20standard%20requires%20a%20written,chemicals%20used%20in%20the%20laboratory.

When experments need to e conducted on filed we need an other safety plan named Site Specific Safety Plans (SSSP)

2. Site Specific Safety Plans (SSSP)

What you need to know about producing a Site Specific Safety Plan (SSSP) for organization on site test project.

What is a Site Specific Safety Plan (SSSP)?

A Site Specific Safety Plan (SSSP) is an agreement between businesses working on a specific site that determines how health and safety will be managed. When used correctly, it ensures that site information is regularly updated and safety is monitored. This helps all businesses involved in a project comply with Ethiopia's Health and Safety at Work Act.

Benefits

A SSSP improves communication and makes work more efficient on site. Take for example scaffolding - one team may get this on site for a job, but if organization are in the habit of sharing there site safety planning across all parties they'll be able to see if any other teams need it later on for a separate job. It's about working together and coordinating to make the site safer.

Many major main contractors in Ethiopia require a SSSP as a 'must have' for all organization to submit at the tendering process or at the least completed prior to work onsite. Being up to speed and having one prepared makes life easier for everyone.

The SSSP also acts as a step by step guide to ensure you meet all parts of your obligations under the new Legislation to record the following:

- identifying and managing hazards
- reporting accidents and incidents
- training or supervising employees
- preparing for emergencies – first aid and rescue plans
- providing opportunities for employees to be involved in safety procedures

What's Inside?

1 - Agreement

This agreement establishes the basis on which businesses agree to work on a specific operation site.

2 - Site Job Hazard & Risk Register

This is used by the organization to identify job-specific hazards.

3 - Task Analysis & Safe Work Method Statement

This register provides a tool for higher-risk activities. Higher risk is activities like confined-space or asbestos-related work.

4 - Hazardous Products & Substances Register

This is a register of products like glues, resins, solvents or fuels. Organization are required by law to

have a completed register for every substance they bring to or use on site.

5 - Onsite Training and Competency Register

This register is a record of training, qualifications, experience and competencies for employees working on this sit

6 - Emergency Response Plan

This deals with any incidents that arise from activities requiring a rescue. Consider the roles and responsibilities for yourself, trained specialists, equipment operators, and emergency services.

7 - Site Safety Briefing / Toolbox Meeting

These are a means of structuring briefings and meetings in a logical way.

8 - Inspection Checklist

Inspection is a vital part of hazard management. Inspections range from specific (vehicles) to broad (sites), and differ from one industry or trade to another.

9 - Site Incident and Injury Register

This register records any incident that caused, or could have caused, harm to any person on-site.

https://www.sitesafe.org.nz/

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Discus what compliance documentation is? (4 points)
2. Discuss briefly the consequences of failing to follow and work correctly with compliance documents. (2 points)
3. What is the current legislation that covers the environmental protection within your state or territory?(2 points)
4. What is meant by the term 'obligation'?(2 points

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-6	Selecting Plant, tools and equipment

1. Compaction Equipment

There are three basic pieces of equipment available for HMA compaction: (1) the paver screed, (2) the steel wheel roller and (3) the pneumatic tire roller. Each piece of equipment compacts the HMA by two principal means:

1. **By applying its weight to the HMA surface and compressing the material underneath the ground contact area**. Since this compression will be greater for longer periods of contact, lower equipment speeds will produce more compression. Obviously, higher equipment weight will also increase compression.
2. **By creating a shear stress between the compressed material underneath the ground contact area and the adjacent uncompressed material**. When combined with equipment speed, this produces a shear rate. Lowering equipment speed can decrease the shear rate, which increases the shearing stress. Higher shearing stresses are more capable of rearranging aggregate into more dense configurations.

Steel Wheel Rollers

Steel wheel rollers are self-propelled compaction devices that use steel drums to compress the underlying HMA. They can have one, two or even three drums, although tandem (2 drum) rollers are most often used. The drums can be either static or vibratory and usually range from 86 to 215 cm (35 to 85 inches) in width and 50 to 150 cm (20 to 60 inches) in diameter. Roller weight is typically between 0.9 and 18 tonnes (1 and 20 tons) (see Figures 1).

Vibratory Steel Wheel Rollers

Some steel wheel rollers are equipped with vibratory drums. Drum vibration adds a dynamic load to the static roller weight to create a greater total compactive effort. Drum vibration also reduces friction and aggregate interlock during compaction, which allows aggregate particles to move into final positions that produce greater friction and interlock than could be achieved without vibration. Roller drum vibration is produced using a rotating eccentric weight located in the vibrating drum (or drums) and the force it creates is proportional to the eccentric moment of the rotating weight and the speed of rotation (TRB, 2000[1]). Operators can turn the vibrations on or off and can also control amplitude (eccentric moment) and frequency (speed of rotation). Vibration frequency and amplitude have a direct effect on the dynamic force (and thus the compactive force) as shown in Table 1.

Table 1. Vibratory Steel Wheel Roller Parameters (after TRB, 2000[1])

Parameter	Typical Values	Effect of Dynamic Force
Frequency	1,600 to 3,600 vibrations per minute	Frequency $\propto$ (Dynamic Force)2
Amplitude	0.25 to 1.02 mm (0.01 to 0.04 inches)	Amplitude $\propto$ Dynamic Force

Table 2. Typical Vibratory Settings (from TRB, 2000[1])

HMA/MatCharacteristic	Frequency	Amplitude
Thin Lifts (less than about 30mm (1.25 inches))	Operate in static mode. Under vibratory mode, as the pavement increases in density the drums may begin to bounce, which may cause the HMA to shove and become less dense. Also, some of the aggregates may be crushed.	
Lifts between 30 mm and 65 mm (1.25 and 2.5 inches)	High Frequency	Low Amplitude
Lifts beyond 65 mm (2.5 inches)	High Frequency	Low Amplitude
Stiff (more viscous) HMA	High Frequency	Low Amplitude

https://www.pavementinteractive.org/reference-desk/construction/compaction/compaction-equipment/

Concrete equipmen

1. CONCRETE BATCHING PLANT Concrete batching plants basically used to process the materials to form concrete. It mixes all the materials like sand, gravels, cement and water to form a better solution that should be sent to construction site. Concrete batching plants divided further into types according to their working capacity from 20 to 120 cum/hr and they are famous for their mobility as a mobile concrete batcher.

2. CONCRETE BUCKET Concrete bucket is a type of pale used with mixer and it is attached through structural tower. Concrete bucket is used to send the concrete materials to the top of the building

where it pours all the mixture automatically where needed. Concrete buckets also play remarkable roles for cutting labor costs and time.

3. CONCRETE CONVEYOR Concrete conveyors are common conveyor system usually mobilized to use at construction site. They are based on one conveyor belt by which transfers the gravels, cement and other solid materials direct to the mixers and they are also used for filtration of concrete materials from unnecessary impurities.

4. CONCRETE CRUSHER Concrete crushers have two types: one is mobile concrete crusher similar like a bulldozer but has an attachment with its boom arm use to crush the big rock pieces into small gravels but second type mostly can be seen in the industries used for crushing medium sized rocks into powder or gravel form. These concrete crushers are considered as best source for saving labor cost and time.

5. CONCRETE CUTTING MACHINE Concrete cutter or concrete cutting machine is an abrasive tool normally seen as mobile equipment that is used for cutting concrete big pieces with the help of electrical force. Concrete cutting equipment can be seen mostly where the big buildings need to be demolished and these tools are used there to cut the walls through its high-quality blades.

6. CONCRETE MIXER Concrete mixer is best source for the constructors that want to save their precious raw material from wastage that can’ t be tolerated. Concrete mixers used to mix all the elements like cement, gravel and water for better mixing and it also saves the time because of its high efficiency while working.

https://www.slideshare.net/jalal2412/concrete-equipment?from_action=save

Excavation equipment

There are different types of soil excavation tools and machines used in construction. Excavation of soil is necessary in construction point of view and it should be done by hand tools or machineries based on the area of the land or depth of excavation.By the process of excavation, the land is cleaned from tree roots, strums, organic impurities etc., which should harm to the foundation.

Types of Soil Excavation Tools and Machines:

Now a days, for the soil excavation there are so many equipment’s are there and these are classified into two types.

1. Hand tools

2. Machineries

Hand tools for Soil Excavation:

These are generally used for smaller depths of excavations in small areas. Man power is required to operate these tools. The tools come under this category are explained below.

Shovel

Shovel is tool which is used for the purpose of lifting of excavated soil. It is

also similar to spade the difference between spade and shovel is the difference in leading edge. The curvature of metal plate of shovel is generally higher when compared to spade so we can hold the soil easily and lifted it. Shovel can also be used for digging purpose in case of soft soils, sand etc.

Rake

Rake is a tools which is having a horizontal rod having metal teeth and is used to remove the small layers of soil.

Pick axe

Pick axe consists hard spike attached perpendicular to handle. They are used for excavating small trenches in soil. Pick axe can cut the soil even if the soil is of hard type. The metal spike is pointed on one side and wide blade is provided on the other side.

Machinery Tools for Soil Excavation:

These are the tools which are operated by mechanical force and are used for the larger depths of excavations. There are so many types of machine tools with ease of operation are designed in this modern day period.

Tracked Excavator

This is also called as track hoe. It consists of cabinet and long arm. Long arm again consists of 2 parts. The first part which is closure to cabinet is called as Boom and the other part is called as Dipper-stick. Digging bucket is attached to the end of dipper. This entire system can rotate 360 degrees. In this case Vehicle is moved by traction, so we can use this equipment in mines, forestry, pipeline industries etc. the function of excavator is done by hydraulic fluid so, it is also called as hydraulic excavators.

jackhammer

is a pneumatic or electro-mechanical tool that combines a hammer directly with a chisel. It was invented by William Mcreavy, who then sold the patent to Charles Brady King. Hand-held jackhammers are generally powered by compressed air, but some are also powered by electric motors.

Post hole borer

A post hole digger is a tool used to dig narrow holes to install posts, such as for fences and signs.There are different kinds of post hole diggers. A post hole pincer (pictured) is jabbed into the ground in the open position until the blades are buried. At that point the handles are pulled apart to close the tool and grab the chunk of soil loosened. They are then pulled out of the ground with the chunk of soil. The process is repeated until the hole is deep enough, or until the hole is so deep and narrow that the handles can no longer be pulled apart fully. This is one of the weaknesses of this kind of post hole digger.

trencher

Trenchers are pieces of earthmoving equipment that use a metal chain with teeth made of high-strength steel to rip into the ground like a chainsaw would into a tree. Similar to an excavator, a trencher rips up the soil and any roots in the way to create a trench.

Water equipment

Pumps

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps.

Pumps operate by some mechanism (typically reciprocating or rotary), and consume energy to perform mechanical work moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.

pressure cleaner

Pressure washers are part garden hose and part air compressor. A typical **pressure washer** has either a gas-fueled engine or electrical powered motor that powers a water pump. The pump accelerates the water, supplied from a garden hose, to produce high **pressure**. The **washer** is hooked to a high **pressure**-rated hose.

hting equipmen

mobile lighting plant

light tower is a piece of mobile equipment which has one or more high-intensity electric lamps and a mast. Almost always, the lights are attached to the mast, which is attached to a trailer, with a generator set to power the lamps. Normally the lamps are metal halide bulbs and the generator is powered by a diesel engine. However, battery-powered, solar-powered and hydrogen-powered sets are available; light towers with electrodeless lamps lighting are also sold.

Lifting and materials

- pedestrian forklift
- pallet trolleys
- Hoist

Self-Check -6	Written Test

Directions:list three types of pumps?

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-7	Characterization of basic soil types

Soil Characteristics

There are seven soil characteristics that are used to classify the soil: composition, color, texture, structure, soil water, organic matter and chemistry. Each one of them are described briefly below.

Composition

The composition of the soil is placed into four different categories: inorganic material, organic material,water and air. Inorganic material is any compound that is not derived from animal or plant sources. Carbon atoms are not present in inorganic compounds. Organic material is composed of animal and plant sources. Carbon atoms are present in organic compounds. The amount of water and air particles that are present in the soil will also determine it's composition.

Color

The color of the soil is another way to characterize soil. Soil that is black or a rich, deep brown is high in organic content. This soil is very fertile and is ideal for planting and farming. The nutrients in the soil are rich. Yellow, red, or orange soil indicates that it is rich in iron. Soil that has a light gray or white tint has a lot of calcium or silica.

Texture

The texture is the feel of the soil and generally refers to the clay, silt and sand content. There is a texture triangle that scientists use to determine the characteristics of soil. According to the texture triangle, the soil is considered clay if it is less than 0.002 mm. It is silt if the soil is between 0.002 and 0.05 mm. The texture is sand if it is between 0.05 and 2.0 mm.

Structure

Structure is the shape, size and organization of peds. A ped is a soil particle. Soil that has particles that are horizontal, plate-like or flat are called platy. Soil with long, vertical particles that are bound by flat or slightly rounded vertical faces are prismatic and columnar. Particles that are block-like or somewhat square are called blocky. Small, rounded particles are granular.

Soil Water

Soil water means the infiltration which includes the rate and capacity. How fast the water moves through the soil and how much water the soil can hold at saturation level will help determine the type of soil. There are several forms of soil water and includes gravity water, capillary water, field capacity, wilting point, hygroscopic water and the available water capacity.

Organic Matter

Organic matter can be categorized into two forms: litter and humus. Litter also referred to as litterfall, plant litter, tree litter, soil litter or duff. This refers to dead plant materials that are on the ground and provides nutrients to the top layer of the soil. Humus is any organic materials that are stable, they will no longer break down and will remain in their current state for several thousand years.

Chemistry

Soil is classified by the acidity and alkalinity of the matter. It is measured in pH units and is determined by the amount of hydrogen ion concentration within the soil. The pH measurements are

on a scale from 0 to 14, a pH of 7 means that it is neutral. A pH level of 0 to 7 measures the acidity of the soil. A pH level of 7 to 14 measures the alkalinity of the soil.

https://civilengineeringbasic.com/7-important-characteristics-of-soil/

Self-Check -7	Written Test

Directions:in which character of soil we study soil acidity?

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-8	Identifying, confirming and applying project environmental management plan

ENVIRONMENT MANAGEMENT PLAN

The Environment Management Plan (EMP) would consist of all mitigation measures for each component of the environment due to the activities increased during the construction, operation and the entire life cycle to minimize adverse environmental impacts resulting from the activities of the project. It would also delineate the environmental monitoring plan for compliance of various environmental regulations. It will state the steps to be taken in case of emergency such as accidents at the sites including fire. The detailed EMP for the complex is given below.

The Environment Management Plan (EMP) is a site specific plan developed to ensure that the project is implemented in an environmental sustainable manner where all stakeholders involved in the project, including consultants, understand the potential environmental risks arising from the project and take appropriate actions to properly manage that risk. EMP also ensures that the project implementation is carried out in accordance with the design by taking appropriate mitigation actions to reduce adverse environmental impacts during its life cycle. The plan outlines existing and potential problems that may adversely impact the environment and recommends corrective measures where required. Also, the plan outlines roles and responsibility of the key personnel and contractors who will be in-charge of the responsibilities to manage the project site.

The EMP is generally

- Prepared in accordance with rules and requirements of the MoEF and CPCB/ SPCB
- To ensure that the component of facility are operated in accordance with the design
- A process that confirms proper operation through supervision and monitoring
- A system that addresses public complaints during construction and operation of the facilities and
- A plan that ensures remedial measures is implemented immediately.

The key benefits of the EMP are that it offers means of managing its environmental performance thereby allowing it to contribute to improved environmental quality. The other benefits include cost control and improved relations with the stakeholders.

EMP includes four major elements:

- Commitment & Policy: The management will strive to provide and implement the Environmental Management Plan that incorporates all issues related to air, water, land and noise.
- Planning: This includes identification of environmental impacts, legal requirements and setting environmental objectives.
- Implementation: This comprises of resources available to the Society, accountability of contractors, training of operational staff associated with environmental control facilities and documentation of measures to be taken.
- Measurement & Evaluation: This includes monitoring, counteractive actions and record keeping.

It is suggested that as part of the EMP, a monitoring committee would be formed Ethiopian government comprising of the site in-charge/coordinator, environmental group representative and project implementation team representative. The committee's role would be to ensure proper operation and management of the EMP including the regulatory compliance.

Self-Check -8	Written Test

Directions:what are the major element of environmental management plan?

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-9	Materials Safety Data Sheets (MSDS)and materials handling methods

Materials Safety Data Sheets (MSDS)

What is a Material Safety Data Sheet (MSDS)?
A material safety data sheet is a technical document which provides detailed and comprehensive information on a controlled product related to: □

- health effects of exposure to the product □
- hazard evaluation related to the product's handling, storage or use □
- measure to protect workers at risk of exposure □
- emergency procedures.

The data sheet may be written, printed or otherwise expressed, and must meet the availability, design and content requirements of WHMIS legislation. The legislation provides for flexibility of design and wording but requires that a minimum number of categories of information be completed and that all hazardous ingredients meeting certain criteria be listed subject to exemptions granted under the Hazardous Materials Information Review Act. The Purpose of the Data Sheet The data sheet is the second element of the WHMIS information delivery system and is intended to supplement the alert information provided on labels. The third element of the system is the education of employees in hazard information on controlled products, including instruction in the content and significance of information on the MSDS.

I. Preparation Information
This section includes: □

- The name address and telephone number of who prepared the MSDS □
- The date the MSDS was prepared, If more than three years old, it must be updated

II. Product Information
This section: □

- Identifies the product by the name on the supplier label □
- Provides the chemical name, family and formula (including molecular weight) □
- Lists the product identifiers, manufacturer and supplier names, addresses and emergency telephone numbers

III. Physical Data
This section includes information indicating how it looks and how it will behave when it is used, stored, spilled and how it will react with other products indicated through: □

- The state it is in e.g. liquid □
- The odour and appearance of the product □
- The specific gravity, vapour density, evaporation rate, boiling point and the freezing point □
- The vapour pressure, the higher the concentration the higher the possible air concentration
- The odour threshold, which is the lowest airborne concentration of a chemical that can be perceived by smell □
- The pH reflecting the corrosive or irritant nature of the product

IV. Fire and Explosion Hazard
This section describes: □

- The temperature and conditions that can cause the chemical to catch fire or explode
    - UEL (upper explosion limit) or UFL (upper flammable limit) will indicate the highest concentration of a substance in the air that will produce a fire or explosion when a source of ignition (heat, spark or flame) is present
    - LEL (lower explosion limit) or LFL (lower flammable limit) will indicate the lowest concentration of a substance in the air that will produce a fire or explosion when a source or ignition is present
    - From the LEL to the UEL, the mixture is explosive. Below the UEL the mixture is too lean to burn; above the LEL the mixture is too rich to burn. However, concentrations above the UEL are still very dangerous because if the concentration is lowered (by introducing fresh air), it will enter the explosive range □
- Means of extinction including the type of fire extinguisher required □
- Personal Protective Equipment required for fire fighting □
- Some of the storage requirements however more of this information is found in the reactivity data section

V. Reactivity Data:

This section describes: □

- The chemical stability of the product and its reactions to light, heat, moisture, shock and incompatible materials □
- Storage requirements based on the reactivity or instability of the product □ Incompatible products that must not be mixed or stored near each other □
- The need for disposal before they become extremely reactive

VI. Toxicology Properties:

This section describes: □

- The harmful effects of exposure □
- How the product is likely to enter the body and what effects it has on the organs in the body □
- The short-term (acute) and long-term (chronic) health effects from exposure to the product □
- The exposure limits, which indicates the maximum concentration in air of a hazardous substance (gas, vapour, dust, mist, fume) to which nearly all workers (without personal protective equipment) can be repeatedly exposed without adverse health effects. Exposure limits are expressed in three ways:
    - TWA (time weighted average) indicating the maximum average concentration to which workers can safety be exposed for a normal 8- hour workday or 48-hour workweek
    - STEL (short-term exposure limit) indicating the maximum concentration to which workers can safely be exposed for a period of up to 15 minutes. The STEL is higher than the TWA. It may not be sustained more than four times a day
    - C (ceiling) describes the concentration that may not be safely exceeded at any time, even for an instant. The C is higher that the STEL □
- If these limits are to be exceeded, the worker must use recommended personal protective equipment. Exposure limits are expressed as ppm for gases and vapours and as mg/m3 for dusts, fumes and mists □
- Note these limits may be expressed as OEL, PEL and TLV □
- Information used to assess the health problems of any employee who uses the chemical and determine if that worker's problems are related to the chemical

VII. Preventative Measures:

This section provides: □

- Instruction for the safe use, handling and storage of the product □
- The personal protective equipment or safety devices required □
- The steps for cleaning up spills □
- Information on the waste disposal requirements

VIII. First Aid Measures:

This section describes: □

- Specific first aid measures related to acute effects of exposure to the product □
- First aid steps in the correct sequence □
- Information to assist in planning for emergencies

The MSDS may contain additional sections providing further information related to the specific product.

Location of the MSDSs □

- Hard copy readily available □
- Computer terminals □
- Employees and others must know where the MSDS is and how to use them

MSDS revisions are required every 3 years or sooner if new product information is available.

Trade Secret Exemptions Information may be withheld to protect industries' right to protect confidential business information. This information is referred to as trade secrets.

The producer of the product can withhold: □

- The name and concentration of any ingredient □
- Name of relevant toxicological studies

Once a claim if filed to withhold information the product label must state: □

- Date the exemption filed □
- Claim registration number

The MSDS must state: □

- That an exemption has been granted □
- Date it is granted □
- Registry number □
- Product hazards Medical Access Doctors and nurses can access withheld information however this information remains confidential.

Material Handling

Haynes defines "Material handling embraces the basic operations in connection with the movement of bulk, packaged and individual products in a semi-solid or solid state by means of gravity manually or power-actuated equipment and within the limits of individual producing, fabricating, processing or service establishment". Material handling does not add any value to the product but adds to the cost of the product and hence it will cost the customer more. So the handling should be kept at minimum. Material handling in Indian industries accounts for nearly 40% of the cost of production. Out of the total time spent for manufacturing a product, 20% of the time is utilised for actual processing on them while the remaining 80% of the time is spent in moving from one place to another, waiting for the processing. Poor material handling may result in delays leading to idling of equipment. Materials handling can be also defined as 'the function dealing with the preparation, placing and positioning of

materials to facilitate their movement or storage'. Material handling is the art and science involving the movement, handling and storage of materials during different stages of manufacturing. Thus the function includes every consideration of the product except the actual processing operation. In many cases, the handling is also included as an integral part of the process. Through scientific material handling considerable reduction in the cost as well as in the production cycle time can be achieved.
https://www.uregina.ca/hr/hsw/assets/docs/pdf/Laboratory-Safety/Material-Safety-Data-Sheet.pdf

MATERIAL HANDING EQUIPMENTS

Broadly material handling equipment' s can be classified into two categories, namely:

(a) Fixed path equipments, and

(b) Variable path equipments.

(c) Fixed path equipments which move in a fixed path. Conveyors, monorail devices, chutesand pulley drive equipments belong to this category. A slight variation in this category isprovided by the overhead crane, which though restricted, can move materials in anymanner within a restricted area by virtue of its design. Overhead cranes have a verygood range in terms of hauling tonnage and are used for handling bulky raw materials,stacking and at times palletizing.

(d) Variable path equipments have no restrictions in the direction of movement althoughtheir size is a factor to be given due consideration trucks, forklifts mobile cranes andindustrial tractors belong to this category. Forklifts are available in many ranges, they aremanoeuvrable and various attachments are provided to increase their versatility.Material Handing Equipments may be classified in five major categories.

1. **CONVEYORS**

Conveyors are useful for moving material between two fixed workstations, either continuously or intermittently. They are mainly used for continuous or mass production operations—indeed, they are suitable for most operations where the flow is more or less steady. Conveyors may be of various types, with rollers, wheels or belts to help move the material along: these may be power-driven or may roll freely. The decision to provide conveyors must be taken with care, since they are usually costly to install; moreover, they are less flexible and, where two or more converge, it is necessary to coordinate the speeds at which the two conveyors move.

2. INDUSTRIAL TRUCKS

Industrial trucks are more flexible in use than conveyors since they can move between various points and are not permanently fixed in one place. They are, therefore, most suitable for intermittentpetrol-driven, electric, hand-powered, and so on. Their greatest advantage lies in the wide range of attachments available; these increase the trucks ability to handle various types and shapes of material.

3. CRANES AND HOISTS

The major advantage of cranes and hoists is that they can move heavy materials through overhead space. However, they can usually serve only a limited area. Here again, there are several types of crane and hoist, and within each type there are various loading capacities. Cranes and hoists may be used both for intermittent and for continuous production.

4. CONTAINERS

These are either ‘dead’ containers (e.g. Cartons, barrels, skids, pallets) which hold the material to be transported but do not move themselves, or ‘live’ containers (e.g. wagons, wheelbarrows or computer self-driven containers). Handling equipments of this kind can both contain and move the material, and is usually operated manually.

1. ROBOTS

Many types of robot exist. They vary in size, and in function and manoeuvrability. While many robots are used for handling and transporting material, others are used to perform operations such as welding or spray painting. An advantage of robots is that they can perform in a hostile environment such as unhealthy conditions or carry on arduous tasks such as the repetitive movement of heavy materials.

Self-Check -9	Written Test

Directions:Describe the content of Materials Safety Data Sheets (MSDS)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-10	Job Safety Analysis (JSA)

1. **Job Safety Analysis (JSA)**

A job safety analysis (JSA) is a procedure which helps integrate accepted safety and health principles and practices into a particular task or job operation. In a JSA, each basic step of the job is to identify potential hazards and to recommend the safest way to do the job. Other terms used to describe this procedure are job hazard analysis (JHA) and job hazard breakdown.

The terms "job" and "task" are commonly used interchangeably to mean a specific work assignment, such as "operating a grinder,""using a pressurized water extinguisher" or "changing a flat tire." JSAs are not suitable for jobs defined too broadly, for example, "overhauling an engine"; or too narrowly, for example, "positioning car jack."

2. **Application of JSA**

A JSA is a documented risk assessment developed when company policy directs employees to do so. Workplace hazard identification and an assessment of those hazards may be required before every job.JSAs are usually developed when directed to do so by a supervisor, when indicated by the use of a first tier risk assessment and when a hazard associated with a task has a likelihood rating of 'possible' or greater.Generally, high consequence, high likelihood task hazards are addressed by way of a JSA.These may include, but are not limited to, those with:

A history of, or potential for, injury, harm or damage such as those involving:

1. Fire, chemicals or a toxic or oxygen deficient atmosphere.
2. Tasks carried out in new environments.
3. Rarely performed tasks.
4. Tasks that may impact on the integrity or output of a processing system.

It is important that employees understand that it is not the JSA form that will keep them safe on the job, but rather the process it represents. It is of little value to identify hazards and devise controls if the controls are not put in place. Workers should never be tempted to "sign on" the bottom of a JSA without first reading and understanding it.

JSAs are quasi-legal documents, and are often used in incident investigations, contractual disputes, and court cases.

3. Structure of JSA

The JSA or JHA is usually created by the work group who will perform the task. The more minds and experience applied to analysing the hazards in a job, the more successful the work group is likely to be in controlling them. Sometimes it is expedient to review a JSA that was prepared when the same task was performed on a previous occasion, but care should be taken to ensure that all of the hazards for the job are controlled for the new occasion. The JSA is usually recorded in a standardised tabular format with three to as many as five or six columns.[*clarification needed*] The headings of the three basic columns are: Job step, Hazard and Controls. A Hazard is any factor that can cause damage to personnel, property or the environment (some companies include loss of productionor downtime in the definition as well). A Control is any process for controlling a hazard.

The job is broken down into its component steps. Then, for each step, hazards are identified. Finally, for each hazard identified, controls are listed. In the example below, the hazards are analyzed for the task of erecting scaffolding and welding lifting lugs:

Job step	Hazard	Control
Erect scaffolding	Falling scaffolding components	**Barricade** work area while erecting and dismantling scaffolding
	Working at height	**Verify** scaffolder competence **Inspect** scaffold components and structure **Tag** scaffolding after approval **Wear** appropriate PPE (harness, hard hats, safety footwear etc.) **Tether** tools
Weld lugs	Electrical current	**Wear** insulated gloves **Inspect** cables, connections and tools before use
	Welding fumes	**Ventilate** using intrinsically safe fume extraction fans **Wear** respiratory protection when appropriate
	Welding arc	**Wear** welding helmet with eye protection, fire resistant overalls, welding gloves and apron **Erect** welding screens if appropriate
	Hot weld metal, sparks and slag	**Remove** all combustibles from work area **Lay out** fireproof drop cloths. **Set up** appropriate fire fighting equipment in work area **Maintain** a fire watch during task plus 30 minutes.
Housekeeping	Obstacles in work area	**Maintain** a clear path work area **Remove** unnecessary and vulnerable equipment **Display** warning signage **Barricade** danger areas

Assessing risk levels

Some organisations add columns for risk levels. The risk rating of the hazard prior to applying the control is known as the 'inherent risk rating'. The risk rating of the hazard with the control in place is known as the 'residual' risk rating.

Risk, within the occupational health and safety sphere, is defined as the 'effect of uncertainties on objectives[4]'. In the context of rating a risk, it is the correlation of 'likelihood' and 'consequence', where likelihood is a quantitative evaluation of frequency of occurrences over time, and consequence is a qualitative evaluation of both the "Mechanism of Injury" and the reasonable and realistic estimate of "Severity of Injury".

Example:

> There is historical precedent to reasonably and realistically evaluate that the likelihood of an adverse event occurring while operating a hot particle producing tool, (grinder), is "possible", therefore the activity of grinding meets the workplace hazard criteria.
>
> It would also be reasonable and realistic to assume that the mechanism of injury of an eye being struck at high speed with hot metal particles may result in a permanent disability, whether it be the eye of the grinder operator, a crew member or any person passing or working adjacent to, above or below the grinding operation.
>
> The severity of reasonably and realistically expected injury may be blindness. Therefore, grinding warrants a high severity rating.
>
> Wearing eye protection while in the vicinity of grinding operations reduces the likelihood of this adverse event occurring.
>
> If the eye protection was momentarily not used, not fitted correctly or failed and hot high speed particles struck an eye, the expected mechanism of injury (adverse event) has still occurred, hence the consequence rating remains the same for both the inherent and residual consequence rating.It is accepted that the control may affect the severity of injury, however, the rated consequence remains the same as the effect is not predictable.

One of the known risk rating anomalies is that likelihood and the severity of injury can be scaled, but mechanism of injury cannot be scaled. This is the reason why the mechanism of injury is bundled with severity, to allow a rating to be given.[*citation needed*] The MoI is an important factor as it suggests the obvious controls.

Identifying responsibilities

Another column that is often added to a JSA form or worksheet is the *Responsible* column. The Responsible column is for the name of the individual who will put the particular control in place. Defining who is responsible for actually putting the controls in place that have been identified on the JSA worksheet ensures that an individual is accountable for doing so.

Application of the JSA

After the JSA worksheet is completed, the work group that is about to perform the task would have a toolbox talk, to discuss the hazards and controls, delegate responsibilities, ensure that all equipment and personal protective equipment described in the JSA are available, that contingencies

such as fire fighting are understood, communication channels and hand signals are agreed etc. Then, if everybody in the work group agrees that it is safe to proceed with the task, work can commence.

If at any time during the task circumstances change, then work should be stopped (sometimes called a "time-out for safety"), and the hazards and controls described in the JSA should be reassessed and additional controls used or alternative methods devised. Again, work should only continue when every member of the work group agrees it is safe to do so.

When the task is complete it is often of benefit to have a close-out or "tailgate" meeting, to discuss any lessons learned so that they may be incorporated into the JSA the next time the task is undertaken.

https://en.wikipedia.org/wiki/Job_safety_analysis

Self-Check -10	Written Test

Direc

tions:

what is the application of JSA?

What does the JSA contains?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

List of Reference Materials

1- BOOKS
2- WEB ADDRESSES (PUTTING LINKS)

Mineral Resources Infrastructure Work

Level I

Learning Guide - 51

Unit of Competence: Operate Laboratory Machine and Equipment

Module Title: Operate Laboratory Machine and Equipment

LG Code: MIN MRI1 M14 0519 lo1-LG-51

TTLM Code: MIN MRI1 M14 TTLM 0819v1

LO2. Conduct pre-operational checks

Instruction Sheet	Learning Guide #-

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

- Applying manufacturers manual
- Identifying required materials
- Selecting Fuel and lubricants
- Checking and adjusting fuel, oil, hydraulic fluid and water levels
- Securing/tightening and maintaining bolts, nuts, guards and attachment couplings
- Checking and adjusting function of controls and gauges
- Applying operator's manual to start-up and shutdown

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Select fuel and lubricants according to manufacturer's specifications
- Checkand adjust fuel, oil, hydraulic fluid and water levels according to manufacturer's manual
- Secure/tight and maintain bolts, nuts, guards and attachment couplings in accordance with manufacturer's instructions
- Checkand adjust function of controls and gauges where necessary to comply with manufacturer's manual
- Conduct standard start-up and shutdown procedures according to requirements of operator's manual

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 7.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” in page -.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Applying manufacturers manual

1. Manufacturers manual

Manual (also called an instruction manual or a user guide) is an instructional book or booklet that is supplied with almost all technologically advanced consumer products such as vehicles, home appliances and computer peripherals. Information contained in the owner's manual typically includes:

- Safety instructions; for liability reasons these can be extensive, often including warnings against performing operations that are ill-advised for product longevity or overall user safety reasons.
- Assembly instructions; for products that arrive in pieces for easier shipping.
- Installation instructions; for products that need to be installed in a home or workplace.
- Setup instructions; for devices that keep track of time or which maintain user accessible state.
- Instructions for normal or intended operations.
- Programming instructions; for microprocessor controlled products such as VCRs, programmable calculators, and synthesizers.
- Maintenance instructions.
- Troubleshooting instructions; for when the product does not work as expected.
- Service locations; for when the product requires repair by a factory authorized technician.
- Regulatory code compliance information; for example with respect to safety or electromagnetic interference.
- Product technical specifications.
- Warranty information; sometimes provided as a separate sheet.

https://en.wikipedia.org/wiki/Owner's_manual

Self-Check -1	Written Test

Directions: how should we follow operational manual?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Identifying required materials

Materials

Matter is anything that has mass and occupies space. A useful way to start thinking about matter is to think about the different materials, or substances, that it can be made into.

These materials make up the objects around us, and each of these materials has different properties or characteristics that can be observed or tested. Scientists, technologists and engineers investigate these materials – they experiment with them, compare their properties and relate the results to possible uses.

Types of materials

There are many different types of materials. Some examples of everyday materials are plastics, metals, fabric and glass.Ceramic materials are used to make traditional pottery, right through to advanced ceramics used in engineering and medicine. These inventions require scientists to understand the properties of minerals. You can learn more in the article What are minerals?

Wool is another traditional material that has undergone innovation. Investigate the properties of wool and how they link to its uses in the student activity Exploring wool fibre properties.Some other fascinating, less well known materials
include nanofibres, biologicalmaterials and composites.

Examples of properties

When we refer to the properties of a material, we are talking about features we can sense, measure or test. For example, if we have a sample of metal in front of us, we can identify that this material is grey, hard and shiny. Testing shows that this material is able to conduct heat and electricity and that it will react with an acid. These are some of the metal's properties.

It is important to decide if you are investigating the properties of a material or of an object. For example, are you identifying the properties of a spoon (an object), or are you looking at properties of the material it is made of, for example, stainless steel? Properties like shape and mass may be different for different objects, even when they are made of the same material. Density is a useful property for making comparisons between different materials.

Use this activity to learn more about density.

Other properties of materials can include their viscosity and conductivity.

A commonly talked about property is the state or phase of matter. There are currently five different states of matter that have been identified: solids, liquids, gases, plasma and Bose-Einstein condensate. The last two of these are much less well known.

It is important to note that the state of matter refers to the positioning and movement of the particles that make up a material and not the material itself.

Physical versus chemical

Sometimes it can be useful to distinguish between different types of properties. Physical properties refer to properties that can be observed or measured without changing the composition of the material. Examples include colour, hardness and smell and freezing, melting and boiling points.

Chemical properties are discovered by observing chemical reactions. They include combustion point, reactivity with acids and toxicity.

Changing material properties

Processes such as mixing, heating and cooling can change materials and their properties. This can be useful as the new properties may be better suited for particular purposes. For example, mixing certain metals can create a material that is both strong and lightweight.

https://www.the-warren.org/ALevelRevision/engineering/materials1.htm

Self-Check -2	Written Test

3. Directions:how can we classify materials?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Selecting Fuel and lubricants

Fuels

A fuel is any material that can be made to react with other substances so that it releases energy as heat energy or to be used for work. The concept was originally applied solely to those materials capable of releasing chemical energy but has since also been applied to other sources of heat energy such as nuclear energy (via nuclear fission and nuclear fusion).

Solid fuel

Solid fuel refers to various types of solid material that are used as fuel to produce energy and provide heating, usually released through combustion. Solid fuels include wood , charcoal, peat, coal, hexamine fuel tablets, and pellets made from wood (see wood pellets), corn, wheat, rye and other grains. Solid-fuel rocket technology also uses solid fuel (see solid propellants). Solid fuels have been used by humanity for many years to create fire. Coal was the fuel source which enabled the industrial revolution, from firing furnaces, to running steam engines. Wood was also extensively used to run steam locomotives. Both peat and coal are still used in electricity generation today. The use of some solid fuels (e.g. coal) is restricted or prohibited in some urban areas, due to unsafe levels of toxic emissions. The use of other solid fuels as wood is decreasing as heating technology and the availability of good quality fuel improves. In some areas, smokeless coal is often the only solid fuel used. In Ireland, peat briquettes are used as smokeless fuel. They are also used to start a coal fire.

Liquid fuels

Liquid fuels are combustible or energy-generating molecules that can be harnessed to create mechanical energy, usually producing kinetic energy; they also must take the shape of their container. It is the fumes of liquid fuels that are flammable instead of the fluid.

Most liquid fuels in widespread use are derived from the fossilized remains of dead plants and animals by exposure to heat and pressure inside the Earth's crust. However, there are several types, such as hydrogen fuel (for automotive uses), ethanol, jet fuel and bio-diesel which are all categorized as a liquid fuel. Emulsified fuels of oil-in-water such as orimulsion have been developed a way to make heavy oil fractions usable as liquid fuels. Many liquid fuels play a primary role in transportation and the economy.

Some common properties of liquid fuels are that they are easy to transport, and that can be handled easily. Also they are relatively easy to use for all engineering applications, and home use. Fuels like kerosene are rationed in some countries, for example available in government subsidized shops in India for home use.

Lubrication

A lubricant is a substance, usually organic, introduced to reduce friction between surfaces in mutual contact, which ultimately reduces the heat generated when the surfaces move. It may also have the function of transmitting forces, transporting foreign particles, or heating or cooling the surfaces. The property of reducing friction is known as lubricity.

In addition to industrial applications, lubricants are used for many other purposes. Other uses include cooking (oils and fats in use in frying pans, in baking to prevent food sticking), bioapplications on humans (e.g. lubricants for artificial joints), ultrasound examination, medical

examination. It is mainly used to reduce friction and to contribute to a better and efficient functioning of a mechanism.

Properties

A good lubricant generally possesses the following characteristics:

A high boiling point and low freezing point (in order to stay liquid within a wide range of temperature)

- A high viscosity index
- Thermal stability
- Hydraulic stability
- Demulsibility
- Corrosion prevention
- A high resistance to oxidation

Functions of lubricants

One of the single largest applications for lubricants, in the form of motor oil, is protecting the internal combustion engines in motor vehicles and powered equipment.

Keep moving parts apart

Lubricants are typically used to separate moving parts in a system. This separation has the benefit of reducing friction, wear and surface fatigue, together with reduced heat generation, operating noise and vibrations. Lubricants achieve this in several ways. The most common is by forming a physical barrier i.e., a thin layer of lubricant separates the moving parts. This is analogous to hydroplaning, the loss of friction observed when a car tire is separated from the road surface by moving through standing water. This is termed hydrodynamic lubrication. In cases of high surface pressures or temperatures, the fluid film is much thinner and some of the forces are transmitted between the surfaces through the lubricant..

Reduce friction

Typically the lubricant-to-surface friction is much less than surface-to-surface friction in a system without any lubrication. Thus use of a lubricant reduces the overall system friction. Reduced friction has the benefit of reducing heat generation and reduced formation of wear particles as well as improved efficiency. Lubricants may contain additives known as friction modifiers that chemically bind to metal surfaces to reduce surface friction even when there is insufficient bulk lubricant present for hydrodynamic lubrication, e.g. protecting the valve train in a car engine at startup.

Transfer heat

Both gas and liquid lubricants can transfer heat. However, liquid lubricants are much more effective on account of their high specific heat capacity. Typically the liquid lubricant is constantly circulated to and from a cooler part of the system, although lubricants may be used to warm as well as to cool when a regulated temperature is required. This circulating flow also determines the amount of heat that is carried away in any given unit of time. High flow systems can carry away a lot of heat and have the additional benefit of reducing the thermal stress on the lubricant. Thus lower cost liquid lubricants may be used. The primary drawback is that high flows typically require larger sumps and

bigger cooling units. A secondary drawback is that a high flow system that relies on the flow rate to protect the lubricant from thermal stress is susceptible to catastrophic failure during sudden system shut downs. An automotive oil-cooled turbocharger is a typical example.

Carry away contaminants and debris

Lubricant circulation systems have the benefit of carrying away internally generated debris and external contaminants that get introduced into the system to a filter where they can be removed. Lubricants for machines that regularly generate debris or contaminants such as automotive engines typically contain detergent and dispersant additives to assist in debris and contaminant transport to the filter and removal. Over time the filter will get clogged and require cleaning or replacement, hence the recommendation to change a car's oil filter at the same time as changing the oil. In closed systems such as gear boxes the filter may be supplemented by a magnet to attract any iron fines that get created.

It is apparent that in a circulatory system the oil will only be as clean as the filter can make it, thus it is unfortunate that there are no industry standards by which consumers can readily assess the filtering ability of various automotive filters. Poor automotive filters significantly reduces the life of the machine (engine) as well as making the system inefficient.

Transmit power

Lubricants known as hydraulic fluid are used as the working fluid in hydrostatic power transmission. Hydraulic fluids comprise a large portion of all lubricants produced in the world. The automatic transmission's torque converter is another important application for power transmission with lubricants.

Protect against wear

Lubricants prevent wear by keeping the moving parts apart. Lubricants may also contain anti-wear or extreme pressure additives to boost their performance against wear and fatigue.

Prevent corrosion

Many lubricants are formulated with additives that form chemical bonds with surfaces or that exclude moisture, to prevent corrosion and rust. It reduces corrosion between two metallic surface and avoids contact between these surfaces to avoid immersed corrosion.

Seal for gases

Lubricants will occupy the clearance between moving parts through the capillary force, thus sealing the clearance. This effect can be used to seal pistons and shafts.

https://en.wikipedia.org/wiki/Lubricant

Self-Check -3	Written Test

Directions:list three major function of lubricants?
What is the major use of fuels?

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

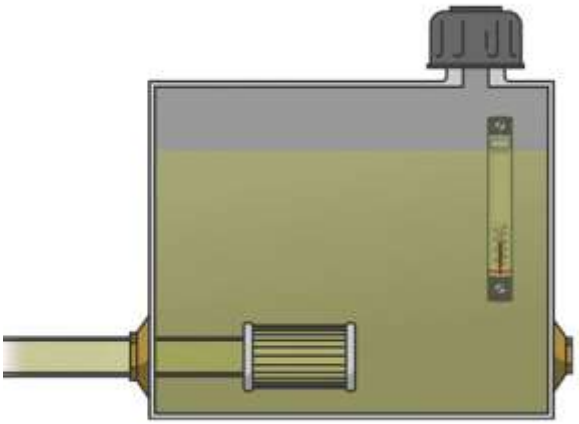
Information Sheet- 4	Checking and adjusting fuel, oil, hydraulic fluid and water levels

1. Mobile plant Hydraulic system

Half of the battle in hydraulic system troubleshooting is knowing exactly what 'normal' is. It's hard to diagnose a component or a section of a system without knowing normal parameters, such as:

- Speeds
- Pressure
- Valve response times
- Sounds
- Vibrations
- Heat levels, etc.

The other half of the battle is preventing breakdowns from occurring in the first place. But again, 'normal' is the reference and the intended operational state. Proper hydraulic system maintenance conducted at the right time should keep a mobile machine in normal or optimal condition. The value of careful observation of a machine in operation cannot be overstated. Learning exactly what to observe takes effort and dedication on the part of a maintainer.What a machine owner ultimately desires is a hydraulic system that provides responsive, consistent, smooth, and forceful motions whenever the machine is put to work, for as many years as possible, and with the fewest surprise breakdowns. The business goals of maintenance on a mobile machine are typically stated as maximum capital life and optimal availability with very high levels of reliability.For machines with a hydraulic system such as a loader, grader, vacuum truck, or a recycling truck, regular care is a must. For an excavator or a skid steer loader that is entirely operated by hydraulics, preventative maintenance work is truly job critical.



Caption: The reservoir is at the heart of a hydraulic system. Keep the breather clean, or switch to a high performance filter-breather for extremely dusty environments. Use a desiccant type of breather-filter for moist environments. Filling via a filter transfer pump instead of pail and funnel may allow for operation with pump inlet strainer.

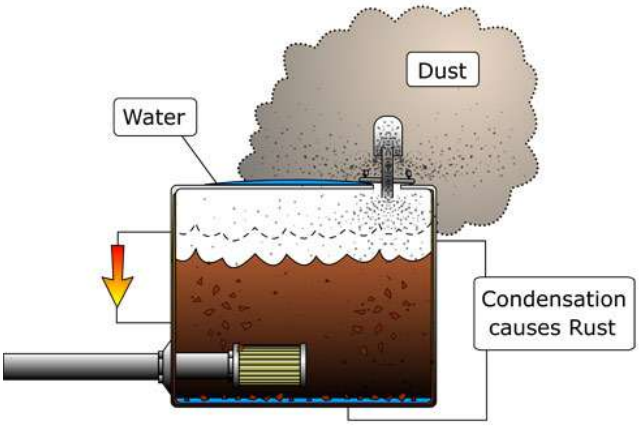
Many basic checks need to be carried out regularly to avoid being caught off guard. The operator can be trained to take care of all of the daily maintenance tasks such as fluid level checks and leak inspections. The service shop should only need to duplicate these tasks after major teardown and repair work has been carried out. Other tasks that require more skill and thoroughness are best left to the shop technician.The types of checks and tests that establish the precisely correct operational

state of the hydraulic system take time to perform—but they do offer payback. If carried out regularly and correctly, these procedures provide the maintenance department with data on any performance deviations. The data, in turn, provides clues as to what could be a major problem in the very early stages. This is where maintenance activity becomes truly valuable.

So many preventative maintenance (PM) work orders in fleet shops are merely checklists with ambiguous tasks such as ‘‘check accumulator for leaks and operation,’’ or ‘‘check the swing motor mounting bolts,’’ or ‘‘check all levers and pedals for proper operation.’’ In some shops, these task lists for hour-specific maintenance intervals go on for pages with no specific test parameters or details. Typically, only two check mark columns are present beside the PM list: ‘OK’ and ‘Needs Repair.’ Many hours can be spent in the maintenance bay confirming that major components of the hydraulic system are still bolted to the machine frame and not leaking. Again, these are tasks that the operator should be carrying out as a normal course of observation each and every day.

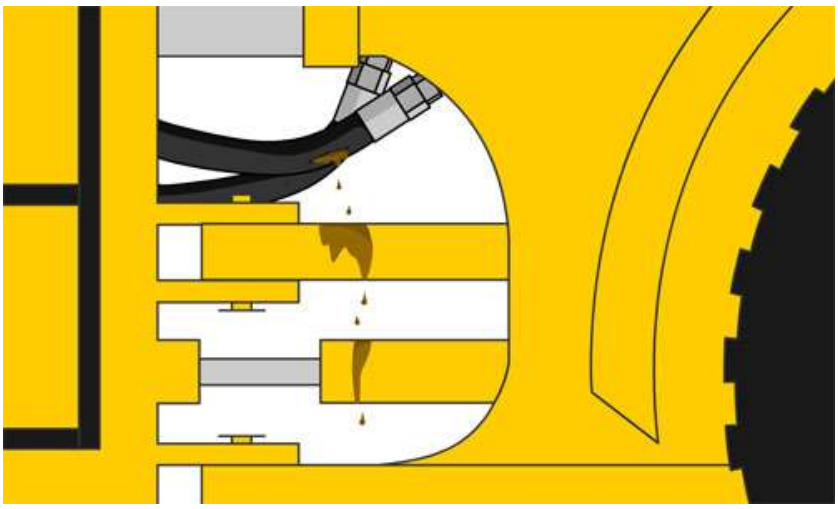
Slightly more complex maintenance tasks are often left undone, such as:

- Pump performance testing
- System pressure settings
- Cylinder and motor wear condition monitoring
- State of cleanliness inside the reservoir
- Particle count in the fluid



These contribute to the failures that affect business results. One PM task that has recently become quite popular is the sampling of lubricants and hydraulic fluids. If the task simply says ‘Sample Fluid,’ with a space for a completion check mark, then hopefully the technician doing the sampling has had the training to know how best to collect a consistent and valid sample. This is like going to the doctor for a checkup and then being sent to the lab for a blood test. You want a highly trained lab technician for a number of reasons, all tied to quality. Hydraulic fluid sampling is very important work, and just like lab work, the quality of the results depends on the technician’s skill and consistency.

Hydraulic fluid sampling and lab testing done right, with the results properly analyzed, is a maintenance task that not only saves money on unnecessary filter element replacements, but can also signal when to finally drain and replace the fluid, and when to start investigating a potential pump problem. The fluid only needs to be changed when it has actually deteriorated. A pump saved from failure or changed out before catastrophic system damage has obvious business benefits. These are all big money savers. However they require a customized and science-based approach to maintenance—as opposed to arbitrarily assigning tasks for a certain interval of running hours.



Machines that move along rough roadways or operate under the extreme conditions of a mine or a construction site should always be monitored for external leaks. Vibrations loosen fasteners, and pressure spikes can test the life of a hose or fitting. The operator is the best person to complete these checks.

It is not uncommon for maintenance planners in large organizations to schedule the changeout of major components, such as a hydraulic pump, based on the number of running hours. In many of these cases, however, the hour interval is established by a reliability team that has carefully studied one particular model of machine, in the company's unique operating environment for many years. The interval for the component changeout is often stretched beyond the original equipment manufacturer's recommendation. In some cases the interval is shorter. The point is that a customized, scientific approach is applied in these cases for the sake of the desired business results.

At minimum, fundamental care and maintenance of the mobile hydraulic system should address the following major areas:

1.1. **Levels**:-Maintaining the level of fluid in the hydraulic reservoir is about much more than just making sure that there is enough liquid volume to supply all cylinders at full extension. The surplus volume also provides cooling, allows for a minor amount of air bubbles that may have entered the system to dissipate, and perhaps allows some solid particles (not yet trapped by a filter) to settle out in front of the tank baffle as the fluid returns from the work application circuits.Failing to keep the reservoir at the correct level can invite condensation to accumulate on the exposed inner surfaces, and drip down into the hydraulic fluid. If the operating environment is humid or moist, a desiccant breather or a vacuum-breaker style of breather/fill cap will be helpful.Be sure to check the normal fill level when all single rod cylinders are retracted and with the brake or steering accumulators bled back to tank.

Does your machine feature an electronic pilot control system? If so, you likely have some variable current valve solenoids on proportional pressure control valves. The operator's control levers signal these valves either directly or through an electronic control module. These valves have very small components inside and move only a tiny fraction of an inch. Contaminants will foul electronic proportional valves quickly and leave the machine out of service. If you have been filling your main reservoir with a pail and funnel, now is the time to consider a new method. Pumping fluid into the reservoir via a filtration system has become standard practice for many fleets.

1.2. **Leaks and safety**—If you see dripping or hydraulic fluid spraying from any hose, tube, fitting or component housing, do not touch any surfaces at or near that leak location. A fluid injection injury could be fatal or leave you disabled for life. Be sure to achieve a zero pressure state before any close

inspection of a leaking component, or disassembly of any fluid line connection. Internal leaks can also develop. The operator won't be able to observe these directly. Unusual noises and temperatures are often the only clues.

1.3. **Temperatures**—Hydraulic oil temperature monitoring provides very useful clues to the state of a system. If the reservoir is topped up, and if cooling fans and radiators appear to be functioning normally, then higher temperatures are often correlated with internal leaks. At high pressures, a surprising amount of flow can pass through a fairly small orifice opening. Flow through this abnormal path will cause a heat build-up due to the friction of fluid molecules rubbing against the orifice surfaces.

Caption: Thermography cameras are now affordable for small fleets. Comparing the heat signatures of parallel cylinders and motors is just one way keep an eye out for internal leaks.

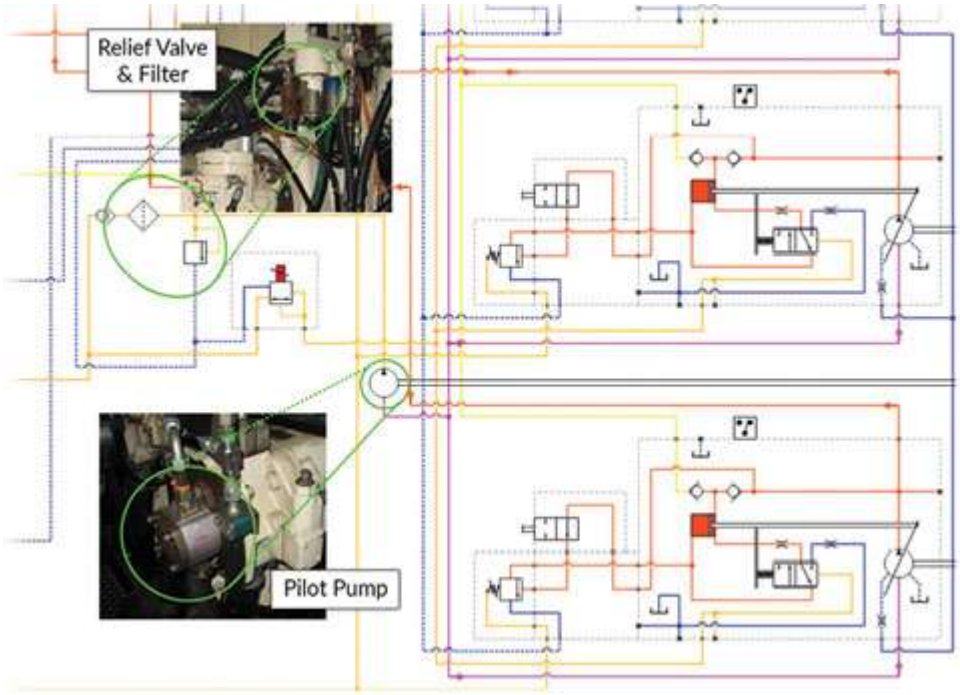
The presence of an internal leak can sometimes be revealed by a slowdown in cylinder stroke or motor speed, though in systems with sufficiently oversized, variable displacement pumps, aslowdown may not occur. A component, such as the pump itself, or a motor or cylinder that has lost its internal seal, may only register an unusually high temperature.

The operator should be trained to watch for the normal hydraulic fluid temperature as reported on the instruments in the cab. Any increase in temperatures should be reported without delay. A maintenance technician can then be dispatched to verify the cooling system performance, and to use his thermography camera to compare against each other and against carefully documented normal values, the heat signature of critical components such as pumps, swing motors or boom lift cylinders.

The operator can also be trained to periodically check the speeds of a hydraulic fan motor, using a non-contact photo tachometer, and to clean the hydraulic cooler/radiator.

1.4. **Pressures**—For most large machines, and even for some small- and medium-sized machines with electrical/electronic operator joysticks, the first layer of hydraulic control is the pilot control system. A pilot system may even be present on machines that feature very little electrical and

electronic control. These pilot systems are separate hydraulic circuits used to move large directional valve spools into position, or to shift a pump swash plate.



The pilot system is easily overlooked due to its small size. But keeping an eye on the pressure setting and filter of this critical system supports reliability goals.

Maximum pilot pressures are often only one-quarter or one-fifth of the maximum pressures found in the main cylinder and motor circuits. Yet without periodic testing of these medium pressure systems, a worn pilot pump or maladjusted pilot circuit relief valve can result in many wasted hours of flow testing and diagnostics for slow functions in main circuits. Checking the health (pressures and the range of current supplied to the solenoids) of the pilot system several times per year provides an opportunity for fine-tuning.

It is important to test the main system relief valve pressure several times per year. In some cases, the maximum system pressure is limited by a cutoff pressure control (compensator) on the main piston pump. In many cases, both a relief valve and pump compensator are present in the system, with the relief valve to be set higher than the compensator. Again, without periodic checks—which do take some time to carry out—many hours can be wasted chasing a system overheating problem or a function slow down, or even a function stall.

Verifying the standby (margin) pressure setting on machines with a load sense system can be time consuming on the first occasion, but helps ward off fuel consumption, hydraulic system overheating and slow function response.

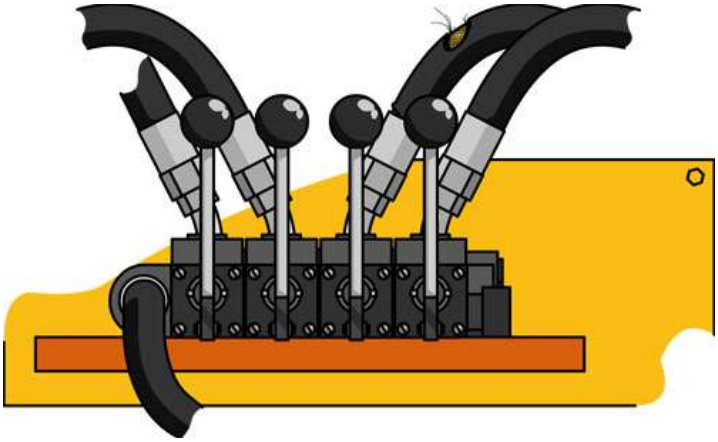
Many mobile machines use the energy-saving hydraulic design known as load sensing. Standby pressure (sometimes, but not always the same value as margin pressure) means an additional, adjustable pressure control on the pump housing.

Using a scientific-based approach to understanding how long a component should operate reliably is critical to cost-effective operation of all hydraulic components. In part 1, we discussed the importance of keeping an eye on the following:

1. Fluid levels
2. Leaks and safety
3. Temperatures
4. Pressures

1.5. **Fluid condition and cleanliness** — Countless studies and papers clearly show how attention to the qualities and state of the hydraulic fluid is key to reliability and asset life, and how problems can be detected and dealt with at an early stage.

Fluid analysis was once only popular for aircraft and some large-scale utility plants. Today even the owner of a single piece of construction equipment can fit this cost into the maintenance budget. Many manufacturers now provide service ports to allow easy sample collection. The cost of fluid analysis at a laboratory is most often more than paid for by the unnecessary periodic filter changes that are avoided with careful monitoring.



1.6. **Pump and hydraulic motor mounting** — A tiny amount of free play and misalignment on the mounting of a pump can bring on severe damage. A missing bolt or a number of loose bolts can result in catastrophic failure when pump shaft splines grind and twist in the socket of the driving gear. Check pump mount bolts at the drive box or PTO for correct torque value. A simple visual observation that the bolts are not loose is not good enough. Similar issues apply for the hydraulic motor mounts.

1.7. **Overall mechanical lubrication** — Obviously a mobile machine has more systems to maintain than just the hydraulics. Gearbox lube and the greasing of swing gears and bearings, along with the pins where the cylinders mount and pivot can directly impact hydraulic system performance. Failing to grease can show up as a hydraulic cylinder slowdown or stall, and possibly an over-temperature

condition as well. If enough mechanical binding occurs, pressures may reach maximum values with minimum payloads on a lifting boom and a relief valve may crack open, dividing flow.

Gearbox lube and the greasing of swing gears and bearings, along with the pins where the cylinders mount and pivot can directly impact hydraulic system performance.

1.8. **Brakes —** Brake systems need to be reliable to the maximum degree. Many off-highway mobile machines such as loaders and graders utilize the main hydraulic system for braking functions. Often these machines are in transit on public highways. Whether they are on road or off, braking action is crucial to human safety.
Most hydraulic brake systems consist of a gear or piston pump that flows through a check valve as it charges a small accumulator to a specific pressure. Once the correct pressure is reached, the brake pump is unloaded through a special valve. Obviously the accumulator precharge gas pressure will need to be checked periodically.

Keep in mind that the braking circuit is not really a flow-based motion control circuit. It is a force control circuit. As the operator slightly depresses the brake pedal, (a valve most similar to a pressure reducing valve), the spool opens for only for a brief moment.

Contaminants in the fluid could easily cause such a valve to stick open, which would apply full braking force, or prevent the system check valve at the beginning of the circuit from closing. Any air in the system will cause a delayed, weak and spongy brake response (another very important reason to keep the reservoir topped up at the correct level). For the sake of human safety, the quality of hydraulic fluid must be maintained to the highest level.

https://www.mobilehydraulictips.com/can-keep-mobile-machine-running-efficiently-part-1/

Self-Check -4	Written Test

Directions:how do you perform level check?
Does hydraulic system in small plants include air filtration?

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Securing/tightening and maintaining bolts, nuts, guards and attachment couplings

Causes of Loose Bolts — and Ways to Prevent Them

A pressurized bolted flange joint assembly begins to leak, creating a safety hazard. A rotor with its blades separates from the nacelle and spins off a wind turbine, crashing to the ground. Under constant vibration from the engine of an ocean freighter, loose bolts on a large piece of mining equipment work their way off the bolted joints and roll around the hull, inflicting further damage to the equipment.

What Causes Loose Bolts?

Bolted joints are critical to the safe operation of many types of equipment in a wide range of applications, including power generation, manufacturing, mining, and transportation.

In a bolted joint, tightening the nut actually stretches the bolt a small amount, like pulling on a stiff spring. This stretching, or tension, results in an opposing clamp force that holds the two sections of the joint together. If the bolt comes loose, this clamp force weakens.

Loose bolts are not just an irritating nuisance. If the joint is not quickly retightened, the application may begin to leak fluid or gas, the bolt may break, equipment may become damaged, or catastrophic accidents may occur.

There are at least five causes of loose bolts, which can occur separately or in combination:

Under-tightening. By definition, an under-tightened bolt is already loose and the joint does not have enough clamp force to hold the individual sections together. This can lead to sideways slippage between sections, placing unwanted shear stress on the bolt that could eventually cause it to break.

Vibration. Experiments on bolted joints under vibration show that many small ‘‘transverse’’ movements cause the two sections of the joint to move in parallel with each other and with the bolt head or nut. These repeated movements work against the friction between the bolt and joint threads that is holding the joint together. Eventually, vibration will cause the bolt to ‘‘unwind’’ from the mating threads and the joint to lose its clamp force.

Embedding. The design engineers who specify the tension on a bolt allow for a break-in period, during which bolt tightness relaxes to a certain degree. This relaxation is caused by micro-embedding of the bolt head and/or nut into the joint surface, and can occur with both soft materials, such as composites, as well as hard, polished metals. If the joint has not been designed properly, or if the specified tension was not achieved on the bolt at the start, this embedment of the joint can lead to a loss of clamp force.

Gasket creep. Many bolted joints include a thin, flexible gasket between the bolt head and the surface of the joint to seal the joint completely against gas or liquid leaks. The gasket itself acts as a spring, pushing back against the pressure of the bolt and the joint face. Over time, and especially near high heat or corrosive chemicals, the gasket may ‘‘creep,’’ which means it loses its springiness, leading to loss of clamp force. This can also happen if the gasket area directly next the bolts is crushed, or if the bolts are not tightened evenly across the entire face of the joint.

Differential Thermal Expansion. If the material of the bolt and the joint are different, large differences in temperature due to rapid environmental changes or cycling industrial processes can cause bolt material to expand or contract rapidly, possibly loosening the bolt.

Shock. Dynamic or alternating loads from machinery, generators, wind turbines, etc., can cause mechanical shock – a sudden force applied to the bolt or the joint – causing the bolt threads to slip relative to the threads of the joint. Just as with vibration, this slippage can ultimately lead to loosening of the bolts.

Steps to Prevent Loose Bolts

Because loose bolts are so common, an astonishing array of devices has been invented to prevent them from occurring. Here are five basic types of prevention methods:

Washers. Washers are typically wider than the bolt head, with the additional surface area adding extra friction to the joint to maintain the clamp force. However, simple split washers, sometimes called helical spring washers, have been found to actually loosen the bolt under vibration even faster than a joint with no washer. Conical, or Belleville washers, are cup-shaped washers that perform little better than spring washers in vibration tests.

Several types of locking washers have been developed, with flutings, ribs or teeth that dig into the surface of the joint during the tightening process, in order to prevent loosening. This may cause permanent damage to the joint finish or surface, which may be unacceptable, such as in critical aerospace applications where surface indentations may cause fatigue stresses. It may also prevent re-tightening of the joint to the proper tension.

Wedge-locking washers work in sets of two, with each washer having opposite facing wedges that interact with each other and with the joint and nut surfaces to prevent self-turning of the bolt. The wedges are designed to add tension (stretch) to the bolted joint if the bolt begins turning due to vibration or shock, preventing a loss of clamp force.

Castellated nuts

Mechanical devices. Numerous clever gimmicks have been developed to lock a tightened nut into place on a bolted joint. Castellated nuts have a slotted end and are used with a cotter pin or wire that fits through a hole drilled in the bolt. Locking fastener systems have a shaped flat retainer, similar to a washer, and a clip that fits into a groove on the bolt head. Tab washers have two tabs on opposite sides, which fold up to secure the bolt head or nut after installation, and may have teeth that can penetrate the surface of the joint to hold it in place. While these devices do prevent the nut from falling off the bolt, they generally do not help the joint maintain the specified clamp force.

Prevailing torque nuts. Nylon or metal inserts inside a nut (sometimes called a ‘‘lock nut’’) can add extra friction to prevent loosening. A related idea is to fit a spring inside the nut, which firmly grasps the bolt threads and is designed to move in the opposite direction of the nut if vibration or other forces cause it to unwind. Nylon inserts cannot be used in harsh chemical or high-heat applications, and typically can’t be reused because the bolt threads cut grooves into the nylon, diminishing its ability to hold after re-tightening. Because the insert on most lock nut styles only covers part of the internal threads, a strong transverse motion or shock can still cause the bolt to self-loosen.

Double nuts. According to an article in Fastener + Fixing, the idea of using two nuts, a thick one and a thinner one (called a jammer nut), has been used for over 150 years to prevent loosening of bolted joints. A modern application is a system using two nuts each having different sized threads which advance at different rates on a dual-threaded bolt. In this way, transverse motions that may cause one nut to advance will not affect the second nut.

Adhesives. Liquid adhesives, as well as heated thermoplastic coatings or solid adhesive patches, have successfully been used to ensure bolts in certain applications do not come loose. The problem is that they make it harder to disassemble the joint later.

Maintaining Proper Tension Ensures Bolts Stay Tight

The combination of good bolted joint design, proper clamp force development, and suitable bolt retention devices can reliably secure a bolted joint against many of the challenges raised here.

A good bolted joint will be designed with the proper size and type of bolt and nut, and specify the optimal amount of tension to achieve the clamp force required to maintain joint integrity.

In the application itself, proper development of clamp force requires that the correct level of tension (preload) in each bolt has actually been achieved – and remains at that level throughout its operating lifetime.

http://www.smartbolts.com/insights/loose-bolts-causes-ways-prevent/

Self-Check -3	Written Test

Directions:what are causes of loosen fasteners?
How vibration can cause a loosen fastener?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-6	Checking and adjusting function of controls and gauges

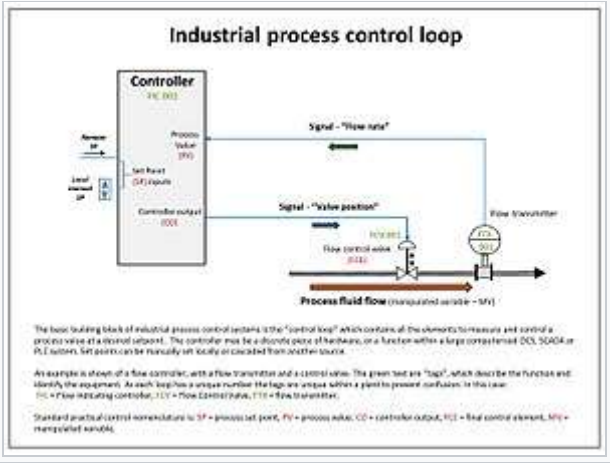
Control system

A control system manages, commands, directs, or regulates the behavior of other devices or systems using control loops. It can range from a single home heating controller using a thermostat controlling a domestic boiler to large Industrial control systems which are used for controlling processes or machines.

For continuously modulated control, a feedback controller is used to automatically control a process or operation. The control system compares the value or status of the process variable (PV) being controlled with the desired value or setpoint (SP), and applies the difference as a control signal to bring the process variable output of the plant to the same value as the setpoint.

Open-loop and closed-loop control

There are two common classes of control action: open loop and closed loop. In an open-loop control system, the control action from the controller is independent of the process variable. An example of this is a central heating boiler controlled only by a timer. The control action is the switching on or off of the boiler. The process variable is the building temperature.This controller operates the heating system for a constant time regardless of the temperature of the building.



Example of a single industrial control loop; showing continuously modulated control of process flow.

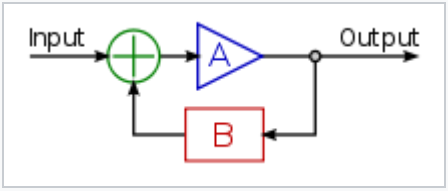
In a closed-loop control system, the control action from the controller is dependent on the desired and actual process variable. In the case of the boiler analogy, this would utilise a thermostat to monitor the building temperature, and feed back a signal to ensure the controller output maintains the building temperature close to that set on the thermostat. A closed loop controller has a feedback

loop which ensures the controller exerts a control action to control a process variable at the same value as the setpoint. For this reason, closed-loop controllers are also called feedback controllers.

Feedback control systems

In the case of linear feedback systems, a control loop including sensors, control algorithms, and actuators is arranged in an attempt to regulate a variable at a setpoint (SP). An everyday example is the cruise control on a road vehicle; where external influences such as hills would cause speed changes, and the driver has the ability to alter the desired set speed. The PID algorithm in the controller restores the actual speed to the desired speed in the optimum way, with minimal delay or overshoot, by controlling the power output of the vehicle's engine.

Control systems that include some sensing of the results they are trying to achieve are making use of feedback and can adapt to varying circumstances to some extent. Open-loop control systems do not make use of feedback, and run only in pre-arranged ways.



A basic feedback loop

In the case of linear feedback systems, a control loop including sensors, control algorithms, and actuators is arranged in an attempt to regulate a variable at a setpoint (SP). An everyday example is the cruise control on a road vehicle; where external influences such as hills would cause speed changes, and the driver has the ability to alter the desired set speed. The PID algorithm in the controller restores the actual speed to the desired speed in the optimum way, with minimal delay or overshoot, by controlling the power output of the vehicle's engine.

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Logic control

Logic control systems for industrial and commercial machinery were historically implemented by interconnected electrical relaysand cam timers using ladder logic. Today, most such systems are constructed with microcontrollers or more specialized programmable logic controllers (PLCs). The notation of ladder logic is still in use as a programming method for PLCs.

Logic controllers may respond to switches and sensors, and can cause the machinery to start and stop various operations through the use of actuators. Logic controllers are used to sequence mechanical operations in many applications. Examples include elevators, washing machines and

other systems with interrelated operations. An automatic sequential control system may trigger a series of mechanical actuators in the correct sequence to perform a task. For example, various electric and pneumatic transducers may fold and glue a cardboard box, fill it with product and then seal it in an automatic packaging machine.

PLC software can be written in many different ways – ladder diagrams, SFC (sequential function charts) or statement lists.

On–off control

On–off control uses a feedback controller that switches abruptly between two states. A simple bi-metallic domestic thermostat can be described as an on-off controller. When the temperature in the room (PV) goes below the user setting (SP), the heater is switched on. Another example is a pressure switch on an air compressor. When the pressure (PV) drops below the setpoint (SP) the compressor is powered. Refrigerators and vacuum pumps contain similar mechanisms. Simple on–off control systems like these can be cheap and effective.

Gauge (instrument)

A **gauge** or **gage**, in science and engineering, is a device used to make measurements or in order to display certain dimensional information. A wide variety of tools exist which serve such functions, ranging from simple pieces of material against which sizes can be measured to complex pieces of machinery. Depending on usage, a gauge can be described as "a device for measuring a physical quantity", for example "to determine thickness, gap in space, diameter of materials, or pressure of flow", or "a device that displays the measurement of a monitored system by the use of a needle or pointer that moves along a calibrated scale".

Basic types

All gauges can be divided into four main types, independent of their actual use.

1. **Analogue instrument meter** with *analogue display* ("needles"). Until the later decades the most common basic type.
2. **Digital instrument meter** with *analogue display*. A screen that shows an "analogue meter", commonly used in modern aircraft cockpits, and some hospital equipment etc.
3. **Digital instrument meter** with *digital display*. Only numbers are shown at a digital display.
4. **Analogue instrument meter** with *digital display*. Only numbers are displayed, but through a mechanical or electro-mechanical display (today very rare but has existed for clocks, certain Doppler meters and informational screens at all kinds of stations and airports)

The two first basic types are usually easier for the human eyes and brain to interpret, especially if many instrument meters must be read simultaneously. The other two types are only displaying digits, which are more complex for humans to read and interpret. The ultimate example is cockpit instrumentation in aircraft. The flight instruments cannot display figures only, hence even in the most modern "glass-cockpits" where almost all instruments are displayed at screens, few figures are visible. Instead the screens display analogue meters.

Checking and adjusting

Measurement device

To stop any unwanted variation in a production process, a control loop monitors the process regularly to check it's performing as it should. This is usually done by a sensor that measures a particular property like temperature. A transmitter converts the sensor's output into a signal which is sent to a controller. The signal can be sent individually or with other signals through a special network - called a 'fieldbus'.

The controller

The controller compares the measurement recorded by the sensor against the pre-set value. If there's an unacceptable difference it initiates appropriate action. For example, if an oven's temperature has fallen too far, it instructs the regulator to send more fuel to the burners to increase it up to the required set-point.

Most of the control tasks required by an industrial process can be handled by a well-designed and well-tuned **single-loop controller**. These normally monitor a single measurement and adjust one regulator, but they can also be linked to another controller to adjust another related set-point. This is known as a 'cascade system'.

The regulator

The regulator controls the throughput of the process. It responds to commands from the controller and makes adjustments where necessary. Control valves are the most common type of regulator - these adjust the flow of a fluid in response to messages from the controller. A variable speed pump is an alternative type of regulator which controls the flow of a fluid more accurately and with greater energy efficiency. Variable speed drives can also be used where the controller regulates the movement of solid materials rather than fluids or gases.

https://books.google.com.et/books/about/Introduction_to_Process_Control.html?id=o6olMcQgnjcC&source=kp_book_description&redir_esc=y

Self-Check -6	Written Test

Directions:Describer close loop control system?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-7	Applying operator's manual to start-up and shutdown

The **operations manual** is the documentation by which an organisation provides guidance for members and employees to perform their functions correctly and reasonably efficiently. It documents the approved standard procedures for performing operations safely to produce goods and provide services. Compliance with the operations manual will generally be considered as activity approved by the persons legally responsible for the organisation.

The operations manual is intended to remind employees them of how to do their job. The manual is either a book or folder of printed documents containing the standard operating procedures, a description of the organisational hierarchy, contact details for key personnel and emergency procedures. It does not substitute for training, but should be sufficient to allow a trained and competent person to adapt to the organisation's specific procedures.

The operations manual helps the members of the organisation to reliably and efficiently carry out their tasks with consistent results. A good manual will reduce human error and inform everyone precisely what they need to do, who they are responsible to and who they are responsible for. It is a knowledge base for the organisation, and should be available for reference whenever needed. The operations manual is a document that should be periodically reviewed and updated whenever appropriate to ensure that it remains current.

Motor graders are sophisticated machines equipped to handle tough conditions, but they need to be operated properly and optimally. Beginner users, and even experienced operators, should take note of the proper procedures for operating them.

To begin, how should you start and shut down the machine? Here's a basic guide.

Starting up your motor grader

Make sure all your pre-start procedures have been followed. These include checking for any defects or potential problems while you grease the machine. Do any parts seem worn or broken? Are there any leaks? Check the fuel, coolant and oil levels; the power-steering reservoir and power-shift transmissions. Make sure you've done all the checks suggested in the Operator's manual. Then you're ready to start.

In neutral and with the parking brake on, open the throttle to a quarter and turn the starter. Depress the clutch to ease the starter load, and don't press on the starter for more than 30 seconds. If you do, you may need to wait a couple minutes before using the starter again.

Once the motor has started, idle for a few minutes as you check the gauges. Are all of them operating? Then check the controls, giving the hydraulic oil some time to warm up.

Shutting down the motor grader

When it comes time to shut down the machine, give it a few minutes to cool down. Two to three minutes should do it. Make sure you park the machine as near to level as possible, lower all hydraulic equipment to the ground and set the parking brake.

Once the machine is off, walk around the machine looking for any leaks (such as leaks in the hydraulic system hose or connections; fuel, coolant, grease or oil leaks) or loose, worn parts.

Finally, use the following checklist as part of your post-shutdown quality check:

- check for blade wear and tear (they should be wearing straight, not cupped in the middle)
- check the levels of the oil, coolant, fuel
- check for any dirt or mix that should be cleaned to prevent hindrances to the sliding surface, lubrication point or pivot setting.

http://www.fao.org/3/W7295E/w7295e04.htm

Operation Sheet 1	CONTENT- pre- operation check

Steps		Conditions to check	Remark
1	Mechanical	Running Hours (check the hourly guage and enter amount)	
2		Clean generator for good condition Clean shed for good condition	
3		Fuel tank at least 50% full Fuel leaks? Fuel cap on?	
4		Motor Oil level is okay Motor Oil condition	
5		Radiator, no leaks Radiator coolant level okay?	
6		Battery connections good? Battery water level ok? Battery Charger is charging?	
7		No Leaks (look underneath generator)	
8		Exhaust system is functioning normally?	
9		Auto-start is working?	
10		All Tools and equipment are present and in good condition?	
11		Water decanter (does it need to be drained?)	
12	safety	Fire extinguisher present Fire extinguisher working First Aid Kit present? First Aid Kit complete?	
13	Document	Generator Log present? Daily Check forms present? Manuals present?	

Mineral Resources Infrastructure Work

Level I

Learning Guide - 52

Unit of Competence: Operate Laboratory Machine and Equipment

Module Title: Operate Laboratory Machine and Equipment

LG Code: MIN MRI1 M14 0519 lo1-LG-52

TTLM Code: MIN MRI1 M14 TTLM 0919v1

LO3. Use small plant and equipment

Instruction Sheet	Learning Guide #-

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

- Applying safety plan
- Identifying site hazards and establish controls
- Identifying and applying operating techniques
- Operating machines within design specifications
- Locating plant and equipment safely
- Interpret and apply information

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Identify Site hazards associated with small plant and equipment operations andestablish appropriate controls in accordance with the requirements of the site safety plan
- Identify and apply Operating techniquesfor small plant and equipment to achieve optimum output in accordance with manufacture's design specifications while maintaining specified tolerances
- Operated machine to produce results within design specifications to meet specified tolerances
- LocatePlant and equipment safely when not in immediate use

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 7.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” in page -.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Applying safety plan

OPERATIONAL SAFETY PLAN

The POS (Operational Safety Plan, OSP) is the document that the employer of the company carrying out the work prepares to operate on construction sites in accordance with the current regulations regarding occupational safety.

The drafting of the OSP replaces the obligation to draw up the Risk Assessment document but only for the specific site.

For a further discussion of the remaining obligations on the part of the employer, please refer to the General Document, to be supplemented with the treatment of specific risks that require health surveillance for exposed workers.

A. General Requirements

Machine guarding will be provided to protect the operator and other employees in the machine area from injury as a result of coming in contact with moving parts in the mechanical motions of the machines.

B. Hand Tools

Use the correct tool for the task at hand. Keep landscaping tools in good condition. Use tools in the manner they are intended to be used. Store tools in a safe place. A safe cutting tool is one that is sharp and clean. Tool handles should be smooth and strong. Shovels, spades, and other digging tools should have parts that are smooth and properly shaped.

C. Electric Landscaping Tools

Read the operator's manual carefully before switching on the tool. If a tool is equipped with a three-hole grounded receptacle, a three-wire extension cord should be used.

Never use electrical power tools in the rain or when grass or shrubs are wet. Do not abuse the flexible electric cord. The cord should be draped over the shoulder while the tool is in operation. Never carry a tool by the receptacle. Always us a cord heavy enough to carry proper current. Be sure to avoid cutting the cord with the tool or equipment.

Hand and Portable Powered Tools and Other Hand-Held Equipment

1. General requirements:

All hand and portable powered tools and equipment will be maintained in a safe condition free of worn or defective parts.

2. Point of operations guards:

All portable powered tools capable of receiving guards and/or are designed to accommodate guards will be equipped with such guards so as to prevent the operator from having any part of his/her body in the danger zone during the operating cycle.

3. Power cut-off and pressure control devices:

a. Woodworking tools -- Hand-held, power-driven woodworking tools will be provided with "deadman" control, such as a spring actuated switch, valve, or equivalent device so that power will be automatically shut-off whenever the operator releases the control.

b. Electric tools (general) -- Portable electric tools which are held in the hand shall be equipped with switches of a type which must be manually held in closed position. (See Appendix A: Lockout/ Tagout Manual at the end of this Campus Safety and Health Manual for proper lockout/tagout procedures.)

C. Gasoline Powered Equipment - Gasoline is made for one purpose--to create an explosion, thereby releasing energy for power. When used improperly, gasoline can cause death and destruction. The following points should be followed when handling gasoline:

1. Never use gasoline for cleaning floors, tools, cloths or hands. Gasoline is only to be used in engines as a source of energy.
2. Always store gasoline in an approved closed container. Never use an open container, glass or other breakable container.
3. Pouring gasoline from one container to another may generate a charge of static electricity.
4. Gasoline spills should be cleaned up immediately to prevent accumulation of vapors. Do not allow electrical switches to be turned on until the gasoline vapors have dispersed. Electrical devices that start automatically, such as cold water fountains, may be shut off at the main switch if the main switch can be pulled safely.
5. If gasoline is spilled on a person, remove the saturated clothing immediately and keep the person and clothing away from sources of ignition. Wash the affected area of skin with soap and water to avoid a skin rash or irritation. If the eyes are involved, flush them with water and get the person to a doctor.
6. Gasoline tanks or equipment parts that are likely to contain gasoline should be drained or dismantled only out of doors or in a well ventilated area free from sources of ignition.
7. Never smoke in fueling areas, fuel system servicing areas, maintenance areas, bulk fuel delivery areas or similar locations.
8. Never dispense gasoline into the fuel tank while the engine is running or if the motor is hot.
9. Never store equipment with fuel in the tank inside a building where vapors could reach an open flame or spark. Allow the engine to cool before storing in any enclosure.
10. Never run an engine indoors.

https://www.nap.edu/read/18294/chapter/8

Self-Check -1	Written Test

Directions:
what are the most popular safety analysis methods?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Identifying site hazards and establish controls

What is a hazard?

There are many definitions for hazard but the most common definition when talking about workplace health and safety is “A hazard is any source of potential damage, harm or adverse health effects on something or someone.”

The CSA Z1002 Standard "Occupational health and safety - Hazard identification and elimination and risk assessment and control" uses the following terms:

- Harm – physical injury or damage to health.
- Hazard – a potential source of harm to a worker.

Basically, a hazard is the potential for harm or an adverse effect (for example, to people as health effects, to organizations as property or equipment losses, or to the environment).

Please see the OSH Answers on Hazard and Risk for more information.

What is hazard identification?

Hazard identification is part of the process used to evaluate if any particular situation, item, thing, etc. may have the potential to cause harm. The term often used to describe the full process is risk assessment:

- Identify hazards and risk factors that have the potential to cause harm (hazard identification).
- Analyze and evaluate the risk associated with that hazard (risk analysis, and risk evaluation).
- Determine appropriate ways to eliminate the hazard, or control the risk when the hazard cannot be eliminated (risk control).

Overall, the goal of hazard identification is to find and record possible hazards that may be present in your workplace. It may help to work as a team and include both people familiar with the work area, as well as people who are not – this way you have both the experienced and fresh eye to conduct the inspection.

When should hazard identification be done?

Hazard identification can be done:

- During design and implementation
    - Designing a new process or procedure
    - Purchasing and installing new machinery
- Before tasks are done
    - Checking equipment or following processes
    - Reviewing surroundings before each shift
- While tasks are being done
    - Be aware of changes, abnormal conditions, or sudden emissions
- During inspections
    - Formal, informal, supervisor, health and safety committee
- After incidents
    - Near misses or minor events
    - Injuries

To be sure that all hazards are found:

- Look at all aspects of the work and include non-routine activities such as maintenance, repair, or cleaning.
- Look at the physical work environment, equipment, materials, products, etc. that are used.
- Include how the tasks are done.
- Look at injury and incident records.
- Talk to the workers: they know their job and its hazards best.
- Include all shifts, and people who work off site either at home, on other job sites, drivers, teleworkers, with clients, etc.

- Look at the way the work is organized or done (include experience of people doing the work, systems being used, etc).
- Look at foreseeable unusual conditions (for example: possible impact on hazard control procedures that may be unavailable in an emergency situation, power outage, etc.).
- Determine whether a product, machine or equipment can be intentionally or unintentionally changed (e.g., a safety guard that could be removed).
- Review all of the phases of the lifecycle.
- Examine risks to visitors or the public.
- Consider the groups of people that may have a different level of risk such as young or inexperienced workers, persons with disabilities, or new or expectant mothers.

What types of hazards are there?

A common way to classify hazards is by category:

- biological – bacteria, viruses, insects, plants, birds, animals, and humans, etc.,
- chemical – depends on the physical, chemical and toxic properties of the chemical,
- ergonomic – repetitive movements, improper set up of workstation, etc.,
- physical – radiation, magnetic fields, temperature extremes, pressure extremes (high pressure or vacuum), noise, etc.,
- psychosocial – stress, violence, etc.,
- safety – slipping/tripping hazards, inappropriate machine guarding, equipment malfunctions or breakdowns.

Self-Check -2	Written Test

4. Directions:how can we identify hazards in work environment?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet- 4	Operating machines within design specifications

A **specification** often refers to a set of documented requirements to be satisfied by a material, design, product, or service. A specification is often a type of technical standard.

There are different types of technical or engineering specifications (specs), and the term is used differently in different technical contexts. They often refer to particular documents, and/or particular information within them. The word *specification* is broadly defined as "to state explicitly or in detail" or "to be specific".

Using the term "specification" without a clear indication of what kind is confusing and considered bad practice.

A **requirement specification** is a documented requirement, or set of documented requirements, to be satisfied by a given material, design, product, service, etc. It is a common early part of engineering design and product development processes, in many fields.

A **functional specification** is a kind of requirement specification, and may show functional block diagrams.

A **design or product specification** describes the features of the *solutions* for the Requirement Specification, referring to either a designed solution **or** final produced solution. It is often used to guide fabrication/production. Sometimes the term *specification* is here used in connection with a data sheet (or *spec sheet*), which may be confusing. A data sheet describes the technical characteristics of an item or product, often published by a manufacturer to help people choose or use the products. A data sheet is not a technical specification in the sense of informing how to produce.

An "**in-service**" or "**maintained as**" **specification**, specifies the conditions of a system or object after years of operation, including the effects of wear and maintenance (configuration changes).

Specifications are a type of technical standard that may be developed by any of various kinds of organizations, both public and private. Example organization types include a corporation, a consortium (a small group of corporations), a trade association (an industry-wide group of corporations), a national government (including its military, regulatory agencies, and national laboratories and institutes), a professional association (society), a purpose-made standards organization such as ISO, or vendor-neutral developed generic requirements. It is common for one organization to *refer to* (*reference*, *call out*, *cite*) the standards of another. Voluntary standards may become mandatory if adopted by a government or business contract.

specification sheet

spec sheet is a document that summarizes the performance and other technical characteristics of a product, machine, component (e.g., an electronic component), material, a subsystem (e.g., a power supply) or software in sufficient detail that allows design engineer to understand the role of the component in the overall system. Typically, a datasheet is created by the manufacturer and begins with an introductory page describing the rest of the document, followed by listings of specific characteristics, with further information on the connectivity of the devices. In cases where there is relevant source code to include, it is usually attached near the end of the document or separated into another file.

Depending on the specific purpose, a datasheet may offer an average value, a typical value, a typical range, engineering tolerances, or a nominal value. The type and source of data are usually stated on the datasheet.

A datasheet is usually used for technical communication to describe technical characteristics of an item or product. It can be published by the manufacturer to help people choose products or to help use the products. By contrast, a technical specification is an explicit set of requirements to be satisfied by a material, product, or service.

An electronic datasheet specifies characteristics in a formal structure that allows the information to be processed by a machine. Such machine readable descriptions can facilitate information retrieval, display, design, testing, interfacing, verification, and system discovery. Examples include transducer electronic data sheets for describing sensor characteristics, and Electronic device descriptions in CANopen or descriptions in markup languages, such as SensorML.

Self-Check -4	Written Test

Directions:where can we get the working capacity of a given machinery?

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Locating plant and equipment safely

Concept of Plant Layout:

The concept of plant layout may be described as follows:

Plant layout is a plan for effective utilisation of facilities for the manufacture of products; involving a most efficient and economical arrangement of machines, materials, personnel, storage space and all supporting services, within available floor space.

Objectives/Advantages of Plant Layout:

Following are the objectives/advantages of plant layout:

- (i) Streamline flow of materials through the plant
- (ii) Minimise material handling
- (iii) Facilitate manufacturing progress by maintaining balance in the processes
- (iv) Maintain flexibility of arrangements and of operation
- (v) Maintaining high turnover of in-process inventory
- (vi) Effective utilisation of men, equipment and space
- (vii) Increase employee morale
- (viii) Minimise interference (i.e. interruption) from machines
- (ix) Reduce hazards affecting employees
- (x) Hold down investment (i.e. keep investment at a lower level) in equipment.

Plant Layout in Operation Management

Plant layout refers to the physical arrangement of production facilities. It is the configuration of departments, work centers and equipment in the conversion process. It is a floor plan of the physical facilities, which are used in production.

According to Moore ‘‘Plant layout is a plan of an optimum arrangement of facilities including personnel, operating equipment, storage space, material handling equipment and all other supporting services along with the design of best structure to contain all these facilities’’.

Plant Location and Plant Layout in Production Management

The Plant location and Plant layout in production management are

Objectives of Plant Layout

The primary goal of the plant layout is to maximize the profit by arrangement of all the plant facilities to the best advantage of total manufacturing of the product. The objectives of plant layout are:

1. Streamline the flow of materials through the plant.
2. Facilitate the manufacturing process.
3. Maintain high turnover of in-process inventory.
4. Minimize materials handling and cost.
5. Effective utilization of men, equipment and space.
6. Make effective utilization of cubic space.
7. Flexibility of manufacturing operations and arrangements.
8. Provide for employee convenience, safety and comfort.
9. Minimize investment in equipment.
10. Minimize overall production time.
11. Maintain flexibility of arrangement and operation.
12. Facilitate the organizational structure.

Self-Check -3	Written Test

a. Directions:what is plant layout?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-6	Interpret and apply information

Collecting Information in the Workplace (Internal Links)

Inspections

Regular inspections are a great way to spot problems. Use your eyes, ears and nose as you walk through the job site. Note whether the air feels too hot or cold. Record the hazards you find such as labels on chemical containers, dangerous machinery, wet floors, attacks from inmates or clients, lifting, contact with blood or body fluids, and so on.

Talk to your co-workers as you go through the workplace. They will know about problems that you may not be able to spot. Your co-workers can tell you if working conditions have changed over time. They can also let you know if there have been any close calls where someone almost got hurt.

Keep notes on where you find hazards. Note the names of people who give you information. It is also a good idea to draw a floor plan of the area.

If you have a checklist as you go through the workplace you will not have to remember everything you are looking for. You can use the checklist to go back later to see if problems have been corrected. There are sample checklists in later chapters. AFSCME's health and safety staff can help you design a checklist for your workplace.

Surveys

Surveys can be useful to find out what problems concern members and what they are willing to do about them. They can be done in the form of a written questionnaire or in person. Keep these points in mind when using a written survey:

- Keep it as short as possible.
- Use words that everyone will understand.
- Ask questions that can be answered yes or no, true or false, multiple choice, or with a check mark.
- Leave space for workers to write additional information and opinions.

There are sample surveys in later chapters. AFSCME's health and safety staff can help you design a survey form for your workplace.

You need a plan on how to carry out your survey. How will you get the surveys out to workers and how will you get them back? Who will sort through the answers you get back? What will be done with the results?

It is often more effective to do a survey by asking workers questions and writing down their responses. The benefits of a one-on-one survey are that:

- They are a good technique for organizing as they get people talking about their jobs.
- It is a way to involve workers who do not read well without embarrassing them.
- You will often get a better response than by sending out paper that may get lost or ignored.

Besides finding out what workers are concerned about, ask if they would be willing to put some time and energy into solving a problem. If no one is concerned enough about a problem to do anything about it, this may not be a good issue to start working on.

Niosh health hazard evaluation (HHE)

The National Institute for Occupational Safety and Health (NIOSH) is part of the federal Centers for Disease Control and Prevention. NIOSH conducts research on the health effects of workplace hazards and how to control them. NIOSH also has a Health Hazard Evaluation Program in which its experts will investigate the toxic effects of substances or work practices in the workplace. An HHE can be requested by the employer, the workers' representative, or jointly.

Workplace communication is the process of exchanging information and ideas, both verbal and non-verbal, within an organization. An organization may consist of employees from different parts of the society. These may have different cultures and backgrounds, and can be used to different norms. To unite activities of all employees and restrain from any missed deadline or activity that could affect the company negatively, communication is crucial.

Improving safety

Mining is an inherently dangerous business and communications play a key role in improving the safety of individuals and increasing operational efficiency. Technology has enabled active surveillance and remote monitoring. It has even helped to provide better medical response following major incidents.

Self-Check -6	Written Test

Directions:what a communication tools in workplace?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation Sheet 1	CONTENT- pre operation check of oil level

How to Check Your Car's Oil Step-by-Step

Step 1: Turn Off the machine

First thing's first, make sure your vehicle engine is off and that it's been sitting for while on level ground. You want the engine to be cool, not hot like it had just been running. Go ahead and pop the hood!

Step 2: Find the Oil Dipstick

Next, you'll want to find the oil dipstick. Your dipstick usually has an orange or yellow top and sticks out near the engine. There should be a loop that you can grab onto, but there might not be. All cars are different, so you might have to consult your owner's manual if you are having trouble finding it.

Step 3: Pull Out the Dipstick

Grab the oil dipstick, pull it out, and wipe the end with a lint-free rag or a paper towel. When the dipstick is clean, dip it fully back into the pipe and pull it out again.

Step 4: Assess t he Level

When you pull the dipstick back out, take a look at the bottom and see where on the stick the oil covers. There are two small fluid level lines marked on your oil dipstick letting you know where the minimum and maximum oil level should reach. There should be motor oil covering the dipstick up to the maximum mark.

Step 5: Adjust Oil Levels if Needed

If the level is good, shove that puppy back into the pipe and call it a day. If not, you might have to add oil to the engine. To do this, remove the oil cap and carefully pour in the correct amount until the oil level reaches the line marked on your dipstick. Check out your vehicle's owner manual for info on where the oil goes, what kind you need (synthetic oil, 5W-30, 10W-40, etc.), and how much you should add. These ratios can vary depending on a number of factors like if you have a diesel engine or if you use synthetic oil.

If the tank requires a whole quart of oil to get it to the right level, it's way too low and you should probably check in with a mechanic so they can make sure you don't have an oil leak.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1.
Task 2.
Task N.

List of Reference Materials

3- BOOKS
4- WEB ADDRESSES (PUTTING LINKS)

Mineral Resources Infrastructure Work

Level I

Learning Guide - 53

Unit of Competence: Operate Laboratory Machine and Equipment

Module Title: Operate Laboratory Machine and Equipment

LG Code: MIN MRI1 M14 0519 lo1-LG-52

TTLM Code: MIN MRI1 M14 TTLM 0919v1

LO4. Carry out operator maintenance

Instruction Sheet	Learning Guide #-

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

- Applying safety plan
- Identifying site hazards and establish controls
- Identifying and applying operating techniques
- Operating machines within design specifications
- Locating plant and equipment safely

Self-Check -6	Written Test

Directions:what a communication tools in workplace?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1.
Task 2.
Task N.

List of Reference Materials

5- BOOKS
6- WEB ADDRESSES (PUTTING LINKS)

Mineral Resources Infrastructure Work

Level I

Learning Guide - 53

Unit of Competence: Operate Laboratory Machine and Equipment

Module Title: Operate Laboratory Machine and Equipment

LG Code: MIN MRI1 M14 0519 lo1-LG-53

TTLM Code: MIN MRI1 M14 TTLM 0919v1

LO4. **Carry out operator maintenance**

Instruction Sheet	Learning Guide #-

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

- Applying organizational maintenance requirements
- Preparing plant/equipment shutdown
- Conducting inspection and fault finding
- Removing and replacing defective parts
- Carrying out regular programmed maintenance

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- shutdown and prepare plant/equipment for operator maintenance as per manufacturer's manual and organisational requirements
- Conduct inspection and fault finding in accordance with the manufacture's specifications and/or organisational requirements
- Remove and replaceDefective parts safely and effectively according to manufacturer's manual and organisational requirements
- carry outRegular programmed maintenance tasks in accordance with the manufacturer's and/or organisational requirements

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 7.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” in page -.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Applying organizational maintenance requirements

MAINTENANCE ORGANIZATION CHARTS

We will now how to organize the maintenance staff, which is its hierarchical structure. Define therefore some typical organizational maintenance departments.

Basic organizational

The simplest situation may be that of a medium sized company with a staff of fewer than 15 people.

Would consist of a Chief of Maintenance, most of the department responsible. From it depend direct staff, grouped into two categories: officials and aides. Central departments of quality, safety and environment would support the Maintenance Manager, but not dependent on it, neither hierarchical nor functionally.

Advanced Structure 

When the number of workers grows, it is necessary to provide a more complete, providing for the creation of a number of specific positions, such as direct staff support to help facilitate the management of the department. Some of these posts are related to work direct personal control (Manager, Team Leaders, etc..). Others, however, is also doing management and support, trying to direct staff do not have to worry about a series of works, for which also does not have to be specially prepared.

Advantages and disadvantages of specialization

The most important advantage of specialization is that, by having a plot to focus less on learning and training, it is possible to go deeper, and the knowledge we have of the equipment is more comprehensive. This is the advantage of specialization in general can learn more about something if the field is smaller.

The disadvantages would be the following:

- For procedures that require several specialties, performance decreases. A task is composed of several sub-tasks, some of which are electrical, mechanical and other, for example. Waiting for a specialist during the time that others are working performance will decrease staff (some work while others wait for these last)
- The number of people necessary. The greater specialization has, the greater the number of unique people who perform a series of specific tasks in which there is no one with the necessary education and training.
- The number of workers needed in the maintenance department, especially in small and medium enterprises.

Promoting versatility.

The versatility and tactical optimization

The versatility of a maintenance engineer is the antithesis of specialization. This means the possibility that an operator can intervene in maintenance tasks related to various kinds of maintenance. The overall versatility mean that an operator could intervene in maintenance repairs of any kind within the company.

Promoting versatility overcomes the disadvantages found in the specialization: reducing the number of people necessary (more people trained to a greater number of tasks), increases performance, and allows to decrease the number of human resources in the maintenance department.

Economic performance versatility are so favorable that today any company who wants to reduce their costs (ie, almost all companies) must planteárse la as a means to achieve this goal.

One question that arises when we try to raise as versatility is making the transition from a situation where specialization towards maintenance workers to perform multiple functions. The steps we must take are:

- Identify unique tasks. Exclusive tasks are those that perform only a very small number of operators
- Identify tasks that can be performed by other specialties. Not all tasks can be performed by any operator (some need high training and a long period of training to be developed effectively), but many can be performed by any operator with a minimum training period. It is for certain measurements, the disconnection of an engine or welding underperforming.
- Develop a training plan that includes training in performing tasks that are considered unique and tasks that are considered likely to generalize.
- Perform this training plan. Of course, we must not only stay in the design phase of the plan, but must establish resources and time needed to do, to plan and carry it out
- Compose work procedures and technical instructions. If all activities were properly performed procedimentadas department with instructions and procedures clear and understandable by any operator (sometimes called guide-donkeys), exclusivity, and the indispensability specialization would not be a problem. The wording of these documents ensures that any operator at all times have the information necessary to perform any task.
- Primar economically versatility. Reverting to the operators themselves a part of the savings for the company to have different skills, motivate staff is achieved to opt for the non-specialist. It is important to have any effect, must be on the payroll as an additional plus for versatility, instead of increasing the bulk primary wage
- Create categories based on versatility. Certain companies that have opted for versatility have made a difference between staff trained in various specialties and expertise. The highest category corresponds to different skills. This category can be increased or no economic impact.
- Select the new staff be provided versatile. To implement this form of promotion of non-specialization, it is only necessary that new staff be required between the terms of engagement have knowledge and / or experience in various specialties.

http://www.mantenimientopetroquimica.com/en/tpm/144-articles-of-interest/103-boroscope-analysis-of-gas-turbine.html

Self-Check -1	Written Test

Directions:what is the advantage of specialization in maintenance ?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Preparing plant/equipment shutdown

What to Do to Prepare for Plant Shutdown:

Make a Plan: Utilize tools available to you to outline a thorough plan of what needs to be accomplished during or before the plant shutdown, such as a scheduling software or even a spreadsheet.

Prioritize time critical activities with a list.

Use past documentation/experiences to help you apply a duration for each repair. Analyze where/why overruns occurred and what you can do to avoid them this time.

These are the systems and equipment that need to be serviced in order for your plant to run efficiently until your next shutdown:

- The equipment/system needing service.
- The scope of work for the repairs/maintenance.
- Its priority rank, 1 being most crucial and 100 being the least.
- Include the trades needing access to the equipment/system. Can they work at the same time? What order will they need access?
- Do you have a lockout plan? Who locks this equipment out?

Prioritize access.

Many contractors work together and need access to the same piece of equipment and system. To save time and decrease costs, identify which contractors get access to the equipment first. For each piece of equipment or system, list the contractors needing access and what their priority is. Consider a pre-shutdown coordination meeting or call including all contractors working on critical equipment.

Use this as a guideline to create your shutdown schedule. Have contingency plans ready to go if issues are found upon inspection. Have your list of lower priority items for contractors that complete scope ahead of schedule. If you brought in the materials ahead of time, some items that didn't make the cut may still be completed.

Provide a schedule of work ahead of time.

- List the equipment, the duration and the contractor's priority.
- As you know, there is a lot of planning involved and you might have missed something. To save time with debates that can happen on site, release these ahead of time so everyone can have their questions answered.

Have a map of your site:

- List parking areas.
- Smoking areas.
- Cell phone areas.
- Contractor staging areas.
- Exit plans.

Organize Your Team: During a plant shutdown, roles often change. Maintenance professionals are often shifted to new areas of the plant or someone could be placed in charge of temporary contractor management. In the event that new folks will need hired on temporarily, Omni One can help!

Prepare Your Equipment: Shutdown is a time for maintenance and preventative maintenance – this means testing, troubleshooting, and repair! Be sure that you have the right tools available to get the job done, before and during shutdown.

Meet Regularly: Before shutdown begins, meet with your team to make sure that every employee is aware of what they will be doing over the next week or so. Meetings are recommended to touch base every single day, even more than once, to ensure that each task is completed.

Document Everything: ‘‘The best inspection in the world will do you no good if you can’t prove it." (Hy-Lok). Make sure to dot the i’s and cross the t’s on all formal documents and be open to process improvement measures. You will thank your team come time for the next shutdown!

Expect a Surprise: With any plan, something is bound to go wrong. A task might take longer than anticipated to complete, or additional work could present itself. These are things that can be avoided, but not entirely. Overcompensate for available staff and get all hands-on deck while there is still time.

https://www.amacs.com/the-importance-of-shutdowns-in-plant-operations/

https://www.omnione.com/career-resources/detail/4631/preparing-for-a-successful-plant-shutdown

Self-Check -2	Written Test

5. Directions:how can we plan a plant shutdown?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Conducting inspection and fault finding

Overview and Basic Terminology

A “fault” is another word for a problem. A “root cause” fault is a fundamental, underlying problem that may lead to other problems and observable symptoms. (It might not be directly observable). A root cause is also generally associated with procedures for repair.

A "fault" or "problem does not have to be the result of a complete failure of a piece of equipment, or even involve specific hardware. For instance, a problem might be defined as non-optimal operation or off-spec product. In a process plant, root causes of non-optimal operation might be hardware failures, but problems might also be caused by poor choice of operating targets, poor feedstock quality, poor controller tuning, partial loss of catalyst activity, buildup of coke, low steam system pressure, sensor calibration errors, or human error. A fault may be considered a binary variable (”OK” vs. “failed”), or there may be a numerical “extent”, such as the amount of a leak or a measure of inefficiency.

A symptom is an observed event or variable value, needed to detect and isolate faults. If a symptom is the response to a question or an on-demand data request (when actively testing a system instead of just passively monitoring it), it is referred to as a test or test result.

Fault detection is recognizing that a problem has occurred, even if you don't yet know the root cause. Faults may be detected by a variety of quantitative or qualitative means. This includes many of the multivariable, model-based approaches discussed later. It also includes simple, traditional techniques for single variables, such as alarms based on high, low, or deviation limits for process variables or rates of change; Statistical Process Control (SPC) measures; and summary alarms generated by packaged subsystems.

Fault diagnosis is pinpointing one or more root causes of problems, to the point where corrective action can be taken. This is also referred to as “fault isolation”, especially when emphasizing the distinction from fault detection. In common, casual usage, "fault diagnosis" often includes fault detection, so “fault isolation” emphasizes the distinction.

Other elements of Operations Management Automation related to diagnosis include the associated system and user interfaces, and workflow (procedural) support to for the overall process. Workflow steps that might be manual or automated include notifications, online instructions, escalation procedures if problems are ignored, fault mitigation actions (what to do while waiting for repairs), direct corrective actions, and steps to return to normal once repairs are complete.

Automated fault detection and diagnosis depends heavily on input from sensors or derived measures of performance. In many applications, such as those in the process industries, sensor failures are among the most common equipment failures. So a major focus in those industries has to be on recognizing sensor problems as well as process problems. Distinguishing between sensor problems and process problems is a major issue in these applications. Our usage of the term "sensors" includes process monitoring instrumentation for flow, level, pressure, temperature, power, and so on. In

other fields such as network & systems management, it can include other measures such as error rates, CPU utilization, queue lengths, dropped calls, and so on.

In the following material, we focus mainly on online monitoring systems, based on sensor or other automated inputs, but possibly including on some manual input from end users such as plant operators. However, we also consider a broader viewpoint of diagnosis not just as a technology, but also as part of the business process of fault management. Also, diagnosis as a decision support activity rather than a fully automated operation is common in the management of large, complex operations such as those found in the process industries and network & systems management. It is also a natural fit for operations such as call centers for customer support, where a significant amount of diagnosis is done. In those cases, there may be support from a workflow engine as well as the types of tools traditionally associated with fault detection and diagnosis

Knowledge andunderstandingYou need to know andunderstand:

- you must have a working knowledge and understanding of what yourresponsibilities are in respect of Health, Safety and Environment. Thisshould include the limits of your personal responsibility, your legalresponsibility for your own health and safety and the health and safety ofothers
- you must have a working knowledge of the relevant regulations and thesafe working practices and procedures required within your work area
- you must have a working knowledge and understanding of faultdiagnostic aids. This could be expected to include mechanical testequipment, historical data and schematic drawing
- you must have a working knowledge and understanding of fault findingmethods and techniques this should include how to investigate problems,how to identify the extent and location of problems and what to do whencauses are difficult to find, and which actions can be taken to deal withthe fault
- you must have a working knowledge and understanding of analysismethod and techniques. This could be expected to include historicaldata, comparison, and circuit measurements
- you must have a working knowledge and understanding of companyprocedures and manufacturers guidelines for the operating and care oftest equipment and control procedures
- you must have a working knowledge and understanding of assessing thelikely risks arising from faults such as fire, electric shock and damage toplant
- you must have a working knowledge and understanding of maintenancereporting documentation and control procedures and how descriptionsshould be presented, why it is important to record results of thediagnosis, and why it is important to relay conclusions on to others in atime span appropriate to the nature of the problem
- you must have a working knowledge and understanding of yourresponsibilities with regard to the reporting lines and procedures in yourworking environment

<u>Additional InformationScope/rangerelated toperformancecriteria</u>

1 The level and extent of responsibility extends to determination andfollow up of the information needed to support a clear and accuratedefinition of the problem and the selection and analysis of diagnosticprocedures appropriate to the problem as identified. In some cases,you may still be expected to refer to others for final authorisations, eventhough you remain responsible foridentifying and implementingdecisions.

2 The type of plant and equipment may be single or multiple technology.Typical plant and equipment could be:

2.1 Rotating equipment and tools

2.2 Protection methods

2.3 Fluid distribution systems.

3 The type of fault finding techniques or procedures, diagnostic aids andequipment could include:

3.1 Function testing
3.2 Comparison diagnosis
3.3 Substitution
3.4 Examination of failed components
3.5 Operational performance testing
3.6 Timed monitoring
3.7 Sectional isolation

4 The type and range of problems and faults may arise fromenvironmental factors such as exposure to sudden temperaturechanges and/or from human error and/or from materials that have beenused in or by the plant and equipment and/or from inherent features ofthe plant and equipment such as design aspects, age, and/or naturalwear and tear.

5 The level and complexity of diagnosis can be achieved by applyingprocedures which are formally specified or which are devised by thecandidate in response to the symptoms of the fault.

6 The record keeping systems and procedures to include:

6.1 Test results
6.2 Data sheets
6.3 Company procedures

Scope/rangerelated toknowledge andunderstanding

The Knowledge and Understanding levels expressed indicate the minimumlevel of knowledge and understanding sufficient to perform your role in amanner that would normally be associated with the minimum acceptableperformance of a competent person undertaking your role.

The expression ”working knowledge and understanding” indicates you areable to:

1. Identify and apply relevant information, procedures and practices toyour usual role in your expected working environments needing onlyoccasional recourse to reference materials
2. Describe, in your own words, the principles underlying your workingmethods. This does not mean the ability to quote “Chapter and verse”.Rather you must know what supporting information is available, howand where to find it and from whom to seek further guidance andinformation confirm any additional required detail
3. Interpret and apply the information obtained to your role, your workingpractice and in your expected working environment

https://www.sqa.org.uk/files/aq/FP7004.pdf

Self-Check -3	Written Test

Directions:why is inspection so important?

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet- 4	Removing and replacing defective parts

When equipment breaks down, everything from your productivity to your bottom line is disrupted. Your team needs a quick and effective solution. The difficult question arises- should you try for a repair, or replace the asset outright?

Replacing equipment is the larger investment, so many technicians choose to repair the equipment instead of replacing it. But the costs that go along with frequent breakdowns — lower productivity, defective output, rising labor costs, and unmet production schedules — can sometimes be greater than the cost of replacing the equipment outright.

Leaving your decisions to guesswork can be a costly and dangerous approach. If you aren't using a computerized maintenance management system (CMMS) effectively, you'll be forced to make decisions reactively, and as soon as something breaks down, you'll need to make a quick decision on what to do. With productivity plummeting, your decision will likely be made from an emotional standpoint, rather than solid data to support your decision.

Data Driven Decisions

Without a plan in place, your only concern will be getting your production back online as quickly as possible. The reactive decision you're forced to make may work out, but you may also end up making a hasty decision that solves the problem in the short-term but isn't the best solution in the long run.

In addition to the obvious replacement cost for a new piece of equipment, there are several other factors to take into consideration when deciding whether to repair or replace a piece of equipment:

- Ongoing maintenance costs over the remaining life of the equipment
- The impact any repair would have on productivity and quality
- Costs incurred from the equipment downtime
- Health, safety, and environmental costs that come with equipment breakdown
- Training costs for a new piece of equipment
- Disposal costs

- Installation costs

With so many factors to consider, it's clear this decision shouldn't be made without the proper data analysis.

1. Analyze the Costs

Always think in the long-term when analyzing the costs of repairing or replacing. For a new piece of equipment, consider the cost of purchasing the equipment, its service life, potential salvage value, operating costs, and any revenue increase it may bring.

For an old piece of equipment, consider its remaining service life, operating costs, its market value and future salvage rate. From these figures, you can determine an annual average cost for each option, which will then be easy to compare.

2. Consider the Age of Equipment

Equipment does not age with grace. The older your machinery, the more extensive repairs it will need. This often translates to higher maintenance costs. As you continue to repair, the machine will give you less and less for your investment of repair. You may want to consider replacing an old malfunctioning piece of equipment for a newer, technologically advanced model that will give you better efficiency and longevity. When your equipment is new, it makes more sense, in many cases, to repair it once it malfunctions.

3. Consider the Cost of Repairs

What are the cost of repairs, and more importantly, how often will you be paying those costs for repairs? Documenting asset repair events provides information on number and frequency of breakdown events and costs for the repairs. Can you tell if you're going to continue repairing this equipment several times a year, or will it likely just be a one-time fix?

4. Consider Downtime

What's the impact of downtime while the asset is being repaired? If it takes several days to repair, and if this happens frequently, you're looking at too many hours of lost productivity. Consider this when deciding if repair or replacement is better in your situation.

Keep in mind, however, that repairing often takes less time than replacing a machine. Replacing involves waiting for the replacement to arrive, installation, new training, and more. If you're on an extremely tight schedule and if the equipment is crucial to your process, you may lose too much in production if you take the time to replace.

5. Consider Safety

Remember that older equipment can cause injury to workers if it malfunctions. Even if you stay up to date on maintenance, equipment wears down as it ages. Thoroughly inspect your machinery before making your decision so you can determine if your current equipment will continue to provide a safe environment for your workers. If it won't, replacement is the obvious choice. If it is still meeting safety standards, it's worth comparing costs of a replacement versus repair.

6. Consider Efficiency

Always think of the long run. How efficient is your machine operating now, and will a simple repair keep efficiency at the level you want, or would a new piece of equipment that uses less fuel, offers newer features, and breaks down less frequently be better for your efficiency and your bottom line?

https://www.micromain.com/asset-repair-or-replace/

Self-Check -4	Written Test

Directions:why do we need to replace a machinery? And what procedures to follow?

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Carrying out regular programmed maintenance

PROGRAM/PREVENTIVE MAINTENANCE

By working with clients over many years we have come to know their plant almost as well as they do. Our experience tells us that regular programmed servicing saves thousands in the long run, not to mention the heartache.

WHAT IS PROGRAM MAINTENANCE (PM)?

PM is a maintenance process where the condition of the equipment is monitored for early signs of impending failure. Advanced technologies are used in order to determine equipment condition. The advanced technologies include the following, but not limited to:

- Oil Analysis programs- Particle count, Spectrochemical analysis, filtergram
- Pump and motor performance testing
- Vibration Analysis and Measurement
- Thermo / inspections
- Graphing cycles in pressure and flow

IN ADDITION

- Preventative Maintenance Inspections
- Magnetic Plug Inspections
- Filter Analysis
- System Reviews and redesigns

WHY THE NEED FOR PROGRAM MAINTENANCE?

Steps to operational excellence:- In order to achieve your goals, we must firstly address your needs. Which are:

- Predict equipment failures
- View the overall condition of the equipment
- Greater accuracy in failure prediction
- Reduce the cost of condition monitoring
- Improve equipment and component reliability
- Optimise equipment performance

Preventive Maintenance Objectives:

- Reduce major repairs by correcting minor difficulties as soon as they are evident. This means listening to your operators who usually recognise before management that machinery is making a "funny noise" or other irregularity in performance of equipment. Do not punish employees who are trying to report a defect beyond their control.
- Maintain equipment in a more productive state. Keep it clean; repair or replace lost or worn parts immediately. Follow the machinery manual recommendations.
- Improve scheduling of repairs. Do not postpone needed repairs. Delaying repairs usually results in much more costly problems later on.
- Maintain safety. Some parts as they become worn become dangerous, as in worn chain or belt drives. Staff are valuable and injuries are costly from the standpoint of lost time and training replacements, not to mention adverse impacts on employee morale.
- Improved customer service. A well-maintained mill looks good to the customer and helps assure the customer that the feed is made correctly the first time.
- Reduce overall operating costs. The miller of aquaculture feeds benefits from a well-maintained facility through reduced costs of operation and customer satisfaction.
- Provide trained maintenance personnel. Training of maintenance staff should be a high priority with high-level management oversight. Too often maintenance is seen as the bottom of the ladder, when in reality the quality and training of staff for this important responsibility should be paramount.

WHAT ARE THE BENEFITS OF CONDITION MONITORING?

By applying our technology as outlined above, we have helped you to achieve the following benefits:

- Fewer breakdowns
- Greater productivity
- Reduced costs
- Optimise oil change periods
- Extend equipment life
- Greater equipment performance

SERVICES/CAPABILITIES

- Structured program maintenance
- Planned service
- Asset database management
- Oil analysis

http://www.fao.org/3/y1453e0j.htm
http://blog.infraspeak.com/how-to-do-preventive-maintenance/

Self-Check -5	Written Test

Directions:what is preventive maintenance?
What will we consider in maintenance planing?

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation Sheet 1	CONTENT-

Method of compressor operator maintenance

Step 1- Check compressor lubricant level in crankcase and cylinder lubricator and, if necessary, add to level indicated by sight gauge.

Step 2- Check cylinder lubrication feed rate and adjust, as necessary.

Step 3- Check lubricant pressure and adjust as necessary to meet specified operating pressure.

Step 4- Check cylinder jacket cooling water temperatures.

Step 5- Check capacity control operation. Observe discharge pressure gauge for proper LOAD/UNLOAD pressures.

Step 6- Drain control line strainer.

Step 7- Check operation of automatic condensate drain trap (intercooler and aftercooler).

Step 8- Drain condensate from discharge piping as applicable (dropleg and receiver).

Step 9-Check intercooler pressure on multi-stage machines, and refer to manufacturer's manual if pressure is not as specified.

Operation Sheet 2	CONTENT-

Procedures for Generator **Layup**

When an emergency generator is removed from service for a permeate period of time it is placed in the layup status. Some basic steps to place a generator in layup can include:

Step 1. Disconnect generator batteries.

Step 2. Drain fuel system and change fuel filters.

Step 3. Drain coolant and change coolant filters.

Step 4. Replace air filters.

Step 5. Insure all intake and exhaust ports are covered.

Step 6. Disconnect all generator supply connections.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1.
Task 2.
Task N.

List of Reference Materials

7- BOOKS
8- WEB ADDRESSES (PUTTING LINKS)

Mineral Resources Infrastructure Work

Level I

Learning Guide - 54

Unit of Competence: Operate Laboratory Machine and Equipment

Module Title: Operate Laboratory Machine and Equipment

LG Code: MIN MRI1 M14 0519 lo1-LG-54

TTLM Code: MIN MRI1 M14 TTLM 0919v1

LO5.Clean up

Instruction Sheet	Learning Guide #-

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

- Clearing work area
- Disposing or recycling materials
- Cleaning, checking, maintaining and storing plant, equipment and tools

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Work area is cleared and materials are disposed of or recycled in accordance with project environmental management plan
- Plant, equipment and tools are cleaned, checked, maintained and stored in accordance with manufacturer's recommendations and standard work practices

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 20.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” in page -.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.

Information Sheet-1	Clearing work area

Environmental management plan

The Environment Management Plan (EMP) would consist of all mitigation measures for each component of the environment due to the activities increased during the construction, operation and the entire life cycle to minimize adverse environmental impacts resulting from the activities of the project. It would also delineate the environmental monitoring plan for compliance of various environmental regulations. It will state the steps to be taken in case of emergency such as accidents at the sites including fire. The detailed EMP for the complex is given below.

The EMP is generally

- Prepared in accordance with rules and requirements of the Environmental Protection Authority and the Environmental Units of Competent Sectoral Agencies
- To ensure that the component of facility are operated in accordance with the design
- A process that confirms proper operation through supervision and monitoring
- A system that addresses public complaints during construction and operation of the facilities and
- A plan that ensures remedial measures is implemented immediately.

The key benefits of the EMP are that it offers means of managing its environmental performance there by allowing it to contribute to improved environmental quality. The other benefits include cost control and improved relations with the stakeholders.

The objectives of the EMP are to:

- Identify a range of mitigation measures which could reduce and mitigate the potential impacts to minimal or insignificant levels;
- To identify measures that could optimize beneficial impacts;
- To create management structures that address the concerns and complaints of stakeholders with regards to the development;
- To establish a method of monitoring and auditing environmental management practices during all phases of development;
- Ensure that the construction and operational phases of the project continues within the principles of Integrated Environmental Management;
- Detail specific actions deemed necessary to assist in mitigating the environmental impact of the project;
- Ensure that the safety recommendations are complied with;
- Propose mechanisms for monitoring compliance with the EMP and reporting thereon; and
- Specify time periods within which the measures contemplated in the final environmental management plan must be implemented, where appropriate.

1.2. Preparation and implementation of the EMP

When preparing the EMP for a proposed activity, useful background information includes:

- Documents from the EIA process (eg. Final Scoping Report and/or Environmental Impact Report) and Record of Decision, that provide the context for the EMP, and which should include background information on the proposed project, predicted positive and negative impacts, management actions to mitigate negative impacts and enhance positive impacts
- High-level documents that set the framework for environmental management for the proposed activity, such as a Strategic Environmental Assessment (SEA), Strategic

Environmental Management Plan (SEMP), over-arching Environmental Management System (EMS), or results from an Integrated Development Planning (IDP) process.

Local monitoring programs that the EMP would need to take into consideration.

- Sometimes certain monitoring requirements for the project can be served by existing monitoring programs such as those carried out by a local authority.
- Information on existing monitoring and liaison forums that the EMP could link with in terms of communication and reporting, such as an Environmental Monitoring Committee.
- Environmental policies or guidelines from the project proponent that need to be applied to the EMP for a particular activity. This is particularly relevant for international companies.
- Updated project information that may provide more detail than presented for the EIA. The EIA process may lead to more detailed investigations into implementation of certain mitigation actions. The findings of these investigations can be included in the EMP.
- Applicable legislation that would be of relevance to the implementation of the project.

Reference:

https://www.westerncape.gov.za/Text/2005/7/deadp_emp_guideline_june05_5.pdf

Hill R.C. 2000. Integrated Environmental Management Systems in the implementation of projects. South African Journal of Science 96: 50-54.

2.1. Cleaning tools and equipment

Equipment of all types should be cleaned at the location of last use before being moved to a new location.Different types of materials require different cleaning methods

Preclearing, by removing heavy accumulations of soil and debris with appropriate tools, will save water during later washing operations. Effective cleaning to eliminate invasive species materials and prevent their spread can be accomplished by thoroughly removing soil and debris using pressurized water. In certain situations, cleaning with compressed air, rather than water, could prevent damage to certain equipment areas such as engine wiring systems and vehicle cabs.

Personnel who use equipment during cleaning operations are responsible for properly using

Personal Protective Equipment (PPE) that is appropriate to the cleaning activity. Using cleaning and disinfectant chemicals, power washers, air compressors, and other types of cleaning equipment may present unique working hazards. PPE items may be required to protect hearing, skin, eyes, respiration, and other body resources. For example, certain types of cleaning equipment may require electrical power and may present electrical hazards to the operator.

Even the most careful cleaning of any equipment, however, will not guarantee that the equipment is absolutely free of contamination. Successful cleaning is dependent upon many factors, such as the amount of care taken during the cleaning operation, the type of cleaning equipment being used, the level of training of the cleaning operator, the type of equipment being cleaned, and the particular invasive species.

After decontamination, equipment should be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment should be moved away (preferably upwind) from the decontamination area to prevent re-contamination. If the equipment is not to be immediately re-used it should be covered with plastic sheeting or wrapped in aluminum foil to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

2.2. Checking of Equipment and Tools

This is designed to encourage all staff to check equipment and tools regularly for faults and condition and report defects to Management immediately and not to use defective tools or equipment.

Outcomes required

The overall intention is to raise awareness of using faulty tools or equipment and that all are aware of their duty of care to themselves and others of ensuring they do not. Also the empowerment they have in not conducting unsafe acts by using and also in confidently raising with management issues with equipment and tools supplied by the company.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Explain what Environment Management Plan mean (EMP)? List out the objectives of EMP. (5 Points)
2. Discuss how EMP is prepared and implemented? (5 Points)
1. Discus why Cleaning tools and equipment is important? (3 Points)
2. Discuss importance of checking for defects prior to use.(3 Points)
3. What is Equipment maintenance mean? Discuss why is needed?(2 Points)
4. Discuss briefly on the benefits of Proper Storage of Tools and Equipment's.(2 Points)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Disposing or recycling materials

Disposal of Nonhazardous and Nonregulated Waste

Some nonregulated laboratory waste is hazardous and should be safely managed. There are more waste management options for nonregulated waste, especially with regard to hazard reduction procedures.

Some laboratories have policies that require all chemical waste to be handled as if it were regulated as hazardous. This recognizes the potential liabilities associated with misperceptions or the improper handling of nonregulated as well as regulated waste. For example, a trash hauler or landfill operator may become alarmed by a laboratory chemical container, even if it contains sucrose. Note that if different types of waste are comingled, though, then the mixture must be treated as hazardous waste, and the cost for disposal of the nonhazardous portion may increase. Also consider the possibility that a hazardous material may be improperly labeled or described as nonhazardous.

When safe and allowed by regulation, disposal of nonhazardous waste via the normal trash or sewer can substantially reduce disposal costs. Many state and local regulations restrict or prohibit the disposal of waste in municipal landfills or sewer systems, and so it is wise to check the rules and requirements of the local solid waste management authority and develop a list of materials that can be disposed of safely and legally in the normal trash. The common wastes usually not regulated as hazardous include certain salts (e.g., potassium chloride and sodium carbonate), many biochemicals, nutrients, and natural products (e.g., sugars and amino acids), and inert materials used in a laboratory (e.g., noncontaminated chromatography resins and gels). In some places, the laboratory's hazardous waste disposal firm may assist with disposal of nonregulated materials.

Treatment and Disposal Options

As described in the introduction to this chapter, the third tier of waste management entails reclamation and recycling of materials from the waste. These methods should be considered in conjunction with the fourth tier, disposal. Reclamation, recycling, and disposal methods for chemical hazardous waste are described in this section.

The question of what forms of treatment are allowed under federal regulations poses a dilemma for laboratory professionals. Federal regulations define treatment as "any method … designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render the waste nonhazardous or less hazardous …." In most cases, treatment requires a state or federal permit. The regulatory procedures and costs to obtain a permit for treatment are beyond the resources of most laboratories. Under federal law, laboratory treatment of chemical hazardous waste without a permit is allowed in the following instances:

- small-scale "treatment" that is part of a laboratory procedure, such as the last step of a chemical procedure;
- a state that allows "permit-by-rule," treatment, that is, by allowing categorical or blanket permitting of certain small-scale treatment methods;
- elementary acid-base neutralization; and
- treatment in the waste collection container (see for regulatory information).

Of course, treatment restrictions apply only to chemical hazardous wastes that are regulated by EPA. Some biological toxins not listed by EPA can be easily denatured without a permit by heat or an appropriate solvent. No permit is required to irretrievably mix small amounts of controlled substances (not regulated by EPA) into bulk waste flammable solvents. Because illegal waste treatment can lead to fines, it is most important that, before carrying out any processes that could be considered treatment, the responsible laboratory personnel or the institution's EHS office check with the local, state, or regional EPA to clarify its interpretation of the rules. Some states do allow small-scale treatment of waste, but many do not.

To minimize costs and manage laboratory waste most efficiently, it is important to consider treatment and disposal options as early as possible, and plan ahead. For example, the method of waste collection impacts how waste will be stored, as well as its efficient transfer to a treatment or disposal facility. In addition to the hazard reduction procedures described above, laboratories utilize several treatment and disposal options because of the great variety of waste generated, and because each option (described below) has its own advantages for specific wastes, and so planning can be difficult. Although landfill disposal is not described separately below, it is often the disposal method for encapsulated waste, treatment residues, and ash from incineration. Note that disposal options change as technology and environmental concerns change. When feasible, waste minimization is always a best practice.

Treatment and Recycling

There are various methods for physical and chemical treatment of hazardous wastes, as well as methods for recycling, reclamation, and recovery of valuable materials contained in the waste. These methods include neutralization, oxidation-reduction, distillation, digestion, encapsulation, and several forms of thermal treatment. While the expense and practicality of these technologies is largely based on the specific nature and volume of the material, treatment or recycling is preferable to incineration for some hazardous wastes. For example, high- and low-pH wastes may be neutralized, resulting in treatable wastewater and salts. Incineration of mercury and other toxic metals is restricted; recycling, recovery, or encapsulation is environmentally preferred. Filtration of aqueous-based wastes may also significantly decrease volumes and result in wastewaters suitable for treatment in a sewage treatment facility. Note that recycling and reclamation extend to reclamation of energy as well as materials, and flammable waste liquids from laboratory operations are almost universally consolidated and used in fuel blending operations, typically to power cement plants. These liquids may also be used as a fuel source for rotary kilns.

Release to the Atmosphere

The release of vapors to the atmosphere, via, for example, open evaporation or laboratory chemical hood effluent, is not an acceptable disposal method. Apparatus for operations expected to release vapors should be equipped with appropriate trapping devices. Although laboratory emissions are not considered a major source under the Clean Air Act, deliberate disposal of materials via evaporation of vapors is strictly prohibited under RCRA.

Chemical hoods, the most common source of laboratory releases to the atmosphere, are designed as safety devices to transport vapors away from laboratory personnel, not as a routine means for volatile waste disposal. Units containing absorbent filters have been introduced into some laboratories, but have limited absorbing capacity. Redirection of hood vapors to a common trapping device can completely eliminate discharge into the atmosphere.

Incineration

Incineration is the most common disposal method for laboratory wastes. Incineration is normally performed in rotary kilns at high temperatures (1200–1400 °F). This technology provides for complete destruction of most organic materials and significantly reduces the volume of residual material which must be disposed of by landfill. However, it is an expensive option, generally requiring the use of significant volumes of fuel to generate the required temperatures. Also, some materials, such as mercury and mercury salts, may not be incinerated because of regulations and limitations of the destruction capability.

Waste Disposal - Disposal of Laboratory Wastes

Disposal Procedures

It is the clear responsibility of all lab workers to ensure the safe and correct disposal of all wastes produced in the course of their work. Improper and irresponsible disposal of chemical wastes down drains, to the Local Authority refuse collection, or into the atmosphere is forbidden by law. The Aldrich Handbook provides a useful summary of the correct disposal procedure for most chemicals. Due to new legislation, increasingly strict environmental controls and the escalating costs of disposal, it is essential that the appropriate disposal procedures given below are strictly adhered to:

Wash down drains with excess water

- Concentrated and dilute acids and alkalis
- Harmless soluble inorganic salts (including all drying agents such as $CaCl_2$, $MgSO_4$, Na_2SO_4, P_2O_5)
- Alcohols containing salts (e.g. from destroying sodium)
- Hypochlorite solutions from destroying cyanids, phosphines, etc.
- Fine (tlc grade) silica and alumina

It should be noted in particular that no material on the "Red List" should ever be washed down a drain. This list is as follows:

- compounds of the following elements:- antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, tellurium, thallium, tin, titanium, uranium, vanadium and zinc.
- organohalogen, organophosphorus or organonitrogen pesticides, triazine herbicides, any other biocides.
- Cyanides
- mineral oils and hydrocarbons
- poisonous organosilicon compounds, metal phosphides and phosphorus element
- fluorides and nitrites

Incineration (Solvent Waste collection)

- all organic solvents including water miscible ones
- soluble organic waste including most organic solids
- paraffin and mineral oil (from oil baths and pumps)

Laboratory waste bins and controlled waste

All waste suitable for the Local Authority refuse collection, except recyclable paper and glass, is termed 'controlled waste'. Items in this category which includes dirty paper, plastic, rubber and wood, should generally be placed in the waste bins available in each laboratory and will be collected by the cleaners. However, each laboratory must also have a container for certain items which are not allowed to be put in the normal waste bins. In this special controlled waste container should be put:- all broken laboratory glassware, any sharp objects of metal or glass, all fine powders (preferably inside a bottle or jar) and dirty sample tubes or other items lightly contaminated with chemicals (but not any syringes or needles). Laboratory controlled waste containers must be emptied regularly and never allowed to overflow. Under no circumstances must any item of glass, sharp metal or fine powder ever be put in a normal laboratory waste bin. The tops must be removed from all bottles put out for disposal and there should be no detectable smell of chemials from any bottle put for disposal.

Waste for special disposal

This is a troublesome and expensive method of disposal and the quantity of special waste must be kept to an absolute minimum. Only the following items should be disposed of in this way:

1. Schedule 1 poisons (but not cyanides) and other highly toxic chemicals
2. Materials heavily contaminated with substances in (i)
3. Materials contaminated with mercury
4. Carcinogenic solids including asbestos.

Special waste must be collected in a separate labelled bottle or jar for disposal. On no account must different types of waste be mixed. Advice should be sought from the School Safety Co-ordinator before beginning any work which will produce waste requiring special disposal in order to ensure that :

- the waste can be disposed of
- it is collected in the most suitable form so as to minimise the cost involvedand
- it will be stored under suitable conditions.

The importance of handling waste for special disposal to the School Safety Co-ordinator immediately the container is full or the work is finished is emphasised. The hoarding up of hazardous waste in laboratories is strictly forbidden.

Environmental Health and Safety Services should be notified of all 'Special Waste' on the appropriate University form (see section on waste - A Microsoft Word '97 copy of the Special Waste Notification Form can be downloaded - Here)

Glass recycling

For environmental reasons the recycling of glass is encouraged, but only certain items of waste glass produced within laboratories are acceptable for recycling. Each laboratory should have a bin for recyclable glass. Only clean glass bottles such as those in which chemicals are received, and broken or waste plate glass are allowed. All broken laboratory glassware, items significantly contaminated by chemicals, sample tubes, droppers and glass wool must be disposed of as controlled waste. The recycling service will refuse to empty a recycling container if any of these prohibited items is discovered in it.

Bottles for bulk solvents

The importance of returning the specially labelled winchesters for solvents which are bought in bulk to the Store ready for direct refilling is emphasised. They must not be contaminated in any way and should not normally be washed out. Bottles containing sodium must not, under any circumstances, be returned directly to the Store. When sodium is first added to a bottle of solvent a label indicating this (available from the Store) should be attached. When the bottle is empty the sodium must be safely destroyed by adding ethanol or methylated spirit and the label removed. The bottle must then be washed out, dried and returned to the Store ready for direct refilling.

Empty winchester bottles may be re-used e.g. for the disposal of waste solvents. They must first be washed out with water if they have contained a corrosive or harmful chemical e.g. concentrated acid or ammonia.

https://www.standrews.ac.uk/staff/policy/healthandsafety/publications/waste/waste-disposaloflaboratorywastesguidance/

Self-Check -2	Written Test

6. Directions:how we can transport wesat to disposal site

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Cleaning, checking, maintaining and storing plant, equipment and tools

Introduction

Raw materials form a critical part of manufacturing as well as service organization. In any organization, a considerable amount of material handling is done in one form or the other. This movement is either done manually or through an automated process. Throughout material, handling processes significant safety and health; challenges are presented to workers as well as management. Therefore, manual material handing is of prime concern for health and safety professional, and they must determine practical ways of reducing health risk to the workers.

Material Handling

Manual material handling ranges from movement of raw material, work in progress, finished goods, rejected, scraps, packing material, etc. These materials are of different shape and sizes as well as weight. Material handling is a systematic and scientific method of moving, packing and storing of material in appropriate and suitable location. The main objectives of material handling are as follows:

- It should be able determine appropriate distance to be covered.
- Facilitate the reduction in material damage as to improve quality.
- Reducing overall manufacturing time by designing efficient material movement
- Improve material flow control
- Creation and encouragement of safe and hazard-free work condition
- Improve productivity and efficiency
- Better utilization of time and equipment

It is critical for manufacturing organization to identify importance of material handling principle as the critical step in promoting the job improvement process. Manual material handling significantly increases health hazard for the workers in from lower back injuries.

In the current competitive and globalized environment, it is important to control cost and reduce time in material handling. An efficient material handling process promotes:

- Design of proper facility layout
- Promotes development of method which improves and simplifies the work process
- It improves overall production activity.
- Efficient material handling reduces total cost of production.

Principles of Material Handling

Material handling principles are as follows:

- **Orientation Principle:** It encourages study of all available system relationships before moving towards preliminary planning. The study includes looking at existing methods, problems, etc.
- **Planning Principle:** It establishes a plan which includes basic requirements, desirable alternates and planning for contingency.

- **Systems Principle:** It integrates handling and storage activities, which is cost effective into integrated system design.
- **Unit Load Principle:** Handle product in a unit load as large as possible
- **Space Utilization Principle:** Encourage effective utilization of all the space available
- **Standardization Principle:** It encourages standardization of handling methods and equipment.
- **Ergonomic Principle:** It recognizes human capabilities and limitation by design effective handling equipment.
- **Energy Principle:** It considers consumption of energy during material handling.
- **Ecology Principle:** It encourages minimum impact upon the environment during material handling.
- **Mechanization Principle:** It encourages mechanization of handling process wherever possible as to encourage efficiency.
- **Flexibility Principle:** Encourages of methods and equipment which are possible to utilize in all types of condition.
- **Simplification Principle:** Encourage simplification of methods and process by removing unnecessary movements
- **Gravity Principle:** Encourages usage of gravity principle in movement of goods.
- **Safety Principle:** Encourages provision for safe handling equipment according to safety rules and regulation
- **Computerization Principle:** Encourages of computerization of material handling and storage systems
- **System Flow Principle:** Encourages integration of data flow with physical material flow
- **Layout Principle:** Encourages preparation of operational sequence of all systems available
- **Cost Principle:** Encourages cost benefit analysis of all solutions available
- **Maintenance Principle:** Encourages preparation of plan for preventive maintenance and scheduled repairs
- **Obsolescence Principle:** Encourage preparation of equipment policy as to enjoy appropriate economic advantage.

Material handling operations are designed based upon principles as discussed above. Material handling equipment consists of cranes, conveyors and industrial trucks.

Equipment maintenance

Tools and equipment must be maintained if they are to be operated in a safe and effective manner. Elements of good maintenance requirements include:

- Inspection of the tools and equipment at must occur checkout or start-up of the job. This can include such items as a visual inspection of the power cord to make sure it is not damaged, visual inspection to make sure equipment parts are securely attached, and inspection for cleanliness.

- Inspection of tools and equipment must also occur at check in or at completion of the job. This should include cleaning the tools after use, reporting any problem with the tool or equipment while in use, draining any excess fuel or flammable fluids from the equipment.
- Routine maintenance as per the manufacturer's requirements should be carried out.

Proper Storage of Tools and Equipment:

To ensure that tools and equipment remain in good condition and last for a long time, store them properly. Properly stored tools and equipment will be easy to find when needed and are less likely to be lost.

Example: Good practices for mechanical room

Parts should be properly stored and labeled	
Tools should be properly placed on the board, and labeled. Consider drawing the shapes of the tools on the board so that they always get put back in the same position.	
Use bins for storing small parts	
Consider making an individual (or individuals) responsible for the good maintenance of tools and parts.	

2.4.1. **Benefits of Proper Storage of Tools and Equipment:**

- Tools and parts are kept in good condition and are easy to find
- Costs are reduced
- Productivity is increased because time is not lost looking for tools, parts and equipment
- Workshop staff develop a sense of responsibility and pride in their work

How?

✓ Workshop staff identify tools, parts and equipment

- ✓ Workshop staff develop a system for labeling and storing tools, parts and equipment

Reference:

https://www.managementstudyguide.com/material-handling.htm

Self-Check -3	Written Test

Directions:what is material handling?
List five material handling tools?

Note: **Satisfactory rating - 2 points** **Unsatisfactory - below 2 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

operation Sheet-1	Metal scrap recycling

The Metal Recycling Process

Follow following main stages of the metal recycling process are as follows:

Step 1. Collection

The collection process for metals differs than that for other materials because of higher scrap value. As such, it is more likely to be sold to scrap yards than sent to the landfill. The largest source of scrap ferrous metal in the U.S. is from scrap vehicles.

Other sources include large steel structures, railroad tracks, ships, farm equipment, and of course, consumer scrap. Prompt scrap, which is created in the course of new product manufacturing, accounts for one-half of ferrous scrap supply.

Step 2. Sorting

Sorting involves separating metals from the mixed scrap metal stream or the mixed multi-material waste stream. In automated recycling operations, magnets and sensors are used to aid in material separation.

At the entrepreneurial level, scrappers may employ a magnet, as well as to observe the material color or weight to help determine the metal type. For example, aluminum will be silver and light. Other important colors to look for are copper, yellow (for brass) and red, for red brass. Scrappers will improve the value of their material by segregating clean metal from the dirty material.

Step 3. Processing

To allow further processing, metals are shredded. Shredding is done to promote the melting process as small shredded metals have a large surface to volume ratio.

As a result, they can be melted using comparatively less energy. Normally, aluminum is converted into small sheets, and steel is changed into steel blocks.

Step 4. Melting

Scrap metal is melted in a large furnace. Each metal is taken to a specific furnace designed to melt that particular metal. A considerable amount of energy is used in this step.

Still, as mentioned above, the energy required to melt and recycle metals is much less than the energy that is needed to produce metals using virgin raw materials. Based on the size of the furnace, the degree of heat of the furnace and volume of metal, melting can take from just a few minutes to hours.

Step 5. Purification

Purification is done to ensure the final product is of high quality and free of contaminants. One of the most common methods used for purification is Electrolysis.

Step 6. Solidifying

After purification, melted metals are carried by the conveyor belt to cool and solidify the metals. In this stage, scrap metals are formed into specific shapes such as bars that can be easily used for the production of various metal products.

operation Sheet-2	plastic scrap recycling

Step 1: collect

The first step in the recycling process is always collecting the plastic material that is to be recycled.

Step 2: Sorting

After plastics are collected and transported to a recycling facility, the next step is sorting.

Machines sort plastics into different areas based upon a multitude of properties that are often dependent upon the recycling facility or what final product is being produced.

Step 3: Washing

Just like with clothes, fruits/vegetables, and many other things, plastics must be washed before they are further processed. The goal of this step is to remove impurities and everything that is not made from plastic.

Step 4: Resizing

Resizing consists of shredding or granulating the plastic waste into small particles. This increases the surface area of the plastic, making it easier to process, reshape, and transport if needed.

Step 5: Identification and separation of plastics

The identification and separation of plastics is when the now small plastic particles are tested to determine their quality and class.

Step 6: Compounding

Compounding is when the small particles are smashed and melted together into plastic pellets. The pellets can then be used in the production of other plastic products.

Operation Sheet 1	CONTENT-

DO NOT use this machine unless a teacher has instructed you in its safe use and operation and has given permission

Safety glasses must be worn at all times in work areas.

Appropriate hearing protection (*Class 5- SLC_{80}>26 dB*) must be worn.

Appropriate protective footwear must be worn.

Wear a hard hat if required.

Rings and jewellery must not be worn.

Wear an approved dust mask (*P2 dust and fumes)*.

Use compressed air safely – horseplay with compressed air can cause injuries

PRE-OPERATIONAL SAFETY CHECKS

1. **Ensure the work area is well ventilated and not interfering with other students or activities.**
2. **Visually check all air hoses and electrical leads used with the compressor for damage and slip/trip hazards.**
3. **Ensure all guards for the compressor (e.g. belt and pulley cover) are in place and in good working order.**
4. **Ensure you are familiar with the operation of the ON/OFF switch.**
5. **Check that the regulator is set to the appropriate pressure for the activity.**
6. **Check the oil level of the compressor in the oil sight glass.**

OPERATIONAL SAFETY CHECKS

1. **Ensure all attachments used with the air compressor are in good condition before using.**
2. **Be careful when attaching and disconnecting tools to the air hose. Hold the air hose and tool firmly during this process.**
3. **Check the compressor regularly, noting pressure increase and cut-out/cut-in pressure.**
4. **Listen for any air leaks from any flexible airlines and immediately report any leaks.**
5. **Adjust pressure regulator to suit work requirements – discuss with your teacher.**

6. **Turn off and disconnect air hoses and electrical leads after use.**
7. **Never leave air compressor and equipment unattended.**

HOUSEKEEPING

1. **Leave the work area in a safe, clean and tidy state – remove any waste.**
2. **Release condensation from the drain before storing air compressor away.**
3. **Air hoses and electrical leads should be coiled with large loops.**

POTENTIAL HAZARDS

- **Material blown under pressure**
- **Slips, trips and falls**
- **Excessive noise**
- **Unrestrained air hose whipping around**
- **Compressed air**
- **High pressure air hose couplings**
- **Manual handling – equipment and materials**

FORBIDDEN

- **Never use compressed air to clean off clothes, workbenches or floor surfaces**

Never direct compressed air at your body or another person.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1.
Task 2.
Task N.

List of Reference Materials

9- BOOKS
10- WEB ADDRESSES (PUTTING LINKS)