Dairy product processing
Level-III

Based on May 2019, Version 2 OS and March 2021 v1

Module Title: - Identify and maintain Equipment Faults

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LG #13	LO #1- Identify scope of operational check.

Instruction sheet

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

- identifying and classifying Equipment components and operating systems
- matching appropriate tests and procedures to the equipment operating systems.
- identifying Special test procedures and parameters.
- explaining the operating principles of hydraulic, pneumatic, mechanical and electrical/electronic systems
- implementing Measures to control identfied hazard .
- observing and undertaking Checks on the physical condition of the equipment.
- reordering Preliminary observations.
- discussing test procedures with appropriate personnel

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 and classify Equipment components and operating systems
- match appropriate tests and procedures to the equipment operating systems.
- identify Special test procedures and parameters.
- explain the operating principles of hydraulic, pneumatic, mechanical and electrical/electronic systems
- implement Measures to control identified

- observe and undertake Checks on the physical condition of the equipment.
- re-order Preliminary observations.
- discuss test procedures with appropriate personnel.

Learning Instructions:

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

Information Sheet 1- identifying and classifying Equipment components and operating systems

1.1.Introduction

The following information may assist dairy processors in evaluating the array of equipment they use in their establishments. It provides general guidelines applicable to all dairy equipment as well as additional guidelines for specific types of equipment. Dairy processors can use this in conjunction with their maintenance , sanitation control measures and their operating system to evaluate equipment and components which may affect the safety of dairy products.

in addition information sheet will provide a description of the equipment used for the main processes involved in the manufacture of many dairy products: separation of cream from milk, pasteurization, and homogenization.

Milk as produced on-farm is transformed into a vast array of dairy products: fluid milks and creams, evaporated and dried products, yogurt and fermented milk products, butter, ice cream, and cheese.

The machinery (equipment) involved in all of these transformations is as varied as the products themselves.

It will also briefly describe the type of equipment used in the manufacture of specific milk products: membrane separation, evaporation, dehydration, ice cream freezers, butter churns, and cheese vats.

you are always concerned about the quality of processed food but it cannot be guaranteed until quality of processing equipment is ensured. The manufacturers and users of modern dairy and food processing equipment demand the use of stainless steel (SS) as the predominant material of construction. Stainless Steel has become the standard material of construction because of its ability to maintain a high level of performance, while keeping corrosion to a minimum .

1.2 Dairy processing equipment

- ❖ Butter equipment
    - churner
    - reworker (butter or cheese operation)
    - fore warmer
- ❖ Cheese equipment
    - cheese vat
    - curd knives
    - drain table
    - curd mill
    - wash water tank and filter
    - moisture probes
    - chill tank moulding equipment ,waxing tank and vaccum chamber
- ❖ Dry products equipment
    - sugar tank
    - whey crystallized tank
    - high pressur tank
    - Drying chamber
    - collectors
- ❖ Evaporated products equipment
    - Hot well
    - Evaporator
- ❖ Fluid milk products equipment
    - case washing room
    - case conditioning and handling
- ❖ Frozen products equipment

- liquid sugar tank
- flavour tank
- freezer
- mixing vat and fruit feeders

❖ Process cheese equipment

- **Gr**inder/graters
- weigh tank
- Extruder
- vacuum treatment equipment

❖ Raw receiving equipment

- milk metering sytem
- mechanical sampler
- cans
- can washer and steamer

❖ Universal equipment

- indicating thermo meter
- recording thermo meter
- storage tank
- pumps ,pipelines and valves
- saparator
- Homoginizer

❖ packaging and sealing equipment

- filler
- blende/texturizer
- conveying equipment
- packaging tables
- scales

1.3 Specific criteria for evaluating operating sytem of dairy processing equipment.

Butter equipment

Churns

Conventional churns:

- Examine the door gasket, buttermilk valve, vent, cream inlet fitting
- Look for deep pitting or corrosion on interior of churn, cracks

Continuous churns:

- Examine the cream inlet and fittings, hollow interior of beater, screens used for buttermilk removal, buttermilk outlet, couplings of working augers, dosing ports for injection of salt slurry
- Look for dead ends, open seams, exposed threads or bolted joints on beaters, product accumulation in-between working and header plates, butter residue in chamber

Large continuous churns have product contact components of such size, weight and complexity that complete disassembly is a major undertaking. Therefore, cleaning reliance is placed on CIP procedures which are recommended by the churn manufacturer.

- Verify the cleanliness of the equipment by checking areas that may be difficult to clean and that may cause contamination

- ***Buttermilk equipment***

Buttermilk, the by-product of butter churning, may be sold for animal feed or receive further processing and be used for human consumption (for example, buttermilk powder, blending with fluid milk for use in other products).

- Examine the holding tanks, drain pan, pipelines, loading area
- Verify the following criteria based on end use of the buttermilk:

    - ✓ Human food - sanitary design, either cooled to 4°C or lower or promptly processed (less than 2 hours post churning)
    - ✓ Animal feed - equipment does not contribute to unhygienic conditions (odours, cross-contamination, insects)

- ***Reworker (butter or cheese operations)***

A reworker is used to prepare blocks of tempered butter for moulding and packaging in a print operation. Essentially it is an auger conveyor that makes the butter malleable as it travels to the print machine. It is important that the rework operation be carried out at the proper temperature to ensure good textural properties. Poor reworking that disrupts the butter emulsion will result in free water. These water droplets facilitate the activity of microorganisms and consequently the deterioration of butter.

Another example where reworkers are used would be during the processing of pasta filata type cheeses such as mozzarella cheese

- ✓ Examine the indicating thermometer probes, product contact surfaces and frameworkForewarmer

When making butter from cream that needs neutralizing, the term "forewarmer" is used to designate a coil type vat for warming the cream for neutralization. The cream is then pumped out to the High Temperature Short Time (HTST) system or vats for batch

pasteurization. When cream is neutralized and pasteurized in the same vat, evaluate the fore warmer using the criteria in Batch pasteurization.Examine sanitary seals, vat liner, coils, valves and fittings, centreboard and covers

- **Cheese equipment**

Cheese vats

- ✓ Examine the interior and exterior of vats, outlet valve (sanitary type), spray balls and curd knives

Curd knives

Cutting the cheese into uniform size cubes is important for proper cooking, salting and composition control. The knives used in open vats may be mechanically or manually operated. These knives are subject to a substantial amount of repair work due to their construction; the wires can be quite fragile.

- ✓ Examine the condition of wires, smooth welds (silver solder), quality of the repairs, storage conditions when not in use

- ***Drain tables***

Typically the drain table is a long rectangle with a central drain trough, covered by perforated or slotted drain plates. Some drain tables have gasketed, liquid tight end doors. In use, the curd/whey mixture is run from the curd vat into the tank.

- ✓ Examine the gaskets, perforated drain plates and framework

- ***Curd screens and sifters***

Curd screens and curd sifters are used to remove curd particles from the whey. Due to the small holes in the screens, they are usually difficult to clean and should be carefully examined.

- Examine screens, gaskets, outlets and cloths for straining

- ***Agitator carriages***

  - Examine:

    - ✓ Curd forkers (and nylon tips)
    - ✓ Conditions of carriages (enclosed type, free of dust, debris, flaking material)
    - ✓ Maintenance and operation of the agitator assembly (during operation examine for oil leaks, flaking material, motor and belt covers in place)

- **Curd mill**

Most curd mills for cheddar cheese are rotary type, but Mozzarella cheese requires a dicer type unit that uses a plunger to force the curd through sturdy knives.

- ✓ Examine the hopper, chamber, plunger and knives
- ✓ Look for no metal to metal rubbing, product accumulations, flaking material on external surfaces, dirt or grease from motor and drive mechanism

- ***Wash water tank and filter***

Following the cooking process, the cheese curd is washed.

- ✓ Examine the filters, potable water used, tank and pipelines (free of rust and other foreign material), culinary steam used if water heated by steam

- ***Hoop filler***

The hoop filler is used to direct cheese curd into cheese hoops.

- ✓ Examine the cleanliness and condition

- ***Cheese hoops and moulds***

- ✓ Examine the cleanliness and condition

- ***Hoop and rack washer***

Cleaning hoops and racks can be accomplished in a variety of ways, ranging from soaking them in cleaning solutions to automatic washing equipment. This activity produces high moisture conditions which are optimal for microbial growth.

- ✓ Ensure cleaning tasks are carried out in a sanitary manner
- ✓ Conduct cleaning tasks in an area away from manufacturing areas where the product is exposed to the atmosphere

If high pressure washing systems are used, aerosols are likely to form and pose microbiological risks. It is recommended that these systems be located outside of processing areas. If it is not possible to locate these pressure washer systems outside of processing areas, they can still be used to wash hoops and racks provided precautions are taken to ensure control of aerosols and other airborne contaminants.

- Examine the location of washing areas (precautions taken if not isolated from processing room), adequate exhausting of vapour, maintenance of cleaning equipment and handling of clean hoops
- For automatic washers, examine the length of cycle, water velocity, wash solution strength and temperature.

- ***Presses***

The press compresses the cheese after it has been placed in the hoops. This aids the expulsion of whey and the development of a compacted cheese. Because the pressing step may be done under a vacuum it also assists in cooling the curd.

- ✓ Examine the drain trough and rails, press head (no oil leaks), outlet of press drippings and framework

- ***Press cloths***

Press cloths are used in the pressing operation to aid in the development of a smooth rind. Traditional materials have been replaced with textured synthetic cloths; as well, finely perforated stainless steel moulds have eliminated the need for cloths.

- ✓ Examine the handling procedures for reusable cloths (washed after each use), storage conditions of both wet and dry cloths

- ✓ Use proper containers and solutions for the wet storage of reusable cloths and away from airborne contamination and dust during dry storage

- ***Moisture probes***

Moisture probes are used when making cheese in large styles, such as barrels, 640 pound blocks, etc. It uses vacuum probe equipment to withdraw whey from the cheese.

- ✓ Examine the components of the probe system, attachments (metal clamps) of flexible hoses to stainless steel stub ends, whey discharge lines and vessels

- ***Chill tank***

Moulded cheese is to be cooled before it is placed in the brine tank. Since chilling is a post pasteurization step, it is important that the water used be potable and the tank be in good condition.

- ✓ Examine the cooling water (potable, microbiologically tested, changed or treated as required), condition of tank

- **Moulding equipment**

The Pasta Filata category of cheeses includes such varieties as Mozzarella and Provolone. The curd produced in the manufacture of these cheeses is allowed to develop into a curd mass. This curd mass (plastic curds) is then kneaded and formed mechanically into moulds or shaped by hand. Although the curds can be manipulated by hand, the kneading process is generally done by machine.

- ✓ Examine the cleanliness and condition of product contact surfaces and external framework

- **Vacuum chamber**

The pressing time of cheese blocks can be reduced by using vacuum to remove air from the curd and give a more compact cheese. It is important that this process does not contaminate the cheese. In particular, the contamination of the outer surface of the cheese with anything that is liable to modify the development of the surface flora (inhibitors or activators) should be prevented.

- ✓ Examine the cleanliness and condition of interior surfaces of the vacuum chamber, racks, wooden pallets,
- ✓

Self-check 1	Written test

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

Test I Short Answer Questions

1. write down universal equipment ?(5pts)
2. write down packaging and sealing equiment ? (5pts)
3. write down cheese equpment ? (5pts)

4, list down butter equipment ? (5pts)

Note: **Satisfactory rating - 20 points** **Unsatisfactory - below 20 points**

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

Score = _____

Rating: _____

Information Sheet 2- matching appropriate tests and procedures to the equipment operating systems.

2.1 Introduction

The Appropriate testing can be done by trained establishment personnel or a reliable third party.

A summary of the results of the testing can be recorded on the test procedures form

The tests described in this information are designed to ensure that the components are functioning properly.

Designate a person (ideally someone other than the operator of the equipmment) to review the results on a timely basis to ensure accuracy of testing and that corrective action was taken both on the equipment and on the product, if necessary.

Develop a written program for the routine, planned testing of the critical process equipment and controls, including procedures that outline what tests are being performed, frequency, who is responsible, verification procedures, corrective action and records kept.

In addition, perform these equipment tests any time there are alterations or new installations to the critical processes in order to evaluate the effectiveness of the changes and the impact on the system.

For example: A pasteurization system is made up of a pasteurizer and an intricate grouping of components all working together to ensure that every particle of product has been properly pasteurized. adding a control mechanism in the cooling section; installing a proximity switch.

2.2 Testing procedures of equipment operating system

test procedures is a formal specification of test cases to be applied to one or more target program modules

Test 1: Milk-flow controls - milk temperatures at cut-in and cut-out

A: Installation and inspection test

Application:

- All safety thermal limit recorders used in connection with HTST pasteurizers.

Frequency:

- Upon installation and once every 6 months there after.
- Whenever the seal on the sensing element of the recorder-controller is broken and the reason for the breaking of the seal may have an effect on the sensing element.

Criteria:

- No forward flow until pasteurization temperature has been reached.
- Flow is diverted before temperature drops below minimum pasteurization temperature.
- Cut-in temperature is higher than cut-out temperature.

Apparatus:

- Water, oil or other suitable media bath and agitator.
- Indicating or certified test thermometer meeting the specifications of Water bottle.

Method:

- Observe the actual temperature of the indicating thermometer at the instant forward flow starts (cut-in) and stops (cut-out).

Procedure 1: Cut-in temperature

1. While the media in the bath is completely flooding the sensing element of the safety thermal limit recorder and the indicating or certified thermometer, increase the heat in the bath gradually at a rate not exceeding 0.5ºC (1ºF) every 30 seconds. Rapidly agitate the media bath throughout the test.
2. Observe the indicating or certified thermometer reading at the instant the flow diversion device (FDD) starts to move.
3. Observe that the frequency pen reading is synchronized with the recording pen on the same reference arc.
4. Record the indicating or certified thermometer reading.

Procedure 2: Cut-out temperature

1. After the cut-in temperature has been determined and while the media is above the cut-in temperature, allow the media to cool slowly at a rate not exceeding 0.5ºC (1ºF) per 30 seconds. Cool media in a bottle may be used if necessary.
2. Observe indicating or certified thermometer reading at the instant forward flow stops.
3. Record the indicating or certified thermometer reading.

Test procedures form

Critical process equipment and controls tests and calibrations

Name and address of the dairy facility:

Licence #: Provincial #: HTST unit #: Date:

Dairy specialist/technician name and address:

Example of completed form for homogenizer:

Equipment or control	Criteria	Test #	Results	Date	Signature
Inter-wiring	• homogenizer of lesser capacity than FCD, installed downstream from FCD: inter-wired with FCD and equipped with a time delay relay of 1 second	13			

Example of completed form for separator:

Equipment or control	Criteria	Test #	Results	Date	Signature
Properly valved-out	• fail safe valve out to by-pass separator whenever FCD is de-energized	13			

fig 1.1 Test procedures form .

Self-Check – 2	Written test

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

Test I: Short Answer Questions

1. define test procedures?(3 pts)
2. whar are apparatus used for testing oprating system of milk flow controler?(5 pts)
3. what is appropriate test (2 pts)?

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

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

Score = _____

Rating: _____

Information Sheet 3- identifying Special test procedures and parameters.

3.1 Introduction

TESTING AND EVALUATION

The term "testing" is usually used in connection with an analysis of the behaviour of a machine compared with well defined standards under ideal and conditions

In contrast "evaluation" involves measurement of machine perfonnance under real farm conditions. The purpose of obtaining information by is to compare a device or machine with the requirement which it was developed to fulfil well defined standards under ideal conditions.

3.2 Types of special test

Maintenance Testing:- Activities that involve using test equipment to assess condition in an offline state. These activities are predictable and can be scheduled and budgeted. They may be scheduled on a time or meter basis but may be planned to coincide with scheduled equipment outages. Since these activities are predictable, some offices consider them “routine maintenance” or “preventive maintenance.” Some examples are governor alignments and balanced and unbalanced gate testing.

Diagnostic Testing :- Activities that involve using test equipment to assess the condition of equipment after unusual events, such as equipment failure/ repair/replacement or when equipment deterioration is suspected. These activities are not predictable and cannot be scheduled because they are required after a forced outage. . Some examples are governor troubleshooting, unit balancing, and vibration testing

3.3 Catagories of the test

The types of test procedure selected as appropriate will be influenced by .

- the stage of the development of the equipment to be tetsed
- the potential benefiaciary of the test report

- **the stage of the development of the equipment to be tetse**

Whether the test is required at the design, prototype development or manufacturing stage will affect types the type of proedures that should applied .

The procedure involves the identification and quantification of the need for the innovation in technical ,social and economic terms. any negative effects (e.g. on the labour demand or need for new inputs or processes) must be included in the analysis .

Testing and evaluation at the are aimed at the manufcturing stage are aimed at measuring the quality of the product.

The Potential Beneficiaries

An appropriate test procedure can only be selected if the use of lhe information to be produced is well defined. There is a range of possibilities:-

Test reports can help potential users of a machine to compare the performance of alternatives and select the model most suited to their needs. points out, in most countries where this type of information is available, it very little interest. The most important factor for a potential user is the reputation of the manufacturer or distributor. The Potential Beneficiaries

testing parameters during aging are driven by the heart of the system. This ensures the correct measurements of the currents and the voltages for drain and gate, the input and

output powers, the reflected power, and the room temperature, the soleplate and dissipation radiators' temperature.

To characterize the aging of the device, param eters are measured.

Table 2.1. Physical parameters recorded by the workbench

Signal generation		Parameter measured		Min	Max
Electrical supply	Drain supply	V_{ds}	High level	0 V	60 V
			Low level		
		I_{ds}	High level	80 mA	4 A
			Low level		
	Gate supply	V_{gs}	High level	–15 V	+ 15 V
			Low level		
		I_{gs}	High level	– 200 mA	+ 200 mA
			Low level		
Temperature	Recorded temperature	Soleplate	Temperature	25°C	85°C
		Dissipated temperature	Temperature		
		External temperature	Temperature		
		Peltier power	Average	0 W	100 W
RF parameters	Power supply	Input power	Peak power	0 W	50 W
		Output power	Peak power	0 W	1 kW
		Reflected power	Average power	0 W	50 W

eters are measured.

fig 3.1 phycal parameter recorded by workbench

Self-Check – 3	Written test

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

Test I: Short Answer Questions

1. Define testing ?(3pts)
2. Define evaluation (3pts)
3. what are catagories of test procedures (4pts)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

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

Score = _____

Rating: _____

Information Sheet 4- explaining the operating principles of hydraulic, pneumatic, mechanical and electrical/electronic systems.

4.1 Introduction

Operating system · multiprocessing operating systems allow many processes to be active, where each process is a “thread” of computation being used to execute .

4.2 Hydraulics and Pneumatics: Operational Characteristics.

Operation of Hydraulics system While control valve is in neutral position, the pump flow passes through the valve and back to the reservoir.

When the valve is shifted, oil is directed to the piston side of the cylinder and causes the piston to move while extending the rod. If the valve is returned to neutral, the oil is trapped in the cylinder, holding it in a fixed position, while pump flow is returned to the reservoir. Shifting the valve in the opposite direction permits the oil to pass through the valve back to the reservoir. The relief valve limits the system pressure to a certain amount. Relief valves are commonly incorporated into the directional control valve.

A hydraulic system with a double acting cylinder and a 4-way valve is different from the single acting cylinder system where the cylinder can exert force in both directions. When the control valve is in neutral, flow is returned to the reservoir. When shifted in one direction, oil is directed to the piston side of the cylinder, causing the cylinder to extend. Oil from the rod side passes through the valve back in order to flow to reservoir. If the valve is shifted to neutral, oil in the cylinder is trapped, holding it in a fixed position. When the valve is shifted in the opposite position, oil is directed to the rod side of the cylinder, causing the cylinder to retract. Oil from the piston side passes through the valve back to the reservoir.

4.3 The basic components of a fluid power system are:

i. Reservoir

ii. Pumps

iii. Strainers and filters

iv. Directional Control Valves

v. Relief Valve

vi. Connectors & Fittings

vii. Cylinder

- **Reservoir**

A properly constructed reservoir is a tank to hold oil until the system demands fluid. It is also capable to dissipate heat from the fluid, separate air from the oil and settle out contamination in the oil.

The reservoir generally has fluid three times more than the pump output per minute.

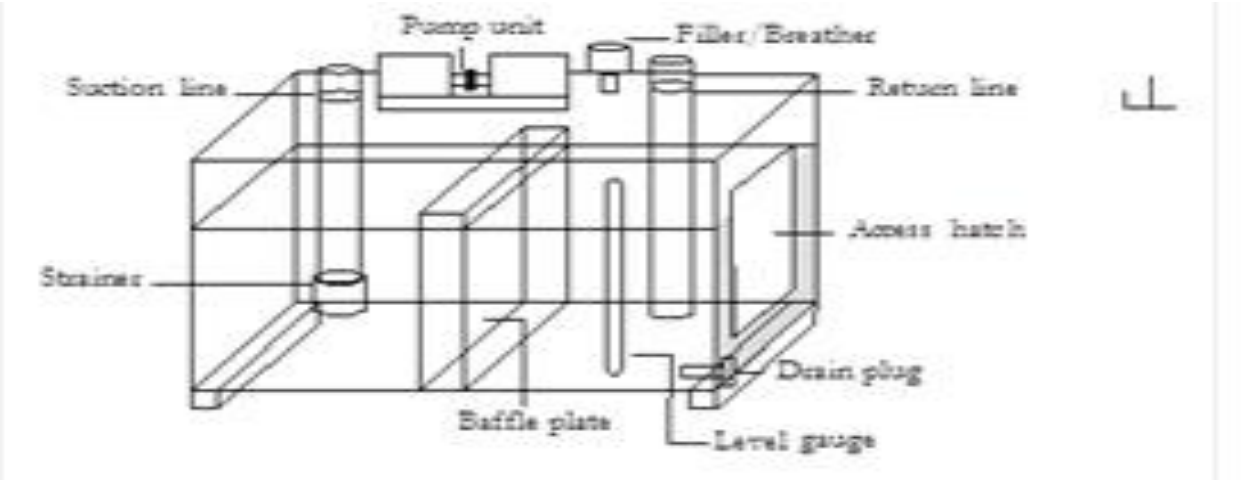

fig 4.3.1 hydraulic resevoir

- **Pumps**

The purpose of a hydraulic pump is supplying a flow of fluid to a hydraulic system. As the pump provides flow, it transmits a force to the fluid. As the fluid flow encounters resistance, this force is changed into pressure. The hydraulic pump is used to force the fluid from the reservoir to rest of the hydraulic circuit by converting

mechanical energy into hydraulic energy. The most common two types of pumps are centrifugal pumps and reciprocating pumps.

Main parts of a centrifugal pump.

1) Delivery line, 2) Shaft seal, 3) Suction line, 4) Impeller, 5)Pump casing, 6)Back plate, 7) Motor shaft ,8) Motor, 9) Stainless steel shroud and sound insulation

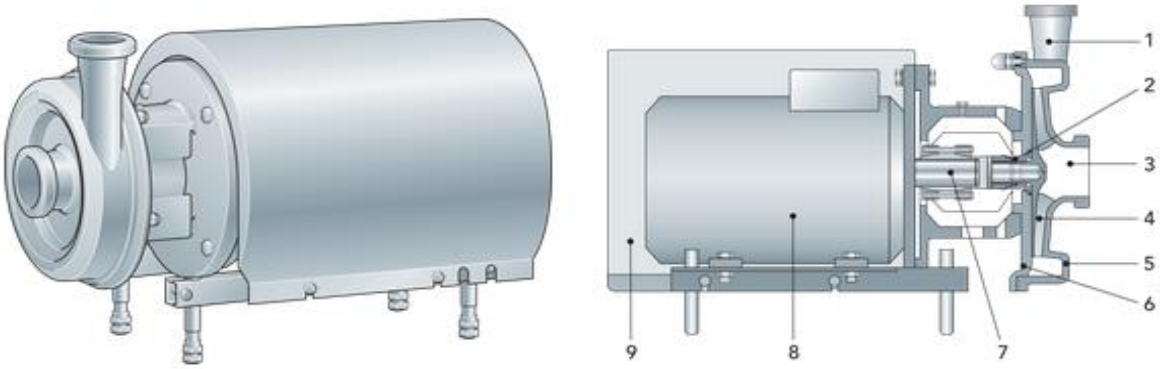

fig 4.3.4 a) centrifugal pumps

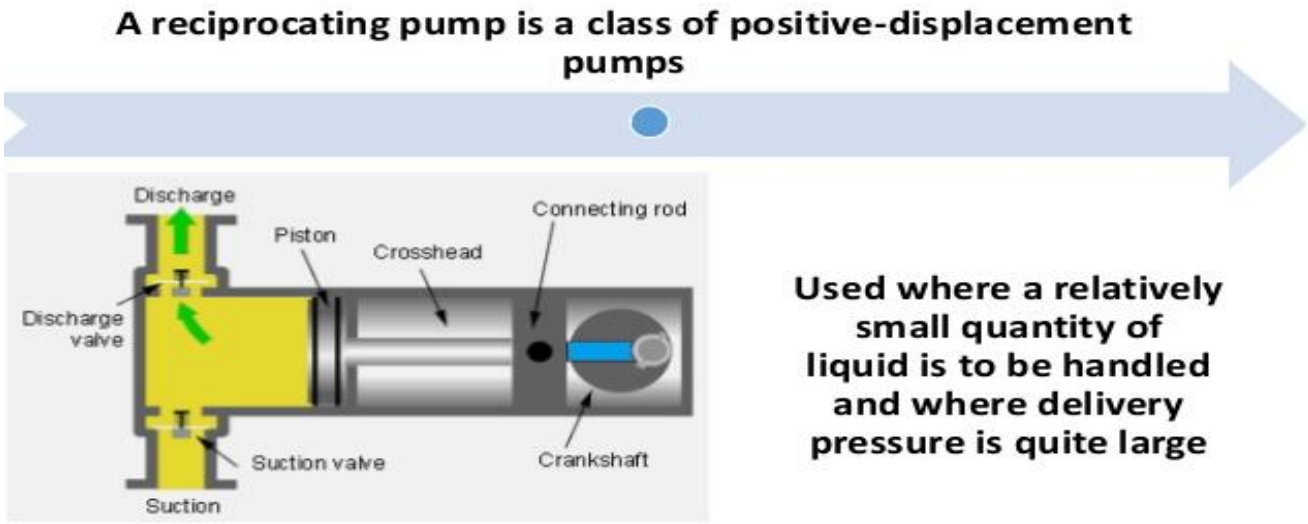

fig 4.3.4 b) reciprocating pump

- **Strainers and filters Strainers**

are constructed of fine mesh wire screens or of screening elements consisting of specially processed wire of varying thickness wrapped around metal frames. They do not provide as fine a screening action as filters, but they offer less resistance to flow and are used in pump suction lines where pressure drop must be kept to a minimum. On the other hand, the most common device installed in hydraulic systems to prevent foreign particles and contaminations from remaining.

fig 4.3.4 **Strainers and filters**

- **Directional Control Valves**

Directional control valves are designed to direct the flow of fluid to a point in a hydraulic system. Also, they may be operated by differences in pressure acting on opposite sides of the valving element, or may be positioned manually, mechanically, or electrically. Often two or more methods of operating the same valve will be used in different phases of its action.

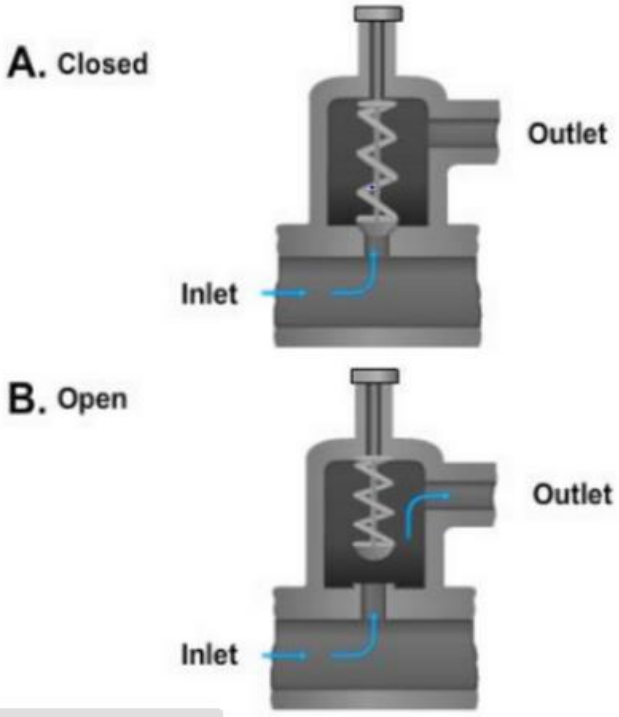

fig 4.3.3 directional control valve

- **Relief Valve**

The safe and efficient operation of hydraulic circuits, systems components, and related equipment require a type of controlling pressure. There are many types of automatic pressure control valves. Some of them only provide an escape for pressure that exceeds the set pressure, some only reduce the pressure to a lower pressure system or subsystem, and some keep the pressure in a system within a required.

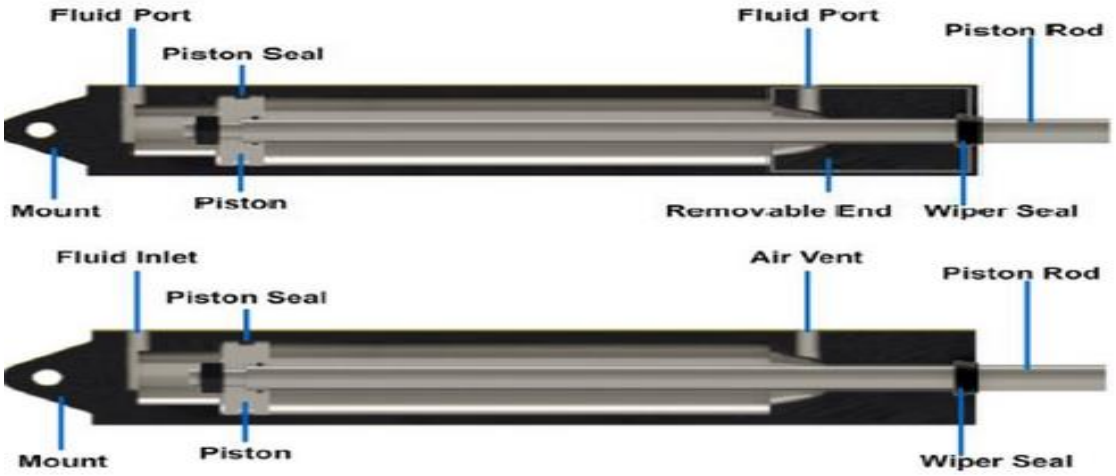

fig 4.4.4 relif valve

- **Connectors & Fittings**

There are many types of connectors and fittings required for a fluid power system. Fittings are used to connect the units of a hydraulic system, including the individual sections of a circulatory system. The type of connector or fitting depends upon the type of circulatory system (pipe, tubing, or flexible hose), the fluid medium, and the maximum operating pressure of the system. Some of the most common types of connectors are threaded connectors, flared connectors, flexible hose couplings, and reusable fittings. Threaded connectors are used in low pressure pipe systems.

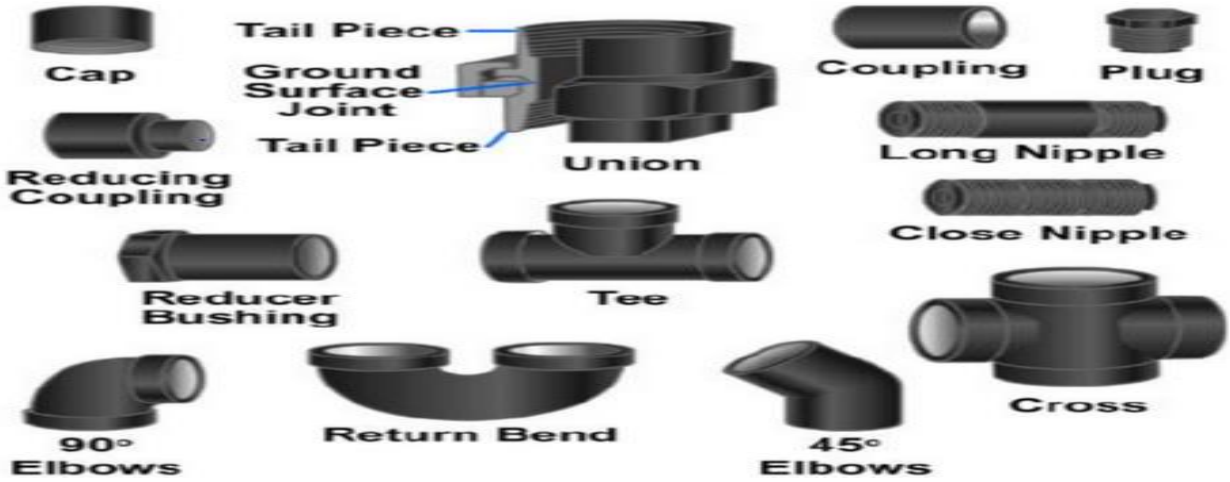

fig 4.3.5 coonnectors and fitting

4.4 Pneumatic systems are generally used in industrial machines that are powered by compressed air or compressed inert gases. Pneumatic systems are used to convert gases pressure to mechanical power. Practically, the machines work with vacuum and positive gases pressure are categorized in pneumatic systems. The required air is provided to the system by pressurized compressor which stores the air in strengthened steel tank.

The pneumatic systems are based on the system that uses compressed air to transmit and control energy. Most pneumatic systems rely on a constant supply of compressed air to utilize. This pressure is provided by an air compressor. The compressor takes air from the atmosphere and stores it in a high pressure tank called a receiver.

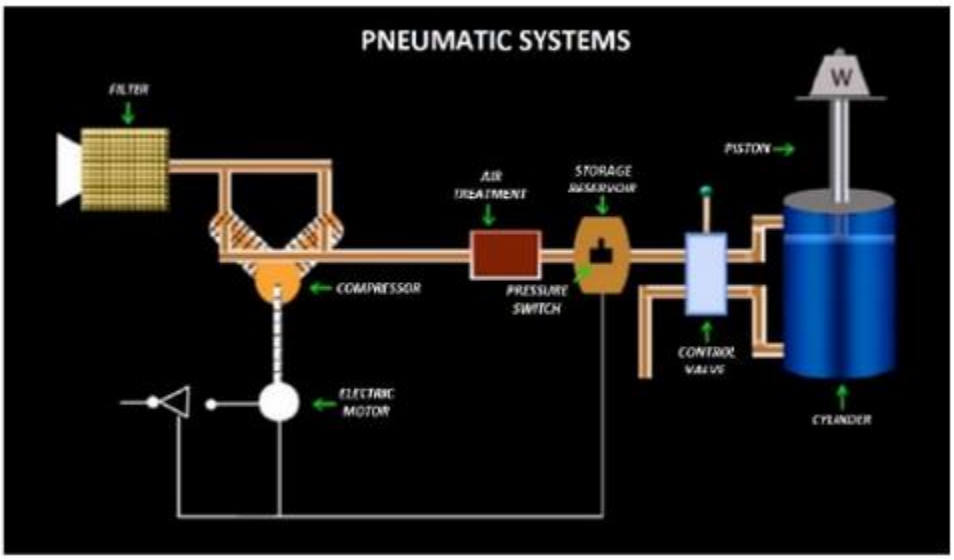

fig 4.4 Pneumatic systems

This compressed air is then supplied to the system through a series of pipes and valves. The main components of a pneumatic system are:

i. Control Valve

ii. Cylinder

iii. Compressor

iv. Sensor

v. Filter

vi. Reservoir (Receiver)

Control Valve :- Valves provide direction control of air, arrange the flow rate and pressure air.

The main function of the control valve is maintaining constant downstream pressure in the air line. Due to the high velocity of the compressed air flow, there is flow-dependent pressure drop between the reservoir and load.

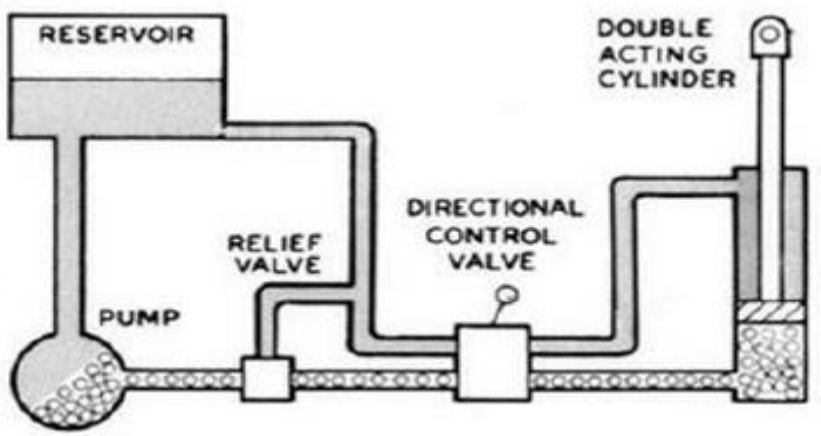

fig 4.4.1 control valve

Cylinder

Single acting cylinder has only one entrance that allows compressed air to flow through. Therefore, it can only produce thrust in one direction.

in double acting cylinder, air pressure is applied alternately to the relative surface of the piston, producing a pushing force and a retracting force.

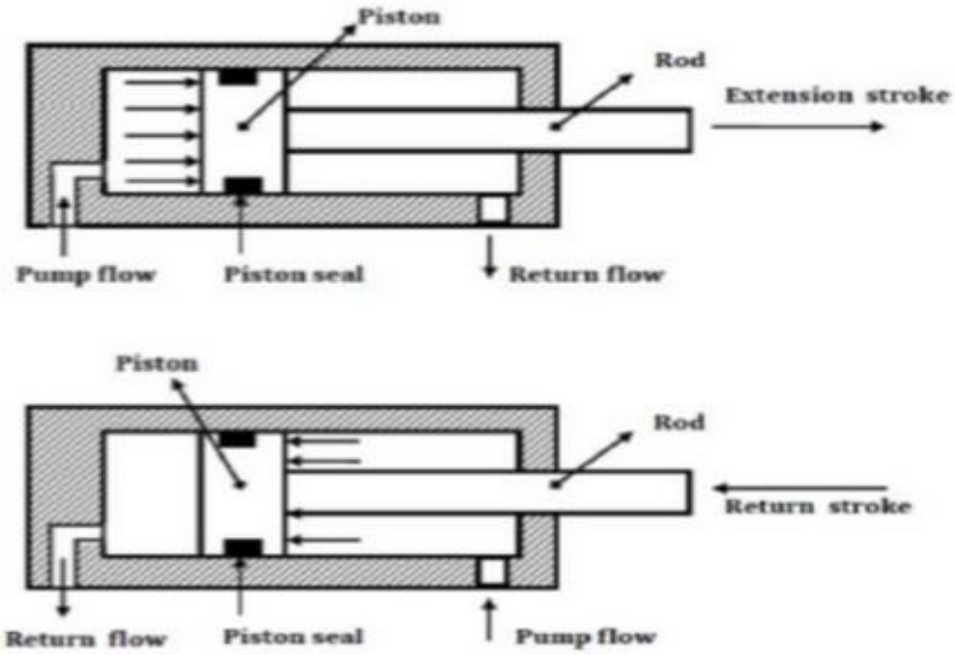

fig 4.4.2 cylinder

Compressor Air

compressor converts the mechanical energy of an electric or combustion motor into the potential energy of compressed air. The compressor increases the pressure of fresh air drawn from the atmosphere. External power supply called motor is used to drive the compressor.

Fig 4.4.3 .compressor air

- **Filter**

A pneumatic filter is a device which removes contaminants from a compressed air stream. While blocking contaminant particles the membrane of filter allows air to pass through to a venturi. A pneumatic filter should be placed as the first component at the inlet of air circuits.

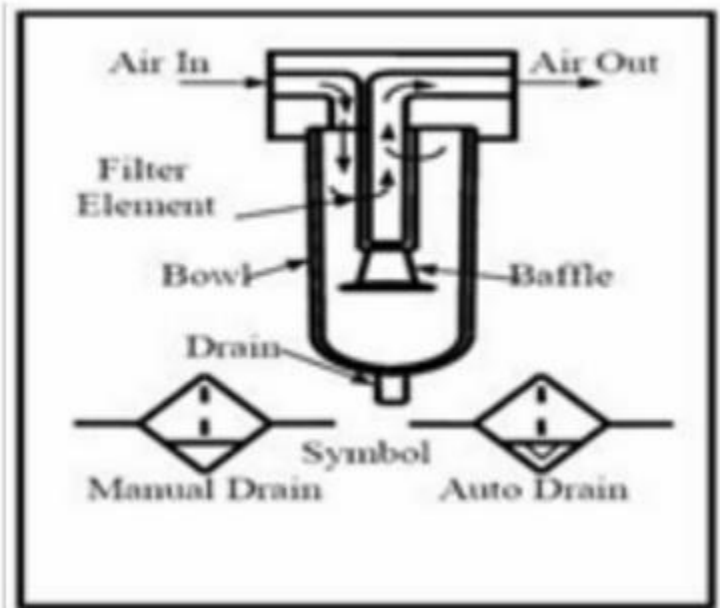

fig 4.4.4 filter

Self-Check – 4	Written test

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

Test I: Short Answer Questions

1. Define operating system ?(2pts)
2. define pneaumatic system (3pts)
3. define operation of hydaulic system (5pts)?
4. list down components of hydraulic system (5pts)??
5. list down main components of pneamatic system (5pts) ?

Note: **Satisfactory rating - 20 points** **Unsatisfactory - below 20 points**

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

Score = _____

Rating: _____

Information Sheet 5- implementing Measures to control identfied hazard

5.1 introduction

Hazards are biological, chemical, or physical agents likely to cause illness or injury if they are not controlled.

5.2 Types of workplace hazards include:

Safety hazards such as those caused by inadequate machine guards, unsafe workplace conditions, unsafe work practices.

Biological hazards caused by organisms such as viruses, bacteria, fungi and parasites.

Chemical hazards caused by a solid, liquid, vapour, gas, dust, fume or mist.

Ergonomic hazards caused by physiological and psychological demands on the worker, such as repetitive and forceful movements, awkward postures arising from improper work methods, and improperly designed workstations, tools, and equipment.

Physical hazards caused by noise, vibration, energy, weather, heat, cold, electricity, radiation and pressure.

Psychosocial hazards that can affect mental health or well-being such as overwork, stress, bullying, or violence.

5.2. Risk control of machinery and equipment hazards

5. 2.1 Risk control of general hazards

Where exposure to machinery and equipment hazards cannot be eliminated or substituted for machinery and equipment of improved design, risk controls must be applied to the hazards to prevent or reduce the risk (chance) of injury or harm. Workplace health and safety laws require the highest order control be applied.

Higher order machinery and equipment risk controls are preventative by nature, are effective and durable for the environment it is used in, and deal directly with the hazard at its source.

Lower order machinery and equipment risk controls, such as personal protective equipment (PPE), can prevent injuries, but are generally not as effective as higher order

controls, as they rely more on worker behaviour, maintenance programs and supervision.

Administrative controls use systems of work to reduce risk by providing a framework of expected behaviours. Examples are rotation of staff to reduce exposure to a hazard, or a documented safe system of work, such as 'lockout tagout'.

These types of controls rely on extensive instruction, information, training and supervision. In terms of time and ongoing administration by managers and employers to ensure the desired behaviour occurs,administrative controls can be the most expensive and least effective form of hazard control

Common mechanical hazards and associated risks for machinery and equipment are shown below.

Hazard	Risk
Rotating shafts, pullies, sprockets and gears	Entanglement
Hard surfaces moving together	Crushing
Scissor or shear action	Severing
Sharp edge – moving or stationary	Cutting or puncturing
Cable or hose connections	Slips, trips and falls (e.g. oil leaks)

5.3 HACCP(Hazard Analysis Critical Control Point) is a systematic way to identify, evaluate, and control food safety hazards.

HACCP prevents food safety hazards rather than reacts to food safety hazards.HACCP

To develop a HACCP plan, one follows the seven principles.

1: Conduct a hazard analysis.

- Identify hazards associated with a specific menu item.
  - Prepare a flow diagram that outlines all handling/preparation steps from receiving to service.
  - List likely hazards associated with each step.
  - Identify how to prevent the hazards at each step.

- List the hazards that are likely to occur *and* that will cause severe consequences if not controlled.
- Hazards that are low risk and that are not likely do not need to be considered.

2: Determine CCPs

- A control point is any point, step, or procedure where biological, physical, or chemical factors can be controlled.
- A critical control point (CCP) is a point, step, or procedure where an identified hazard can be prevented, eliminated, or reduced to acceptable levels.
- Critical control points are monitored much more frequently than are control points.

3: Establish critical limits

- This step involves establishing criteria that must be met to prevent, eliminate, or the reduce the identified hazard at the CCP so that the food is safe to eat.
- Examples of critical limits are:
  - temperature, time, physical dimensions, water activity, pH, and available chlorine

Critical limits can come from regulatory standards and guidelines, scientific literature, experimental studies, and consultation with experts.

4: Establish monitoring procedures

- Monitoring is a planned observation or measurement:
  - to determine if a CCP is under control
- Examples of monitoring include:
  - Visual observations
  - Temperature measurements
  - Time assessment
  - pH measurements
  - Water activity measurements

5: Establish corrective actions

- Corrective actions focus on:
  - what to do when a product does not meet the critical limit.
- Maintain records of all corrective actions taken.

6: Establish verification procedures

Four phases of verification needed for a HACCP plan:

- Determine that the critical limits at all CCPS are sound.
- Make sure that the establishment's HACCP plan is being properly implemented.
- Have regulatory personnel review the plan to make sure that it is being properly implemented.
- Check the accuracy of all monitoring equipment.

7: Establish record keeping

The following make up the records of a HACCP Plan

- List of HACCP team and their assigned responsibilities
- Description of each menu item
- Flow diagram for each menu item indicating CCPs
- Hazards associated with each CCP and preventive measures
- Critical limits
- Monitoring procedures
- Corrective actions plans
- Record keeping procedures
- Procedures for verification of the HACCP plan.

Self-Check – 5	Written test

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

Test I: Short Answer Questions

1. What is hazard ?(2 pts)
2. Write down types of work place hazard ? (3 pts)
3. what are orders for risk control of general hazards? (5pts)
4. definfe HACCP (hazard analyis critical control point) ? (5pts)
5. write down principles of HACCP (hazard analyis critical control point) ? (5pts)

Note: **Satisfactory rating - 20 points** **Unsatisfactory - below 20 points**

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

Score = _____

Rating: _____

Information Sheet 6- observing and undertaking Checks on the physical condition of the equipment

6.1. Checking tools, equipment and machinery

A very good safety habit to adopt is to conduct daily pre-operational checks of tools, equipment and machinery each day before you use them.

Pre-operation checks are not only a good safety practice, they can also save you a lot of money in maintenance and downtime costs. If you find any problems during your pre-operational check, make sure you correct the problem before using the machine.

6.2 before operating a machine it is important to;

- Walk around and look at all fluid levels such as engine oil, fuel, and hydraulic fluid.
- Look underneath the machine ; do you see any big leaks or puddles of fluid that have accumulated under the machine.
- Look closely at the tires.
- Check the batteries to make sure they are securely held down, the connections are clean and the electrolyte level is good.
- As you are walking around, look for any obvious damage like cracked or broken parts, leaking or damaged hoses.
- Make sure that the steps are clean of any grease or mud that could cause you to slip.
- Check to see that the operator's platform or cab is free of any objects that could interfere with the operation of the tractor. If you have a cab tractor, keep the windows clean for good visibility.
- Properly adjust the seat for a comfortable position. Check the seatbelt to see if it is functioning.

Self-Check – 6	Written test

Directions:

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

Short Answer Questions

1. Write down at least three guidelines for pre opratiponal checks of the equipment tasks?(5)
2. what is pre-operational checks of eqipment and machinery ?(5)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

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

Score = _____

Rating: _____

Information Sheet 7:- recording Preliminary observations.

7.1 Introduction

Preliminary observations on the working performance of a machine
What should I check before operating a machine and equipment ?

- Adjust seat and controls.

During Preliminary observations of the machine

- check that the machine is complete , with all safeguards fitted , and free from defects
- produce a safe system of work for using and maintaining the machine
- ensure every static machine has been installed properly and is stable (fixed down)
- chooose the right machine for the job and do not put machines where customers or visitors may be exposed to risk

7.2 Check for correct operation of the following:

- Parking Brake--holds against slight acceleration.
- Foot Brake--holds, stops vehicle smoothly.
- Clutch and Gearshift--shifts smoothly without jumping or jerking.
- Steering--moves smoothly; no "play".
- Lights--headlights, warning lights, and turn signals operational.
- Dash Control Panel--all lights and gauges operational.
- All Moving Parts--no strange noises.
- Horn--operational.
- Visibility--mirrors properly adjusted; windows clean and intact.
- Wipers/washer--functioning and intact.
- Tires--pressure, tread depth or damage.
- Wheels and fasteners--no defects in rim, loose or missing fasteners.

- Seat belts--in good condition and being used.
- Vehicle back-up alarm--operational, where required.
- Hydraulic systems--no evidence of leaks and systems operate smoothly.
- Fluid levels - oil, gas, brakes, washer fluid. Check for leaks.
- Load--secure and complying with regulations; hitch in good condition.
- Emergency equipment--installed and inspected as required by law or company policy.
- Record and report any defects to your supervisor immediatel

7.2.1 checking for correct operation

Self-Check – 7	Written test

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

Test I: Short Answer Questions

1. list down priliminary observation of the machine ? (5pts)
2. write down checks for correct operation equipment and machines ? (5pts)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

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

Score = _____

Rating: _____

Sheet 8- discussing test procedures with appropriate personnel

8.1 INRTODUCTION

With today's importance on validation and equipment acceptance, the Industries uniquely meets your specific requirements with a stand-alone Factory Acceptance Testing (F.A.T.) facility.

Once equipment fabrication is completed, vessels are moved to facility, where they are tested based on your pre-established proocedures .

These procedures and the customized validation documentation package, become part of it. Inspection, testing and document review are pre-validation

the dedicated facility eliminates testing at congested plant sites, or by third party vendors, requiring additional shipping and handling

Prevents potential delays to delivery and start-up

special test procedues test the critical processes (for example, high temperature short time (HTST), batch pasteurizer, aseptic processing and packaging system (APPS) and higher heat shorter time (HHST)) according to the test procedures .

This testing can be done by trained establishment personnel or a reliable third party.

A summary of the results of the testing can be recorded on the test procedures form in

Designate a person (ideally someone other than the operator of the pasteurizer) to review the results on a timely basis to ensure accuracy of testing and that corrective action was taken both on the equipment and on the product, if necessary.

Develop a written program for the routine, planned testing of the critical process equipment and controls, including procedures that outline what tests are being performed, frequency, who is responsible, verification procedures, corrective action and records kept.

In addition, perform these equipment special tests any time there are alterations or new installations to the critical processes in order to evaluate the effectiveness of the changes and the impact on the system.

8.2 H.T.S.T. EQUIPMENT TEST PROCEDURES

Sequence of Testing

Equipment testing should be conducted in the following sequence to minimize equipment run times.

Pasteurizer Not Operating – 3, 1, 4, 2, 7, 10, 8, 5B, 5E, 5C (dual stem), 9

Pasteurizer Operating – 5A, 5C (single stem), 5G, 11, 5D, 5F

Test 01 Indicating Thermometer - Temperature Accuracy

(Tolerance - .5 ^{o}F indicator, 1 ^{o}F air space)

Prepare a water bath at a temperature within (over) 3 ^{o} F of the appropriate pasteurization temperature. Remove the heat source and agitate. Insert check thermometer and indicating thermometer and compare readings. Repeat.

Test 02 Recording Thermometer - Temperature Accuracy

(Tolerance – 1 ^{o}F)

Prepare 3 water baths (boiling, ice water and pasteurization range). Immerse the recorder in boiling water for 5 minutes. Remove the recorder from the boiling water and immerse in water at pasteurization temperature and compare with the indicator after a 5 minute stabilization period. Repeat with ice water bath.

Test 03 Recording Thermometer - Time Accuracy

(Tolerance – Recorded time of pasteurization not to exceed the true elapsed time)

Compare the recorded time over a period of 30 minutes with an accurate watch. Enter on chart and initial.

Test 04 Recording Thermometer Check Against Indicating Thermometer

(Tolerance – Recording thermometer shall not read higher than indicator)

Compare the indicator temperature with the recorder temperature at a stabilized pasteurization temperature.

Test 05 Flow Diversion Device - Proper Assembly and Function

A. Leakage Past Valve Seat

On initial H.T.S.T. start-up with steam to heater off and system operating with FDD in diverted flow position, disconnect the forward flow piping from the FDD. Observe the valve seat for leakage.

Self-Check – 8	Written test

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

Test I: Short Answer Questions

1. write down seuence of testing ?(5pts)

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

1. Once equipment fabrication is completed, vessels are moved to facility, where they are tested based on your pre-established proocedures.(2pts).
2. This testing can be done by trained establishment personnel or a reliable third party. (3pts)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

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

Score = _____

Rating: _____

LG #14	LO #2- Plan operational checks.

Instruction sheet

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

- checking specifications and notes from preliminary observations
- planning Testing sequence.
- identifying Safe area for testing
- making Arrangements for any additional resources

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**:

- check specifications and notes from preliminary observations
- plann Testing sequence.
- identify Safe area for testing
- make arrangements for any additional resources

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

Information Sheet 1- checking specifications and notes from preliminary observations.

1.1 Introduction

Equipment specifications are written documents or manuals that stipulate the method of production capacity, power requirement, fabrication methods and other finer details of the equipment that makes it apt for use. An engineer must have a clear understanding of equipment specifications to avoid equipment breakages.

The specifications established provide the basis for a quality maintenance program which may be effectively carried forward through official inspection, grading, and quality control service.

1.2 Safe operating procedures are written instructions that detail the steps that will be performed during a given procedure; including information about hazards and how these hazards will be controlled.

1.3 A manufacturing specification contains all the information that is needed to make the product. It describes the stages of manufacture and the materials needed, using flowcharts, diagrams, notes and samples.

A manufacturing specification is done once the final product has been developed.

A preliminary observations“circle check” or pre-operational inspection of equipment prior to every use will reduce the chance of equipment being operated in an unsafe condition. This makes it easier to spot and deal with maintenance issues early before they turn in to a problem causing downtime, equipment damage or expensive repairs.

UNIDO REQUIREMENTS			TO BE COMPLETED BY THE INVITEE			
Item	Name and Required Parameter	QTY	Unit Price	Total Item Price	Compliance*)	Remarks**)
			Currency USD	Currency USD	Yes/No	
1	**Milk VAT (400Kg)** Specifications: ▪ Stainless steel fabrication. ▪ Capacity 400L. ▪ Inner jacket grade 316 thickness 3mm. ▪ Outer jacket grade 304 thickness 1.5mm. ▪ Heating and cooling structure thickness 3mm. ▪ Polyurethane isolation thickness 50 mm density 40Kg/m³. ▪ Fully welded all-stainless steel construction and fully cleaned with acid. ▪ Vertical agitator motor 1HP with thermic protection. ▪ Stirring Speed: 36rpm to 42 rpm. ▪ Milk-paddle to circulate the contents of the vessel while heating. ▪ Power: 400V – 50Hz. ▪ Distributor tubular vapor in the bottom, 4 feet, vapor entrance/water, vapor exit/water. ▪ Outlet 50mm stainless steel valve. ▪ High temperature water safety valve.	1				

fig 1.1 Technical specifications of dairy processing equipment.

Self-Check – 1	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. define equipment specification ?(3pts)
2. define safe operatinng procedures ? (2pts)
3. define manufacring specification ?(3pts)

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

1. A manufacturing specification is done once the final product has been developed. (2pts)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

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

Score = _____

Rating: _____

Information Sheet 2- planning Testing sequence.

2.1 Introduction

Planning is an integral part of all elements of the management system and to be effective involves the design and development of suitable processes and organizational structure to manage aspects and their associated risk control systems proportionately to the needs, hazards, and risks of the organization. Planning is equally important to deal with health risks that might only become apparent after a long latency period. It also establishes objectives that define the criteria for judging success or failure of the management system. Objectives are identified on the basis of either the results of the initial status review, subsequent periodic reviews, or other available data.

A testing sequence consists of test steps arranged in a hierarchy. You can use a test sequence to define test inputs and to define how a test will progress in response to the simulation. A test step contains actions that execute at the beginning of the step.

An operational plan is a strategic document that defines how different teams or departments like recruitment, marketing, and finance, contribute to reaching different company goals and objectives. It summarizes the daily activities required for running a successful business.

- **Systematic Test Planning**

Test planning is the collection of specific information about various characteristics of a system and the test environment, and the recognition of the implications of these characteristics for test design. Because a single, unanticipated restriction can render worthless an otherwise well considered design, test planning is extremely important as an input to test design.

the components of operational test planning and add some technical details.

The components of test planning include:

- defining the purpose of the test;
- identifying methods for handling test factors;

2.2 Testing and Operational Sequence

It is to plan the order of the operation by process, regarding the fixed orders through the Operation Order Release Planning. It is to grasp the progress status of the operation, to consider the priority, setup time, and etc., and to make an operation sequencing list.

Test 01 Leak Protection Valve

Test not applicable to H.T.S.T. system.

Test 02 Indicating Thermometer on Pipelines - Thermometric Response

(Tolerance – 4 sec. over 12 ^{o}F temperature range)

Establish a water bath slightly above maximum pasteurization temperature for the thermometer for the thermometer being tested. Immerse indicator in cool water bath. Insert indicator in hot water bath and start stopwatch at 19 oF below bath temperature and stop stopwatch at 7 oF below bath temperature.

Test 03 Recorder / Controller - Thermometric Response

(Tolerance – 5 sec. over 12 oF temperature range) Establish a water bath at 7 oF above cut-in temperature using indicator. Immerse recorder in bath and start stopwatch at 12 oF below cut-in temperature and stop stopwatch when controller cuts-in.

Self-Check – 2	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. define planning ?(5 pts)
2. what is an operational plan? (5pts)
3. what is systematic test planning ? (5pts)
4. write down com[onents test planning (5pts)

Note: Satisfactory rating - 20 points	Unsatisfactory - below 20 points

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

Score = _____

Rating: _____

Information Sheet 3- identifying Safe area for testing

3.1 Planning for Safe area

- Setting up of Machinery

In setting machinery, the equipment should be located, if possible in a lighted dry place with plenty of room to work around it for cleaning and repairs. The arrangement should be that the minimum amount of sanitary piping is used, consistent with efficient operation. Related equipment may be grouped together to facilitate supervision. Straight-line flow of product is usually desirable. If possible allow space for unit machine to be added 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 is bolted down, it is customary to see bolts in the concrete

3.2. Process Facility Description.

Safety requirement specifications is the means by which the hazards of a machine or process are controlled to reduce risks of harm to those working at or near the machine or process.

Well test equipment is essentially a portable production facility; the standards and practices normally applied to process facilities largely apply to the well test facility.

This section describes how the equipment is interconnected, what conditions the well test facility is designed to operate within, and how it will operate. It also details the safety devices built into the process.

A short description of the fluid handling sequence through the main components is usually adequate to describe how the process equipment will handle well fluids. Special

mention of activities in the separator, such as sampling and metering, indicate where most work activity will take place; disposal of fluids at the burners highlights an activity that requires later attention in hazard identification. A piping and instrumentation diagram (P & ID) will describe the interconnections for the equipment and also provide detail of the equipment safety devices.

- **Equipment Placement**

  the test equipment brings with it hazards that are not normally encountered during drilling operations.

  The storage and handling of hydrocarbons on deck requires careful management. For this reason, most offshore rigs assign a specific area for the location of well test equipment.

  The designated area locates well test equipment, as far as practicable, from the accommodation and from other areas where well test activity might clash with essential facility equipment or services. The Vessel Safety Case assesses hazards associated with the placement of well test equipment in this area.

Here are some tips to help make your workplace safe for testing.

- Understand the risks.
- Reduce workplace stress.
- Take regular breaks.
- Avoid stooping or twisting.
- Use mechanical aids whenever possible.
- Protect your back. .
- Wear protective equipment to suit the task.
- Stay sober

3.3 a. Maintenance program

Preventive Maintenance (PM) consists of a series of maintenance requirements that provide a basis for planning, scheduling, and executing scheduled maintenance, planned versus corrective for the purpose of improving equipment life and to avoid any

unplanned maintenance activity/minimize equipment breakdowns. These can be defined through a Maintenance Plan (MP). PM includes adjusting, lubricating, cleaning, painting, and replacing minor components. Time intensive PM, such as bearing/seal replacement (as identified by predictive maintenance), would typically be scheduled/planned for regular plant or 'line' shutdown periods.

The O&M manual itself, and particularly the CMMS or CAFM datea, should be maintained on an as-needed basis, typically whenever systems/equipment are "changed out."

3.4 maintenance plan (mp)

The purpose of a Maintenance Plan (MP) is to describe the best means to maximize equipment operational availability, while minimizing equipment downtime. Once developed, the MP will typically identify PM task descriptions and schedules, troubleshooting, corrective maintenance (repair) task descriptions, and spare parts identification, stockage (quantity), and any unique storage requirements. This information will be incorporated in the manual, both as tabular data and text.

3.5 preventive maintenance data

Preventive maintenance (PM) data includes equipment tag information, procedures, replacement parts, special tools, lubrication requirements, service providers, warranty information, etc. It is often presented in tabular format in the O&M manual. Construction-Operations Building information exchange (COBie)—If specified (based on the draft guide specification, COBie facilitates the capture of real-time as-built asset information by using the collection of contractor submittals. COBie may also be applied through Building Information Modeling (BIM) technology, although BIM is not necessary to implement COBie. Any project can take advantage of/utilize COBie to increase the accuracy and timeliness of data that can be incorporated into system-level operation and maintenance manuals as well as CMMS.

Self-Check – 3	Written test

Name…… ID……. Date…….

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

Test I: Short Answer Questions

1. List the tips to help make your workplace safe for testing ?(4 pts)
2. what is maintenance program ? (4 pts)
3. what is maintenance plan? (MP) (4 pts)
4. what is prevenitive maintenance? (PM) data (5pts)

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

1. Safety requirement specifications is the means by which the hazards of a machine or process are controlled to reduce risks of harm to those working at or near the machine or process. (4 pts)

Note: Satisfactory rating - 20 points Unsatisfactory - below 20 points

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

Score = _____

Rating: _____

Information Sheet 4- making Arrangements for any additional resources

4.1 Additional resources

A. Planning and design phase

Operational & Maintenance activities start with the planning and design of a facility and continue through its life cycle. During the planning and design phases, O&M personnel should be involved and should identify maintenance requirements for inclusion in the design, such as equipment access, built-in condition monitoring, sensor connections, and other O&M requirements that will aid them when the built facility is turned over to the owner/user organization.

The O&M team should be represented on the project development team so they know ahead of time the types of controls, equipment and systems they will have to maintain once the facility is turned over to them. For more on this subject, Coordinating Staff Capabilities and Training with Equipment and System Sophistication Levels."

Consideration should be given for professionally developed system-level O&M Manual(s), rather than the typical vendor-supplied equipment manuals.

The Construction Operations Building Information Exchange (COBie) initiative should also be a consideration. For larger complexes, O&M staff should consider system-wide integration and compatibility of proposed products with existing systems, including tools, equipment and cleaning supplies. This is where the full system commissioning process starts.

B. Construction Phase

To support efficient Operation and Maintenance (O&M), it is important that facility O&M documentation

(1) be required by the owner and

(2) be accurate, and (3) be available in a timely fashion.

System-level and manufacturer manuals of as-installed systems and equipment, including as-built drawings, should be available for review by the owner over the course of the Construction Phase.

C. Operational and Maintenance (O&M) Approach

The O&M organization is typically responsible for operating and for maintaining the built environment. To accomplish this, the O&M organization must operate the systems and equipment responsibly and maintain them properly. The utility systems may be simple supply lines/systems or may be complete production and supply systems. The maintenance work may include planned preventive/predictive/ and maintenance, corrective (repair) maintenance, trouble calls, (e.g., a room is too cold), replacement of obsolete items, predictive testing & inspection, overhaul, and grounds care.

D.coordinating staff capabilities and training with equipment and system sophistication levels

O&M organizations must address the skill level of their staff in light of the O&M systems and components within their facilities. This extends beyond the in-house staff to any contracted services as well. If the skills required to support installed systems and equipment are scarce, either training must be provided or less sophisticated equipment systems utilized to provide an economical working arrangement.

Regardless of their equipment sophistication levels, every organization should develop training programs and track staff qualifications to ensure they are adequate for existing and planned building systems. This will allow organizations to make improvements to training as needed on an ongoing basis. A recurring training program should consider both the type of skills required and the available labor pool skills in the geographic area. Topics for consideration include the following:

- Safety/OSHA regulations and guidelines
- Equipment operational start-up and shutdown procedures
- Normal operating parameters
- Emergency procedures
- Equipment preventative maintenance (PM) plans
- The use of proper tools and materials, to include personal protective equipment (PPE).

Self-Check – 4	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. List down additional resourses ? (3 pts)
2. write down points of consideration for additionally resources ? (5pts)

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

1. Operational & Maintenance activities start with the planning and design of a facility and continue through its life cycle (2pts)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

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

Score = _____

Rating: _____

LG #15	LO #3- Check unit through full operational range

Instruction sheet

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

- undertaking Testing, observing relevant safety and operational requirements
- confirming Results and findings

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:

- undertake , Testing, observing relevant safety and operational requirements
- confirm Results and findings.

Learning Instructions:

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

Information Sheet 1- undertaking Testing, observing relevant safety and operational requirements.

1 Introduction

Periodic Inspection and Testing. All electrical installations deteriorate with age and use. They should therefore be inspected and tested at regular intervals to check whether they are in a satisfactory condition for continued use. Such safety checks are commonly referred to as 'periodic inspection and testing.

1.1 Inspection and Testing

Inspection and testing of electrical equipment must be carried out by a competent person who has the relevant knowledge, skills and test instruments to carry out the relevant inspection and testing. The person carrying out any testing of electrical equipment should also be competent to interpret the test results of any equipment they use

1.2 A regular program of inspection, testing and tagging comprises:

- a visual check to ensure there are no obvious problems
- a series of electrical tests to ensure the safety of the item
- tagging of the equipment to indicate to users that the item has been identified
- as safe in accordance with and when the item is due to
- be tested again
- provision of a detailed Asset Register and Log Book.

1.3 Safety Practice

Safety can basically be defined as principles and procedures adopted in a working environment aimed at reducing the risk of endangering ones health to as lower a level as it can be possibly be achieved.

In order to ensure that such a practice is in place, it is required to set the intended goals to be achieved, planning and measuring the performance with given time.

In other words there must be a system which is in place which should be included in the normal norms of practice within the prosthetics and orthotics facility. Safety Management like any other system in a working environment has an implications on ethical issues, set-up rules, regulations and direct or indirect financial burden.

In order to implement an effective safe practice and in adhering as well as observing to its implications, the following principles should be clearly defined:

- Outlined organizational structure to manage risk
- Identification of workplace risk and implement suitable control
- Ensure there is a sound and set-up effective communication within the entire centre
- Ensure there is a formally and consistently outlined procedure of identifying, noting,registering and prompt acting on all without failure.
- Ensure there is a follow up and a consistent process to be followed over through the existence of the Centre

1.4 Check equipment before use (or at least once a week)

- Inspect equipment for any sign of damage or parts that may need repair or replacement, and lubricate as necessary (according to instructions).
- Check that equipment is plugged into the voltage stabiliser or uninterrupted power supply, where these are required

Self-Check – 1	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. write down principles to implement an effective safe practice ? (5pts)
2. define periodic inspection and testing.? (3pts)

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

1.Inspection and testing of electrical equipment must be carried out by a competent person who has the relevant knowledge, skills and test instruments to carry out therelevant inspection and testing.(3pts)

2. Safety can basically be defined as principles and procedures adopted in a working environment aimed at reducing the risk of endangering ones health to as lower a level as it can be possibly be achieved. (4 pts)

Note: Satisfactory rating - 15 points Unsatisfactory - below 15 points

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

Score = _____

Rating: _____

Information Sheet 2- confirming Results and findings.

2.1 Introduction

inspection is taken to mean: "observations of work environment, work practices, equipment used, work posture or reported hazard and may be done with or without an inspection checklist". The inspection may be generic or it may be specific to assess a particular risk, task or part of the Occupational Health and Safety management system (OHSMS).

The purpose of an inspection is to identify whether work equipment can be operated, adjusted and maintained safely, with any deterioration detected and remedied before it results in a health and safety risk. Not all work equipment needs formal inspection to ensure safety and, in many cases, a quick visual check before use will be sufficient. However, inspection is necessary for any equipment where significant risks to health and safety may arise from incorrect installation, reinstallation, deterioration or any other circumstances.

The need for inspection and inspection frequencies should be determined through risk assessment. inspection should concentrate on those safety-related parts which are necessary for the safe operation of work equipment and, in some cases, this may require testing or dismantling. However, not all safety-critical features on a particular item of work equipment may require inspection at the same intervals.

An inspection can vary in its extent, as the following demonstrate:

- quick checks before use (eg electric cable condition on hand-held power tools, functional testing of brakes, lights on mobile machinery)
- weekly checks (eg presence of guarding, function of safety devices, tyre pressures, and the condition of windows, mirrors and on mobile plant).

more extensive examinations, undertaken every few months or longer (eg general condition of a ladder, close examination of a safety harness, portable appliance testing

Self-Check – 2	Written test

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

Test I: Short Answer Questions

1 .define inspection? (3 pts)

2. write variation of inspection in its extent (5pts)

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

1. The purpose of an inspection is to identify whether work equipment can be operated, adjusted and maintained safely.(2pts)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

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

Score = _____

Rating: _____

LG #16	LO #4- Identify fault and/or formulate recommendations.

Instruction sheet

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

- identifying Impact of fault on work schedule.
- recording Proposals for equipment repair.
- explaining report to relevant workplace personnel
- undertaking Repairs

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 Impact of fault on work schedule.
- record Proposals for equipment repair.
- explain report to relevant workplace personnel
- undertake Repairs .

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

Information Sheet 1- identifying Impact of fault on work schedule

1.1 Introduction

equipmen faults are an unplanned occurrence or defect in an item which may result in one or more failures of the item itself or of other associated equipment. NOTE - In electrical equipment, a fault may or may not result in damage to the insulation and failure of the equipment.

Fault reporting is a maintenance concept that increases operational availability and that reduces operating cost through three mechanisms.

- Reduce labor-intensive diagnostic evaluation
- Eliminate diagnostic testing down-time
- Provide notification to management for degraded operation.

The impact of Equipment failure happens. can run the gamut from easily fixed with minimal losses to catastrophic, depending on factors like repair costs, total downtime, health and safety implications, and impact on production and delivery of services.

There are several common reasons equipment can break down, and understanding why your equipment may be failing is your first line of defence against the serious consequences of unplanned downtime.

1.2 five common causes of equipment failure

- Improper operation
- Failure to perform preventive maintenance
- Too much preventive maintenance
- Failure to continuously monitor equipment
- Bad (or no!) reliability culture

1.2 preventing equipment failure

Equipment failure can occur for a number of reasons, but in many cases these dangerous incidents are preventable. Adequate training and adherence to lock-out/tag-out procedures can make a real difference in workplace safety.

Performing regular maintenance on essential assets can also go a long way in ensuring equipment can handle the day's tasks without unexpected malfunctions. For maintenance to be an effective deterrent of equipment failure, however, it must be done as a preventive measure, not a reactive course of action.

Creating a schedule of planned maintenance for each and every asset in your facility can keep your system running with few interruptions due to equipment malfunctions. Regular preventive maintenance allows service professionals identify the beginnings of potential problems before they cause equipment slowdowns or shutdowns. Working with a national company that offers centralized services gives large, far-reaching businesses the ability to deploy high-quality maintenance projects and asset inspections throughout their entire network. To learn more about creating a planned maintenance schedule at your facilities, reach out to Miner.

1.3 Equipment failure leads to accidents in the workplace

Any time a piece of equipment isn't performing correctly, the risk of accidents increases. Employees can't always predict the ways in which equipment will malfunction, and the element of surprise doesn't benefit anyone in a work environment. Regular planned equipment maintenance can greatly reduce the frequency of equipment failure and prevent accidents in the workplace.

Self-Check – 1	Written test

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

Test I: Short Answer Questions

1. what is equipment fault ? (2pts)
2. what is fault reporting ? (2pts)
3.write down three mechanisms for reduction of equipment faults ? (4pts)
4 .what are common causes of equipment failure? (4 pts)

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

1. Equipment failure can occur for a number of reasons, but in many cases these dangerous incidents are preventable (3pts)

Note: Satisfactory rating - 15 points Unsatisfactory - below 15points

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

Score = _____

Rating: _____

Information Sheet 2- recording Proposals for equipment repair

2.1 inroduction

Repair means responding to the breakdown of equipment and undertaking work to correct the problem in order to return the equipment to a working condition.

Before equipment can be repaired, you need to be aware that there is a problem.Therefore, there should be a clearly understood system for reporting faults and breakdowns and equipment users should be encouraged to report faults and breakdowns as soon as possible. If there is no back-up equipment, a breakdown will mean that the service the equipment was providing will come to a halt.

Simple repairs can be done by the in-house or external maintenance and repair team. If the equipment is repaired where it is used, it is important that the team is trained to work safely and that they don't create hazards for patients or staff.

More complex repairs will be carried out by specialised maintenance personnel; they might come to the eye care unit or you may have to send the equipment to them for repairs.

It is important to have a schedule for preventative maintenance of each item of equipment. This consists of a timetable stating when (and how frequently) maintenance should be done, and a list of maintenance activities for each item. These schedules should provide simple guidelines for all types of equipment, covering the tasks to be undertaken in the following areas:

- Care and cleaning
- Safety checks
- Functional and performance checks
- Maintenance tasks (changing bulbs, lubricating moving parts, etc.)

2.2 Record-keeping for maintenance

The preventative maintenance schedule for users can be accompanied by a weekly or monthly ‘tick sheet’ near the item of equipment, with a space for each day so that users can date and sign it, thereby showing that they have carried out the required tasks. This may include a space for users to indicate what spare parts, such as bulbs, were used. On a regular basis, the list of spare parts used should be noted in the central maintenance and repair record so that more spare parts can be ordered.

The central maintenance and repair record can be used to keep track of all other maintenance, including maintenance done by the in-house team, by vendors, or by service agents. The information captured should include the date, the equipment reference number, what was done, who did the work, and when next maintenance is due.

Record-keeping for repair

What should be recorded	This provides information about…
The details of repair work done on each machine (including cause/suspected cause, and who carried out the repair)	• The history of each machine • Common problems
The spare parts and materials used	• The parts most frequently used • What needs to be re-ordered
The date equipment has broken down, and the date it is repaired.	• What still needs to be repaired (which allows you to prioritise the next week's tasks) • The duration equipment is not in use (down-time)
The causes of any delays	• What the most common causes of delays are (skill, labour, spare parts, transport, bureaucratic delays, money) and what additional resources may be needed to complete work on time

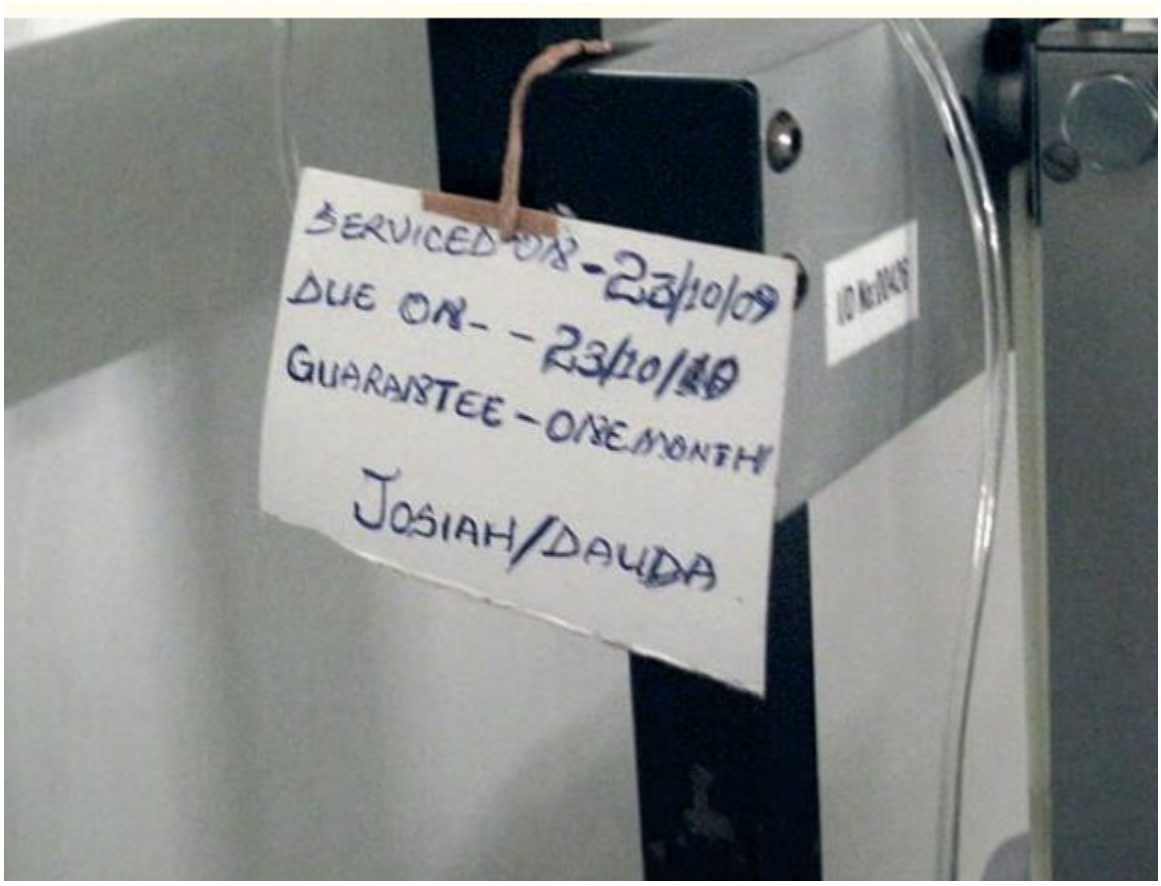

fig 2.2 Record-keeping for maintenance

Self-Check – 2	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. write down task undertaken for repair and maintenace of equipment?(4 pts)

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

1. Repair means responding to the breakdown of equipment and undertaking work to correct the problem in order to return the equipment to a working condition. (3pts)

2. Simple repairs can be done by the in-house or external maintenance and repair team (3 pts)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

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

Score = _____

Rating: _____

Information Sheet 3- explaining report to relevant workplace personnel

3.1 introduction

fault reporting is a maintenance concept that increase operational availablity and that reduces operating cost through three mechanisms .

- reduce -labour intensive diagnostic evaulation
- eliminate diagnostic testing down time
- provide notification to management for degraded operation

The team (relevavant personell) finding and recommendation are detailed in a written report .the report on a serrious equpment fault can be extensive .

a report on a minor fault and diagoniss should still be complete

3.2 A report should include .

- background information where and when the faults was vreported or the inccidebnt occured, who and what was involved.etc.
- An accuont of the potential effectes of the equipment faults ,the of inccident, sequence of events ,extent of dmage .
- an anaysis of the equipment faults or damage causes
- recommendation for immediate and long term -term action to remedy the faults or prevent the reccurence of an incicident

3.3 Explaining how completed reports are used.

management uses the report to decide on corrective action recommendation.

it takes time to implement a corrective action so it's helpfully to set up a time line table and assign some one to be resposible for keeping track of the progress

a good way to identify areas that need more attention to safety is to periodically analyize the iniccindent report . and in the case of an injury or illness ,the reports can be used to help with OSHA'S record keeping requirement .

Self-Check – 3	Written test

Name…… ID…… Date…….

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

Test I: MULTIPLE CHOICE

1 A report should include? (5 pts)

A) background information where and when the faults was vreported or the inccidebnt occured, who and what was involved.etc.

B) An accuont of the potential effectes of the equipment faults ,the of inccident, sequence of events ,extent of dmage .

C) an anaysis of the equipment faults or damage causes recommendation for immediate and long term -term action to remedy the faults D) all of the above.

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

1. a good way to identify areas that need more attention to safety is to periodically analyze the iniccindent report. (3 pts)

2. management uses the report to decide on corrective action recommendation (2pts)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

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

Score = _____

Rating: _____

Information Sheet 4- undertaking Repairs.

4.1 introduction

Repair of machinery includes the repair and maintenance of industrial machinery and equipment like sharpening or installing commercial and industrial machinery blades and saws; the provision of welding (e.g. automotive, general) repair services; the repair of agricultural and other heavy and industrial machinery and equipment (e.g. forklifts and other materials handling equipment, machine tools, commercial refrigeration equipment, construction equipment and mining machinery), including machinery and equipment .

This includes: - repair and maintenance of non-motor vehicle engines- repair and maintenance of pumps, compressors and related equipment- repair and maintenance of fluid power machinery- repair of valves- repair of gearing and driving elements- repair and maintenance of industrial process.

furnaces- repair and maintenance of lifting and handling equipment- repair and maintenance of industrial refrigeration equipment and air purifying equipment- repair and maintenance of commercial-type general-purpose machinery- repair of power-driven hand-tools- repair and maintenance of metal cutting and metal forming machine tools and accessories- repair and maintenance of other machine tools-

typical repair and maintenance program includes several types of activities that address different aspects or components of facilities' systems and have different objectives and outcomes. Maintenance is typically a continuous activity that addresses routine work that is accomplished on a recurring basis and includes some minor repairs. More important and often more expensive repair requirements are typically identified as separate projects.

4.2 Repair and Maintenance activities include the following .

- Preventive maintenance, which includes planned, scheduled, periodic inspection, adjustment, cleaning, lubrication, parts replacement, and minor repair of equipment and systems.
- Programmed major maintenance, which includes maintenance tasks whose cycle exceeds 1 year (such as painting, roof maintenance, road and parking lot maintenance, and utility system maintenance).
- Predictive testing and inspection activities that involve the use of technologies to monitor the condition of systems and equipment and to predict their failure.
- Routine repairs to restore a system or piece of equipment to its original capacity, efficiency, or capability.
- Emergency service calls or requests for system or equipment repairs that unlike preventive maintenance work—are unscheduled and unanticipated.

Self-Check – 4	Written test

Name…… ID…… Date…….

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

Test I: multiple choice

1. Repair and Maintenance activities include the following? (5pts)

A) Preventive maintenance, which includes planned, scheduled, periodic inspection, adjustment, cleaning, lubrication, parts replacement.

B) Programmed major maintenance, which includes maintenance tasks whose cycle exceeds 1 year.

C) Predictive testing and inspection activities.

D) Routine repairs to restore a system or piece of equipment **E)** all of the above

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

1. Maintenance is typically a continuous activity that addresses routine work that is accomplished on a recurring basis and includes some minor repairs. (3pts)

2. Repair of machinery includes the repair and maintenance of industrial machinery and equipment like sharpening or installing commercial and industrial machinery blades and saws (2pts)

Note: Satisfactory rating - 10 points Unsatisfactory - below 10 points

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

Score = _____

Rating: _____

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WEB ADDRESSES

1. Appendix G: Preventing cross connections
2. https://detail.en.china.cn/provide/p141281914.html
3. https://www.alibaba.com/product-detail/herb-medicine-slicing-machine-tea-leaf_62073355456.html?spm=a2700.7724857.normallist.24.638e11aevxec59
4. https://www.plantengineering.com/articles/seven-steps-for-a-successful-shutdown/
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The trainers who developed this learning guide

S.N	Name	Level	Educational Background	Institution	Region	Telephone	E-mail
1	Tesfaye Asrat	B	Animal Science	Motta PTC	Amhara	0923233339	tesfaye99love@gmail.com
2	Geresu Germamo	B	Food Science & Post harvest Technology	Wolayita Sodo PTC	SNNP	0916610590	geresug57@gmail.com
3	Hirpha Ketema	A	Animal Production	Holeta PTC	Oromia	0969432985	hirphaketema2@gmail.com
4	Mulugeta Tesfaye	A	Dairy Science	EMDIDI	Oromia	0911984834	tmulugeta47@yahoo.com
5	Sefi Shiferaw	B	Food Science & Post harvest Technology	Holeta PTC	Oromia	0938872353	sefishifera@gmail.com
6	Tadesu Fikrie	A	Animal Production	Burie PTC	Amhara	0946238747	tadesufikrie2016@gmail.com
7	Tarekegn Cheo	B	Agricultural & Process Engineering	Hawasa PTC	Sidama	0931239119	tarekegecheo155@gmail.com
8	Abera Shiferaw	B	Animal Production & Health	Holeta PTC	Oromia	0911556155	aberashiferaw2014@gmail.com
9	Wondye Hatew	B	Animal Production	Holeta PTC	Oromia	0925255341	hare2013@gmail.com

Federal TVET Coordinator

S.N	Full Name	Organization	Position	Telephone	E-mail
1	Workneh Asmamaw	Federal TVET Agency	TVET Curriculum TTLM Expert	0955205855	workasmamaw@gmail.Com