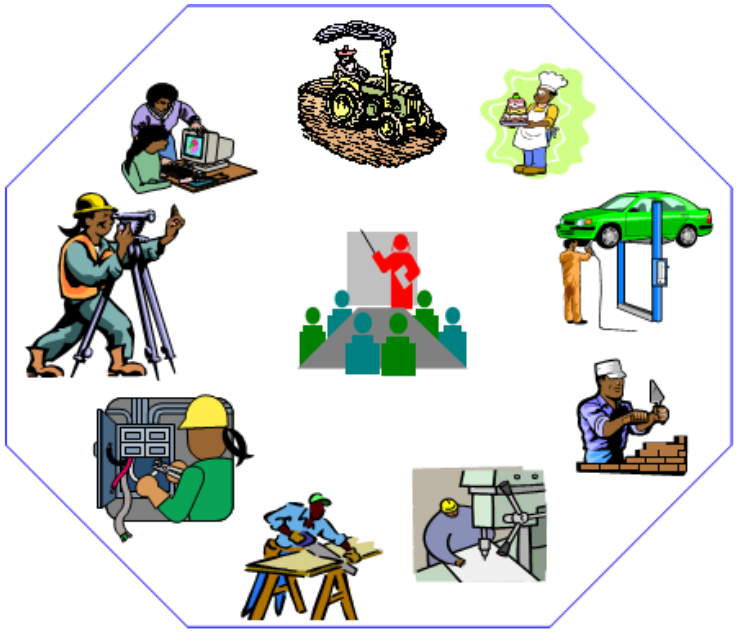
# Fruit and Vegetable Processing Level III

Based on May 2019, Version 2 OS and Sept. 2020, V1 Curriculum



## Module Title: Identifying Equipment Fault and Formulate Recommendations

**LG Code: IND FVP3 M12 0321LO (1-5) LG (39-42)**
**TTLM Code: IND FVP3 TTLM 0321v1**

**March, 2021**

**Bishoftu, ethiopia**

## Table of content

| LG #39 | 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, classifying tools, equipment and operating systems
- Matching tests and procedures
- Identifying special test procedures and parameters
- Explaining operating principles of hydraulic, pneumatic, mechanical and electrical/electronic systems
- Implementing measures to control identified hazards
- Observing and undertaking checks on the physical condition of equipment's
- Recording preliminary observations
- Discussing test procedures

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, classify tools, equipment and operating systems
- Match tests and procedures
- Identify special test procedures and parameters
- Explain operating principles of hydraulic, pneumatic, mechanical and electrical/electronic systems
- Implement measures to control identified hazards
- Observe and undertaking checks on the physical condition of equipment's
- Record preliminary observations
- Discuss test procedures

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
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Information Sheet 1- Identifying, classifying tools, equipment and operating systems

### 1.1. Introduction

A tool is a device that can be used to produce an item or accomplish a task, but that is not consumed in the process. Fruit and vegetables as produced on-farm is transformed into a vast chain of fruit products: juice and powder products. Type of equipment used in the manufacture of specific fruit products: membrane separator, evaporator, dehydrator, pasteurizer and strainer. The manufacturers and users of modern 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 Tools and Equipment

Tools and equipment are materials used to measure/ identify equipment fault include the following

- Vibration meter
- Tachometer
- Current tester, used to measure flow of current in circuit
- Thermal hand tools specific for the task
- Flow meter, scales, used to measure flow rate of fluid
- tape measure
- Micrometer
- Caliper, for measuring size e.g. Fruit and cereals
- Ultrasonic thickness

## Vibration

Dynamic monitoring (spectrum analysis, ultrasonic analysis) involves measuring and analyzing energy emitted from mechanical equipment in the form of waves, such as vibration, pulses, and acoustic effects, over a period of time. Vibration Monitoring used to monitor the health of rotational equipment. This involves the trending and analysis of certain machine performance parameters to detect and identify developing problems such as:

- imbalance
- Miss-alignment
- Bearing Faults
- Gear Tooth Mesh
- Under/Over Lubrication

**Tachometers**

Tachometers measure the engine speed in revolutions per minute (rpm). This instrument determines the rotational speed. The classification of Tachometer is different in differ books .Somewhere there is just broad classification whereas at other places classification is one the basis of principal ,types of uses or construction.


Figure1: Tachometer types

**Piping vibration**

Piping vibration is commonly caused by machine vibration, opening and closing of valves, and even the transmission of the fluid itself .If the pulsations are large, the instantaneous flow may temporarily exceed the rated flow range of the flow meter. In this situation, the flow displayed on the flow meter is smaller than the actual flow. Volume type reciprocating pumps are known for generating large pulsations.

**Irregularity or deviation in flows**

The distribution of flow velocity within circular piping is uniform after the flow has passed through a sufficient amount of straight pipe. On the other hand, the distribution of flow velocity becomes irregular due to bends in the piping or changes in the pipe diameter. Drifting occurs when the center of the distribution of flow velocity shifts away from the center of the pipe. Swirl flow occurs when the fluid rotates around a center axis, parallel to the direction of flow. Both swirling and drifting cause irregular distributions of flow velocity. Performing flow measurements in these conditions may lead to large measurement errors.

**Air bubbles**

When dealing with an open system, it is possible for air to be introduced into the system during liquid intake. Air or impurities that have blended into the liquid cause bubbles. For a vortex flow meter, these bubbles disturb the creation of Karman vortices. For an ultrasonic flow meter, they inhibit the propagation of ultrasonic waves. Both cases result in malfunctions. For electromagnetic type flow meters, bubbles can cause unstable flow readings. This is due to the fact that detection is based on volume and the bubbles are mistaken for fluid.

**Ultrasonic thickness gauge**

Ultrasonic thickness measurement (UTM) is a method of performing non-destructive measurement (gauging) of the local thickness of a solid element (typically made of metal, if using ultrasound testing for industrial purposes) basing on the time taken by the ultrasound wave to return to the surface. This type of measurement is typically Performed with an ultrasonic thickness gauge.


**Figure 2.** hand held ultrasonic thickness gauge

| Self-check 1 | Written test |
|---|---|

**Directions:** Answer all the questions listed below.

## Part I: Write the short answer

1. Write down tools and equipment used for checking faults ?(5pts)

## Part II. Choice

1. Which of the is not a tool used to measure equipment fault ?

   A. pH meter B. Tachometer C. micrometer D. caliper

2. _____is an instrument used to measure the rotation speed of shaft of disk.

   A. Caliper B, micro meter C, tachometer D, gauge

Information Sheet 2. Matching tests and procedures to the equipment operating system

Testing include as a minimum.

Pipework Cleanliness, internal and external Flow rate/balancing

System component pressure drops Pressure reducing valve settings Safety relief valve selling and operation. Operation of all components Performance-temperature/noise Purity of Fluid Earth bonding

Ductwork Leakage Cleanness, internal and external Damper Operation Fire & smoke operation Flow rate balancing System component performances- heating/cooling batteries filter box operation / calibration Performance-temperature/noise air change Operation of all components Purity Earth bonding. Plant Equipment Operation-normal abnormal safety devices interlocks Performance duty /speed/pressure / efficiency/ noise Standby Component performance- heat / cool / batteries /filter Cleanliness, internal and external Vibration Electrical safety I security / bonding

Room Environmental - temp, humidity, air change, noise Air flow direction, distribution,

**Pressure testing of pipework systems**

A) Upon the completion of each length or section of the pipework the operator shall subject the length or section to a hydraulic test and demonstrate to the satisfaction of the Engineer that the length of the section is sound and watertight. The test pressure shall be one and a half times the maximum working pressure, whichever is the greater, for a period of two consecutive hours. Items of equipment, e.g. safety valves, bursting discs, set to operate at or below this pressure shall be isolated or removed prior to applying this test.

B) All faults discovered during such-test- shall be remedied by the operator at his own expense and the test re-applied until the Engineer is satisfied that the section is sound and watertight.

C) Installations sections thereof which will be embedded in the structure or concealed in permanently sealed ducts, trenches etc., shall be individually tested as they are laid and before being embedded or concealed.

D) All pressure tests shall be carried out before the application of thermal insulation. On completion of the test, the water is to be released and drained completely away as rapidly as possible, the section then being thoroughly sluiced through to ensure the removal of as much dirt and foreign mailer as possible before being refilled and put into service.

Air leak testing of ductwork systems

1. All ductwork and equipment items shall be checked for air leakage. This shall be completed before installation or enclosure of ductwork and before any terminal units are fixed.

2. The air leakage tests shall be based on the measurement of air leakage at constant pressure. The test pressure shall be the design static pressure of the section to be tested plus 250 pa. The aggregate of air leakage shall not exceed 1% of the system design air flow rate, and leaks shall not be audible. The air leakage rate for any section shall not be in excess of the permissible rate, in0.03 m3/s per meter, for the whole system.

3. Sufficient time shall be allowed, before testing, for the sealant to cure. The ductwork system, or section to be tasted shall be sealed by the incorporation of, blanking plates fitted at flanged joints, for main ducts and for small open ends, polythene bags may be used. The polythene bags may be retained to aid in preventing the ingress of dirt into the system.

4. Care shall be exercised in jointing tested sections of the ductwork system together, as it will generally be impracticable to test such joints.

B. Test Apparatus and Methods

1. Portable test apparatus shall be provided by the Contractor and shall comprise the following equipment: Electrically driven fan capable of delivering not less than O.03m3/s against a duct pressure of 2.5 Kpa, a static pressure gage suitable for recording the duct static pressure test, an inclined pressure gage, a variable speed type, and a flow measuring device complete with test cocks. The accuracy of the measuring device shall be +/-5% of the permitted air leakage rate.

2. The apparatus shall be connected to the blanking plate inserted in the section of ductwork to be tested. With the bleed valve fully open or the variable speed motor set to minimum speed, start-up fan, and adjust fan speed or close bleed valve until static

pressure reading on static pressure gage reaches desired value. If pressure cannot be obtained, the ductwork shall be checked for obvious leaks and rectified.

| Self-check 2 | Written test |
|---|---|

**Directions:** Answer all the questions listed below.

**Write short answer Questions**

1 list down tools and equipment s for fault testing ? (.pts)

***Note:*** **Satisfactory rating 2.5 ≥points** **Unsatisfactory - below 2.5 points**

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

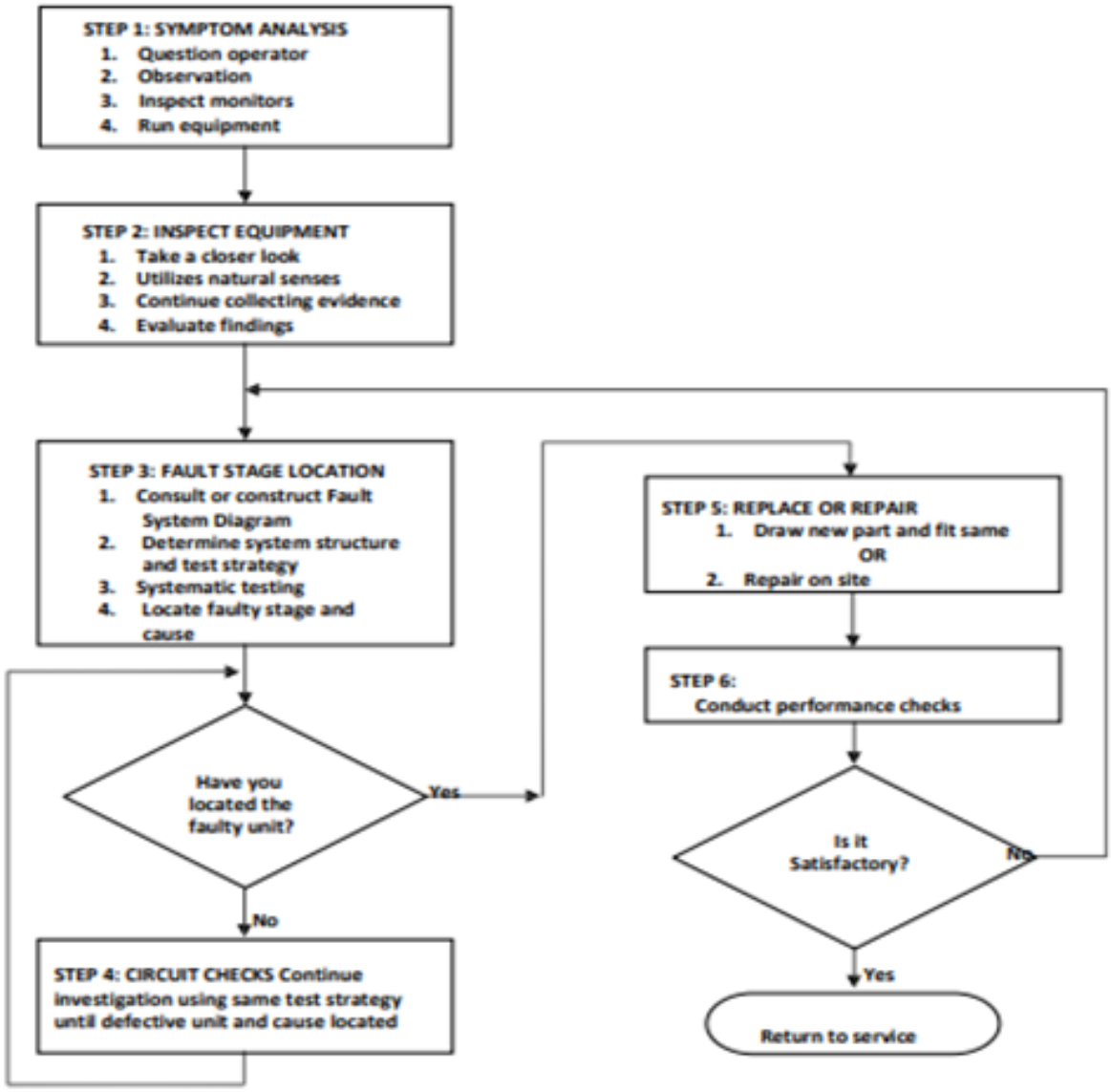
Score = _____

Rating: _____

Information sheet 3- Identifying special test procedures and parameters

Table1.testprocedureparameters

| *System* | *Monitored Parameters* |
|---|---|
| Engine operating parameters | Speed, power, rotation direction |
| Fuel oil system | Pressures in various parts of system, temperature, viscosity, leakage |
| Cooling water system (fresh water and sea water) | Pressures, temperatures |
| Piston cooling parameters | Pressure, temperature, flow |
| Cylinder fresh water cooling system | Pressure, temperature, flow |
| Fuel valve coolant | Pressure, temperature |
| Lubricating oil system | Pressures, temperatures, flow |
| Compressed air system | Pressures |
| Scavenging air system | Pressures, temperature |
| Exhaust gas | Temperatures |
| Turbocharger parameters | Lubricating oil temperatures, pressures, speed |




. Figure 3. Test procedure

Information sheet 4- Explaining operating principles of hydraulic, pneumatic, mechanical and electrical/electronic systems

Hydraulic system is a drive technology where a fluid is used to move the energy from e.g. an electric motor to an actuator, such as a hydraulic cylinder. The hydraulic system works on the principle of Pascal's law which says that the pressure in an enclosed fluid is uniform in all the directions. The fluid is theoretically uncompressible and the fluid path can be flexible in the same way as an electric cable. The basic principle behind any hydraulic system is very simple - pressure applied anywhere to a body of fluid causes a force to be transmitted equally in all directions, with the force acting at right angles to any surface in contact with the fluid.

The controlled movement of parts or a controlled application of force is a common requirement in the industries. These operations are performed mainly by using electrical machines or diesel, petrol and steam engines as a prime mover. These prime movers can provide various movements to the objects by using some mechanical attachments like screw jack, lever, rack, and pinions etc. However, these are not the only prime movers. The enclosed fluids (liquids and gases) can also be used as prime movers to provide controlled motion and force to the objects or substances. The specially designed enclosed fluid systems can provide both linear as well as rotary motion.

**Basic Components of a Hydraulic System**

Hydraulic systems are power-transmitting assemblies employing pressurized liquid as a fluid for transmitting energy from an energy-generating source to an energy-using point to accomplish useful work.

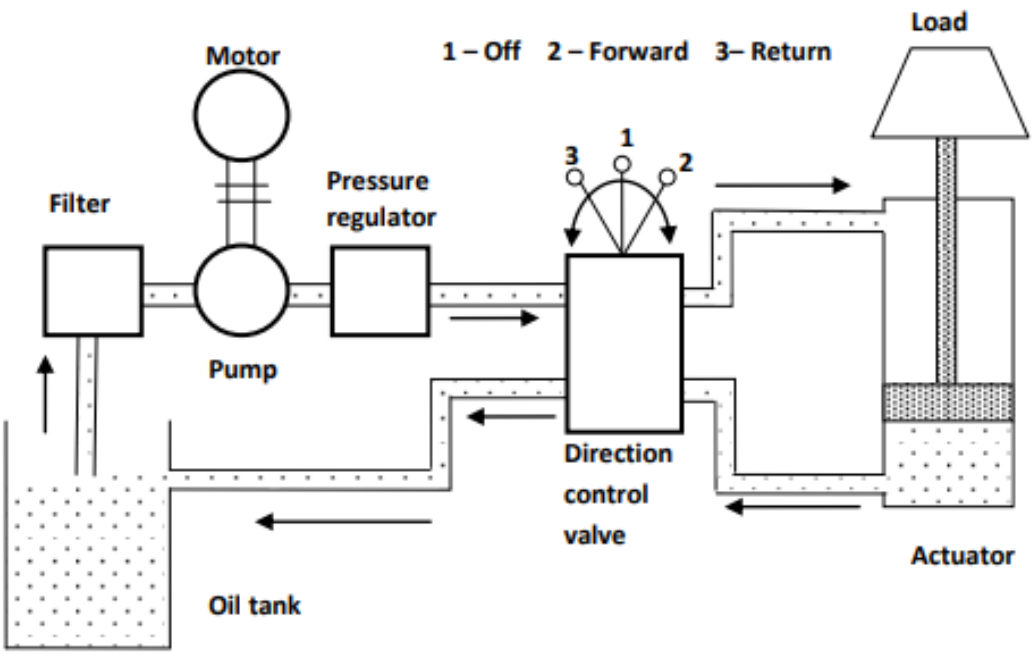



Figure 4. Components of a hydraulic system

Function of the components shown in figure 4 as follows:

1. The hydraulic actuator is a device used to convert the fluid power into mechanical power to do useful work. The actuator may be of the linear type (e.g. hydraulic cylinder) or rotary type (e.g. hydraulic motor) to provide linear or rotary motion, respectively.

2. 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.

3. Valves are used to control the direction, pressure and flow rate of a fluid flowing through the circuit. Motor 1 – Off 2 – Forward 3– Return 3 2 1 Load Direction control valve Pump Oil tank Filter Actuator Pressure regulator

4. External power supply (motor) is required to drive the pump.

5. Reservoir is used to hold the hydraulic liquid, usually hydraulic oil.

6. Piping system carries the hydraulic oil from one place to another.

7. Filters are used to remove any foreign particles so as keep the fluid system clean and efficient, as well as avoid damage to the actuator and valves.

8. Pressure regulator regulates (i.e., maintains) the required level of pressure in the hydraulic fluid. The piping shown in Figure. 4 is closed-loop type with fluid transferred from the storage tank to one side of the piston and returned back from the other side of the piston to the tank. Fluid is drawn from the tank by a pump that produces fluid flow at the required level of pressure. If the fluid pressure exceeds the required level, then the excess fluid returns back to the reservoir and remains there until the pressure acquires the required level. Cylinder movement is controlled by a three-position change over a control valve.

1. When the piston of the valve is changed to upper position, the pipe pressure line is connected to port A and thus the load is raised.

2. When the position of the valve is changed to lower position, the pipe pressure line is connected to port B and thus the load is lowered.

3. When the valve is at center position, it locks the fluid into the cylinder (thereby holding it in position) and dead-ends the fluid line (causing all the pump output fluid to return to tank via the pressure relief)

**Pneumatic system**

A pneumatic system is a system that uses compressed air to transmit and control energy. Pneumatic systems are used extensively in various industries. Most pneumatic systems rely on a constant supply of compressed air to make them work. This is provided by an air compressor. The compressor sucks in air from the atmosphere and

stores it in a high pressure tank called a receiver. This compressed air is then supplied to the system through a series of pipes and valves.

The word ‘Pneumatic’ means air. Pneumatics is all about using compressed air to do the work. Compressed air is the air from the atmosphere which is reduced in volume by compression thus increasing its pressure. It is used as a working medium normally at a pressure of 6 kg/sq mm to 8 kg/sq mm. For using pneumatic systems, maximum force up to 50 KN can be developed. Actuation of the controls can be manual, pneumatic or electrical actuation. Compressed air is mainly used to do work by acting on a piston or vane.

**Basic Components of a Pneumatic System:**

Pneumatic system carries power by employing compressed gas, generally air, as a fluid for transmitting energy from an energy-generating source to an energy-using point to accomplishusefulwork.

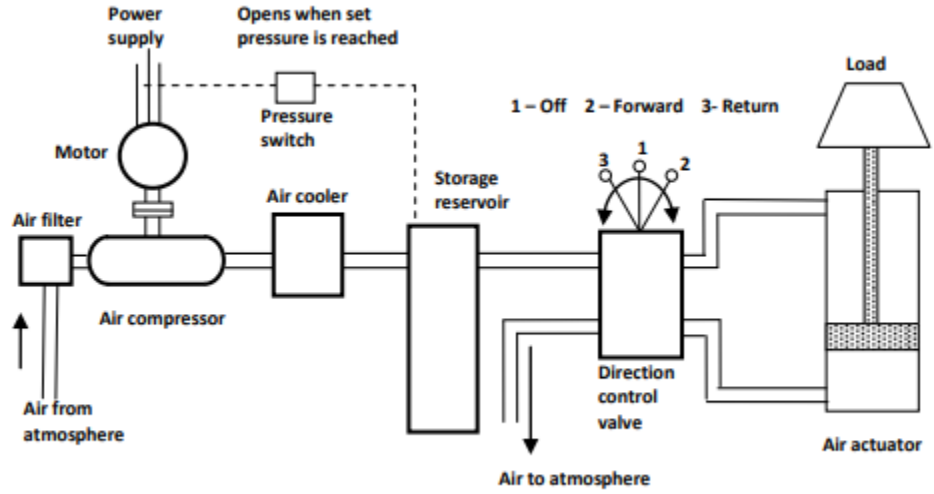



Figure 5. Components of a Pneumatic

The functions of various components shown in figure 5 as follow:

1. The pneumatic actuator converts the fluid power into mechanical power to perform useful work.
2. The compressor is used to compress the fresh air drawn from the atmosphere.
3. The storage reservoir is used to store a given volume of compressed air.
4. The valves are used to control the direction, flow rate and pressure of compressed air.
5. External power supply (motor) is used to drive the compressor.
6. The piping system carries the pressurized air from one location to another.

Air is drawn from the atmosphere through an air filter and raised to required pressure by an air compressor. As the pressure rises, the temperature also rises; hence, an air cooler is provided to cool the air with some preliminary treatment to remove the moisture. The treated pressurized air then needs to get stored to maintain the pressure.

With the storage reservoir, a pressure switch is fitted to start and stop the electric motor when pressure falls and reaches the required level, respectively.

The three-position change over the valve delivering air to the cylinder operates in a way similar to its hydraulic circuit..

Table :2 Comparison between a hydraulic and a pneumatic system

| S. No. | Hydraulic System | Pneumatic System |
|---|---|---|
| 1. | It employs a pressurized liquid as a fluid | It employs a compressed gas, usually air, as a fluid |
| 2. | An oil hydraulic system operates at pressures up to 700 bar | A pneumatic system usually operates at 5–10 bar |
| 3. | Generally designed as closed system | Usually designed as open system |
| 4. | The system slows down when leakage occurs | Leakage does not affect the system much |
| 5. | Valve operations are difficult | Valve operations are easy |
| 6. | Heavier in weight | Lighter in weight |
| 7. | Pumps are used to provide pressurized liquids | Compressors are used to provide compressed gases |
| 8. | The system is unsafe to fire hazards | The system is free from fire hazards |
| 9. | Automatic lubrication is provided | Special arrangements for lubrication are needed |

Information sheet 5- Implementing measures to control identified hazards

Man-machine interfaces that can affect the health and safety of exposed workers must be carefully established, whether they are moving elements (mechanical hazard), electrified components (electrical hazard), machine components that are too hot or too cold (thermal hazard), noise, vibration, visible(laser) or invisible radiation (electromagnetic), hazardous materials or awkward postures (ergonomic hazard).These hazards are then linked to the hazardous situations to which the workers are exposed.

To control hazardous energy, you have to prevent it from being transmitted from its source to the equipment that it powers. You can accomplish that by doing the following:

- Identify energy sources.
- De-energize equipment by isolating or blocking the energy sources.
- Dissipate potential (stored) energy that could affect the equipment.
- Lock out the equipment's energy-isolating device.
- Tag out the energy-isolating device only if you can't lock it out.

**rotating and moving machinery**

**Guard (Protector)**

Physical barrier designed as a component of the machine and that provides a protective function.

A guard can achieve its effect: • alone. It is then effective only when it is held in place securely, if it is a fixed guard; • associated with an interlocking device. In this case, protection is ensured, regardless of the position of the guard.

Fixed guard (equivalent to the "permanent protector" defined in the ROHS) Guard secured in such a way (for example, by screws, nuts or welding) that it can only be opened or removed with tools or by eliminating the means of fixation.

**electrical, hydraulic or pneumatic energy sources**

Auer detector tubes/gas testers these testers are used by drawing air through the detector tubes which contain chemical reagents sensitive to selective gases.

Information Sheet 6. Observing and undertaking checks on the physical condition of equipment's

## 6.1. Observation of physical condition of equipment's

Observation and surveillance condition-monitoring (CM) techniques (i.e., visual, audio, and touch inspections) are based on human sensory capabilities. They can serve as a supplement to other condition-monitoring techniques. These techniques will help detect problems such as loose/worn parts, leaking equipment, poor electrical/pipe connections, steam leaks, pressure relief valve leaks, and surface roughness changes.

Observation and Surveillance condition monitoring Techniques

Visual Inspection Visual inspection practices are the oldest and most common techniques employed in industry. Human observation helps identify a broad range of potential problems, including loose or worn parts; leaks of lubricating oils, hydraulic fluids and process liquids; missing parts; poor electrical or pipe connections; etc. Inspection standards are easy to establish and communicate to assigned personnel. Essentially, all machines and equipment in the industrial setting can be monitored with this technique. Also, human sensory-based inspections can verify the results from other CM techniques..

Audio Inspections Audio inspection practices are common CM techniques employed in industry. The monitoring of machinery and equipment by listening to it operate helps identify a broad range of potential problems, including worn high-friction bearings, steam leaks, pressure relief valve leaks or discharges, coupling leaks, excessive loading on pumps, poor mechanical equipment alignment, etc. Humans are particularly sensitive to new or changed sounds and are easily taught to report and investigate unusual sounds. This technique is often a supplemental inspection to visual inspections. The inspection can be enhanced through the use of directional microphones.

| **Self-Check #6** | Written Test |
|---|---|

Name…… ID…… Date…….

Directions**:** Answer all the questions listed below.

**Write short answer questions (8 points)**

1. What are physical observation to detect equipment fault?

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

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

Information Sheet 7.Recording preliminary observations

## 7.1 Introduction

Records should be made or completed at the time each action is taken. Any change to a record should be approved, signed and dated by authorized persons. Preliminary observations or pre-operational inspection of equipment prior to every use will reduce the chance of equipment being operated in an unsafe condition. Record and report any defects to your supervisor immediate away from where food is stored and prepared

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.

During Preliminary observations of the machine

- Ensure every static machine has been installed properly and is stable
- Choose the right machine for the job
- Ensure fixed guards are in place to prevent hands or other parts of the body from entering the trapping space
- Guards or safety devices must never be removed or adjusted, except by an authorized person for maintenance purposes.
- Working parts should be well lubricated and free of rust and dirt.
- The area around the machine must be adequately lit and kept free of materials, which might cause slips or trips.
- Familiarize yourself with and check all machine operations & controls.
- Faulty equipment must not be used.
- Report faults immediately
- Be aware of other personnel in the immediate vicinity and ensure the area is clear before using equipment.
- 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

**Fault Condition Reporting**

While repairs are under way it is sometimes necessary to hand over the work or the equipment to someone else. If this is to work efficiently you must be able to pass on all relevant information. This is also important to ensure the safety of all personnel while the system is not in its usual operating condition.

**The steps involved are:**

1. Document all changes to normal operational line-up either in the log or, if the system is in use, on forms supplied for this purpose. You should also make notes in your personal journal.

2. Set out work schedules in accordance with safe practices and nominated company procedures. This may require you to document all notifications given to relevant persons together with authority to carry out running repairs, work permits, clearance certificates, tags(danger and out of service, etc.)

3. Highlight any special precautions or fallback procedures relating to operation of running equipment.

4. Prepare a concise report on the current status of the repair being undertaken including personnel involved, equipment or tooling obtained, equipment or tooling ordered or required, parts availability, strip-down status of the machine and estimated completion time.

**Table 3.Fault recording Format**

| Fault/symptom | Possible Cause | Solution |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

| **Self-Check #7** | Written Test |
|---|---|

Name…… ID…… Date…….

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

Write short answer (8 points)

1. List the fault occur at preliminary observation?

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

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

## Information Sheet 8.Discussing test procedures with appropriate personnel

A machine operator is a person trained in operating, controlling, and maintaining high speed sophisticated machines and equipment that are used in the manufacturing of smaller production equipment and other utility products. Machine operators perform various duties which include arranging and testing machines before production, cleaning up machine parts after each work procedure, inserting all production materials in the various parts of the machine for enhancement of production output, and troubleshooting machine problems to determine faults.

In food processing industry, working with appropriate personnel is very important equipment testing including

- Scheduling maintenance for fault
- Isolated or locked flammable/explosive/toxic from work area
- Carrying out equipment maintenance
- Monitoring and maintaining warehouse equipment and machinery
- Setting up manufacturing equipment
- Overseeing training of new or Junior Machine Operators
- Using machine equipment to complete tasks
- Performing routine inspections of manufacturing equipment
- Evaluating the efficiency of each unit regularly, identifying improvements as needed.

.

| **Self-Check #8** | Written Test |
|---|---|

Name…… ID…… Date…….

**Directions:** Answer all the questions listed below.

Write short answer questions (6 points)

1. Why appropriate personnel is important in food company?

2. Explain the role of machine operator?

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

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

| LG #40 | 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 and areas
- planning testing sequence/s noting areas
- 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 and areas
- plan testing sequence/s noting areas
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Follow the instructions described below.

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## Information Sheet 1. Checking specifications and notes from preliminary observations and areas

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. 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. 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.

Table 4. Fruit grinder Specification

| No | Name | Specification |
|---|---|---|
| 1 | Grinder or Juicer | Material :stainless steel,Power:350 watt,Capacity:5L,Voltage :220-240v,Cord length:1.2m,Volume :500ml,Box dimension :232x330x470, Weight:3.59kg |

Figure Juicer

| **Self-Check #1** | Written Test |
|---|---|

Name…… ID…… Date…….

**Directions:** Answer all the questions listed below.

Write short answer questions (6 points)

1. Define equipment specification ?(3pts)
2. Write the advantage of operational manual (3pts)

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

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

Information Sheet 2. Planning testing sequences of noting areas

## 2.1. Planning testing sequences

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 establishes objectives that define the criteria for judging success or failure of the management system.

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. Having established the symptoms of a fault it is then necessary to conduct tests to confirm the symptoms and to attempt to determine the location of the fault within the equipment. Manufacturers will often build test points into the system. Built in test facilities are generally for first line maintenance staff, such as lamps, pressure gauges, multi meters etc. Facilities for testing equipment are often limited. However it is desirable that plant users specify (when able to) what is required to make the system maintainable by means of diagnostic methods. Consider the problem then collect and evaluate the facts. The fundamental steps in the logical diagnostic process for all type of equipment are:

- Symptom analysis
- Equipment Inspection
- Fault stage location
- Circuit checks
- Repair or replace
- Perform test

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.

| Self-Check #2 | Written Test |
|---|---|

Name…… ID…… Date…….

**Directions:** Answer all the questions listed below.

**Short Answer Questions (6 points)**

1. Define planning ?(2pts)
2. What is an operational plan? (2pts)
3. What is systematic test planning ?(2pts)

***Note:*** **Satisfactory rating ≥3points** **Unsatisfactory – below3 points**

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

**Information Sheet 3. Identifying Safe area for testing**

## 3.1. Arranging Safe area for testing

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 testing location must either be sufficiently remote that there is no risk to people, or a form of enclosure must be provided to contain the unintended release of stored energy.

The arrangement should be that the minimum amount of sanitary piping is used, consistent with efficient operation. 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 (1part cement and 2 1/2 parts sand) and sufficient water. 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.

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. 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.

Work surface area for each worker must be more than 1.2 m across (recommended to be at least 1.5 m) and 0.6 m deep, excluding bench space for laboratory equipment

Deeper worktop may be required for specific and large equipment where access to back of the worktop from the front is not normally required.

Sufficient leg/knee clearance should be left under the bench top for persons who use the bench top as a working/write-up area. Personnel working within laboratory areas must be able to work and move unimpeded by each other and by fixed equipment.

| 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 (6 points)**

1. What is the advantage of working in safe area?

***Note:*** **Satisfactory rating ≥3points** **Unsatisfactory – below 3 points**

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

## Information Sheet 4. Making arrangements for any additional resources

Plant layout is the arrangement of equipment/ machines/ facilities in a plant for the efficient functioning of the whole system with a view to maximize the profit. All the equipment and conveying machines should be arranged in proper coordination depending on the flow sequence and characteristics of equipment. Safety design in industry should be organized with the highest hazards (e.g., fume hoods) farthest from the entry door and the least hazardous elements (e.g., write-up stations) closest to the door. Write-up desks and benches should be accessible without having to cross in front of fume hoods. All safety equipment such as emergency showers, eyewashes, first-aid kits and spill kits, adequacy of storage facilities, and maintenance. There should be at least one ABC fire extinguisher either inside the lab, or in close proximity Good housekeeping is also a basic part of accident and fire prevention. Effective housekeeping can eliminate some workplace hazards and help get a job done safely and properly. Poor housekeeping can frequently contribute to accidents by hiding hazards that cause injuries.

Proper placement of equipment and conveying machines- Depending on requirements, the layout can be single level, multi storied, or combined designs.

Economic distribution of services- The layout, in addition to proper placement of important equipment, should also have provision for efficient and economic distribution of water, process steam, power, and gas, etc. The distribution lines for these utilities should not interrupt the normal working of the people

. Suitable use of floor and elevation space- This will depend on the type of food processing plant and the special facilities and equipment used for the system. • New site development or addition to a previously developed site- If we want to plan the plant on a site, which already has some installed equipment, office rooms and storage godowns, etc., then the layout should consider these amenities

Future expansion- The layout should have sufficient provision for future expansion. The layout should have adequate provision for disposal of solid, liquid and gaseous wastes..

A good plant layout, in general, has the following advantages

- Better utilization of machine and man power, and services;
- Reduced material handling, thus saving in labor and cost, less production delays;
- Reduced inventory in process, thus saving in investment and working capital;
- Increased output/ production per unit time, labor, money and energy; and
- Easier and better supervision

In addition to the above, a properly designed layout helps to maintain proper sanitation and safety standards in a plant. It reduces confusion between different sections of workers, and improves moral of the workers. All these factors directly affect the output.

| Self-Check #4 | Written Test |
|---|---|

Name…… ID…… Date…….

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

**Write short answer (10 points)**

1. How arrange the additional resource in industry?(2)
2. What is layout ?(2)
3. List the advantage of plant's good layout?(4)

***Note:*** **Satisfactory rating ≥5points** **Unsatisfactory – below5 points**

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

| LG #41 | **LO#3- Check unit through full operational range.** |
|---|---|
| Instruction sheet | |
| **Learning Instructions:** | |
| Read the specific objectives of this Learning Guide.<br>Follow the instructions described below.<br>1. 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.<br>2. Accomplish the “Self-checks” which are placed following all information sheets.<br>3. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks). | |

Information Sheet 1- Undertaking testing, observing relevant safety and operation

### 1.1. Introduction

Testing is the process of exercising one or more assessment objects under specified conditions to compare actual and expected behaviors or examination of the process of checking, inspecting and reviewing, observing, studding or analyzing one or more assessment objects to facilitate understanding, achieve clarification or obtain evidence.

### 1.2. Undertaking testing

All electrical installations will require inspection and testing at periodic intervals as they will deteriorate with age, use, possible damage and any additions or alterations by non-competent persons.

### 1.3. Observing relevant safety and operation

Safety can basically be defined as principles and procedures adopted in a working Environment aimed at reducing the risk of endangering one's health and equipment's. 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. Safety management like any other system in a working environment has implications on ethical issues, set-up rules, regulations and direct or indirect financial burden.

#### 1.3.1 Check equipment before use or pre-use inspections

Ensure that all power sources are turned off when the machine is not in use. This includes electrical and pneumatic power. Understand the lockout/tag out procedure and use it before inspecting, maintaining, servicing or cleaning the equipment to help prevent anyone from accidentally turning on power to the machine.

Read the manual for any special operational instructions for each piece of equipment and know how the equipment functions and understand the operating processes.

Know how to shut down the equipment and stop buttons, emergency stop buttons or cables are located at various locations on the machinery.

Activating these stop mechanisms will shut down specific equipment and know where these stops are located and the equipment they shut down before operating the machinery.

- Understand the equipment safety labels and heed them.
- For new equipment, check plant voltage with the voltage specified on the machine.
- Electrical specifications for your machine are printed on the machine serial number tag.
- A properly grounded electrical receptacle is required for safe operation regardless of voltage requirements
- Treat this equipment with the respect its power and speed demand. Use it only for its intended purpose. Keep the operating zone free of obstacles that could cause a person to trip or fall toward an operating machine.
- Keep fingers, hands or any part of the body out of the machine and away from moving parts when the machine is operating.
- Stay alert and think clearly while operating or servicing the equipment and be aware of operations and personnel in your surroundings.
- Be attentive to indicator lights, warning lights and/or operator interface screens displayed on the machine and know how to respond.
- Do not operate machinery if you are fatigued, emotionally distressed or under the influence of drugs or alcohol.
- Know where the first aid safety station and fire extinguishing equipment is located.
- Never sit or stand on the machine or on anything that might cause you to fall against the machine.
- The purpose of an observation is to identify and reinforce safe behaviors, and eliminate unsafe behaviors and protect equipment from break down.

- Keep clear and never put any foreign object into the operating area.

### 1.3.2 Safety symbols in operating equipment


Indicates a hazardous situation which, if not avoided, WILL result in death or serious injury.


Indicates a hazardous situation which, if not avoided, COULD result in death or serious injury.


Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.


Indicates information considered important but not hazard related (EX: messages relating to equipment/property damage).

| 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 the relevant inspection and testing.(4pts)

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 - 8 points** **Unsatisfactory - below -8 points**

Information Sheet 2- Confirming results and findings

## 2.1 Confirming results and findings

Confirming results and findings by observations of work environment, work practices, equipment used, work posture or reported hazard. 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 is a formalized procedure for identifying workplace hazards. There are three main types of inspections: one-time inspections, pre-use inspections, and periodic inspections. One-time inspections are performed before operating new or modified equipment or processes.

Periodic inspections are done at some regular interval to evaluate areas that have the potential to cause injuries. They should be done often enough to find hazards before they cause injures. For example, monthly inspections of departments in a manufacturing facility may be sufficient, but more frequent inspections are required for areas.

Confirming results and findings

- Faults are diagnosed without causing damage to workplace property, component or equipment.

- Any faults in conflict with roadworthiness or safe operation of component/equipment are immediately brought to the attention of the supervisor for action.
- Inspections are carried out according to industry regulations/guidelines, OH&S legislation, legislation and enterprise procedures/policies.
- Settings and adjustments of the equipment can be performed by and independent qualified agency familiar with this work.
- Quick checks before use (e.g. electric cable condition on hand-held power tools, functional testing of brakes, lights on mobile machinery)
- Weekly checks (e.g. presence of guarding, function of safety devices, tyre pressures, and the condition of windows, mirrors and on mobile plant).
- Some of the reasons of equipment failure are incorrect installation, reinstallation, deterioration or any other circumstances.

| 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: Choose the best answer** (8 point)

**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 –>5 points** **Unsatisfactory - below -5 points**

| LG #42 | LO#4-identify fault and 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 or problem on work schedule
- Faults finding, cost/time implications and approval systems in records proposal's for equipment repair
- Explaining report
- Undertaking repairs with appropriate procedures

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**:

- Identifies impact of fault or problem on work schedule
- Faults finding, cost/time implications and approval systems in records proposal's for equipment repair
- Explain report
- Undertake repairs with appropriate procedures

**Learning Instructions:**

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

Information Sheet 1- Identifying impact of fault or problem on work schedule

### 1.1 Introduction

The primary reasons heavy equipment breaks down are poor maintenance, poor electrical connections, not replacing worn parts and ignoring warning signals so that the operator must check the equipment electrical connections, oil levels, replace belts and worn out parts and understand warning signals to protect equipment and the worker health .

### 1.2 Causes of equipment faults and its characteristics

Equipment 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.

There are two basic causes of equipment failure. Thus are

A. routine causes and

B. non-routine causes

A. Routine causes of faults

Routine causes can be resolved by applying operational knowledge to apply existing, or develop new solutions, either individually or in collaboration with relevant experts.

- develop solutions to faults which do not have a known solution
- follow through items initiated until final resolution has occurred
- faults outside area of responsibility/expertise to designated person

B. Non-routine causes

Non-routine faults are unexpected faults or variations of previous faults and are associated with one or more of the following:

- response of equipment to materials variations

- new or changed materials
- changed equipment settings (e.g. higher speed or throughput)
- equipment breakdown or in need of maintenance
- out-of-specification product or variations

### 1.3. Electrical Equipment faults

The electrical power system is growing in size and complexity in all sectors such as generation, transmission, distribution, and load systems. An electrical fault is the deviation of voltages and currents from nominal values or states. Under normal operating conditions, power system equipment or lines carry normal voltages and currents which results in safer operation of the system.

The main reasons to cause electrical faults include the following.

**Equipment Failures**

Various electrical equipment like drum washing, blanching, grading and sorting etc. causes short circuit faults due to malfunctioning, aging, insulation failure of cables, and winding. These failures result in high current to flow through the devices or equipment which further damages it.

**Human Errors**

Electrical faults are also caused due to human errors such as selecting improper rating of equipment or devices, forgetting metallic or electrical conducting parts after servicing or maintenance, switching the circuit while it is under servicing, etc.

**Smoke of fires**

Ionization of air, due to smoke particles, surrounding the overhead lines results in spark between the lines or between conductors to the insulator. This flashover causes insulators to lose their insulating capacity due to high voltages.

**Over current flow**

When the fault occurs it creates a very low impedance path for the current flow. This results in a very high current being drawn from the supply, causing the tripping of relays, damaging insulation and components of the equipment.

**Loss of Equipment**

Heavy current due to short circuit faults results in the components being burnt completely which leads to improper working of equipment or device. Sometimes heavy fire causes complete burnout of the equipment.

**Disturbs Interconnected Active Circuits**

Faults not only affect the location at which they occur but also disturb the active interconnected circuits to the faulted line.

**Electrical Fires**

Short circuit causes flashovers and sparks due to the ionization of air between two conducting paths which further leads to fire as we often observe in news such as building and shopping complex fires.

### 1.4. Hydraulics equipment faults

Maintaining your hydraulic equipment is an important part of using it. However, you may encounter issues if you don't follow proper instructions.There are five common hydraulics equipment problems thus are

1. Unnecessary oil changes and using the wrong type of oil
2. Changing the filters too often
3. Overworking the engine

4. Waiting for the equipment to prime itself

5. Not learning how to properly use the equipment

Table 5.Faults and possible cause

| Fault/Symptom | Possible Cause | Remedy |
|---|---|---|
| Machine does not work | The machine is not plugged in | Plug the machine into the electrical outlet |
| | The ground fault safety in the electrical panel has tripped | Check the electrical panel |
| | A fuse in the electrical panel is faulty | Check the electrical panel |
| | A fuse in the machine is faulty | Consult your dealer |
| | The motor protection of the machine is switched off | Consult your dealer |
| The vacuum pump does not run at full speed | The oil is too thick or contaminated | Change the oil. Page20: 10.2 |
| | The pump motor runs on two phases | Check the voltage; if correct, consult your dealer |
| The vacuum in the package is insufficient | The programmed vacuum value is too high | Lower the vacuum value in the program |
| | The packaging material is of poor quality | Select a better-quality packaging material |
| | The product damages the bag | Program a higher value for Soft-Air |
| | The machine gases the package | Turn off the gassing function |
| The seal is leaking | The package seam is poorly formed | Increase the sealing time and/or reduce the MAP gas pressure |
| | The package seam is burnt | Decrease the sealing time |
| | The opening of the vacuum bag is contaminated | Try again and make sure that the opening of the bag stays clean |
| | The sealing beam is dirty | Clean the sealing beam |
| | The Teflon lining of the sealing beam is damaged | Replace the Teflon lining |
| | The silicon rubber seal in the counter beam is damaged | Replace the silicon rubber seal |

| | | |
|---|---|---|
| There is not enough gas in the bag | The bag is too small | Select a bigger bag |
| | The programmed gas level is too low | Increase the gas level value |
| | The bag is not correctly positioned over the gas outlets | Adjust the bag position |
| The machine does not seal | The bag is not correctly positioned over the sealing beam | Adjust the bag position |
| | The sealing wire is broken | Replace the sealing wire |
| | The thermal safety of the power supply was tripped | Wait until the safety resets, which can take half an hour. Decrease the sealing time |
| | The electrical contacts of the seal beam have fouled | Remove the seal beam and clean the pins and contacts with sand paper |
| The service symbol appears when turning on the machine, indicating the remaining production hours or cycles | The service interval counters have reached their maximum programmed values   | To reset the service interval counters after the oil change: Start machine and while the display shows the hours or cycles, press and hold the button |

## 1.5 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.

| 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: Give short and answer** (**10point)**

1. What is equipment fault? (2pts)
2. Write down three mechanisms for reduction of equipment faults? (4pts)
3. 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 (4pts)

***Note:*** **Satisfactory rating – 7points** **Unsatisfactory - below -7 points**

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

Information Sheet 2- Faults finding, cost/time implications and approval systems in records proposal's for equipment repair

2.1 .Fault finding technique

The fault finding technique is a method for finding and fixing operating malfunctions. These steps include collecting evidence, analyzing evidence, locating faults, determining and removing causes, rectifying faults and running a systems check.

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 and identify the root cause. 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.

Repairs are restoration work for when something gets broken, damaged or stops working.

Maintenance are routine activities meant to prevent damage and prolong the life of appliances, fixtures, and the property itself. Examples include regular cleaning of air-conditioning units, grease traps, repainting, and the likes. In these examples, nothing is broken or damaged, but work is still done to slow down deterioration.

## 2.2. Benefits of keeping maintenance and repair record

1. Prevent expensive repair works from happening
2. Helps you create specialized maintenance programs
3. Prevent problems regarding warranty claims
4. It increases the safety of operators
5. Helps you track who is accountable for a piece of equipment

6. It increases the resale value of the equipment

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<br>• Common problems |
| The spare parts and materials used | • The parts most frequently used<br>• 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)<br>• 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 |

| 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: Give short and answer** (**4 point)**

1. 1. Write down task undertaken for repair and maintenance 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 - 5 points** **Unsatisfactory - below 5points**

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

Information Sheet 3- Explaining report

### 3.1 Explaining report

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

A .Reduce labor intensive diagnostic evaluation

B. Eliminate diagnostic testing down time

C. provide notification to management for degraded operation

A report should include

- Background information where and when the faults was reported or the incident occurred, who and what was involved.etc.
- An account of the potential effects of the equipment faults, the of incident, sequence of events of damage.
- An analysis of the equipment faults or damage causes
- Recommendation for immediate and long term action to remedy the faults or prevent the reoccurrence of an incident

### 3.2 Explaining how completed reports are used.

Management uses the report to decide on corrective action and recommendation.

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

a good way to identify areas that need more attention to safety is to periodically analyze the incident 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

B) An account of the potential effects of the equipment faults, the of incident, sequence of events, extent of damage.

C) An analysis of the equipment faults or damage

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 incident report. (3 pts.)

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

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

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

Score = _____

Rating: _____

## 4.1. Undertaking repairs

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

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

1. Ongoing maintenance costs over the remaining life of the equipment
2. The impact any repair would have on productivity and quality
3. Costs incurred from the equipment downtime
4. Health, safety, and environmental costs that come with equipment breakdown
5. Training costs for a new piece of equipment
6. Disposal costs
7. Installation costs

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

1. Analyze the Costs

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

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

2. Consider the Age of Equipment

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

3. Consider the Cost of Repairs

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

4. Consider Downtime

If it takes several days to repair, and if this happens frequently, you're looking at too many hours of lost productivity. Consider this when deciding if repair or replacement is better in your situation.

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

5. Consider Safety

Remember that older equipment can cause injury to workers if it malfunctions. Even if you stay up to date on maintenance, equipment wears down as it ages. Thoroughly inspect your machinery before making your decision so you can determine if your

current equipment will continue to provide a safe environment for your workers. If it won't, replacement is the obvious choice. If it is still meeting safety standards, it's worth comparing costs of a replacement versus repair.

6. Consider Efficiency

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

### 4.2 Repair and Maintenance activities

Routine maintenance refers to any maintenance task that is done on a planned and ongoing basis to identify and prevent problems before they result in equipment failure. Some common routine maintenance includes regular inspections or service work. These can be carried out on a time-based schedule or on a usage-based schedule. Routine maintenance tasks are usually fairly straightforward. They typically do not require specialized maintenance training, skills, or equipment to complete. Because of that, routine maintenance can be carried out by staff outside of the maintenance department, such as machine operators.

Typical examples of routine maintenance include:

- Lubricating, cleaning, or adjusting machinery
- Inspecting equipment to ensure proper operation and safety
- Replacing parts that show deterioration
- Checking, testing, and maintaining safety equipment, such as safety barriers, fire extinguishers, or alarm systems
- Checking for and replacing damaged signage or utilities, like light bulbs

- General workplace maintenance, such as cleaning floors, replacing filters, and washing windows, trash removal, and landscaping

**Advantages of routine maintenance**

There are several advantages to performing routine maintenance at your facility.

- Routine maintenance can decrease downtime and lengthen the lifespan of equipment when used in conjunction with a well-planned preventive maintenance
- Regular routine maintenance can reduce the need for reactive maintenance

Routine maintenance helps assets and equipment working in optimal conditions, leading to fewer failures, better productivity, higher profitability, and improved safety.

**Predictive testing and inspection activities**

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**

System or equipment repairs that unlike preventive maintenance work is unscheduled and unanticipated.

**4.1. Equipment Performance.**

The ideal cycle time is the time taken to produce one unit at rated speed, while the actual cycle time is the machine's operating time divided by the number of units produced. To work out the performance score for a machine, divide the ideal cycle time by the actual cycle time

| 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 (2pts)

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

## Reference Materials

Book:

**WEB ADDRESSES**


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