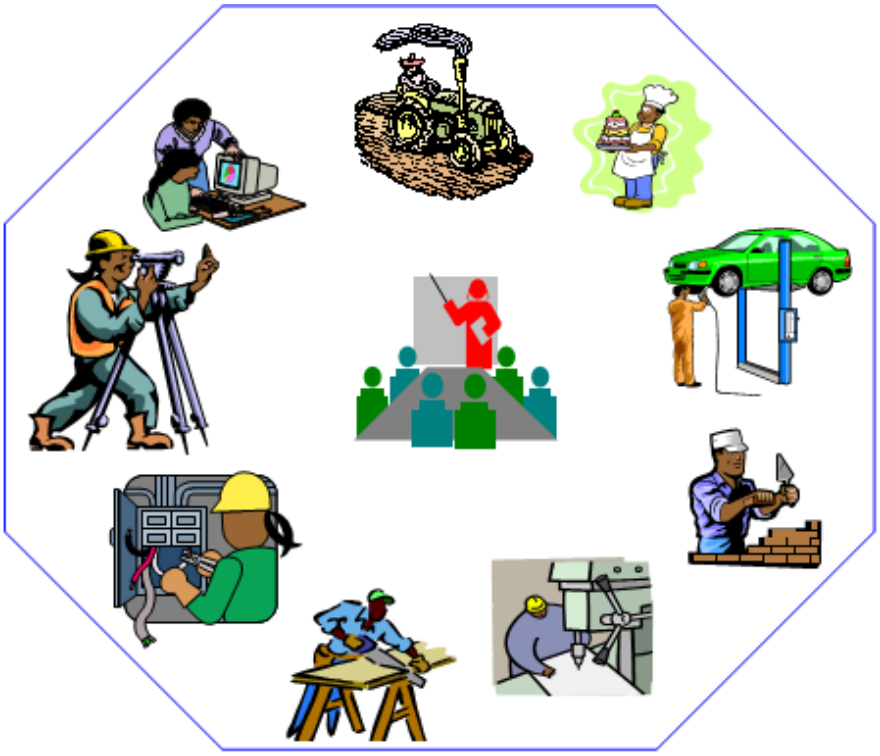
Animal production Level III

Based on **March 2018**, Version 3 OS and March. 2018, V3 Curriculum



Module Title: Operating and Maintaining Livestock Production Machinery and Equipment

LG Code: AGR APR3 M21 LO (1-4) LG (96-99)

TTLM Code: AGR APR3 TTLM 0621 v1

June 2021

Adama, Ethiopia

THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

East Africa Skills for Transformation and Regional Integration Project (EASTRIP)

Table of Contents page

L #96	LO #1 Identify machinery and equipment

Instruction sheet

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

- Identifying specialized machinery and equipment
- Evaluating alternative options of machinery
- Identifying and addressing storage and housing requirements
- Monitoring and assessing machinery innovations.
- Maintaining inventory of machinery and equipment
- Completing routine pre-operational checks
- Recognizing OHS hazards, assessing and minimizing risk

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

- Identify specialized machinery and equipment
- Evaluate alternative options of machinery
- Identify and address storage and housing requirements
- Monitor and assess machinery innovations.
- Maintain inventory of machinery and equipment
- Complete routine pre-operational checks
- Recognize OHS hazards, assessing and minimizing risk

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
5. If you earned a satisfactory evaluation proceed to “Operation sheets
6. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1: Identifying specialized machinery and equipment

1.1 Introduction

Mechanization

Agricultural mechanization holds the use of tools, apparatuses and machines for agricultural land development, production, harvesting and on farm processing

Introduction of machines in agricultural used for different operation of farming to quicker, easier and better production of foods and fibers'

Agricultural mechanization covers the manufacture, distribution and utilization of tools, implements and machines.

Definition of tools, implements, machines and machinery

A tool is the simplest physical aid used in agriculture. The power source is human labor. It embraces wide varieties such as we may get items of crude nature to precise and well-engineered ones. E.g. the spade

Hand Tools are devices that primarily used in performing those jobs that does not require or does not involve the use of a machine or a motor. These handled and powered solely by the person who is using these tools.

An implement is a specific type of tool much related to the power source. There is no complicated mechanism in it. It applies to any device which is relatively simple for performing a mechanical or manual operation. It performs better job than tool. E.g. the traditional plow set

Equipment The necessary items for a particular purpose. Or a tangible property other than land and building that is used in the operations of a business.

A machine is a device with a specific mechanism in it to perform a specific task or tasks with certain mechanical advantage. Or simply it is a device that gives mechanical advantage, which facilitates the doing of work. In other words a machine is an assembly of parts that are made of solid bodies but include in some cases fluid bodies or electricity in conductors and that transmit force, motion and energy one to another in some predetermined manner and to

some desired end (as hoisting a load, or maintaining an electric current).E.g. the row crop planter

Machinery is a collective term for machines and their parts. A machine is considered to be any apparatus that has interrelated parts and is used to perform work .To be equipped with machinery is called **mechanization.**

Plant is a general name for machinery, equipment, appliance, implement or tool and any component or fitting or accessory of these. It can include things as diverse as presses in a foundry, underground drill jumbos in mining and photocopiers in an office.

1.2 Specialized machinery and equipment of livestock production

1.2.1 Cattle production machinery and equipment

1. Milking machine and equipment

Machine milking is to extract milk from the cow by vacuum. The machines designed to apply a constant vacuum to the end of the teat to suck the milk out and convey it to a suitable container, and to give a periodic squeeze applied externally to the whole of the teat to maintain blood circulation.

There are four main **types** of milking **machines** currently available on the market:

1. Electric
    - Movable
    - Fixed
2. Battery
3. Gas
4. Manual.

Electric **machines** are perfect for small to medium-sized farms that have a handful of livestock

The basic layout of the three main types of milking machines are:

- Pump to remove air from the vacuum pipeline
- Vacuum regulator
- Container to collect the milk that comes into the teacup assembly during milking.

Figure 1: a) Electrical movable milking machine b)Fixed milking machine

2. Milk processor machine (cream separator and churner)

I. **cream separator**

Defined as a device that separates the whole milk into skimmed milk or **cream**. It is a centrifugal device and commonly used on farms in the past years. This device is beneficial, especially for farmers, to milk their cows manually

Figure 2: a) Electric cream separator b) Hand Crank Cream Separator (manual)

II. Butter churner

Device **used** to convert cream into butter, done through a mechanical process, frequently via a pole inserted through the lid of the **churn**, or via a crank **used** to turn a rotating device inside the **churn**.

Figure 3: a) Modern electric churner b) Traditional butter churning clay pot

3. Calf Box

Chrome-tanned calfskin having square markings on the grain because of rolled lengthwise and crosswise compare board

The **calf warmer** creates a comfortable, enclosed environment for newborns during the critical hours after birth. The **heater** is located in a separate enclosure at the rear of the **calf warmer**. The interior of the **calf warmer** provides enough room so the **calf** can lie down or stand

Figure 4: Calf box

4. Milk container and transport equipment (Villon)

Used to transport **milk** from the cow to the home, some of these **cans** date back hundreds of years. The earliest metal **milk cans** are from the Island of Guernsey about 1,000 years ago, where they were made by hammering sheets of metal into a set form in the same way armor of the era was made.

Figure 5: Different types of milk continer

5. Baler

baler or **hay baler** is a piece of farm machinery used to compress a cut and raked crop (such as **hay**, cotton, flax **straw**, salt marsh **hay**, or silage) into compact bales that are easy to handle, transport, and store.

Figure 6: Grass hay baler New hay baler range

6. Loaders

Loader tractors in Monett MO are mostly for **agricultural** use. Digging depth and lifting capacity based on the size and weight of the tractor. **Agricultural loaders** specifically designed used by **farm** tractors. Most of them nowadays made to fit on any size of tractor whether big or small.

Figure 7: Wheel loader Mini agricultural loader

7. Manure Solid Liquid Separator

Solid-liquid **separation** is the partial removal of organic and inorganic **solids** from animal manures. **Solids separation** creates two manure streams, a **solids** rich fraction

composted or anaerobically digested, and a liquid rich fraction that is easier to pump and handle

With a vibrating screen **separator**, liquid **manure** pumped across a controlled vibrating screen. Liquid flushes through the screen while the solids moved to the screen edge Solids accumulate on the screen and move down while liquids move through the screen.

Liquid animal **manure** is a valuable source of nutrients and organic matter for crop production and applied by a variety of methods including spray irrigation, land surface spreading, and shallow subsurface injection

Figure 8: Solid Liquid Separation Device

8. Stationary engines

A **stationary engine** is an **engine** whose framework **does** not move. They **are** used to drive immobile equipment, such as pumps, generators, mills or factory machinery, or cable cars.

Figure 9: Stationary engines stock

9. Spraying equipment

A sprayer is a device used to spray a liquid, where sprayers commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients**.**

Figure 10: Knapsack sprayer

agricultural spray equipment

10. Irrigation equipment

Irrigation equipment divided into

- Pipes
- pipe connector fittings
- flow control devices
- filters
- Fustigation **equipment**
- water emitters
- automation **equipment**
- operation **equipment**
- Water-lifting devices.(generator)

Figure 11: Irrigation pipe Agricultural irrigation Pp fitting

Figure 12: Fatigation irrigation system Mini inline emitters

Figure 13: Generater water pumpe Irrigation equipment

11. Forklifts

Combination of hydraulics pulley system and other things to lift heavy materials across different distances. Commonly used in warehouses, construction sites and other places that need to transport many heavy materials

Figure 14: Forklifts

12. feed mixers and miller

The mixer known as the heart of the feed mill. All raw materials must pass through the mixer as they make their way through the mill

The mixer turns different ingredients into a homogenous mass in which every pellet or feed ration contains the same amount of each ingredient.

Figure 15: Feed mixer Feed miller

13. Automatic Weighing system

Automatic scales work without the assistance and intervention of the operator. The entire weighing procedure carried out automatically following a pre-determined process, which defined for the respective scales during design

Figure 16: Automatic Weighing system

14. Feed grinders

10v hammer mill is an easy to use grinder that allows for at-home production of livestock feed. ... For grinding corn and other grains into more manageable sizes for livestock. Useful for producing small batches **or mixing home blends of feed. Produces a coarsely ground flour for baking.**

Figure 17: Feed grinders

15. Chopper

Feed Chopper is mechanical device used to cut the straw or hay into small pieces to mix it together and fed to cattle. This improves animal digestion and prevents animal from rejecting any part of their food

Figure 18: Electric and diesel animal feed chopper machine

1. Mower

A mower person or machine that cuts (mows) grass or other plants that grow on the ground. Larger mowers or mower-conditioners are mainly used to cut grass (or other crops) for hay or silage and often place the cut material into rows, which are referred to as windrows.

Figure 19: Mowers for hay and silage making **Mower modern agriculture**

17. Agricultural tractor

Modern tractors used for

- Ploughing
- Tilling

- Planting fields in addition to
  - ✓ Routine lawn care
  - ✓ Landscape maintenance
  - ✓ Moving or spreading fertilizer
  - ✓ clearing bushes

Tractors offer advantages on small farms as well as in regular lawn and garden work

Figure 20: Agricultural tractor

2. Fertilizing application

Dry and liquid fertilizer application equipment includes broadcasters, attachments for row-crop planters or cultivators, and fertilizer drills. Dry and liquid fertilizers sometimes applied through irrigation water through special injection systems

Figure 21: Fertilizing application

18. Agricultural Vehicle

Agricultural vehicles used for farming include tractors, harvesters, etc. motor vehicle with large back wheels, thick tires, and used in farms for pulling machinery at a slow speed. Tractors mostly used for carrying the trailer or machinery used in agriculture or construction

The most common **types** of **equipment** and **machinery** used on **farms** include **tractors**, balers, combines, plows, mowers, planters, and sprayers

Figure 22: Agricultural Vehicle

19. Grain handling equipment

Grain handling facilities are facilities that may receive, handle, store, process and ship bulk raw agricultural commodities such as (but not limited to) corn, wheat, oats, barley, sunflower seeds, and soybeans

Grain handling products include bucket elevators, distributors, drag conveyors, screw conveyors and catwalk & support towers.

Figure 23: Grain handling equipment

B. Poultry production machinery and equipment

1. Incubator

An **incubator** is a device used to grow and maintain microbiological cultures or cell cultures. The **incubator** maintains optimal temperature, humidity and other conditions such as the CO_2 and oxygen content of the atmosphere inside. The most commonly used temperature both for bacteria such as the frequently used

Figure 24: Incubator

2. De-beaker

Beak trimming is the partial removal of the tip of the beak, and results in a beak that is blunt or rounded at the end. It is one of the most common methods utilized by the poultry industry (mainly the egg and turkey industries) to control the impacts of severe feather pecking.

Beak trimming **should** done between 7-10 days age and only by properly trained personnel. Beak trimming errors can result in additional pain and suffering **to** an already stressful procedure.

Figure 25: Automatic electric beak cutter

3. Poultry waterer

Figure 26: Manual poultry waterer Automatic poultry waterer

4. Poultry Feeder

Feeder is the device that supplies the feed to the poultry. For privately raised chickens, or chickens as pets, feed delivered through jar, trough or tube feeders. The use of poultry feed can also supplemented with food found through foraging.

Figure 27: Manual poultry feeder Automatic feeder

C. Bee keeping production machinery and equipment

1. Honey extractor

Honey extractor is a mechanized device, which used, for the extraction of honey from bee combs without damaging them.

Figure 28: Manual Honey extracter Electric honey extracter

2. Wax presser

Honey press is a machine that squeezes honeycomb between two surfaces. One uses roller drums to press wax passed between the rollers

Figure 29: Manual honey wax presser Honey and wax presser system

3. Casting mould

Casting is the act of pouring liquid material into the cavity of a mold. After a period, this liquid will cure via chemical reaction or cooling. The solidified part casting, which ejected or broken out of the mold to complete the process

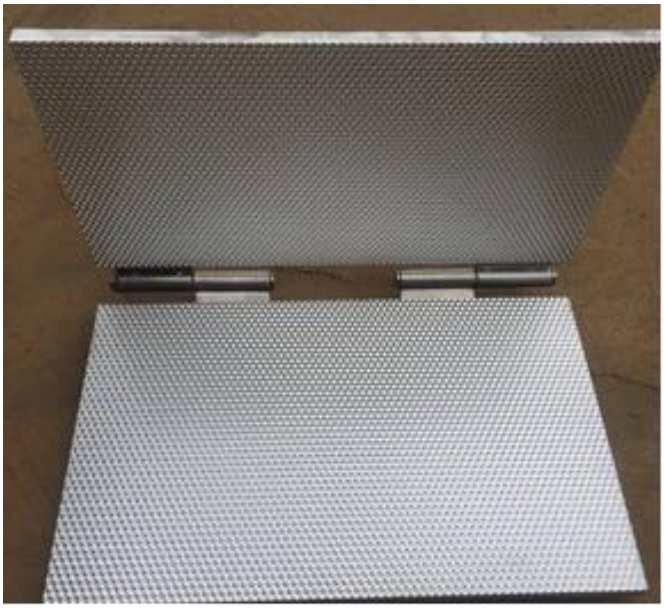


Figure 30: Bee wax sheet casting mould

4. Uncapping machine

Automatic feed uncapping machine, 400 V, with uncapping tank, electric heated knives. Reference: W209600E. Uncapping machine is a device, which can mechanically prepare capped honey frames for the process of honey extraction.

Figure 31: Fully automatic Uncapping machine

Self-Check 1	Written Test

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

Fill the blank space

1. _____use of tools, apparatuses and machines for agricultural land development, production, harvesting and on farm processing (2%)

2. List down at least 10 cattle production machinery and equipment (5%)

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

3. List down **Poultry production machinery and equipment (4%)**

_____,_____

_____,_____

Note: **Satisfactory rating 6 and 11 points** **Unsatisfactory below 6 and 11 points**

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

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 2: Evaluating Alternative options of machinery applicability

2.1 Alternative options of machinery

In agricultural production, they are different Alternative option used to get farm machinery and equipment based on the capacity, interest etc. of the farmer.
The main objective of **Alternative options is farming at low cost and risk.**

The different Alternative option of machinery and equipment of farmer are:

- The use of shared machinery arrangements,
- Contractors,
- Membership of machinery syndicates
- Leasing or hiring, participation in machinery rings

2.1.1. The use of shared machinery arrangements,

Sharing Machinery has the potential to help small-scale farmer and growers gain access to

- Specialized machinery
- Improved efficiency in cost-effective ways.

Inter-farm cooperation through machinery sharing gives grower's access to specialized machinery that:

- Improves production efficiency
- reduces labor
- Facilitates scaling-up production.

In some cases, sharing equipment led to cooperation in other areas such as:

- Input purchases
- Marketing.

Benefits Realized from Sharing Equipment

Sharing Equipment and machine have number of benefits from sharing machinery like:

- Reduced machinery costs

- Access to more specialized equipment and machine
- Attainable, improved efficiency particularly through
    - ✓ Labor savings
    - ✓ reduced production risks
    - ✓ Additional collaboration.

Reduced costs

The main benefit of the equipment and machine realized through reductions in their own labor and improved timeliness of operations and Decrease the loss of production by operating the required work in short time

Access to specialized equipment

Unaffordable or economical not able to purchase the equipment individual ownership cost prohibitive for the beginning and very small-scale producers got chance to us equipment or machine since relatively less costly piece of equipment, available funds limited (have share based on the capacity) for small scale producers.

Improved efficiency and/or labor savings

Sharing equipment improved efficiency for some of, if not all, the members of the groups, primarily through reduced labor input. e.g Hat harvesting, Hay baler, animal feed planting, De-beaking

Other benefits In addition to cost and labor savings,

Benefit of having “backup” should something go wrong. When one grower’s tractor broke down during the growing season, easily able to borrow equipment or machine a (tractor) from one of partners. Learned that working together when one farmer has a hard time or has a farm failure or has personal issues and has to pull back a little, the other farmers fill in the gaps.” Sharing equipment can lead to other types of sharing as well. Of particular importance sharing labor.

The sharing arrangement gave one partner access to additional help that did not have before like:

- Labor sharing may happen on occasional basis as well

- Some groups extended their collaboration to purchasing bulk quantities of supplies such as:
- Animal feed
- Bull
- Fertilizer
- Pesticides
- Harvest containers
- Boxes

Challenges occurred by shared machinery

- Overlap scheduling of equipment/machine use
- Added management costs were overcome with careful planning and frequent
- Need transparent communication among partners

It is important to note that equipment sharing is not appropriate in all situations. Depending on the labor a machine would replace, the difficulty of the task mechanized, and the costs of mileage and time spent in transport, sharing may not make economic sense. Furthermore, sharing equipment is not for everyone. Group collaboration requires trusting other members and a willingness to be flexible when things do not go as planned. While machinery sharing is not a one-size-fits-all solution for expanding production

2.2 Contractors

- Membership of machinery syndicates
- Leasing or hiring, participation in machinery rings.

Self-Check 2	Written Test

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

Fill the blank space

1. Write the different Alternative option of machinery and equipment for farmer (4%)

_____

_____

_____

_____

2. Write the Challenges occurred by shared machinery (3%)

_____

_____

_____

Note: **Satisfactory rating 4 and 7 points** **Unsatisfactory below 4 and 7 points**

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

Answer Sheet

Score = _____

Information Sheet 3: Identifying and addressing machinery and equipment storage and housing

3.1 Identifying and addressing machinery and equipment

All equipment should cleaned with a high-pressure washer to remove dirt and trash residue. Accumulated trash and dirt can create

- Fire hazards
- Electrical malfunctions
- Corrosion
- Rust of equipment, which may result in breakdowns next season

Once equipment is clean, farmers should thoroughly service and lubricate the machine. Also check for worn belts, loose bolts, oil leaks and the condition of all hoses, in addition to operational/ performance checks. Off-season is the time to make those necessary repairs and adjustments to avoid undue downtime during the next busy season. Oftentimes, implement dealers offer service specials during the off-seasons, which can mean real savings.

The store of machinery and equipment should be

- Completely shade
- Away from house from human and animal
- Dry
- Clean
- Near to the field

Storage of Machineries and equipment

Storage of machine and equipment categorized into

A. Long period of time
B. short period of time

Long time storage: when machineries or equipment's are stored for long time without operation they must be stored in:

- Leveled and well-ventilated room
- The room should prevent the machine from rain, sun light, excessive dusts and impurities.
- Long time storage can be for one year
- After that, the engine would started, warmed up and reheated for an extended period of storage.

If the engine **not used for more than 6 months** the following recommendations for starting and removing from storage will help to minimize corrosion and deterioration.

1) Change engine oil and replace oil filter, used oil will not give adequate protection
2) Service air cleaner
3) Draining and flushing cooling system recommended and refill with the appropriate coolant.
4) Remove V-belts of fan/alternator
5) Remove and clean batteries, store them in a cool dry place and keep them fully charged
6) Disengage the clutch for any drive line
7) Clean the exterior of the engine with salt free water and paint any scratched or chipped painted surfaces
8) Coat all exposed metal surfaces with grease or corrosion inhibitor if not feasible to point.
9) Seal all openings on engine with plastic bags and tape
10) If the machine must be stored outside a room, store it on a dry protected place and cover it with a water proof canvas or another suitable protective material wipe it with strong water proof tape

Equipment stored in the same condition

1. Clean the entire parts with salt free water
2. Paint or grease parts that are exposed for corrosion
3. Seal all openings of connections with the prime movers etc.

Self-Check 3	Written Test

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

Fill the blank space

1. List down the facility required for machine and equipment storage of (5%)

_____,_____

_____,_____

_____,_____

2. Write the categorize of machine and equipment storage (2%)

_____,_____

3. Lis down at least eight recommended principle of starting and removing machine. If the engine not used for more than 6 months. (4%)

_____
_____
_____
_____
_____
_____

Note: **Satisfactory rating 6 and 11 points** **Unsatisfactory below 6 and 11 points**

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

Answer Sheet

Score = _____

Information Sheet 4: Monitor and assess machinery innovations.

4.1 Introduction

Monitoring of a program or intervention involves the collection of routine data that measures progress toward achieving program objectives. It used to track changes in program outputs and performance over time.

Tools of monitoring and Evaluation

- Theory of Change.
- Logical Framework (Log frame)

Monitoring and Evaluation Plan.

- Statistics
- Open Datasets.
- System Data.
- Surveys.
- Interviews and Focus Groups.(operetar)
- Sample Size.

Steps of monitoring and Evaluation

- **Step** 1: Identify Program Goals and Objectives. ...
- **Step** 2: Define Indicators. ...
- **Step** 3: Define Data Collection Methods and TimeLine. ...
- **Step** 4: Identify **M&E** Roles and Responsibilities. ...
- **Step** 5: Create an Analysis Plan and Reporting Templates. ...
- **Step** 6: Plan for Dissemination and Donor Reporting.

Types of **monitoring and Evaluation**

Complete list of condition monitoring techniques

- Oil Analysis/Tribology
- Vibration Analysis/Dynamic Monitoring
- Motor Circuit Analysis

- Thermography/Temperature Measurements/Infrared Thermography
- Ultrasonic Monitoring/Acoustic Analysis/Airborne Ultrasonic
- Radiography/Radiation Analysis/Neutron Radiography

There are three basic categories of monitoring:

- Technical monitoring
- Functional monitoring
- Business process monitoring.

Self-Check 4	Written Test

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

Fill the blank space

1. Mention the complete list of condition monitoring techniques (5%)

_____

_____

_____

_____

2. Write the basic categories of monitoring (3%)

_____

_____

_____

Note: **Satisfactory rating 5 and 8 points** **Unsatisfactory below 5 and 8 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 5: Maintaining Inventory of machinery and equipment

5.1 Maintaining machinery and equipment with manufacturer's specification

Maintenance defined as efforts taken to keep the condition and performance of a machine always like the condition and performance of the machine when it is still new. **Divide maintenance activities** into two parts: planned **maintenance** activities and unplanned **maintenance** activities.

The main objective of equipment maintenance is to avoid machines and equipment breakdown & enhancing performance. It includes equipment maintenance by performing several activities such as:

- part replacement
- Repairing
- Servicing.

Tools Used Mechanical Maintenance, Repair and Operation

- Draw Works.
- Travelling Block.
- Coiled Tubing.
- Drilling Instrumentation.
- Drilling Generators.
- Wireline Equipment.
- Completion **Tools**.
- Oil **Tools**.

The things, which go wrong with equipment easily solved by refering to the manufacturer's instruction manual. It is very unfortunate if equipment unsatisfactory when a simple adjustment as explained in the instructions manual would solve the problem.

Most manufacturers of livestock production equipment furnish complete instructions that show exactly how the equipment is to operated,

Most breakages of machinery and loss of efficiency, together with unsatisfactory operation traced from failure by following the manufacturer's instructions. It is impossible for busy superintendent to carry around all detailed instructions for all machineries. It is therefore important at all times that the instructions available to the man who operates the machine.

The superintendent/supervisor should occasionally check them over with the operator to make certain that the operator has absorbed the information in the instruction book.

4.2. Maintaining machinery and equipment according to enterprise requirements

Enterprise requirements include:

- SOPs (Standard Operating Procedure)
- Industry standards
- Production schedules
- MSDSs (Material Safety Data Sheets)
- work notes
- Product labels
- Manufacturer specifications
- Operators manuals
- Enterprise policies and procedures including
    - ✓ Waste disposal
    - ✓ Recycling
    - ✓ Re-use guidelines)
- OHS procedures
- Supervisors oral or written instructions
- Work and routine maintenance plans.

Self-Check 5	Written Test

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

Fill the blank space

1. Mention the tools used for mechanical maintenance, repair and operation (5%)

_____,_____

_____.____

_____,_____

_____,_____

2. List down the enterprise policies and procedures (3%)

_____,_____

_____

3. Write down at least ten enterprise Maintenances requirements for **machinery and** equipment (5%)

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

Note: **Satisfactory rating 7 and 13 points** **Unsatisfactory below 7 and 13 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 6. Completing pre-operational checks

6.1 Completing pre-operational checks of machinery and equipment

The pre-operational check is important for the workers safety. It involves a daily check of the machines health. Any forklift or warehouse machine that needs repairs, maintenance or observed unsafe to operate taken out until such repair or maintenance has been done It is important to carry out a series of checks before using a piece of machinery. This is particularly important in situations in which a number of people use the same machine. Larger companies and organizations usually have a system of checks, and a maintenance department that will deal with reported defects.

Individuals working alone or in small teams will responsible for checking and maintaining their own machines. Operator must able to follow a checklist to ensure that they complete all the necessary check

Pre-operational checking include:

- The machine suitable for the job
- All safety devices such as guards are in right place and working correctly
- The operator is properly trained to do this job and use this machine safely
- The instruction manual for the machine has been provided, read and understood
- Suitable clothing is available and worn e.g. close fitting so as not to snag on vehicle and
- Machinery controls or be caught on moving machine components
- The right personal protective equipment (PPE) is available and worn
- Jewelers (including watches and rings) that might snag have been removed
- Long hair has been secured (tied back or enclosed in a hair net) in such a way that it cannot snag on vehicle and machinery controls or be caught up in moving machine parts
- Risk assessment has been carried out • the work has been properly planned and communicated to those who may be at risk

- Everyone understands what needs to done and has a system of communication agreed on

6.2 Checking the machine before use

Basic machine checking carried out before working with any machinery and equipment, to make sure that it is in good working order and safe to use.

The requirements vary according to the machine and are available in the operator manual for the machine or equipment.

A. Mechanical defects checks include:

- Brakes, wheels and Tyres.
- Guards and other protective devices correctly fitted and maintained in good condition
- They need to in place, securely attached, working and not damaged
- Any damaged or defective guards repaired or replaced before the machine is used.

B. Other checks include:

- Stopping devices are functioning correctly, e.g. Emergency stops
- All controls should be clearly marked to show what they do If work is to be carried out on the machine
- Make sure it done safely, e.g. Check for safe access and that working platforms have guardrails etc.
- Hitching and attachment points safely attached to the towing vehicle and attention to the condition of drawbar / pick-up hitch, and hitch rings, pins, clips etc.
- For self-propelled machines, make sure mirrors are clean and properly adjusted
- Check any other reversing aids are working
- Carryout any pre-use / pre-start checks as specified in the operator manual.

C. Checks used blades (a lawn mower) include

- Before each use, check the cutter blades for damage or excessive wear.

- Never operate the mower with a worn, damaged, split or dented blade (a piece of blade which breaks off and is thrown outwards ca cause serious injuries)
- To avoid severe personal injury, disconnect the spark plug cap to prevent accidental starting
- Wear heavy gloves to protect hands from the cutter blades.

D. Checks engine oil of any machine procedures include

- Check the engine oil level with the engine stopped and the mower on a level surface
- Clean the area around the oil filler cap
- Remove the oil filler cap, and wipe the dipstick clean
- Insert and remove the dipstick without screwing it into the filler neck. Check the oil level
- Shown on the dipstick
- If the oil level is low, add the recommended oil to reach the upper limit mark on the
- Dipstick do not overfill • after checking the engine oil level, screw in the oil filler cap /
- Dipstick securely.

E. Check fuel procedures include

- Do not smoke while re fueling the machine/mower
- Refuel in a well-ventilated area before starting the engine - if the engine has been running, allow it to cool
- Remove the fuel filler cap and check the fuel level
- If the fuel level is low, refill the tank with the correct type of fuel for the motor. Refuel
- Carefully to avoid spilling fuel do not overfill
- After refueling, tighten the fuel filler cap securely as petrol is highly flammable and Explosive
- Never refuel the machine/ mower inside a building where petrol fumes may reach flames or sparks

- Keep petrol away from appliances with pilot lights, barbecues, electric appliances, etc.
- Fuel can damage paint and plastic, be careful not to spill fuel when filling your fuel tank.

F. Check air Cleaner procedures include

- Make sure the air filters are clean and in good condition
- A dirty air filter will restrict airflow to the carburetor, reducing engine performance.
- Grass catcher
- If not sure what cutting height to select, start with a high setting and check the appearance of the lawn after mowing a small area, then re-adjust cutting height if necessary.

N.B. Six routines pre-start check must followed in order to minimize the chances of hydraulic equipment suffering costly, premature component failures and unscheduled downtime:

- Maintain fluid cleanliness;
- Maintain fluid temperature and viscosity within optimum limits;
- Maintain hydraulic system settings to manufacturer specifications;
- Schedule component change-outs before they fail
- Follow correct commissioning procedures
- Conduct failure analysis.

6.4 Check the Installation before operation/start up electric equipment or machine

- Poor machinery and equipment layout can face:
  - ✓ Blamed of many operating
  - ✓ Health and Safety problem
  - ✓ quality assurance problems in processing units
- Set the Churner on milk processing station
- Park the machine at flat and safe place to adjust operator's safety.
- When attaching components, take care of the components will in appropriate position and place.

To start up the machine, first inspect the machine sensitive parts such as

- Bolts, Drain, Cap tightness and Pins.

Self-Check 6	Written Test

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

Fill the blank space

1. List down at least eight pre-operational check of machine and equipment (4%)

_____

_____

_____

_____

_____

_____

2. Write the mechanical defect checking of machine (4%)

_____,_____,_____

_____

_____

_____

3. Write the procedures of machine fuel checking (5%)

_____

_____

_____

_____

_____

Note: **Satisfactory rating 7 and 13 points** **Unsatisfactory below 7 and 13 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 7: Assessing minimizing. And recognizing OHS hazards risk in workplace

7.1. Assessing Occupational Health and Safety hazards in workplace

Open communication and reporting on the implementation of the risk assessment and the measures taken based on the assessment are all important factors in getting the entire staff to commit development of a safe and healthy workplace.

7.2 The main categories of OHS hazards are:

1. Biological Hazards

Biological hazards come from organisms, including people, animals and plants, and threaten human health. Examples of biological hazards include mold, sewage, blood and bodily fluids. These dangers can result in diseases and allergic reactions and limit employees' ability to carry out their work.

- Biological. Biological hazards include:
  - ✓ Viruses
  - ✓ Bacteria
  - ✓ Insects
  - ✓ Animals, etc. that can cause adverse health impacts.

2. Chemical Hazards

Chemicals can be toxic, corrosive, flammable and combustible. As such, they can pose health risks to workers and become hazards if workers inhale, ingest or absorb them through their skin. Chemical hazards can cause acute harm, such as burns, irritation and vomiting, or create chronic health issues, such as asthma, liver damage and cancer.

- Chemical. Chemical hazards are hazardous substances that cause harm like:
  - ✓ Substances (fuel, oils, fertilizer)
  - ✓ Oil
  - ✓ Grease spills

3. Physical Hazard

Physical hazards include activities or natural substances in a work environment that pose health risks. Extreme temperatures, poor air quality, excessive noise and radiation in the workplace can all harm workers, potentially causing respiratory problems, hearing loss and cancer, among other problems.

- Physical. livestock and wildlife
- Safety.
  - ✓ Difficult topography
  - ✓ Varying gradients
  - ✓ Potholes
  - ✓ Ditches
  - ✓ Gullies
  - ✓ Embankments
  - ✓ obstacles (rocks, logs, fences, debris, buildings

4. Ergonomic Hazards: Key Symptoms and Dangers

Poor ergonomics in the workplace can lead to health issues for employees, such as cumulative trauma disorders, repetitive motion injuries and musculoskeletal disorders. Often, ergonomic hazards arise due to workplace design.

Possible ergonomic hazards include the following:

- Poorly adjusted chairs or workstations
- Repetitive movements
- Regular lifting
- Incorrect posture
- Vibration

Whether employees sit at desks that are too short for them, overuse their thumbs on laptops with centrally positioned track pads or strain their eyes looking at screens all day long, poor ergonomics can lead to debilitating symptoms. Sore joints and muscles; tingling in the hands, fingers and limbs; and pain and stiffness in the neck and back can all result from ergonomic hazards.

- Ergonomic. Crushed by a roll over ergonomic hazards associated with
  - ✓ Posture

- ✓ vibration,
- Psychosocial.

5. Electrical Hazards

Electrical hazards can result in burns, shock, fires, explosions and death.

The common electrical hazards include**:**

A. Overhead Power Lines

Overhead power lines carry deadly voltages of electrical power. Failure to maintain a careful distance from them can result in electrocution or severe burns.

B. Damaged Equipment and Tools

Tools or equipment with damaged cords and wires or other defects can pose dangers to those using them. Additionally, untrained workers shouldn't use tools.

C. Improper Wiring

Different electrical currents call for specific types of wiring. Using the wrong wiring can cause overheating and fires. They can also occur from using the wrong type of extension cords, overloading outlets and using improper circuit breakers.

D. Exposed Electrical Parts

As potentially dangerous levels of electrical power surge through electrical components, they must remain safely covered. Temporary lighting, power distribution units and power cords with exposed electrical parts all pose electrical dangers.

E. Wet Conditions

Water makes electrocution more likely. Using electricity in wet environments, particularly when equipment has damaged insulation, poses significant safety risks.

7.3 Potential risks and hazards associated with the operation of machinery and equipment

Some of the potential existing risks that may affect working efficiency of machinery include**:**

- Being kept in poor conditions

- Poorly designed or ill-fitting harnesses, saddles and yokes
- Pulling un-roadworthy or overloaded carts (or other loads)
- Lack of shade
- Working long hours with little rest
- A scraping noise indicates the presence of foreign bodies' e.g. metal chips, dirt of sand.
- A regular grinding noise indicated cracked belts or rollers; and irregular grinding noise may indicate that the bearing cage is rubbing against the inner or outer race.
- A clear, metallic ringing, almost a whistle, indicates lack of lubricant
- A jotting noisy indicates surface crumbling or races and rolling elements out of line. Another cause is hardened deposits on the roiling elements resulting from lubricants of poor quality or improper type.
- Alternatively, strong and weak rattling indicates a loose ball or roller or too much play in the bearing cage.
- A regular humming sound indicates that the bearing is in normal operation

The methods to minimize the OHS risk and hazard

- Using of relevant protective clothing and equipment,
- Use of tooling and equipment,
- Workplace environment and safety handling of material,
- First aid kit
- Hazard control and hazardous materials and substances.
- Using gowns, rubber boots of appropriate size, goggles, gloves etc

Apply safe operating procedures regarding:

- Electrical safety,
- Machinery movement and operation,
- Working in proximity to others and site visitors.

Apply emergency procedures:

- Emergency shutdown and stopping of equipment,

- First aid application and site evacuation. electrical safety,
- Machinery movement and operation

Self-Check 7	Written Test

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

Fill the blank space

1. Mention the main categories OHS hazards in work place (5%)

_____

_____

_____

_____

_____

2. Write the common Electrical Hazards (5%)

_____,_____

_____,_____

_____,_____

3. Write the methods of minimizing the OHS risk and hazard (7%)

_____,_____

_____

_____

_____

_____

_____

Note: **Satisfactory rating 9 and 17 points** **Unsatisfactory below 9 and 17 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

L #97	LO #2 Prepare and implement maintenance plan

Instruction sheet

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

- Identifying maintenance requirements and costs
- Developing maintenance plan
- Identifying, securing and including resource and supply
- Maintaining and repairing equipment and machinery.

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

- Identify maintenance requirements and costs
- Develop maintenance plan
- Identify, secure and include resource and supply
- Maintain and repair equipment/machinery

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks)
5. If you earned a satisfactory evaluation proceed to “Operation sheets
6. Perform “the Learning activity performance test” which is placed following “Operation sheets”
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1. Identifying maintenance requirements and costs

1.1 Identifying maintenance requirements of machinery and equipment

In livestock production maintaining designed to keep equipment, machines and buildings operating optimal

Maintenance of farm equipment and machine refers to all the activities needed to functional continuously to provide the necessary service.

The two words very frequently used together and the abbreviation 'O&M' is widely used. The overall aim of maintenance to ensure operation:

- Efficient
- Effective
- Sustainable system (Castro et al., 2009)

A. Efficient means being able to accomplish something with the

- Least waste of time
- Effort and resources

B. Effective means being successful producing

- The intended result
- Sustainable means able to maintain at the best level over time in this case, the supply of water.

The causes of Machine and equipment maintenance are:

- Wear
- Corrosion
- Design problems
- equipment modifications
- Incorrect use
- Accidents
- Acts of nature

The preventive maintenance programmer includes many sections, an essential one is the maintenance work done directly on the machine. It performed by skilled handicrafts worker and made to provide the engineering staff of milk plants with a guide to maintenance comprising like

1. Basic rules concerning safety at maintenance work
2. Essential information on hygiene requirements relating to milk plants
3. Diagnosis of faults
4. Examples of routine maintenance procedures

1.2 Maintenance requirements.

Point of using livestock production equipment and machine in general not fit and forget technology and regular maintenance essential to ensure the continues functionality of farm machinery and equipment

NB. Equipment manufacturers' maintenance instructions must followed as a minimum requirement and instructions based on the assumption that the equipment used to serve the farm properly.

Maintenance requirements must clear and the consequences of failing to maintain adequately should highlighted. The majority of devices that fail because of inadequate maintenance.

1.3 Sources of Information to maintain machinery and equipment

The Sources of Information to maintain machinery and equipment include,

- Operational diaries
- Staff comment
- Personal testing
- Observation of structures
- Machinery and equipment manufacturers in-service updates
- operator's manuals
- property improvement groups
- Relevant government departments
- other enterprise operators

- service representatives

1.4 Routine maintenance procedures

Manuals for crafts-men engaged in any given industry usually contain a selection of servicing and maintenance instructions related to the equipment most often installed in the factories concerned.

They used in conjunction with handbooks and general instruction of manuals on mechanical maintenance, whose contents cover the job knowledge required by a skilled fitted

The methods of maintenance required machine and equipment diagnosis

A. Checking functions/components

When checking functions or components inputs and outputs should considered Example:

- Input from motor to clutch correct.
- No output from clutch when engaged.
- Fault lies in clutch.

NOTE: The cause may be a tight or worn bearing in the gearbox. Adjusting the clutch could temporarily remove fault but it would eventually recur. Cause must be determined and removed.

B. Half-split approach to fault diagnosis

- **Securing and fixing devices t**hese include
- ✓ **Screws** identified by the head type, length and the type of thread.
- ✓ **Nuts** manufactured as standard and special purpose nuts
- ✓ **Washers** two main types, illustrated
- ✓ Bearings

C. Encoring and fixing devices

Screws used for securing components assemblies identified

Developing maintenance plan

Self-Check 1	Written Test

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

Fill the blank space

1._____ of farm equipment and machine refers to all the activities needed to functional continuously to provide the necessary service (2%). = **Maintenance**

2. Write the causes of Machine and equipment maintenance (4%)

_____,_____

_____,_____

_____,_____

_____,_____

3. Write the Sources of Information for machinery and equipment maintenance (5%)

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

4. List down the method of maintenance required machine and equipment diagnosis (3%)

_____

_____

_____

Note: **Satisfactory rating 8 and 14 points** **Unsatisfactory below 8 and 14 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 2. Developing maintenance plan of machine and equipment

2.1 Developing planned maintenance programmed

Developing planned maintenance programmed is a useful step towards reducing risk, as well as having a reporting procedure for workers who may notice problems while working on machinery. Some items of plant and equipment may have safety-critical features where deterioration would cause a risk. Employers must have arrangements in place to make sure the necessary inspections take place But there are other steps to consider:

Before employers, instruct workers to start maintenance

- Decide if the work done by specialist contractors. Never take on work for which workers are not prepared or competent.
- Plan the work carefully before it starts, ideally using the manufacturer's maintenance instructions, and produce a safe system of work. This will avoid unforeseen delays and reduce the risks.
- Make sure maintenance staff are competent and have appropriate clothing and equipment.
- Try to use downtime for maintenance. This can avoid the difficulties in coordinating maintenance and production work if maintenance work performed before start-up or during shutdown periods.

Safe working areas

- Employers must provide safe access and a safe place of work.
- They must not just focus on the safety of maintenance workers they must take the necessary precautions to ensure the safety of others who may affected by the maintenance work, e.g. other workers or contractors working nearby.
- Employers and the maintenance personnel should set up signs, barriers, and position people at key points if they needed to keep other people out.

maintenance plan

As part of a risk-based asset management strategy, effective equipment maintenance plans and associated tasks will help:

- To Eliminate current bad actor problems
- To improve asset availability while decreasing total cost of ownership. ...

Maintenance plan includes

All the benefits of a service **plan**, but also adds protection for replacement and **repair** of various wear and tear parts

There are many **protected parts** in machine and equipment a **maintenance plan**, and some of the most important **include:**

- The clutch
- Exhaust
- Battery
- brake pads
- steering components
- Engine

2.2 Types Maintenance

General **Four types of maintenance** philosophies

- Preventive
- Corrective
- Risk-based
- Condition-based maintenance.

3.1.1 Corrective or breakdown maintenance

- Carried out when components fail and stop working
- Breakdown is common in many utilities in Ethiopia
- occurs as a result of poor preventive maintenance

3.1.2 Preventive maintenance

Regular, planned activity that takes place so that breakdowns avoided.

Preventive maintenance would include

- Servicing of equipment
- Inspecting equipment for wear and tear

- Replacing as necessary
- Cleaning
- Greasing moving parts of equipment
- Replacing items that have a limited lifespan.

Preventive maintenance is important because it ensures that the asset fulfills its service life. It also prevents crises occurring and costly repairs (in terms of time and money) being needed.

2.2.3 Risk-based maintenance

Maintenance carried out by **integrating analysis, measurement and periodic test** activities to standard preventive maintenance.

The gathered information i viewed in the context of the environmental, operation and process condition of the equipment in the system.

The aim is to perform asset condition and risk assessment define the appropriate maintenance program.

All equipment displaying abnormal values refurbished or replaced. In this way it is possible to extend the useful life and guarantee over time high levels of reliability, safety and efficiency of the plant.

2.2.4 Condition-based maintenance.

Maintenance based on the equipment **performance monitoring** and the **control of the corrective actions** taken as a result.

The real actual equipment condition continuously assessed by the on-line detection of significant working device parameters and their automatic comparison with average values and performance.

Maintenance carried out when certain indicators give the signaling that the equipment is deteriorating and the failure probability is increasing

This strategy, in the long term, allows reducing drastically the costs associated with maintenance, thereby minimizing the occurrence of serious faults and optimizing the available economic resources management.,

Self-Check 2	Written Test

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

Fill the blank space

1. Write the protected parts in machine and equipment **maintenance plan (6%)**

_____,_____

_____,_____

_____,_____

2. Write the types of maintenances (4%)

_____,_____

_____,_____

Note: **Satisfactory rating 6 and 10 points** **Unsatisfactory below 6 and 10 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 3. Identifying, securing and including resource and supply required for maintenance plan

3.1 Resource and supply required for maintenance plan

Resource supply required are:

1. Dairy machinery,
2. Equipment and materials like
    - ✓ Welders
    - ✓ Arc
    - ✓ Gas and MIG
    - ✓ Lathes,
3. Bench presses, multi meters and ohm meters,
4. Inspection pits, lifting and support equipment (jacks, overhead gantry, blocks),
5. Power tools (grinders, drills),
6. Hand tools (spanners, hammers, screw drivers).

Workshop storage requirements may include

- Racks for commonly used like
    - ✓ Steel angle
    - ✓ Rods
    - ✓ Tube metal
    - ✓ Wire,
    - ✓ Racks or boards for orderly placement of tools

3.2.2 Equipment and material for maintenance

Welding machine

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by using high heat to melt the parts together and allowing them to cool, causing fusion. Welding is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal.

Many different energy sources can be used for welding, including a gas flame (chemical), an electric arc (electrical), a laser, an electron beam, friction, and ultrasound. While often an industrial process

Welding may performed in many different environments, including in open air, under water, and in outer space. Welding is a hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to intense ultraviolet radiation.

Until the end of the 19th century, the only welding process was forge welding, which blacksmiths had used for millennia to join iron and steel by heating and hammering. Arc welding and oxy-fuel welding were among the first processes to develop late in the century, and electric resistance welding followed soon after.

Welding technology advanced quickly during the early 20th century as world wars drove the demand for reliable and inexpensive joining methods. Following the wars, several modern welding techniques were developed, including manual methods like shielded metal arc welding, now one of the most popular welding methods, as well as semi-automatic and automatic processes such as gas metal arc welding, submerged arc welding, flux-cored arc welding and electroslag welding

Developments continued with the invention of laser beam welding, electron beam welding, magnetic pulse welding, and friction stir welding in the latter half of the century. Today, as the science continues to advance, robot welding is commonplace in industrial settings, and researchers continue to develop new welding methods and gain greater understanding of weld quality.

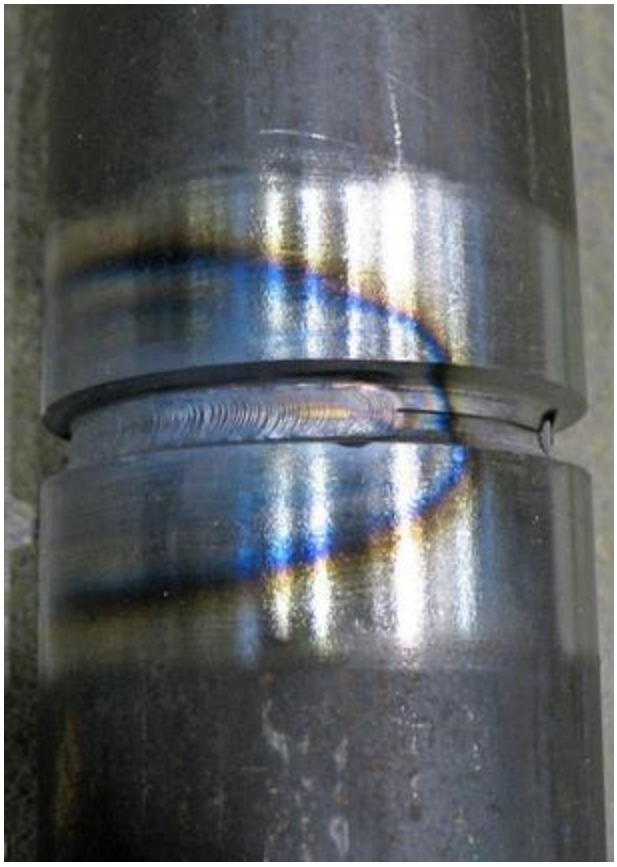


Figure 32: The blue area results from oxidation at a corresponding temperature of 600 °F (316 °C).

3.2.3 Bench-presses, multi meters and ohmmeters,

Multi meter is a measuring instrument that can measure multiple electrical properties.

A typical multi meter can measure

- Voltage
- Resistance
- Current, in which case known as a **volt-ohm-milliamp meter** (**VOM**).

Analog multi meters use a micro ammeter with a moving pointer to display readings. Digital multi meters (DMM, DVOM) have numeric displays and made analog multi meters. Obsolete, as they are cheaper, more precise, and more physically robust than analog multi meters.

Multi meters vary in size, features, and price. They can be portable handheld devices or highly precise bench instruments

Figure 33: An analog multi meter A 4+1⁄2-digit digital multi meter,

3.2.4 Inspection pits, lifting and support equipment (jacks, overhead gantry, blocks),

Lifting equipment

Lifting equipment is any work equipment for lifting and lowering loads, and includes any accessories used in doing so (such as attachments to support, fix or anchor the equipment).

Types of lifting equipment include:

- Overhead cranes and their supporting runways
- Patient hoists
- Motor vehicle lifts
- Vehicle tail lifts and cranes fitted to vehicles
- Building cleaning cradle and its suspension equipment
- Goods and passenger lifts
- Tele handlers and fork lifts
- Lifting accessories

Lifting accessories are pieces of equipment that are used to attach the load to lifting equipment, providing a link between the two. Any lifting accessories used between lifting

equipment and the load may need to be taken into account in determining the overall weight of the load.

Examples of lifting accessories include:

- Fiber or rope slings
- Chains (single or multiple leg)
- Hooks
- Eyebolts
- Spreader beams

Lifting operations

This is a term defined by LOLER regulation 8(2): 'In this regulation "lifting operation" means an operation concerned with the lifting or lowering of a load.'

The load

The load includes any material, people or animals (or any combination of these) that lifted by the lifting equipment.

Loads often provided with permanent or semi-permanent fixed or attached points for lifting. In most cases, these are considered to be part of the load.

Examples of loads include:

- loose bulk materials
- sacks, bags, pallets and stillages
- discrete items (such as a large concrete block)
- machinery and any permanently attached lifting eyes
- a skip and the lugs fixed to its side

3.2.5 Power tools (grinders, drills),

Power tools include:

- Air compressor.
- Alligator shear.
- Angle grinder.
- Band saw.
- Belt sander.

- Biscuit joiner.
- Ceramic tile cutter.
- Chainsaw.

The answer: **use a drill** arbor adapter; It will give your **drill** a ½" arbor that will allow **you** to fit any 1/2 inch arbor (center hole) **grinding** disc onto your cordless **drill** to function as a **grinder** with the appropriate **grinding** wheel. The adapter is a threaded shaft that has a nut above two extra-wide washers

Figure 34: Electric grill grander

3.2.6Hand tools (spanners, hammers, screwdrivers).

Figure 35: Household hand tool Spanner, screwdriver and hammer

Self-Check 3	Written Test

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

Fill the blank space

1. Write the resource required for maintenances of machine and equipment (3%)

_____

_____

_____

_____

_____

_____

2. Mention the power tools require for machine and equipment maintenance (4%)

_____,_____

_____,_____

_____,_____

_____,_____

3. Write the types of lifting equipment (4%)

_____,_____

_____,_____

_____,_____

_____,_____

4. Write the types of lifting accessories (3%)

_____,_____

_____,_____

_____,_____

Note: **Satisfactory rating 8 and 14 points** **Unsatisfactory below 8 and 14 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 4: Assessing potential risk of staff and preparing contingency plan

4.1 Hazards during maintenance

In this context, maintenance simply means keeping the workplace, its structures, equipment, machines, furniture and facilities operating safely, while also making sure that their condition does not decline. Regular maintenance can also prevent their sudden and unexpected failure.

There are two main types of maintenance:

- preventive or proactive maintenance periodic checks and repairs; and
- Corrective or reactive maintenance carrying out unforeseen repairs on workplace facilities or equipment after sudden breakage or failure. This is usually more hazardous than scheduled maintenance.

Maintenance activities can potentially expose people to all sorts of hazards. They are five commonly encountered issues that merit particular attention.

1) Asbestos
2) Falls from height
3) Isolation and permits to work
4) Falls of heavy items
5) Selecting a contractor

4.2 Chemical hazards during maintenance

- Dusts & fibers e.g. asbestos, silica, respiratory sensitizers.
- Dangerous substances e.g. chlorine, oxygen, hydrogen.
- Toxic, oxidizing, explosive, flammable, corrosive.
- Hydraulic fluids, oils, acids, alkalis, organic solvents.

4.5 Hazards from damaged equipment

Accidents involving physical hazards can directly injure workers and can create additional hazards, for example, increased chemical exposure due to damaged protective equipment, or danger of explosion caused by the mixing of chemicals.

4.6 Equipment and machine motion hazards

Equipment and machine motions and actions hazards:

- Entanglement
- Nip points
- Draw-in hazards
- Impact hazards
- Crushing hazards
- Cutting and puncturing hazards
- Burn and abrasion hazards
- Electrical hazards
- High-pressure hazards.

4.7 Hazards from fault equipment

Faulty or overloaded equipment can lead to fires, which can cause damage, injuries and loss of life.

Machine and Equipment Hazards during working around machinery

- Moving parts (e.g., risk of injuries from entanglement, friction, abrasion, cutting, severing, shearing, stabbing, puncturing, impact, crushing, drawing-in or trapping, etc.)
- Energy (e.g., electrical, electromagnetic, magnetic, etc.)
- Heat or cold.
- Noise.
- Vibration.

What should employers do?

Employers who provide equipment for use, from hand tools and ladders to electrical power tools and larger plant, need to ensure that far as is reasonably practicable that the machinery and equipment under their control is safe and without risk to health. One

way to achieve this is for employers to have arrangements in place to make sure machinery and equipment maintained in a safe condition

They should think about what hazards occur if:

- Tools break during use;
- Machinery starts up unexpectedly;
- There is contact with materials that normally enclosed within the machine, i.e. caused by leaks/breakage/ejection etc.

Failing to correctly plan and communicate clear instructions and information before starting maintenance can lead to confusion and can cause accidents. This can be a particular problem if maintenance is during normal production work or where contractors who are unfamiliar with the site.

4.8 The working environment

The general conditions in the workplace (maintenance) effect on the health and safety are:

- Noise levels
- Lighting-
- Temperature-
- Humidity
- Risk assessments

Risks caused by workplace equipment

- Cutting equipment
- Forklift trucks
- Equipment using heat or bright light

Risk assessment needs to assess the likelihood of such hazards occurring. Look at risks, which occur not just during the normal operation of the equipment but also during installation, maintenance, repairs, breakdowns and servicing.

- Risks requiring the use of personal protective equipment.
- Risks from computer workstations physical layout, job done, posture, rest breaks etc. An assessment must carried out by law on these and the employees who use those including homeworkers.

- Risks likely cause upper limb disorders (ULDs).
- Risks when working at height falls from height, falling objects.
- Risks of confined spaces under the Confined spaces Regulations must carry out a risk assessment; assess the level of risk posed and decide whether need to take steps to manage these risks, including putting emergency arrangements in place.

When identify a problem must take steps to minimize the risk to employees. For example:

- Ensure the correct equipment is used for the job
- Provide personal protective equipment for employees
- Plan any work to minimize risks identified

Use appropriate warning signs

- provide appropriate training and guidelines to employees
- maintain and check equipment regularly

The five steps to risk assessment.

- Step 1: Identify hazards, i.e. anything that may cause harm. ...
- Step 2: Decide who may be harmed, and how. ...
- Step 3: Assess the risks and take action. ...
- Step 4: Make a record of the findings. ...
- Step 5: Review the risk assessment.

A contingency plan is a plan devised for an outcome other than in the usual (expected) plan. It used for risk management for an exceptional risk that, though unlikely, would have catastrophic consequences. During times of crisis, contingency plans developed to explore and prepare for any eventuality

Contingency plan

1. Step 1: List down the key risks. ...
2. Step 2: Prioritize the Risks Based on Their Impact. ...
3. Step 3: Create Contingency Plans for Each Event. ...
4. Step 4: Share and Maintain the Plan.

The four steps for managing OHS risks are:

Step 1. Identify hazards. Find out what could cause harm. ...

Step 2. Assess risks.

Step 3. Control risks

Step 4. Review control measures

Self-Check 4	Written Test

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

Fill the blank space

1. Write the five potential hazards during maintenances activities (3%)

_____,_____

_____,_____

_____

2. **Write the Chemical hazards during maintenance (4%)**

_____

_____

_____

_____

3. Write the machine and equipment motions and actions hazards (4%)

_____,_____

_____,_____

_____,_____

4. Write down Machine and Equipment Hazards during working around machinery (3%)

_____,_____,_____,_____

5. Write the Contingency plan steps (3%)

_____

_____

_____

_____

Note: **Satisfactory rating 9 and 17 points** **Unsatisfactory below 9 and 17 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information sheet 5: Maintaining and repairing equipment and machinery

5.1. Machine maintenance

Machine maintenance is the means by which mechanical assets in a facility kept in working order. Machinery maintenance involves regular servicing of equipment, routine checks, repair work, and replacement of worn or nonfunctional parts.

Machines maintained include both

- Heavy-duty industrial equipment
- Simple hand-operated machines.

Maintenance of machinery is frequently handled reactively (e.g. after a breakdown) though it may also done proactively, as with preventive and predictive maintenance.

Preventive maintenance keeps assets in good repair through regularly scheduled service; predictive maintenance relies on equipment monitoring to detect problems before they result in a breakdown.

5.2. Machinery maintenance workers

In most industrial settings, few different types of personnel who involved in the maintenance process.

They are three types of machinery maintenance worker

A. Machinery mechanics

Among the duties of machinery, the mechanic is keeping industrial machinery operational by performing necessary maintenance.

They maintain and repair various forms of equipment including

- conveyor systems
- packaging equipment
- Production machinery

Machinery mechanics typically are not involved in advanced diagnostics. If they perform any type of diagnostic work, it is by visual inspection.

B. Maintenance technicians

A technician differs from a mechanic in that they focus more on the diagnostic side of maintenance. They examine equipment-using computers and instrumentation to determine why it's malfunctioning, then prescribe a solution to the problem.

They might perform the repairs themselves, or a mechanic might assigned to the task.

C. Millwrights

Millwrights have a wider occupational focus than machinery mechanics. While they do repairs and perform maintenance work. They can

- Install
- Assemble
- Dismantle
- Move assets within the facility.

Six industries that utilize machine maintenance

- Plastics product manufacturing
- Automotive manufacturing
- Refineries
- Food production
- Steel mills
- Apparel production

Five maintenance tips to extend equipment life

1. Stay on top of large machinery operator training. ...
2. Add and test lubricants frequently. ...
3. Check for signs of wear. ...
4. Keep large machinery clean, and maintain a clean environment. ...
5. Have a maintenance and repair schedule, and keep good records.

5.3 Maintenance management

Equipment maintenance involves using maintenance methods and procedures to keep organizational equipment in good working condition. It includes both regular inspections and corrective repairs of assets.

5.4 Need of maintenance

The main aim of equipment maintenance is to maintain the functionality of the equipment and to minimize its breakdowns. For mechanical equipment, the maintenance management will involve repair, replacement, and serving of tools.

5.5 Tools and equipment of maintenance

Preventive maintenance is the systematic care and protection of tools, equipment, machines, and vehicles in order to keep them in a safe, usable condition that limits downtime and extends productivity. We must always be aware that maintenance tasks themselves are potentially hazardous and can result in injury.

5.6. Repair and installation of machinery and equipment

This division includes the specialized repair of goods produced in the manufacturing sector with the aim to restore machinery, equipment and other products to working order

The provision of general or routine maintenance (i.e. servicing) on such products to ensure they work efficiently and to prevent breakdown and unnecessary repairs is included

This division does only include specialized repair and maintenance activities. A substantial amount of repair done by manufacturers of machinery, equipment and other goods, in which case the classification of units engaged

Repair and manufacturing activities done according to the value-added principle, which would often assign combined activities to the manufacture of the good. The same principle applied for combined trade and repair. The rebuilding or remanufacture of machinery and equipment considered a manufacturing activity and included in other divisions of this section. Repair and maintenance of goods that utilized as capital goods as well as consumer goods is typically classified as repair and maintenance of household goods

Self-Check 5	Written Test

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

Fill the blank space

1. _____is the means by which mechanical assets in a facility kept in working order (2%)

2. Write the three types of machinery maintenance worker (3%)

_____,_____

_____

3. Write the six industries mostly utilize machine maintenance (4%)

_____,_____

_____,_____

_____,_____

4. List down the five maintenance tips to extend equipment life (4%)

_____

_____

_____

_____

_____

Note: **Satisfactory rating 7 and 13 points** **Unsatisfactory below 7 and 13 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 6: Organizing machinery and equipment on site

6.1 Organize machinery and equipment maintenance plan on site

In a new plant since the maintenance department generally overloaded with work from the start-up period onward, it is advisable to organize the maintenance function during construction of the plant.

- Engineers in the maintenance department have to study the proposed organization chart and prepare operational procedures.
- Mechanical and electrical maintenance teams can benefit from being involved in construction and start-up of the plant.
- The central workshop should be operational very early, before machines installed.
- The maintenance methods office must be set up so that it is in operation when equipment arrives. Method officers should start establishing the preventive maintenance and lubrication file, checking the technical documentation and completing the spare parts forecasts.
- The rest of the central maintenance planning office (CMPO) should gradually put in place, at least one year before start-up.
- The spare parts maintenance section (SPMS) put in place gradually, once the equipment and extra parts start arriving.
- Immediately after start-up, the mechanical and electrical services should concentrate on ensuring the availability of the machines. Priority given as soon as possible to preventive maintenance.

The following priorities should respected once the factory is in operation:

- evaluation of machine data: updating of history cards, preventive programmers
- maintenance management performance indicators;
- stock management;
- - improvement of work methods and planning
- - updating of drawings, technical notices and other documents;
- - Gradual introduction of a maintenance management information system (MMIS).

6.2 Restructuring the maintenance department in existing plant

A. **General maintenance policy and organization**

- define a plan of action to improve maintenance
- obtain full commitment of General Management
- define and implement Corporate Maintenance Management Master Plan
- include maintenance managers on the executive board of directors
- establish a maintenance committee within the company, with the job of observing the implementation of actions for maintenance improvement and evaluating their results

B. Training

- Devise a policy of human resources development for maintenance
- Recruit highly qualified staff for maintenance - provide for additional training if need be
- Establish training courses in maintenance, coordinated with production needs

C. Technical documentation

- Draw up specific terms of reference on technical documentation
- Set up a team of specialists (methods of officers) to do the acceptance of/inspect the technical documentation at the time of the equipment acquisition
- Start training programmers on technical documentation
- Make an assessment of existing technical documentation at the factory - gather all documentation in one central place - make copies for the users
- Complete technical documentation

D. Spare parts

- Make analysis of stocks currently held in the plant
- Make a study of spare parts needs/make sure that designations are accurate
- Set up a stock management department
- Study the parts with a view to local manufacturing of repairs
- Design warehouses of ample size, with adequate facilities for the storage, handling and protection of the spare parts

- Speed up the enterprise's in-house procedures for parts reordering
- Develop parts reclamation/repair techniques

The order of priority of restructuring activities will be as follows:

- Formulating a corporate maintenance management plan, including the maintenance concept and relevant training;
- Informing the workforce about the organization of maintenance;
- Centralizing maintenance activities;
- Introducing an organization chart for the maintenance department;
- Introducing some basic forms (job request, job order) permitting efficient data collection and follow up of work;
- Organizing the maintenance teams;
- Upgrading the technical documentation;
- Upgrading stores of spare parts;
- Organizing job preparation, work scheduling and programming;
- Introducing a maintenance management information system (MMIS);
- Launching a permanent promotion campaign on maintenance;
- Introducing a periodic evaluation system.

6.3 Setting machine

In setting machinery, the equipment should located,

- If possible in a lighted dry place with plenty of room to work around it for cleaning and repairs
- The arrangement should minimum amount of sanitary piping used, consistent with efficient operation
- Related equipment grouped together to facilitate supervision
- Straight-line flow of product is usually desirable
- If possible, allow space for unit machine to add later when the business grows.

Machines especially the heavy ones, are set directly on the floor or on concrete base and grated in thoroughly with a rich cement mixture (1 part cement and 2 1/2 parts sand) and sufficient water.

For improved sanitation, use is made of the ball foot mounting with equipment such as tanks, freezers, fillers etc, on a pipe legs 6-12 inches long having a round foot. Where machinery bolted down, it is customary to see bolts in the concrete.

Organizing machinery and equipment setting on site include:

A. Organize tools

The first step to organizing tools is to do a thorough inventory. Once you have a general idea of the tools on hand, sort them into like categories. Group all of the power tools, the small hand tools, and so on. Next, create zones and use cabinetry to keep the like items together.

B. Organize maintenance department

How to organize a maintenance department to maximize productivity

1. #1) Hire smartly
2. #2) Set a clear hierarchy and communication lines
3. #3) Outline important procedures
4. #4) Manage work and inventory with a CMMS
5. #5) commit to continuous improvement

C. Implement maintenance program

How to set up a preventive Maintenance Plan

1. Get the right people onboard.
2. Set goals for preventive maintenance plan
3. Inventory the equipment and assets
4. Make decisions
5. Get to know the owner's manuals.
6. Schedule for long-term preventive maintenance
7. Schedule for short-term preventive maintenance
8. Train, train, train!

D. Equipment maintenance management

Equipment maintenance involves using maintenance methods and procedures to keep organizational equipment in good working condition. It includes both regular inspections and corrective repairs of assets.

E. Maintenance activities

Maintenance activities include partial or complete overhauls at specified periods, oil changes, lubrication, minor adjustments, and so on. In addition, workers can record equipment deterioration so they know to replace or repair worn parts before they cause system failure.

Self-Check 6	Written Test

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

Fill the blank space

1. Write the maintenance-restructuring department in existing plant (4%)

_____,_____

_____,_____

2. Write the required procedures to Organize machinery and equipment setting on site (5%)

_____,_____

_____,_____

_____,_____

3. Write the set up required in implementing preventive Maintenance program activities (4%)

_____,_____

_____,_____

_____,_____

Note: **Satisfactory rating 7 and 13 points** **Unsatisfactory below 7 and 13 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

L #98	LO #3 Manage operation of machinery and equipment

Instruction sheet

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

- Operating machinery and equipment in safe and controlled manner
- Monitoring performance record and efficiency
- Selecting, using, maintaining and storing suitable PPE
- Identifying, assessing and reporting environmental implications

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

- Operate machinery and equipment in safe and controlled manner
- Monitor performance record and efficiency
- Select, use, maintain and store suitable PPE
- Identifying, assessing and reporting environmental implications

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks)
5. If you earned a satisfactory evaluation proceed to “Operation sheets
6. Perform “the Learning activity performance test” which is placed following “Operation sheets”
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1: Operating machinery and equipment in safe and controlled manner

1.1 Introduction

All organizations should have “safe operating procedures” (SOP’s) for all machinery and equipment operated by them. SOP for machinery help make sure that machines and equipment operated safely include:

- Warnings
- PPE signage
- Pre-operational safety checks
- Operational safety checks
- Stopping procedures
- Housekeeping
- Potential hazards.

1.2 The safe work place

Work in agricultural mechanics involves extensive contact with tools and machinery. Therefore, workers should be especially aware of the hazards that exist and take special precautions as needed.

1.3 Operating agricultural machinery and equipment

1.3.1. Agricultural tractor

The tractor is machine, which used to:

- Pull or to push agricultural
- Construction implements in the field.
- Self-propelled machine driven by engine applied in agriculture.

Figure 36: Agricultural tractor

Agricultural tractor spar parties

A. Heat engine

- Machine, which converts **heat energy** into **mechanical energy**
- Heat generated by the combustion of fuel
- Heat engines can be further divided in to two types
  - ✓ External combustion
  - ✓ Internal combustion.

B. Engine components and accessories

The principal parts of such an engine include:

1. Cylinder: - the cylinder of an IC engine constitutes the basic and supporting portion of the engine power unit. Its major function is to provide space in which the piston can operate to draw in the fuel, mixture or air compress it, allow it to \expand thus generate power

2. Cylinder head. It is the detachable portion of an engine, which covers the cylinder and includes the combustion chamber, spark plugs, nozzles and valves.

3. Cylinder block .It is a solid casting, which includes all cylinders and water jackets.

4. Piston. The piston of an engine is the first part begins movement and to transmit power to the crankshaft as a result of the pressure and energy generate by the combustion of the fuel.

5. Piston pin. The connecting rod connected to the piston through the piston pin.

6. Connecting rod. This is the connection between the piston and crankshaft. The end connecting the piston is known as small end and the other end is known as big end

7. Crank shaft. Connected to piston through the connecting rod and converts the linear motion of the piston in to the rotational of the flywheel.

8. Valves. To allow the air to enter into the cylinder or the exhaust, gases to escape from the cylinder, valves provided, known as inlet and exhaust valves respectively. The valves mounted either on the cylinder head or on the cylinder block.

9. Camshaft. The valves operated by the action of the camshaft, which separate cams for the inlet and exhaust valves.

1o. Flywheel. This is usually made of cast iron and its primary function is to maintain uniform engine speed by carrying the crankshaft through the intervals when it is not receiving power from a piston .It also helps in balancing rotating masses.

11. Injector. It is the component, which delivers finely atomized fuel under high pressure to the combustion chamber of the diesel engine. Main parts injector nozzle body and needle valve. The needle valve pressed against a conical seat in the nozzle body by a spring. Fuel from fuel injection pump with high pressure enters the nozzle body and it lifts the needle valve from conical seat so that fuel forced out of the injector through a small hole provided in the injector tip.

12. Oil tank. It provides a reservoir for the lubricating oil of the engine

13. Radiator. Radiator provided in water-cooled engines. It is a device for cooling the circulating water in the engine block. This helps in transferring the heat from the water to the atmosphere.

14. Fan. Fan is fitted behind the radiator and has 4, 5, or 6 blades. It fixed on the water pump shaft. It serves two purposes in the cooling system of an engine

A. it draws atmospheric air through the radiator and thus increases the efficiency of the radiator in cooling hot water.

B. it throws fresh air over the outer surface of the engine, which takes away the Heat conducted by the engine parts and thus increases the efficiency of the entire cooling system

15. Fuel tank. This is a reservoir of fuel, which contains sufficient fuel for about 10 hrs.

16. Preliminary filter: This fitted between the fuels thank and fuel pump. The function of preliminary filter is to prevent dust and foreign materials from reaching the filter

17. Fuel oil filter: most diesel engines employ a two-stage system of filtering. The function of a primary is to remove water and coarse particles of dusts, while that of the secondary filter is to take care of fine dust particles

18. Fuel feed pump. A Pump which feeds the fuel from the tank to the fuel injection pump called fuel feed pump. It maintains the fuel pressure in the system at a sufficiently high level to circulate the fuel through the filters

19. Air Cleaner: dust entering the tractor engine is often the principal cause of wear. The ideal air cleaner should possess the following characteristics: high efficiency in dust removal from the air, small air restriction, small size infrequent need for servicing, durability etc. They are two types of air cleaners these are dry type and oil bath or wet type filters. The dry type filter cleans the air by vanes then the clean air enters to the intake manifold. The wet type air cleans the air by trapping the dirty particles in the oil bath.

20. Transmission

The major components of a transmission system are

1). Clutch

2). Gear transmission

3). Differential

4). Final drive

21. The tractor drive train has three functions.

- It transmits power from the engine to the wheel, to, hydraulic pump, and other auxiliary drivers:
- Changes the torque and speed required by the particular drive
- Provides means for operator control with disconnected clutches and speed ratio selection for the wheel and power take off **(**PTO) drives.

1. Clutch: the clutch is a device used to connect and disconnect the source of power to the rest of the transmission system

2. **Gear box:** the purpose of the gearbox to adjust the speed of the engine to the speed at which it is required to drive the tractor that is the speed of the tractor wheels. As the engine runs at high speed, and the speed required at the tractor wheels is much less, the main function of the gearbox is that of speed reduction.

3. **Differential:** the power from the engine of the farm tractor transmitted in a straight line from the engine crankshaft, through the gearbox. However, the tractor wheel axle is at right angles to the crankshaft, so the power must also transmitted at right angles. This accomplished by a component called the **differential**.

4. **Final drive:** the last but one component in the transmission system called the final drive, and represents one more step in the speed reduction process. The speed reduction achieved by having a small spur gear that drives a large spur gear.

5. **Wheel and tyres**: The final component in the transmission system, to which power delivered, is the wheel, which, on most modern tractors covered by rubber tyres.

6. **Brakes:** the brakes basically a safety feature on the tractor they are also used for turning the vehicle. The disc or friction plate fixed on either the rear axle shaft or differential shaft

7. **Power take off (pto)shaft:** this shaft provides a power out let from the tractor for driving stationary machines or implements pulled behind the tractor in the field. Such as combines, movers and so on

8. Belt drives: they serve as a useful power outlet for driving stationary machines like feed mills, chaff cutters, and irrigation pumps.

1.3.2 Tillage implements

According to the equipment used, tillage operation classified as primary tillage and secondary tillage operations: likewise, tillage implements categorized as:

- Primary
- Secondary tillage implements.

A. Primary tillage implements: the operations performed to open up any cultivated land with a view to prepare seed bed for growing crops termed as primary tillage. The implements, which used to perform primary tillage operation called primary tillage implements

Some of the primary tillage implements are;

1. Mold board plough

Moldboard plough is a very common implement used for primary tillage operations. It normally cuts a rectangular furrow cross section of the soil.

Figure 37: Moldboard plough

This plough also performs the following functions one a time

Cutting the furrow slice

- Lifting the soil
- Turning the furrow slice
- Pulverizing the soil

According to the number of ploughing bottoms in the plough, moldboard classified as:

I Single bottom moldboard plough: usually animal operated moldboard ploughs will have single bottom

II Multi bottom mold board plough: In this type, 2 0r3 mold board plough working in the field at the same time by attaching 2 0r 3 multi board bottoms to a common frame

According the power used to ploughing, it classified as

a. Animal drawn moldboard plough

Animal power used to pull the moldboard in the field. Only single bottom moldboard plough operated by animal power

b. Tractor drawn moldboard plough: multi bottom moldboard ploughs hitched to the tractor and more area ploughed in a shorter time.

According to the ploughing pattern moldboard ploughs classified as

1. One-way moldboard ploughs: one-way ploughs throw the soil in only one direction usually to the right when seen from behind

2. Two ways moldboard ploughs or reversible moldboard ploughs two-way ploughs have two sets of opposed bottoms.

- The bottoms of two ways plough arranged that the right turning bottom quickly turned with the set, which turns the soil to the left.
- When reach the end of the furrow raise the plough turn around and return across with two-way plough
- These ploughs have the advantage that no back furrows or dead furrows formed in the field.

1.3.3. Sprayer

Uses of sprayer

- Application of insecticides to control various insects, pests and acaricides
- Application of herbicides in order to kill weeds in cultivated forage
- Application of fungicides to minimize the effect of fungal diseases
- Application of insecticide to control insect peas

Figure 38: Knapsack sprayer Garden Sprayer

Sprayer parts and their functions:

1. **Tank**: it is made of corrosive resistant material, from rolled brass sheet, fiberglass, or galvanized iron. It has a filter hole fitted with a filter to pour chemical into it. The tank should have rounded corners and bottom to facilitate easy cleaning through a drain plug.

2. **Pump**: pump needed for the atomization of spray fluid. In pneumatic sprayers, air pump used to compress air over spray fluid to force out through nozzle.

3. **Agitator:** agitation of spray materials in the tank is essential to use the full range of spray materials including powdery emulsions, fungicides and other spraying materials.

4. **Air chamber**: in a reciprocating type pump, an air chamber provided on the discharge line of the pump to level out the pulsations of the pump and thus providing a constant nozzle pressure.

5. **Pressure gauge**: it provided in all sprayers connected to the outlet of the pump in order to show the pressure of spray fluid.

6. **Pipes**: to distribute the chemical under pressure of various nozzles for sprayings, high pressure metallic and rubber pipes fixed on a beam.

7. **Valves**: cut of valves used on delivery line to stop the discharge. Pressure relief valves used, to prevent excessive pressure and to prevent damage of the system. By pass control, valves and main control valves used to direct excess discharge or controlling the liquid flow to pump.

8. **Nozzles:** a nozzle performs the following functions Meters the spray fluid at desired flow rate.

- Atomizes the liquid in to droplets.
- Disperses the spray fluid in a particular pattern.
- Propels the droplets with proper impact on the target

How to select a sprayer

The following aspects considered while choosing a sprayer for applying chemicals

- Volume of the discharge or coverage of the sprayer
- Availability of water
- Spraying is performed than dusting for flying pests
- Nature of crop requiring treatment
- Size of the equipment
- Skill of the worker to operate the sprayer
- Cost of the sprayer

4. **Mower**

Mowers are used to cut grass and other forage crops. The basic principle of cutting remains the same as scissors i.e. two sharp straight blades shear the stalk of the grass at a certain speed. This action defined as moving.

The operating power transmitted into a reciprocating motion. Thus with a multiple action of impact, compactness and shear, the crop is cut and the cut material left in a swath.

5. CHAIN SAW

The chain saw is one of the most useful and time saving power tools ever made. It is also one of the most dangerous. Chain saws serve a broad range of cutting needs, from small trimming jobs to felling very large trees.

6. Pump

The heart of most irrigation systems is a pump. To make an irrigation system as efficient as possible, the pump selected to match the requirements of the water source, the water piping system and the irrigation equipment.

Before selecting an irrigation pump, a careful and complete, inventory of the conditions under which the pump will operate must take place

The inventory must include,

1. The source of water (well, river, pond, etc)
2. The required pumping flow rate
3. The total suction head
4. The total dynamic head

There is usually no choice when it comes to the source of the water; it is either surface water or well water and availability will determined by the local geology and hydrologic conditions. However, the flow rate and total dynamic head determined by

- The type of irrigation system
- The distance from the water source
- The size of the piping system.

7. Combine

A combine is a machine used to harvest crops as it moves across a field. The head of the combine runs through the crop rows and cuts the stalks of the plants. The plants then pulled through the machine and grain separated from the plant material. Corn, soybeans, wheat, barley, and rice harvested with combines.

Figure 39: Combiner

9. Mower

Mower a piece of equipment used:

- To cut standing vegetation
- To harvest forage crops, such as grass and alfalfa. After mowing crop left in rows to dry and picked up by a baler

10. Hay Tatter

- Hay tatter a machine for making hay
- Used after cutting and before windrowing
- Used to turn or scatter the hay in order to aerate the hay and speed up the process of drying
- Improve aroma and color.

11. Hay rake

- Hay rake (collect) used to collect cut hay into windrows for later collection (e.g. by a baler)
- Designed to fluff up the hay and turn over to dry
- Mechanized drawn by a tractor or draft animals, or it may be a hand tool.

12. Baler

- Baler a piece of equipment used to harvest forage crops that cut, dried, and placed in rows.
- Baler pulled behind a tractor and picks dried vegetation up off the ground.

- Inside the baler, material tightly packed or wound into round or rectangular bales.
- When the bale reaches the proper size, the machine wraps the bale with wire or twine to secure it.

Figure 40: Mower (a) Baler (b)

13. Rakes and Mergers

Hay and forage producers have a wide variety of equipment options for raking and merging swaths or windrows. Selecting the proper equipment and operating correctly insure high quality hay and forage with a cost effective harvesting system.

a. Mergers

As forage, harvesters have increased in capacity, the need for merging more swaths into a single windrow.

The major difference between the rakes and mergers is that the mergers lifts the crop onto a belt conveyor that is used to move and deposit the swath into the desired location so the crop is never dragged along the ground. The merger can be used **for either silage or dry hay although its primary use is silage.**

Figure 41: Rakes and Mergers

Tedding is an aggressive action and acceptable for grasses where leaf loss is less of a concern. However, for alfalfa concern that tenders will cause unacceptable leaf loss, especially if the tedding done when the crop partially dry and the leaves are brittle. Tedding adds an additional step in the hay making process: cutting, tedding, raking, and baling

14. Milking machine

The principle of machine milking is to extract milk from the cow by vacuum. The machines designed to apply a constant vacuum to the end of the teat to suck the milk out and convey it to a suitable container and to give a periodic squeeze applied externally to the whole of the teat to maintain blood circulation.

A milking machine installation consists of a pipe work system linking various vessels and other components, which together provide the flow paths for air and milk. The forces necessary to move air and milk through the system arise from the fact that it maintained at a vacuum. Thus, it is atmospheric pressure, which forces air, and intra-mammary milk pressure, which forces milk, into the system, and the combination of these forces causes flow.

To a continuous operation, it is necessary to remove air and milk from the system at appropriate rates.

Parts of machine milking

Milking machines have now developed into systems that show considerable diversity they have the same basic components.

a. Vacuum pump

The air removed by a vacuum pump at a constant rate. Flow of air and milk through three basic types of machine during normal milking. In the bucket (or direct-to-can) machine the milk enters the teat cups and travels through the short milk tubes to the claw where air admitted and the milk and air travel along the long milk tube to the bucket

(or can). The milk remains in the bucket (or can) and the air separates to pass up the vacuum tube to the vacuum pipeline.

b. Pulsate

Usually fixed on the bucket lid admits air intermittently and this passes along the long pulse tube to the teacup chambers. To control the vacuum at a predetermined level air admitted to the system through a vacuum regulator, which fitted, on the vacuum pipeline near to the milking points.

c. Teat cut

Teat cup contact with cow's teats and remove milk

d. Claw milk pools as it removed from the four teats

e. Vacuum tubes that provide vacuum to the teat cups and a milk tube that removes milk away from the claw, a source of vacuum for the machine, and a pulsate that regulates the on-off cycle of the vacuum

Many milking machines today have an automatic take-off (ATO or detacher) device that removes the machine from the cow when milking completed.

Figure 42: Milking machine

Milking machine on a cow indicating machine parts. Note the chain leading from the claw to the left side of the image.

Most cows have four functional teats. Therefore, milking machines designed with four teat cups. These are composed of an inner **rubber liner** and an **outer shell,** usually

made of metal. The rubber liner is relatively thin in the section that sits inside of the shell, while the liner's tube below the shell thicker rubber.

15. Cream separator (Milk separation)

The fat fraction separates from the skim milk when milk allowed standing for at least 30 to 40 minutes. This is known as ''creaming''. The creaming process used to remove fat from milk in a more concentrated form.

A number of methods employed to separate cream from milk.

I Gravity separation

Fat globules in milk are lighter than the plasma phase and hence rise to form a cream layer.

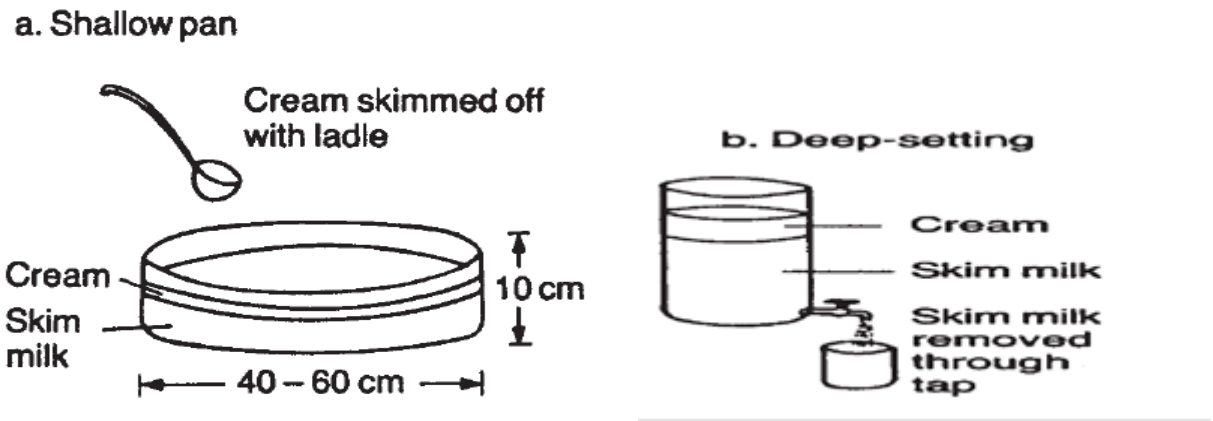


Figure 43: Batch separation of milk by gravity (a) shallow pan (b) Deep setting method

II. Centrifugal separation

Gravity separation is slow and inefficient. Centrifugal separation is quicker and more efficient leaving less than 0.1% fat in the separated milk compared with 0.5--0.6% after gravity separation. It also allowed removal of cream and recovery of the skim milk in a fresh state.

The separation of cream from milk in the centrifugal separator because when liquids of different specific gravities revolve around the same center at the same distance with the same angular velocity. Greater centrifugal force exerted on the heavier liquid than on the lighter one.

a. Operation of cream separator

1. Set bowl, fit the skim milk spout and the cream spout.
2. Fit the regulating chamber on top of the bowl.
3. Put the float in the regulating chamber.
4. Put the supply can in position, making sure that the tap directly above and at the center of the float.
5. Pour warm (body temperature) water into the supply can.
6. Turn the crank handle, increasing speed slowly until the operating speed reached.
7. Open the tap and allow warm water to flow into the bowl. This rinses and heats the bowl, allows a smooth flow of milk and increases separation efficiency.
8. Pour warm milk (37--40°C) into the supply can. Repeat steps 6 and 7 above and collect the skim milk and cream separately.
9. When all the milk used up and the flow of cream stops, pour about 3 liters of the separated milk into the supply can to recover residual cream trapped between the discs.
10. Continue turning the crank handle and flush the separator with warm water.

b. Types of cream separator

a) Manual
b) Electrical

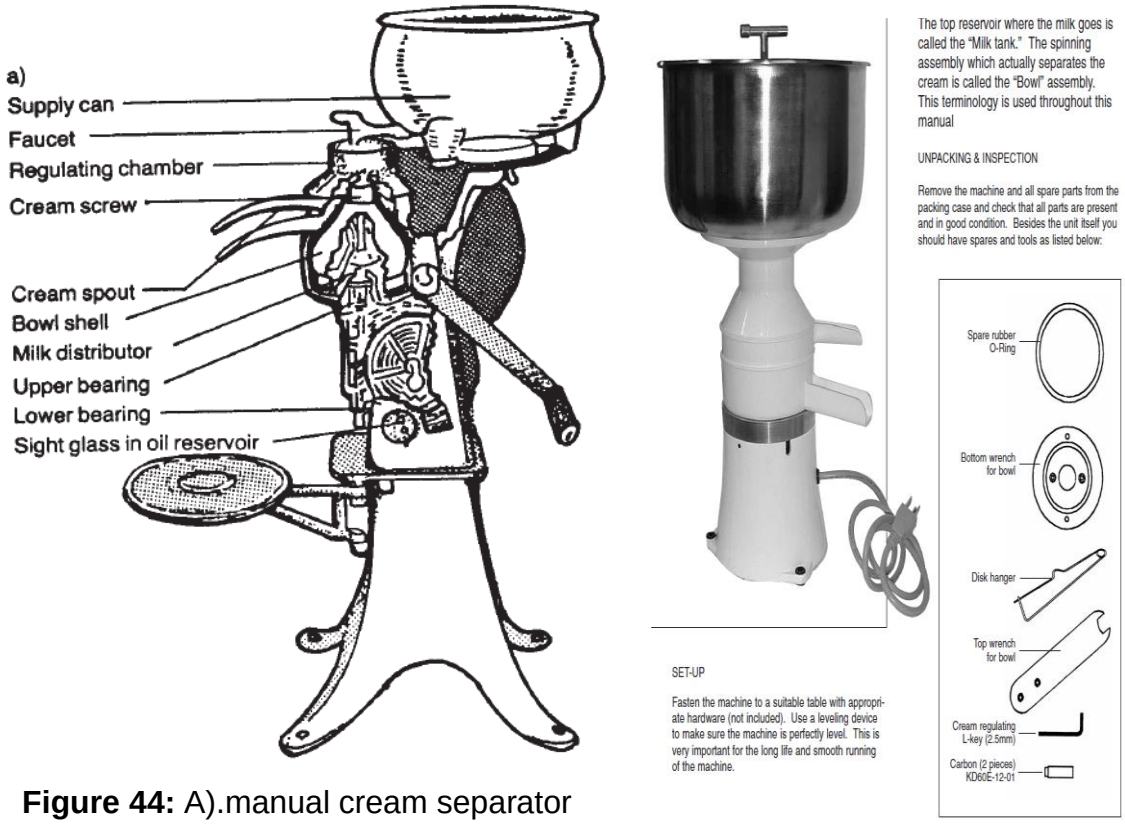
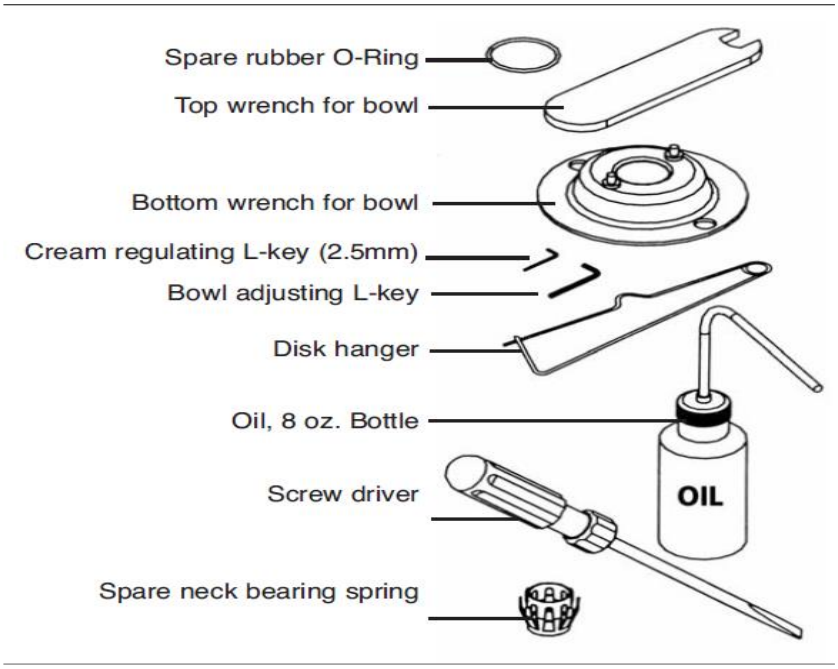


Figure 44: A).manual cream separator b). Electrical cream separator

The cream separator unit should have spares and tools as listed below:



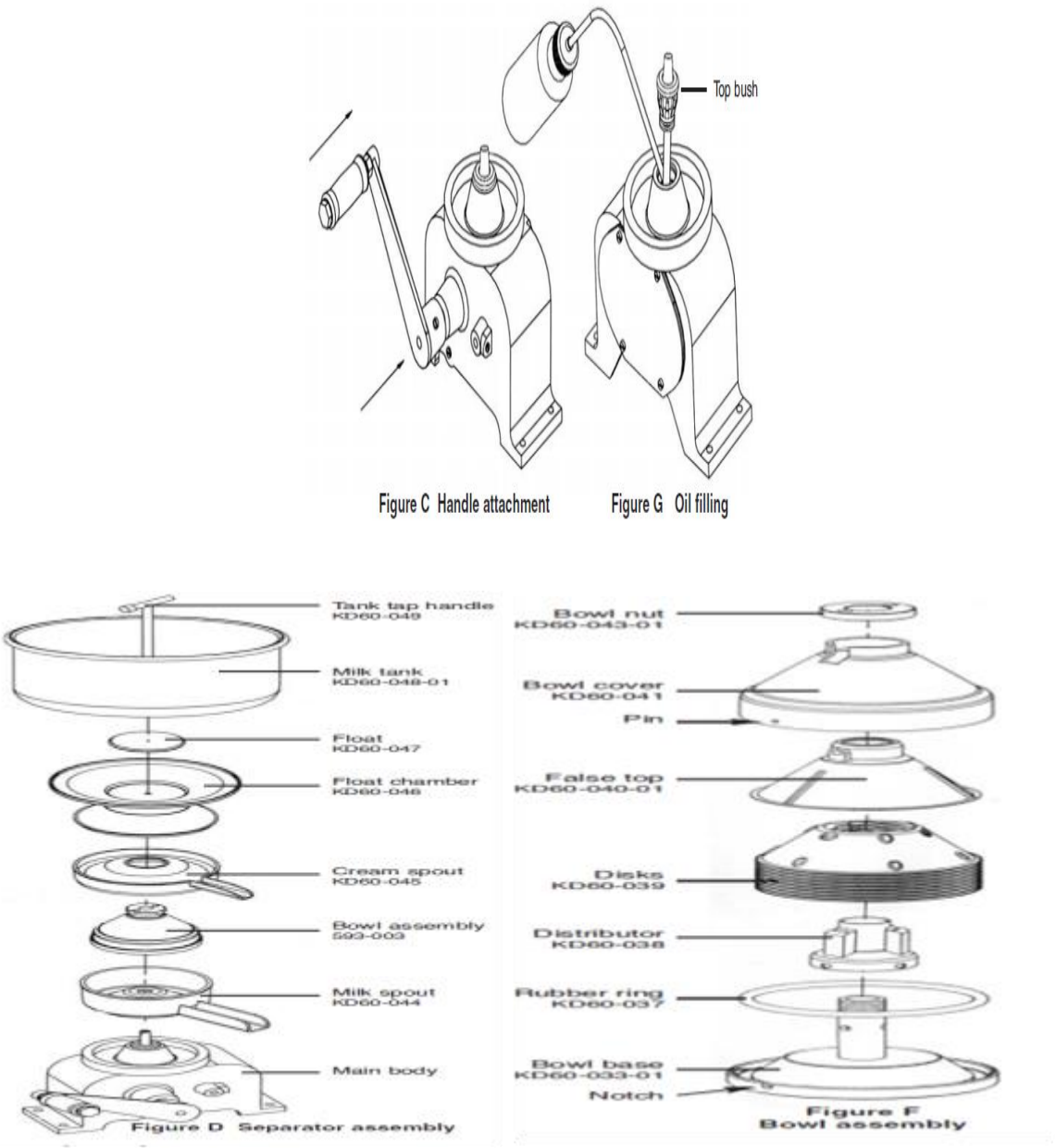


Figure 45: Spares and tools of cream separator

Set-up and oiling the cream separator

Fasten the machine to a suitable table with appropriate hardware (not included). Use a leveling device to make sure the machine perfectly level.

Cleaning of milk contact parts

The bottom wrench should bolted to work table for ease of disassembly of the bowl. Dismantle and wash all parts in soap and warm water until thoroughly clean. Rinse well and wipe dry.

Assembly the cream separator

- Put the bowl assembly back together
- Make sure the bowl cover pin fits into the bowl base notch
- Tighten the bowl nut well
- Place the milk contact parts over the spindle starting with the milk spout
- Next place the bowl assembly making sure it seats properly on the tapered head of the spindle shaft.
- Put the cream spout on next and make sure the cream supply hole on the bowl at least 2mm above the cream pan inner edge
- If adjusting required, locate the bowl adjusting nut at the bottom of the base and use the bowl adjusting L-key to raise or lower the spindle
- Place the float chamber, the float and the milk tank in place
- Make sure the milk tank placed with the “ON” label at the front
- Tighten the tank tap handle. Put the tap in “OFF” position.
- Separator is now ready for use.

Cleaning and storage

- After separating batch of milk, dismantle the spinning bowl and clean all milk contact parts thoroughly as described above
- Dry thoroughly and store in a clean dry place. Many of the impurities in the milk collect as slime on the wall of the separator bowl.
- This slime contains remnants of milk like: skim milk and cream, all of which will decompose and ferment unless removed promptly
- If not thoroughly washed the separator bowl becomes a source of microbial contamination
- Skimming efficiency reduced when the separator bowl and discs are dirty and milk deposits on the separator can cause corrosion.

Washing the separator

After flushing the separator with warm skim milk, the bowl should flushed with clean water until the discharge from the skim milk spout clean. This removes any residual milk solids and makes subsequent cleaning easier

The bowl should dismantled and all parts like:

- Bowl
- Bowl cover
- Discharge spouts
- Float supply tank and buckets washed by:
  - ✓ Brush
  - ✓ Hot water
  - ✓ Detergent
  - ✓ Rinse with scalding water
  - ✓ Allow the parts to drain in a clean place protected from dust and flies.

Assembling the bowl

1. Fit the milk distributor to the central feed shaft.
2. Fit the discs on top of each other on the central shaft.
3. Fit the cream screw disc.
4. Fit the rubber ring to the base of the bowl
5. put on the bowl shell, ensuring that it fits to the inside of the base.
6. Screw the bowl nut on top.

The rest of the separator essentially a set of gears arranged to permit the spindle, on which the bowl carried, to turn at high speed. The gears normally enclosed in an oil-filled case.

The bowl usually supported from the bottom and has two bearings:

- One to support its weight
- The second to hold it upright.
- The upper bearing usually fitted inside a steel spring so that keep the bowl upright even if the frame of the machine not exactly level

The assembled bowl lowered into the receptacle, making sure that the head of the spindle fits correctly into the hollow of the central feed shaft.

16. Butter churn

A butter churn is a device used to convert cream (coagulated milk) into butter. That done through a mechanical process, frequently via a pole inserted through the lid of the churn, or via a crank used to turn a rotating device inside the churn.

Process

- The agitation of the cream, caused by the mechanical motion of the device, disrupts the milk fat
- The membranes that surround the fats are broken down, subsequently forming clumps known as butter grains
- Butter grains, during the process of churning fuse with each other and form larger fat globules
- Air bubbles introduced into these fat globules via the continued mechanical action of the churn.
- The butter grains become denser as fat globules attach to them while the air force out of the mixture
- This process creates a liquid known as buttermilk. With constant churning, the fat globules eventually form solid butter and separate from the buttermilk
- The buttermilk drained off and the butter squeezed to eliminate excess liquid and to form it into a solid mass.

Types of Butter Churns

The most historically prominent types of butter churns are the **plunge churn**, which is a container, usually made out of wood, where the butter-making action created by moving in a vertical motion a staff that inserted into the top.

This type of churn is also known as

- An ‘up and down’ churn,
- churning tub,
- Plunger churn

- plumping churn,
- knocker churn
- Plump-kirn or plowt-kirn.

One particularly novel invention of note was the rocking chair butter churn. This device, invented by Alfred Clark, consisted of a barrel attached to a rocking chair. While the rocking chair moved, the barrel moved and churned the milk within into butter.

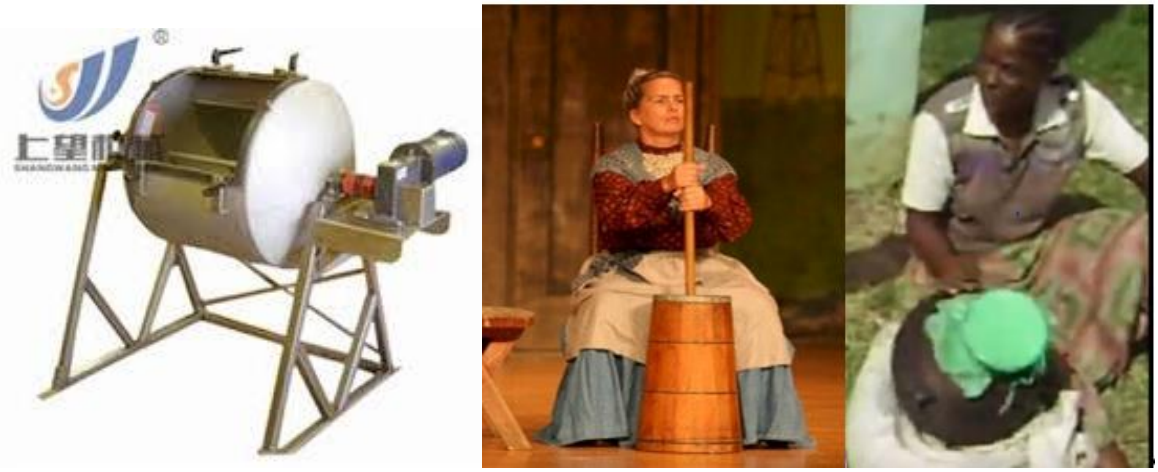


Figure 46: a) Modern electric churner b) Traditional butter churning clay pot

Self-Check 1	Written Test

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

Fill the blank space

1. Write the required safe operating procedures to operate machinery and equipment (3%)

_____,_____

_____,_____

_____;_____

2. Write the two types of agricultural tractor heat engine (2%)

_____,_____

3. Write the major component of transmission (2%)

_____,_____

_____,_____

4. List down agricultural tractor spare parts (2%)

_____,_____

5. List down the parties of sprayer (3%)

_____,_____,_____

_____,_____,_____

_____,_____,_____

6. _____ extract milk from the cow by vacuum. (2%)

7. List down the parties' milking machine (3%)

_____,_____,_____

_____,_____,_____

Note: **Satisfactory rating 9 and 17 points** **Unsatisfactory below 9 and 17 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 2: Selecting using, maintaining and storing suitable PPE

2.1 Select personal protective equipment

PPE defined in the Personal Protective Equipment at Work Regulations as 'All equipment

(Including clothing affording protection against the weather) which intended to be worn or

Held by a person at work, which protects them against one or more risks to their health and safety.

Suitability of PPE

To be able to choose the right type of PPE, the hazards involved in the task or work environment must considered carefully. PPE must also meet the needs of the individual.

The following factors should considered when assessing the suitability of PPE:

- Is the PPE appropriate for the risk involved and conditions at the place where exposure May occur? e.g. goggles are not suitable when full-face protection is required
- Does the PPE prevent or adequately control the risks involved without increasing the overall risk? e.g. gloves should not be worn when using a pillar drill, due to the increased risk of entanglement
- PPE adjusted to fit the wearer correctly. e.g. if a person wears glasses, ear defenders may not provide a proper seal to protect against noise hazards
- Has the state of health of those using it been taken into account?
- What are the needs of the job and the demands it places on the wearer?
- How long will the PPE need to worn?
- What are the requirements for visibility and communication?
- If more than one item of PPE worn, are they compatible? For example, does a particular type of respirator make it difficult for eye protection to fit properly?

Types of PPE:

- Hearing protection
- Head protection
- Eye protection
- Foot protection
- Hand and arm protection
- Body protection
- Respiratory protection

Figure 47: PPE for machine maintenance

2.2 Maintaining PPE

An effective system of maintenance of PPE is essential to make sure the equipment continues to provide the degree of protection for which designed. Therefore, the

manufacturer's maintenance schedule (including recommended replacement periods and shelf lives) must always followed.

Maintenance of PPE may include:

- Cleaning
- Examination
- Replacement
- Repair and testing

The wearer may be able carry out simple maintenance (e.g. cleaning), but more intricate repairs must only be carried out by competent personnel. The costs associated with the maintenance of PPE are the responsibility of the employer.

2.3. Storage for PPE

Where PPE provided, adequate storage facilities for PPE must provided for when it is not in use, unless the employee may take PPE away from the workplace (e.g. footwear or clothing).

Accommodation may be simple (e.g. pegs for waterproof clothing or safety helmets) and it need not be fixed (e.g. a case for safety glasses or a container in a vehicle).

Storage should be adequate to protect the PPE from

- Contamination
- Loss
- Damage
- Damp or sunlight.

When PPE contaminated during use, storage should be separate from any storage provided for ordinary clothing.

Self-Check 2	Written Test

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

Fill the blank space

1. List down the types of PPE used for machine and equipment operation (5%)

_____,_____

_____,_____

_____,_____

_____,_____

2. Write the types of maintenance used for PPE (4%)

_____,_____

_____,_____

3. Write the storage facilities required for PPE (4%)

_____,_____

_____,_____

Note: **Satisfactory rating 7 and 13 points** **Unsatisfactory below 7 and 13 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 3: Identifying, assessing and reporting Environmental implications of machinery operation

3.1 Identifying and assessing environmental implications machinery Operation

Environmental assessment (EA) is the assessment of the environmental consequences (positive and negative) of a plan, policy, program, or actual projects prior to the decision to move forward with the proposed action.

Environmental impact assessment (EIA) is usually applied to actual projects by individuals or companies and the term strategic environmental assessment (SEA) applies to plan policies and programs most often proposed by organs of state.

3.2 Environmental implications

Negative environmental impacts may result from

- Excessive noise and exhaust emissions
- The incorrect use and disposal of maintenance debris like;
  - ✓ Oils containers
  - ✓ Chemical residues
- Hazardous substances
  - ✓ Fuel
  - ✓ Fertilizer
- Impacts may also include
  - ✓ Run-off flows of water
  - ✓ Cleaning agents from servicing, maintenance and cleaning activities
  - ✓ Soil disturbance
  - ✓ Dust problems from high speed and frequent traffic (including irrigation equipment).

Assessing and reporting Environmental implications of machinery operation

A technology's ability to monitor, prevent, minimize, and control emissions of contaminants to all environmental media (water, air, soil), both during the demilitarization process and during process upsets, will determine its environmental

impact. Furthermore, because various treatment technologies and pollution abatement systems result in the accumulation of secondary waste streams, it is important to consider the ability to meet the management and disposal requirements of these streams. Ideally, the treatment method is a complete solution with no long-term storage or disposal requirements for hazardous process waste streams.

Given the nature of the source material treated, damage to equipment during treatment is possible. Hence, technologies for the demilitarization of conventional munitions need to have safety controls to prevent accidental releases of emissions, due to equipment damage, that have environmental or health concerns.

Other environmental impacts that need to consider on ecosystems, include:

- Wildlife
- Marine and aquatic receptors
- Cultural
- Recreational and commercial activities depending on such ecosystems.

Finally, the effects of vibration, noise and shock, visual plumes, and odor need to considered, as they affect nearby communities have impact on the environment.

Self-Check 3	Written Test

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

Fill the blank space

1_____ is the assessment of the environmental consequences (positive and negative) of a plan, policy and program (2%)

2._____is usually applied to actual projects by individuals or companies for strategic environmental assessment (2%)

3. Write the incorrect used and disposed of maintenance debris (waste) (3%)

_____,_____

4. Write the hazards substances from machine and equipment disposal

_____,_____

5. Write the environmental impacts that need to consider on ecosystems (4%)

_____,_____

_____,_____

Note: **Satisfactory rating 6 and 11 points** **Unsatisfactory below 6 and 11 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

L #99	LO #4 Co-ordinate and report maintenance and operation activities

Instruction sheet

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

- Coordinating and timing resources
- Informing operators of appropriate use and their responsibilities
- Monitoring and documenting personnel, activities, timelines and materials
- Completing shut-down procedures
- Completing and maintaining machinery and equipment operational records
- Detailing and reporting contingency situations of machinery and equipment

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

- Coordinate and time resources
- Inform operators of appropriate use and their responsibilities
- Monitor and document personnel, activities, timelines and materials
- Complete shut-down procedures
- Complete and maintain machinery and equipment operational records
- Detailing and reporting contingency situations of machinery and equipment

Learning Instructions:

Read the specific objectives of this Learning Guide.

1. Follow the instructions described below.
2. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them
3. Accomplish the “Self-checks” which are placed following all information sheets.
4. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks)
5. If you earned a satisfactory evaluation proceed to “Operation sheets
6. Perform “the Learning activity performance test” which is placed following “Operation sheets”
7. If your performance is satisfactory proceed to the next learning guide,
8. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1: Co-ordinating and timing resources for machine maintenance and repair operation

3.1 Co-ordinate Maintenance Plan and Schedule (time)

Maintenance planning defined as an end-to-end process that identifies and addresses any possible issues ahead of time. This involves

- Identifying the parts and tools necessary for jobs
- Making sure they are available and laid out in the appropriate areas
- Having a planner write out instructions on how to complete a jobs and determining
- Gathering the necessary parts and/or tools before a job assigned.

Maintenance planning also includes tasks related to parts like:

- Handling reserve parts
- Ordering nonstock parts
- Staging parts
- Illustrating parts
- Managing breakdowns and vendor lists
- Quality assurance (QA) and quality control (QC)

Maintenance planning define the "what," "why" and "how." This means specifying what work needs to be done with what materials, tools and equipment, why a particular action was chosen (why a valve is being replaced instead of a seat) and how the work should be completed.

Maintenance scheduling

Refers to the timing of planned work when the work should done and who should perform it. It offers details of "when" and "who." Scheduling meant to:

- schedule the maximum amount of work with the available resources
- Schedule according to the highest priority work orders
- Schedule the maximum number of preventive maintenance jobs when necessary

- Minimize the use of contract and outside resources by effectively using internal labor

Practical maintenance schedules templet

Equipment	Date checked	Action required	Name of person checked	Signature of person checked	Due date of next check

Maintenance records

Date	Maintenance description	Service provider	Price

When implemented together, maintenance planning and scheduling have a significant benefit in multiple areas of organization. These can include:

- Help with budgeting by controlling resources associated with maintenance
- A reduction in equipment downtime
- A reduction in spare parts
- Improved workflow
- Improved efficiency by minimizing the movement of resources between areas

Maintenance Planning Principles include**:**

- Protect the planner
- Focus on future work
- Component-level files
- Use planner judgment for time estimates
- Recognize the skill of the techs
- Measure performance with work sampling

Maintenance Scheduling Principles include:

- Job plans are needed for scheduling
- Schedules and job priorities are important
- schedule based on the projected highest skills available
- Daily work is handled by the crew leader
- Measure performance with schedule compliance

Self-Check 1	Written Test

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

Fill the blank space

1. Write down the Maintenance Scheduling Principles (4%)

_____

_____

_____

_____

_____

2. Write down Maintenance Planning Principles include (3%)

_____,_____

_____,_____

_____,_____

3. _____ the timing of maintenance performed and who perform it. (2%)

4. Write the task related maintenance planning (4%)

_____,_____

_____,_____

_____,_____

_____,_____

Note: **Satisfactory rating 7 and 13 points** **Unsatisfactory below 7 and 13 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 2: Informing operators of appropriate use and their responsibilities

2.1 Machine Operator Job Description

The Machine Operator will be responsible for performing various tasks to set up, operate, monitor, troubleshoot and perform preventive maintenance on assigned machines. The Machine Operator will also be responsible for inspecting parts to specifications and making adjustments, or tool changes as necessary to maintain quality specifications.

Sets up and operates a production machine in accordance with established procedures and guidelines. Reads and interprets blueprints and diagrams to select, position and secure machinery. Adjusts machine settings to complete tasks accurately, according to specifications and in a timely fashion.

Requires a high school diploma or its equivalent. May have to complete an apprenticeship and/or formal training in area of specialty with 0-2 years of experience in the field or in a related area. Has knowledge of commonly used concepts, practices and procedures within a particular field. Rely on instructions and pre-established guidelines to perform the functions of the job. Work under immediate supervision. Primary job functions do not typically require exercising independent judgment. Typically reports to a supervisor/manager.

2.3 Machine Operator Job Purpose:

- Responsible for operating and maintaining complicated machinery
- Work in dedicated capacity specializing in a single machine or class of machines (e.g. Drills, printers, forklifts)
- Job duties and conditions vary depending on industry and job function
- Machine operators may work outside or indoors and work for a single company or on a contract basis

2.4 Machine Operator Job Duties:

- Operate specialty **machinery** to fabricate, manufacture, assemble, or move products.
- Maintain and monitor **machine** to make sure it **functions** properly.
- Understanding of how operated **machine** works.
- Conduct quality checks periodically.
- Verify adequate materials and supplies are available to complete operations as needed
- Analyze machine operations and output if applicable
- Adjust machine as needed for changeovers, different functions, or other varying needs of production

2.5 Machine Operator Responsibilities:

- Assist in the installation, maintenance, and repair of machinery.
- Operate tools in order to aid in the manufacturing process.
- Perform periodic checks on equipment and solve problems as detected.
- Work with others in order to ensure that equipment is in proper working order
- Ability to work in a fast-paced, high-speed environment, follow standardized work and adhere to safe work practices in a continuous improvement environment
- Experience in a manufacturing environment is a plus
- Perform necessary pre-operation activities to ensure proper equipment startup and operation on multiple pieces of equipment
- Operate/monitor multiple pieces of equipment during operation to ensure quality production and minimal unplanned stops
- Communicate with team members and support teams to ensure continuous production of the correct product at high quality levels with minimal wasted time and materials
- Housekeeping and sanitation

2.6 Machine Operator Skills and Qualifications:

- Knowledge of safe machine practice standards
- Physical agility

- Technical ability
- Spatial understanding
- Good Coordination
- Ability to read blueprints or production schematics is necessary
- Ability to keep up machinery
- Ability to do small to moderate repairs on machinery
- Experience working with said machinery
- Specialized training with said machinery
- Certification in operating said machine normally required
- Experience and having the right credentials is generally more important than college education

2.7 Machine Operator top skills & proficiencies:

- Experience as a Machine Operator
- Knowledge of Production Procedures
- Ability to Read Blueprints, Schematics and Manuals
- Analytical Skills
- Attention to Detail
- Teamwork
- Physical Stamina and Strength
- Handle Heavy Equipment
- Work Independently
- Multitask

Self-Check 2	Written Test

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

Fill the blank space

1. Write down the Machine Operator Job Purpose (4%)

_____

_____

_____

_____

_____

2. Write the Machine Operator top skills and proficiencies required (4%)

_____,_____

_____,_____

_____,_____

_____,_____

3. Write down the Machine Operator Skills and Qualifications required (5%)

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

Note: **Satisfactory rating 7 and 13 points** **Unsatisfactory below 7 and 13 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 3: Monitoring and documenting personnel, activities, timelines and materials

3.1 Equipment documentation

A. The objectives of technical documentation

The lack of equipment documentation is a major problem faced by maintenance services in production plants

Necessity of machine and equipment documentation are:

- To ensure maintenance management
- To repair work
- To manufacture of spare parts
- To rapid troubleshooting
- To Work safety
- For correctly selection and management of spare parts
- Efficient staff training

Unfortunately, when purchasing production equipment, technical documentation frequently neglected by both supplier and customer.

Complete documentation is expensive. For a new factory, it can vary between 8 and 22 per cent of the value of the equipment.

In order to lighten expenses for existing plants, full documentation should only prepared for priority equipment. In any case, investment in setting up or improving technical documentation will only be justified if the documentation used efficiently. For this, the documents must updated regularly and dispatched judiciously.

B. Content of technical n equipment documentation

Technical documentation divided into three types:

- Study and engineering
- Construction and start-up
- Exploitation.

We have paid most attention to the third type, which is vital for the efficient running of the factory, because most of the documents concerning engineering, construction and start-up little used once the factory is in production.

Equipment documentation classified in four different types of file, established by zone, department or production line: these are the general file, the machine files, the utilities file, and the standard files. All the documents presented in hardcover A4 binders.

The different headings separated by numbered insertions so that each heading is easily accessible.

They are different types of file opened for equipment documentation

I) General file

This file consists of:

- technical specifications for the installation
- flow sheets showing the machines and apparatus, and information concerning raw materials, consumption of fluids, etc.; the plant layout and section drawings of installations showing clearly the connections between the different machines
- Operation and service instructions

In order to obtain an overall view of the equipment belonging to the installation, an ‘inventory of machines set up including the machines, apparatus and important accessories

II) Machine files

In the machine files, a distinction made between the important/complex machines and the simple ones

The file of an important or **complex machine** is composed of eight headings under which the equipment documentation is classified

The different headings comprise the following documents, separated by numbered insertion

1. Technical documentation: machine record card/layout drawings/description of functioning
2. Installation and start-up: foundations and installation/transport and handling/instructions for assembling/commissioning
3. Instructions for operation: safety instructions/ operation/instructions for tuning/troubleshooting
4. Service instructions: maintenance/lubrication
5. Drawing stand nomenclature mechanical or electrical and automation/ instrumentation or hydraulic/ pneumatic and other fluids
6. Recommended spare parts
7. Prospects and catalogues
8. Control certificates and commissioning reports

III) Utilities file

The utilities file deals with the distribution network of energy and fluids, such as

- Electricity
- Compressed air
- Water
- Steam
- Gas.

The drawings and documents dealing with machines, which produce energy and fluids, found in the appropriate machine files

The utilities file also contains eight headings, which are:

1. Technical characteristics
2. Description of the installation
3. Exploitation manual for the installation
4. Maintenance
5. Prospectus and service manuals for apparatus and devices
6. List of recommended spare parts
7. Drawings and diagrams
8. Control certificates and commissioning reports

IV) Standard files

Documentation for standard apparatus and accessories (valves, motors, pumps, measuring devices, etc.) for machines or installations classified in the standard files. There are three types of standard file:

- Mechanical
- Electric/automation
- Instrumentation
- These files also contain the same eight headings as above, but the content is simpler.

3.2 Management of equipment documentation

The coding structure of equipment documentation corresponds to different sections of the factory; a code given to each machine, assembly, sub-assembly and apparatus. This permits the allocation of maintenance expenditure to each machine and makes it possible to follow up interventions, which carried out. It is an invaluable tool in maintenance management. This coding used in filing and administering the technical documentation.

The room in which technical documentation is stored should be dust-free and dark so that the documents do not deteriorate. Drawings should be stored in drawers, according to codification number and size (A0 to A4). The machine files, standard files and utilities files should be stored in metal cabinets, according to the file number. Catalogues of standard and commercial parts and products will also be stored in metal cabinets. Filing carried out alphabetically.

Each modification, however small, must recorded immediately on the original documents and made known to the users. This updating is important because it mainly concerns the drawings (electrical, mechanical, etc.).

It must carried out by the methods section together with the drawing section of the CMPO. Each modified drawing will carry a new index. The updates also noted on a sheet in each machine file. In this way, it is possible to see at any time if the plan or document in one's possession is the latest and most up-to-date version.

A. Basic terms of reference for equipment documentation

The terms of reference for documentation to supply by the manufacturer should be available. These added to the terms of reference that deal with general and detailed conditions of purchase.

The objectives of the terms of reference are:

- to determine which documents, drawings and diagrams are to be delivered by the supplier;
- to define the standard format and other requirements which the above documents should satisfy;
- to define the form of presentation in order to obtain uniform documentation which is easy to classify and consult;
- to define the delivery conditions for documentation (where, when, how, number of examples, originals, etc.);
- to determine the responsibilities of the supplier and to fix penalties if the contract is not fulfilled.

B. Improvement actions in the plant

At plant level, the following short-term improvement actions recommended:

- Centralize all technical documentation in one area of the plant;
- Code and classify the documentation, create a system for updating and dispatching;
- Specify priority machines with a high risk of production bottlenecks and make up detailed machine files for them;
- Establish standard terms of reference for technical documentation which must be imposed on equipment suppliers.

C. Equipment Documentation means copies or originals of

(i) all operating specifications, warranties and other similar information obtained by Contractor from **equipment** vendors or Subcontractors or prepared by Contractor or Subcontractors as part of the Work

(ii) (ii) a complete inventory list of all **Equipment** comprising the

Documentation of work site activity determine if the work is on track, provide progress reports to supervisors, and plan for delivery and storage of materials to minimise costs and time wasting for the enterprise

Self-Check 3	Written Test

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

Fill the blank space

1. Write down the Necessity of machine and equipment documentation (6%)

_____,_____

_____,_____

_____,_____

_____,_____

2. Write the Content of technical documentation equipment documentation (3%)

_____,_____

_____,_____

3. Write the types of file opened for material documentation (4%)

_____,_____

_____,_____

Note: **Satisfactory rating 7 and 13 points** **Unsatisfactory below 7 and 13 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 4: Completing shutdown procedures

4.1 Machine and equipment shutdown procedure

Normal shutdown includes steps to render the systems safe, such as removal of hazardous process materials and inert (asphyxiating) gases. The systems might cleaned as part of the shutdown; cleaning is often a process unto itself requiring its own set of startup, operation, and shutdown procedures.

The correct electric machine and equipment shutdown procedure

- Pull plug or throw switch to off position before cleaning or adjusting any machine.
- Keep fingers, hands, spoons for manufacturing
- Away from moving parts.
- Wait until machine stops before moving for machine controlled by key.
- Check all switches to see that they are off before plugging into the outlet.

The fuel machine and equipment shutdown procedure

- Maintaining a clear thoroughfare
- Parking away from hazards
- Securing
- Lower all hydraulic lift equipment to the ground (for hydraulic machine and equipment)
- Re-fuelling
- Cleaning
- Always allow engine to cool down at a fast idle before shutting off
- Allows the valves and pistons to cool down uniformly
- Safe dismount procedures (turning engine off)
- Engaging handbrake and removing vehicle keys.

Particular care must take when **cleaning** the slicing machine are.

- **First, pull the plug.**
- Turn the gauge to zero in order to cover the edge of the blade

- Do not touch the edge of the circulated/ revolving body of machine
- Clean the internal from the center out.
- Clean the inside edge of the machine with a stick that has a cloth wrapped around one end.
- Do not start machine until the locked in place and the attachments are securely fixed

When operating electric machine and equipment

- Turn off motor before scrape (fix) down electric machine and equipment to power
- Use a wooden or plastic plunger rather than hands or spoons to push machine and equipment product (material)
- Keep hands to the front of the revolving machine and equipment when operating.
- Never start a machine until all parts are in their proper places. If a machine that operates with gears, check the gear position
- aware of the lockout procedures that are to be followed before repairing or cleaning any machine
- Lock-out procedures must be clearly posted by management near each machine
- When using electrical power equipment, always follow the manufacturer's instructions and recommendations.
- Do not wear **rings**, a **wristwatch**, or a **tie** when operating electrical power equipment.
- Never talk while operating any machine

Self-Check 4	Written Test

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

Fill the blank space

1. Write down the correct procedure of fuel machine and equipment shutdown (7%)

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

2. Write down the Particular care must take when cleaning slicing machine (6%)

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

Note: **Satisfactory rating 7 and 13 points** **Unsatisfactory below 7 and 13 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 5: Completing and maintaining machinery and equipment operational records

5.1 Introduction

Operators should check all moving parts for excessive wear. On air planters, condition of cutoff brush important and should adjusted properly.

Finally, lubricate all moving parts and inspect all chains and other drive mechanisms for excessive wear or misalignment.

- Inspect all equipment for broken, bent or worn parts. Repair or replace as necessary.
- Apply touch-up paint to scratched or rusted areas.
- Apply a generous coating of wax to help equipment fight the effects of the elements.
- Store equipment in a shed or under a tarp or heavy plastic if possible.

5.2 Maintain maintenance records

Maintaining maintenance records procedures include:

- Time and date when **maintenance** required to done
- Type of **maintenance** required to done
- Asset details such as Number**,** Parts required working condition etc. Some of them
  - ✓ Prevent Expensive Repairs
  - ✓ Increases Safety
  - ✓ Replacing Equipment
  - ✓ Reduce Labor Workload
  - ✓ Manage Each Machine :

5.3 Equipment maintenance record

The equipment maintenance record is a simple document that contains a list of all actions that performed on a certain piece of equipment. It helps keep track of the maintenance history

Generally contains the following two different sections, each containing different types of information:

A. General information

The first section has to do with general information. This information used to identify the piece of equipment. It most commonly includes:

- Name of equipment
- Model or manufacturer
- Serial number
- Location
- Person responsible for equipment

Some equipment maintenance logs also include

- The Purchase date
- Purchase price in this section.

B. List of maintenance actions

The second section lists all the maintenance actions performed on the equipment. It commonly includes the following fields:

- Date when the action was performed
- Description of the action itself
- Name of the person performing the actions

Lastly, some record (logs) also include a remarks section. This section is useful in case the person performing the maintenance might have any special notes to add for future reference.

Table of maintenance action record

Equipment maintenance log content			
Name of equipment		Location	
Serial number		Manufacturer model	
Purchase date		Person responsible for equipment	
Date in service	Description of maintenance	Maintenance performed by	Additional note

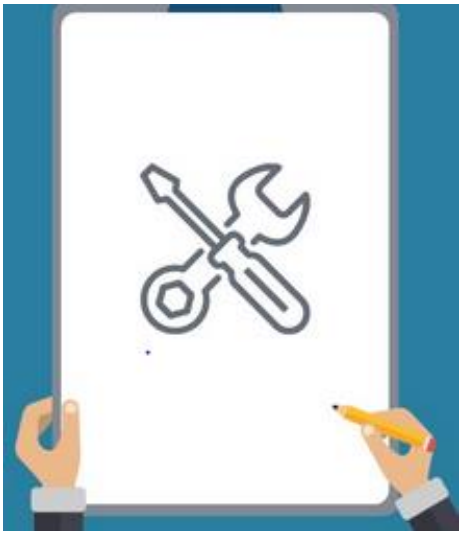


Figure 48: Equipment maintainance record

Advantages of proper maintenance records

- Minimize the number of expensive repairs
- Identify inventory trends
- Increase operator safety
- Pitively impact resale value
- Enhance the health visibility of each piece of equipment

The importance of equipment maintenance record

1. It increases resale value of equipment
2. It saves the upfront costs
3. It identifies trends across makes, models, or components
4. It increases the safety of operators

Figure 49: Safety tag

5.4 Maintaining self-propel (drive) equipment

- Check or drain, flush and refill the radiator with correct coolant.
- Drain engine oil and analyze it to determine the presence of contaminants.
- Check hydraulic system fluid. Replace if needed.
- Check the transmission fluid level. If needed, drain and refill. Install new filters.
- Check fuel tanks for condensation. Fill tanks with high-grade fuel.
- Disconnect battery ground cables if the machine is idle for several months.
- Check fire pressure frequently during the winter.

Self-Check 5	Written Test

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

Fill the blank space

1. Write down the procedures of maintaining maintenance records (5%)

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

2. Write the general contain of equipment maintenance record (3%)

_____,_____

3. List down the contain of general information for maintaining maintenance record of equipment (5%)

_____,_____

_____,_____

_____,_____

_____,_____

_____,_____

4. List down the contain of list of maintenance actions for maintaining maintenance record of equipment (3%)

_____,_____

_____,_____

Note: **Satisfactory rating 9 and 16 points** **Unsatisfactory below 9 and 16 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

Information Sheet 6: Detailing and reporting contingency situations of machinery and equipment

6.1 Contingency situations of machinery and equipment

Contingency situations of machinery and equipment mean noting, when the machine and equipment are became:

- Malfunctions
- Faults
- Irregular performance
- Damage

6.2 Detaille causes of equipment failure (malfunction)

Cause #1: Improper operation

The whole bunch of people who might be in and around equipment on a daily basis who could have a significant impact on its overall operating condition.

One solution to these problems is to ensure enough trained operators to allow for some flexibility and a contingency plan for staff shortage emergencies

Cause #2: Failure to perform preventive maintenance

Most equipment requires regular maintenance for optimal performance, but too often, preventive maintenance is the first task to go when short-staffed and overwhelmed

Tracking equipment and machinery with asset tags can help to keep maintenance schedules on track and equipment operating at maximum operational efficiency.

Cause #3: **Too much preventive maintenance**

Cause #4: **Fail to monitor equipment**

Cause #5: **Bad (or no!) reliability culture**

6.3 Machine and equipment Faults

Machine fault defined as any change in a machinery part or component, which makes unable to perform its function satisfactorily or defined as the termination of availability of an item to perform its intended function.

This cause of industrial machine failure includes things like bearing failure, metal fatigue, corrosion, misalignment, and general surface degradation.

6.4 Contingency plan address the following issues:

- Operation Risk assessment
- Contingency planning
- Software errors outside of normal working hours
- Contingency plan distribution list
- Persons who can authorize the emergency procedure
- Contact points in the event of hardware and software problems
- Potential exposure and containment measures
- Emergency back-up plan

6.5 Identifying and safety tagging machinery and equipment

Any piece of equipment (including tools and furniture) identified as unsafe, either in normal day-to-day activities or during a safety inspection, Equipment identified as faulty should be disconnected and tagged, and appropriate service

People contacted to arrange repair or replacement. With faulty equipment under no circumstances is any sort of repair to undertaken by the Workers. Only authorized technicians specifically trained to service the equipment must deal with the repairs.
Clear signage alerting other users to the danger must posted in clearly visible locations.

The following thing consider for identifying safety work of equipment;

A. Think, plan and check

- Lockout procedure must be employed whenever a piece of equipment is being repaired and
- There is the possibility of that equipment switched on without the knowledge of the repairer.
- Identify all parts of any equipment or system that needs to shut down.
- Find the switches, valves or other devices that need to switch off.
- Follow the correct procedure for the shutdown of equipment so you do not endanger anyone.

B. Communicate

- Tell all staff potentially affected by the tag out of that piece of equipment that this item is not to be used and why.
- Verify all equipment located
- Make sure all personnel informed of any potential danger.
- Verify that the main disconnect switch or circuit breaker cannot accidentally turned on.
- Turn all controls to OFF

6.7 Removal of the tag out tag and lockout device

- The tag out tag and lockout device (where applicable) removed only after all repair work has been completed and a service report received stating that the equipment is safe to be used again.
- Only an authorized person who directly notified of the repairs by the service person should remove the tag out tag and lockout device.

Notify all users of the equipment that the tag out tag removed.

- It is the responsibility of all staff to take immediate action upon identification of any piece of equipment in hazardous or faulty.
- Unsafe equipment should reported by the staff member to their supervisor.

6.8. Report writing on Unsafe or faulty machinery and equipment

In machine world, there are the following defects

- Failure: unintentional damage
- Workmanship: unskilled person
- Design: not fitting actual requirement
- Material: failure at handling
- Operation: mal-operation

The following can occur through the above; the failures should be identified what type of failure what part of the machine or equipment is failed should be reported.

The failures occur due to corrosion, fatigue, failure or wear

1. **Fatigue failure**: when fluctuating loads are applied a crack developed
2. **Corrosion**: corrosion is used to describe an unintentional chemical reaction between a material and its environment
3. **Wear**: is progressive loss of material from surface as a result of sliding or rolling contacts between surfaces or from the movement of fluids containing practices over surface.

Self-Check 6	Written Test

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

Fill the blank space

1. Write down the indicator of Contingency situations of machinery and equipment (3%)

_____,_____

_____,_____

2. Write the causes of equipment failure (malfunction) (4%)

_____,_____

_____,_____

_____,_____

3. Write the issues of contingency plan addressed (5%)

_____,_____

_____,_____

_____,_____

_____,_____

4. Write the machine defect report writing on unsafe or fault of machine and equipment ((5%)

_____,_____

_____,_____

_____,_____

_____,_____

Note: **Satisfactory rating 9 and 16 points** **Unsatisfactory below 9 and 16 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Name: _____ Date: _____

References

Abbott, J.C., 1986. *Marketing improvement in the developing world: what happens and what we have learned* (Vol. 58). Food & Agriculture Org..

Ajmone-Marsan, P. and Globaldiv Consortium, 2010. A global view of livestock biodiversity and conservation–GLOBALDIV. *Animal genetics*, *41*, pp.1-5.

Artz, G.M. and Naeve, L., 2016. The benefits and challenges of machinery sharing among small-scale fruit and vegetable growers. *Journal of Agriculture, Food Systems, and Community Development*, *6*(3), p.19.

Choi, T.M. and Lambert, J.H., 2017. Advances in risk analysis with big data.

Dairy Processing Plant and Equipment Considerations by Eric Goan

Handbook of Farm, Dairy and Food Machinery Paperback – 19 Oct 2010 by Myer Kutz (Author)

IDF. 1990 Handbook of Milk Collection in Warm Developing Countries. IDF Special Issue 9002

mondiale de la Santé, O., 2017. *Comment mettre au point un système pour la réparation et la maintenance des équipements de la chaîne du froid* (No. WHO/IVB/17.05). Organisation mondiale de la Santé.

NO, C.C., UMTRA project technical assistance contractor quality assuranceimplementation plan for surface and ground water.

Prokopenko, J. and North, K., 1996. Productivity and quality management: A modular programme-part i: High potential productivity and quality improvement areas. *Tokyo, Japan: Asian Productivity Organization*.

Prokopenko, J. and North, K., 1996. Productivity and quality management: A modular programme-part i: High potential productivity and quality improvement areas. *Tokyo, Japan: Asian Productivity Organization*.

Tractor-Implement Systems" by Ralph Alcock

Acknowledgement

We would like to express our appreciation to Holeta polytechnic college and experts of regional TVET bureau, who made the development of this learning module with required standards and quality possible.

We wish thanks and appreciation East Africa Skills for Transformation and Regional Integration (EASTRIP) the **World Bank** Project, who covers the financial expenses, scarifying their time and commitments to develop this learning module.

Instructor prepared the TTLM with their full address

No	Name of Instructor	Qual. Lev.	Educational background	Institution	Region	Phone Number	E-mail
	Hirpha Ketema	A	Animal production MSc	Holeta PTC	Oromia	0969432985	hirphaketema2@gmail.com
2	Abera Shiferaw	B	Animal production and health	Holeta PTC	Oromia	0911556155	aberashiferaw2014@gmail.com
3	Temesgen Roro	A	Animal Production	Holeta PTC	Oromia	0917657496	temesgenroro@gmail.com
4	Merga Negassa	A	Animal Production	Holeta PTC	Oromia	0912121944	mergish2005@gmail.com
5	Ayele Mengsha	A	Animal Nutrition	Holeta PTC	Oromia	0911802467	ayelemengesha@ymail.com
6	Wondiye Hateu	B	Animal Production	Holeta PTC	Oromia	0925255341	harme2013@gmail.com
7	Mamo Abdi	A	Environment and sustainable Development	Oromia TVET bureau	Oromia	0917812505	Mamoab57@gmail.com

Answer key

Module Title: Operating and Maintaining Livestock Production Machinery and Equipment

LO #1 Identify machinery and equipment

Self-check1

1. _____use of tools, apparatuses and machines for agricultural land development, production, harvesting and on farm processing (2%)

Agricultural mechanization

2. List down at least 10 cattle production machinery and equipment (5%)

- Milking machine and equipment,
- Milk processor machine(cream separator and churner)
- Calf Box
- Milk container and transport equipment(Villon)
- Baler
- Feed grinders and mixer
- Livestock feeding systems
- Manure Solid Liquid Separator
- Stationary engines, spraying equipment
- irrigation equipment
- Livestock feeding systems

3. List down **Poultry production machinery and equipment (4%)**

- Incubator
- De-beaker
- Waterer
- Feeder

S**elf-check2**

1. Write the different Alternative option of machinery and equipment for farmer (4%)

- The use of shared machinery arrangements,

- Contractors,
- Membership of machinery syndicates, and
- Leasing or hiring, participation in machinery rings

2. Write the Challenges occurred by shared machinery (3%)

- Overlap scheduling of equipment/machine use
- Added management costs were overcome with careful planning and frequent
- Need transparent communication among partners

Self-check3

1. List down the facility required for machine and equipment storage of (5%)

- Completely shade
- Away from house from human and animal
- Dry
- Clean
- Near to the field

2. Write the categorize of machine and equipment storage (2%)

C. Long period of time

D. short period of time

3. Lis down at least eight recommended principle of starting and removing machine. If the engine not used for more than 6 months. (4%)

11) Change engine oil and replace oil filter, used oil will not give adequate protection
12) Service air cleaner
13) Draining and flushing cooling system recommended and refill with the appropriate coolant.
14) Remove V-belts of fan/alternator
15) Remove and clean batteries, store them in a cool dry place and keep them fully charged
16) Disengage the clutch for any drive line
17) Clean the exterior of the engine with salt free water and paint any scratched or chipped painted surfaces
18) Coat all exposed metal surfaces with grease or corrosion inhibitor if not feasible to point.

19) Seal all openings on engine with plastic bags and tape

Self-chec4

Fill the blank space

1. List down the facility required for machine and equipment storage of (5%)

- Completely shade
- Away from house from human and animal
- Dry
- Clean
- Near to the field

2. Write the categorize of machine and equipment storage (2%)

- Long period of time
- short period of time

3. Lis down at least eight recommended principle of starting and removing machine. If the engine not used for more than 6 months.(4%)

- Change engine oil and replace oil filter, used oil will not give adequate protection
- Service air cleaner
- Draining and flushing cooling system recommended and refill with the appropriate coolant.
- Remove V-belts of fan/alternator
- Remove and clean batteries, store them in a cool dry place and keep them fully charged
- Disengage the clutch for any drive line
- Clean the exterior of the engine with salt free water and paint any scratched or chipped painted surfaces
- Coat all exposed metal surfaces with grease or corrosion inhibitor if not feasible to point.
- Seal all openings on engine with plastic bags and tape

Self-check5

1. Mention the tools used for mechanical maintenance, repair and operation (5%)

- Draw Works.
- Travelling Block.
- Coiled Tubing.
- Drilling Instrumentation.

- Drilling Generators.
- Wireline Equipment.
- Completion **Tools**.
- Oil **Tools**.

2. List down the enterprise policies and procedures (3%)

- Waste disposal
- Recycling
- Re-use guidelines)

3. Write down at least ten enterprise Maintenances requirements for **machinery and** equipment (5%)

- SOPs (Standard Operating Procedure)
- Industry standards
- Production schedules
- MSDSs (Material Safety Data Sheets)
- work notes
- Product labels
- Manufacturer specifications
- Operators manuals
- Enterprise policies and procedures including
- OHS procedures
- Supervisors oral or written instructions
- Work and routine maintenance plans.

Self-check6

1. List down at least eight pre-operational check of machine and equipment (4%)

- The machine suitable for the job
- All safety devices such as guards are in right place and working correctly
- The operator is properly trained to do this job and use this machine safely
- The instruction manual for the machine has been provided, read and understood
- Machinery controls or be caught on moving machine components
- The right personal protective equipment (PPE) is available and worn

- Jewelers (including watches and rings) that might snag have been removed

2. Write the mechanical defect checking of machine (4%)

- Brakes, wheels and Tyres.
- Guards and other protective devices correctly fitted and maintained in good condition
- They need to in place, securely attached, working and not damaged
- Any damaged or defective guards repaired or replaced before the machine is used.

3. Write the procedures of machine fuel checking (5%)

- Do not smoke while re fueling the machine/mower
- Refuel in a well-ventilated area before starting the engine - if the engine has been running, allow it to cool
- Remove the fuel filler cap and check the fuel level
- If the fuel level is low, refill the tank with the correct type of fuel for the motor. Refuel
- Carefully to avoid spilling fuel do not overfill
- After refueling, tighten the fuel filler cap securely as petrol is highly flammable and Explosive
- Never refuel the machine/ mower inside a building where petrol fumes may reach flames or sparks

Self-check7

1. Mention the main categories OHS hazards in work place (5%)

- Biological Hazards
- Chemical Hazards
- Physical Hazard
- Ergonomic Hazards: Key Symptoms and Dangers
- Electrical Hazards

2. Write the common Electrical Hazards (5%)

- Overhead Power Lines

- Damaged Equipment and Tools
- . Improper Wiring
- Exposed Electrical Parts
- . Wet Conditions

3. Write the methods of minimizing the OHS risk and hazard (7%)

- Using of relevant protective clothing and equipment,
- Use of tooling and equipment,
- Workplace environment and safety handling of material,
- First aid kit
- Hazard control and hazardous materials and substances.
- Using gowns, rubber boots of appropriate size, goggles, glove

Lo #2. Prepare and implement maintenance plan

Self-check1

1._____ of farm equipment and machine refers to all the activities needed to functional continuously to provide the necessary service (2%). = **Maintenance**

2. Write the causes of Machine and equipment maintenance (4%)

- Wear
- Corrosion
- Design problems
- equipment modifications
- Incorrect use
- Accidents
- Acts of nature

3. Write the Sources of Information for machinery and equipment maintenance (5%)

- Operational diaries
- Staff comment
- Personal testing
- Observation of structures
- Machinery and equipment manufacturers in-service updates

- operator's manuals
- property improvement groups
- Relevant government departments
- other enterprise operators
- service representatives

4. List down the method of maintenance required machine and equipment diagnosis (3%)
   - Checking functions/components
   - Half-split approach to fault diagnosis
   - Encoring and fixing devices

Self-check2

1. Write the protected parts in machine and equipment **maintenance plan (6%)**.
   - The clutch
   - Exhaust
   - Battery
   - brake pads
   - steering components
   - Engine
2. Write the types of maintenances (4%)
   - Preventive
   - Corrective
   - Risk-based
   - Condition-based maintenance.

Self-check3

1. Write the resource required for maintenances of machine and equipment (3%)
   7. Dairy machinery,
   8. Equipment and materials like
   9. Bench presses, multi meters and ohm meters
   10. Inspection pits, lifting and support equipment (jacks, overhead gantry, blocks),
   11. Power tools (grinders, drills)

12. Hand tools (spanners, hammers, screwdrivers).

2. Mention the power tools require for machine and equipment maintenance (4%)

- Air compressor.
- Alligator shear.
- Angle grinder.
- Band saw.
- Belt sander.
- Biscuit joiner.
- Ceramic tile cutter.
- Chainsaw.

3. Write the types of lifting equipment (4%)

- Overhead cranes and their supporting runways
- Patient hoists
- Motor vehicle lifts
- Vehicle tail lifts and cranes fitted to vehicles
- a building cleaning cradle and its suspension equipment
- Goods and passenger lifts
- Tele handlers and fork lifts
- Lifting accessories

4. Write the types of lifting accessories (3%)

- Fiber or rope slings
- chains (single or multiple leg)
- hooks
- eyebolts
- spreader beams

Self-check4

1. Write the five potential hazards during maintenances activities (3%)

6) Asbestos
7) Falls from height
8) Isolation and permits to work
9) Falls of heavy items

10) Selecting a contractor

2. **Write the Chemical hazards during maintenance**

- Dusts & fibers e.g. asbestos, silica, respiratory sensitizers.
- Dangerous substances e.g. chlorine, oxygen, hydrogen.
- Toxic, oxidizing, explosive, flammable, corrosive.
- Hydraulic fluids, oils, acids, alkalis, organic solvents.

3. Write the machine and equipment motions and actions hazards

- Entanglement
- Nip points
- Draw-in hazards
- Impact hazards
- Crushing hazards
- Cutting and puncturing hazards
- Burn and abrasion hazards
- Electrical hazards
- High-pressure hazards.

4. Write down Machine and Equipment Hazards during working around machinery

- Moving parts
- Energy
- Heat or cold.
- Noise.
- Vibration.

5. Write the Contingency plan steps

5. Step 1: List down the key risks. ...
6. Step 2: Prioritize the Risks Based on Their Impact. ...
7. Step 3: Create Contingency Plans for Each Event. ...
8. Step 4: Share and Maintain the Plan.

Self-check5

1. _____is the means by which mechanical assets in a facility kept in working order (2%) **= Machine maintenance**

2. Write the three types of machinery maintenance worker (3%)

- Machinery mechanics
- Maintenance technicians
- Millwrights

3. Write the six industries mostly utilize machine maintenance (3%)
   - Plastics product manufacturing
   - Automotive manufacturing
   - Refineries
   - Food production
   - Steel mills
   - Apparel production

4. List down the five maintenance tips to extend equipment life (3%)
   1. Stay on top of large machinery operator training. ...
   2. Add and test lubricants frequently. ...
   3. Check for signs of wear. ...
   4. Keep large machinery clean, and maintain a clean environment. ...
   5. Have a maintenance and repair schedule, and keep good records.

Self-check6

1. Write the maintenance-restructuring department in existing plant (4%)
   - General maintenance policy and organization
   - Training
   - Technical documentation
   - Spare parts

2. Write the required procedures to Organize machinery and equipment setting on site (5%)
   - Organizing tools
   - Organizing maintenance department
   - Equipment maintenance management
   - Implement maintenance program
   - Maintenance activities

3. Write the set up required in implementing preventive Maintenance program activities (4%)
   1. Get the right people onboard.
   2. Set goals for preventive maintenance plan

3. Inventory the equipment and assets
4. Make decisions. ...
5. Get to know the owner's manuals. ...
6. Schedule for long-term preventive maintenance. ...
7. Schedule for short-term preventive maintenance. ...
8. Train, train, train!

LO #3 Manage operation of machinery and equipment

Self-check1

1. Write the required safe operating procedures to operate machinery and equipment (4%)

- Warnings
- PPE signage
- Pre-operational safety checks
- Operational safety checks
- Stopping procedures
- Housekeeping
- Potential hazards.

2. Write the two types of agricultural tractor heat engine

- External combustion
- Internal combustion.

3. Write the major component of transmission

1. Clutch
2). Gear transmission
3). Differential
4). Final drive

4. List down agricultural tractor spare parts

- Heat engine
- Engine components and accessories

5. List down the parties of sprayer

- Tank
- Pump

- Agitator
- Air chamber:
- Pressure gauge
- Pipes
- Valves
- Nozzles:

6. _____ extract milk from the cow by vacuum. = **machine milking**

7. List down the parties' milking machine

- Vacuum pump
- Pulsate
- Teat cut
- . Claw
- Vacuum tubes

Self-check2

1. List down the types of PPE used for machine and equipment operation (3%)
   - Hearing protection
   - Head protection
   - Eye protection
   - Foot protection
   - Hand and arm protection
   - Body protection
   - Respiratory protection
2. Write the types of maintenance used for PPE
   - Cleaning
   - Examination
   - Replacement
   - Repair and testing
3. Write the storage facilities required for PPE
   - Contamination
   - Loss

- Damage
- Damp or sunlight.

Self-check3

1_____ is the assessment of the environmental consequences (positive and negative) of a plan, policy and program (2%)= **Environmental assessment (EA)**

2._____is usually applied to actual projects by individuals or companies for strategic environmental assessment (2= Environmental impact assessment (EIA)

3. Write the incorrect used and disposed of maintenance debris (waste)

- Oils containers
- Chemical residues

4. Write the hazards substances from machine and equipment disposal

- Fuel
- Fertilizer

5. Write the environmental impacts that need to consider on ecosystems

- Wildlife
- Marine and aquatic receptors
- Cultural
- Recreational and commercial activities depending on such ecosystems.

LO #4 Co-ordinate and report maintenance and operation activities

Self-check1

1. Write down the Maintenance Scheduling Principles (4%)

- Job plans are needed for scheduling
- Schedules and job priorities are important
- schedule based on the projected highest skills available
- Daily work is handled by the crew leader
- Measure performance with schedule compliance

2. Write down Maintenance Planning Principles include **(4%)**

- Protect the planner
- Focus on future work

- Component-level files
- Use planner judgment for time estimates
- Recognize the skill of the techs
- Measure performance with work sampling

3. _____ the timing of maintenance performed and who perform it (2%). **Maintenance scheduling**

4. Write the task related maintenance planning (4%)

- Handling reserve parts
- Ordering nonstock parts
- Staging parts
- Illustrating parts
- Managing breakdowns and vendor lists
- Quality assurance (QA) and quality control (QC)

Self-check2

1. Write down the Machine Operator Job Purpose (4%)

- Responsible for operating and maintaining complicated machinery
- Work in dedicated capacity specializing in a single machine or class of machines (e.g. Drills, printers, forklifts)
- Job duties and conditions vary depending on industry and job function
- Machine operators may work outside or indoors and work for a single company or on a contract basis

2. Write the Machine Operator top skills and proficiencies required (4%)

- Experience as a Machine Operator
- Knowledge of Production Procedures
- Ability to Read Blueprints, Schematics and Manuals
- Analytical Skills
- Attention to Detail
- Teamwork
- Physical Stamina and Strength
- Handle Heavy Equipment
- Work Independently

- Multitask

3. Write down the Machine Operator Skills and Qualifications required (5%)
    - Knowledge of safe machine practice standards
    - Physical agility
    - Technical ability
    - Spatial understanding
    - Good Coordination
    - Ability to read blueprints or production schematics is necessary
    - Ability to keep up machinery
    - Ability to do small to moderate repairs on machinery
    - Experience working with said machinery
    - Specialized training with said machinery
    - Certification in operating said machine normally required

Self-check3

1. Write down the Necessity of machine and equipment documentation (6%)
    - To ensure maintenance management
    - To repair work
    - To manufacture of spare parts
    - To rapid troubleshooting
    - To Work safety
    - For correctly selection and management of spare parts
    - Efficient staff training
2. Write the Content of technical documentation equipment documentation (3%)
    - Study and engineering
    - Construction and start-up
    - Exploitation.
3. Write the types of file opened for material documentation (4%)
    - General file
    - Machine files

- Utilities file
- Standard files

Self-Check 4

1. Write down the correct procedure of fuel machine and equipment shutdown **(7%)**
   - Maintaining a clear thoroughfare
   - Parking away from hazards
   - Securing
   - Lower all hydraulic lift equipment to the ground (for hydraulic machine and equipment)
   - Re-fuelling
   - Cleaning
   - Always allow engine to cool down at a fast idle before shutting off
   - Allows the valves and pistons to cool down uniformly
   - Safe dismount procedures (turning engine off)
   - Engaging handbrake and removing vehicle keys.
2. Write down the Particular care must take when cleaning slicing machine (6%)
   - **First, pull the plug.**
   - Turn the gauge to zero in order to cover the edge of the blade
   - Do not touch the edge of the circulated/ revolving body of machine
   - Clean the internal from the center out.
   - Clean the inside edge of the machine with a stick that has a cloth wrapped around one end.
   - Do not start machine until the locked in place and the attachments are securely fixed

Self-check5

1. Write down the procedures of maintaining maintenance records (5%)
   - Time and date when **maintenance** required to done
   - Type of **maintenance** required to done
   - Asset details such as Number
   - Parts required working condition etc. Some of them

- ✓ Prevent expensive Repairs
- ✓ Increases safety
- ✓ Replacing equipment
- ✓ Reduce labor workload
- ✓ Manage each machine :

2. Write the general contain of equipment maintenance record (3%)

- **General information**
- **List of maintenance actions**

3. List down the contain of general information for maintaining maintenance record of equipment (4%)

- Name of equipment
- Model or manufacturer
- Serial number
- Location
- Person responsible for equipment
- The Purchase date
- Purchase price in this section.

4. List down the contain of list of maintenance actions for maintaining maintenance record of equipment (3%)

- Date when the action was performed
- Description of the action itself
- Name of the person performing the actions

Self-check6

1. Write down the indicator of Contingency situations of machinery and equipment (3%)

- Malfunctions
- Faults
- Irregular performance
- Damage

2. Write the causes of equipment failure (malfunction) (4%)

- Improper operation
- Failure to perform preventive maintenance

- Too much preventive maintenance
- Fail to monitor equipment
- Bad (or no!) reliability culture

3. Write the issues of contingency plan addressed (4%)

- Operation Risk assessment
- Contingency planning
- Software errors outside of normal working hours
- Contingency plan distribution list
- Persons who can authorize the emergency procedure
- Contact points in the event of hardware and software problems
- Potential exposure and containment measures
- Emergency back-up plan

4. Write the machine defect report writing on unsafe or fault of machine and equipment ((3%)

- Failure: unintentional damage
- Workmanship: unskilled person
- Design: not fitting actual requirement
- Material: failure at handling
- Operation: mal-operation