Lapidary

Level-II

Based on Jan 2014, Version 1 OS and April, 2021, V1 Curriculum

Module title: Undertake Routine Operational Maintenance of Machinery

LG Code: MIN LAP2M03LO(1-3)LG(30-32)

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LG #30	LO #1- Perform operational maintenance

Instruction sheet

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

- Performing basic operational maintenance on the equipment and machinery
- Adjusting ,cleaning and storing equipment

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

- Perform maintenance on the equipment and machinery
- Adjust ,clean and store equipment

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).
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Information Sheet 1- Performing basic operational maintenance on the equipment and machinery

1.1 Operational maintenance

Operational maintenance is the care and minor maintenance of equipment using procedures that do not require detailed technical knowledge of the equipment's or system's function and design. This category of operational maintenance normally consists of:

- Inspecting
- Cleaning
- Servicing
- Preserving
- Lubricating, and adjusting, as required.

Such maintenance may also include minor parts replacement that does not require the person performing the work to have highly technical skills or to perform internal alignment.

Operational maintenance can be done in different servicing schedules as:

- Daily
- Weekly
- Monthly
- Quarterly
- Annually

Normal wear and tear can result in lower machine efficiency. Preventive maintenance assures optimal working conditions and conserves the life span of the

equipment. A planned preventive maintenance may cause small hindrance for production, but that is nothing compared to actual downtime caused by a breakdown

As the term implies, operational maintenance, is performed by the operator of the equipment. Its purpose is threefold:

1. to make the operator aware of the state of readiness of the equipment;
2. to reduce the delays that would occur if a qualified technician had to be called every time a simple adjustment were needed; and
3. to release technicians for more complicated work

This form of preventative maintenance can be performed in any setting where machines, equipment, or vehicles are used. This may include manufacturing plants and factories, lapidary work shop as well as automotive shops. Some operational maintenance responsibilities can be as simple as inspecting the machine to spot any changes or issues. This allows the operator to detect a potential danger, such as loose fasteners or debris that could contribute to an accident. Basic cleaning, including removing debris or excess grease from a machine, is also considered part of operational maintenance.

Depending on the type of equipment in use, operators may also be responsible for replacing worn out filters or cartridges, or removing and replacing a worn belt, cutting tool, or grinding stone. Operational maintenance may entail keeping machinery well lubricated to reduce the risk of friction or failure. Many basic machine adjustments needed during the course of operation also fall within this category of preventative maintenance.

1.2 Maintenance vs. Operations.

The maintenance department and the operation side of a business are often disconnected. Operations focus on maximum production; run equipment 100% of the time to produce as much product as possible. The maintenance team on the other hand value preserving the lifespan of the equipment.

Here are five top tips for large machinery maintenance:

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

1.3 basic types of maintenance

Maintenance may be classified into four categories:
(Some authors prefer three categories- scheduled and preventive maintenances are merged)

- Corrective or Breakdown maintenance
- Scheduled maintenance
- Preventive maintenance
- Predictive (Condition-based) maintenance

A. Corrective or Breakdown maintenance

✓ Corrective or Breakdown maintenance implies that repairs are made after the equipment is failed and cannot perform its normal function anymore

✓ Quite justified in small factories where:
- Down times are non-critical and repair costs are less than other type of maintenance
- Financial justification for scheduling are not felt

Disadvantages of Corrective Maintenance

- Breakdown generally occurs inappropriate times leading to poor and hurried maintenance
- Excessive delay in production & reduces output
- Faster plant deterioration
- Increases chances of accidents and less safety for both workers and machines
- More spoilt materials
- Direct loss of profit

- Cannot be employed for equipments regulated by statutory provisions e.g. cranes, lift and hoists etc

B. Scheduled Maintenance

- Scheduled maintenance is a stitch-in-time procedure and incorporates
  - inspection
  - lubrication
  - repair and overhaul of equipments
- If neglected can result in breakdown
- Generally followed for:
  - overhauling of machines
  - changing of heavy equipment oils
  - Cleaning of water and other tanks etc.

C. Preventive Maintenance (PM)

- Principle – “Prevention is better than cure”
- Procedure - Stitch-in-time
- It
  - locates weak spots of machinery and equipments
  - provides them periodic/scheduled inspections and minor repairs to reduce the danger of unanticipated breakdowns

Advantages of PM

- Reduces break down and thereby down time
- Lass odd-time repair and reduces over time of crews
- Greater safety of workers
- Lower maintenance and repair costs
- Less stand-by equipments and spare parts
- Better product quality and fewer reworks and scraps
- Increases plant life
- Increases chances to get production incentive bonus

D. Predictive (Condition-based) Maintenance

- In predictive maintenance, machinery conditions are periodically monitored and this enables the maintenance crews to take timely actions, such as machine adjustment, repair or overhaul
- It makes use of human sense and other sensitive instruments, such as
    - ✓ Audio gauge
    - ✓ Vibration analyzer
    - ✓ Amplitude meter
    - ✓ Pressure
    - ✓ Temperature and resistance strain gauges etc.
- Unusual sounds coming out of a rotating equipment predicts a trouble
- An excessively hot electric cable predicts a trouble
- Simple hand touch can point out many unusual equipment conditions and thus predicts a trouble

Each type of maintenance has its own design of programs that include the list of information about different issues about the equipment /machinery/part. For instance,the necessary items for establishing an effective preventive maintenance program are:

1. Every equipment uniquely identified by prominent ID number or serial number and product type
2. Accurate equipment history records
3. Failure information by problem/cause/action
4. Experience data from similar equipment
5. Manufacturer's interval and procedure recommendations
6. Service manuals
7. Consumables and replaceable parts
8. Skilled personnel
9. Proper test instruments and tools
10. Clear instructions with a checklist to be signed off
11. User cooperation
12. Management support.

Table: preventive maintenance check list

Preventive maintenance parameters	Yes	No	Comment
Standardization • Is equipment already in use that provides the desired function? • Is this the same as existing equipment? • Are there problems with existing equipment? • Can we maintain this equipment with existing personnel? • Are maintenance requirements compatible with our current procedures'?			
Reliability and Maintainability • Can vendor prove the equipment will operate at least to our specifications? • Warranty of all parts and labor • Is design fault-tolerant? • Are tests go/no go'?			
Service Parts • Is recommended replacement list provided? • Is the dollar total of spares less than 10%, of equipment cost? • Do we already have usable parts? • Can parts be purchased from other vendors'? • Are any especially high quality or expensive parts required'?			
Training • Is special technician training required'? • Will manufacturer provide training? • At no additional cost for first year'? • At our location as required'.)			
Documentation • All technical manuals provided? • Installation • Operation • Corrective and preventive maintenance • Parts			
Special Tools and Test Equipment • Do we already have all required tools and test equipment? • Can at least 95% of all faults be detected by use of proposed equipment'? • Are calibration procedures minimum and clear?			
Safety • Are OHS and other applicable requirements met? • Arc any special precautions required'? • Can one person do all maintenance?			

Preventive maintenance is the common type of maintenance that operators at the low levels are required to perform. The major procedures that should be followed to perform preventive maintenance include the following steps:

1. schedule and perform regular inspections of machinery and equipment
2. conduct regular cleaning of machinery, equipments and other related facility
3. lubricating moving parts to reduce wear and tear
4. adjust controls for optimal performance and energy efficiency
5. repair and replace any defective machinery and equipment parts

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 operational maintenance? (2pts)
2. List at least 3 purposes of operational maintenance.(3pts)
3. What is the difference between maintenance and operations departments?(2pts)

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

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

Score = _____

Rating: _____

Information Sheet 2- Adjusting, cleaning and storing equipment

2.1 Adjusting equipment

After maintenance of faults of the machinery and equipment, adjustments including assembling the disassembled parts, tightening of the loosen parts, allocating of the equipment at the right position, updating operating parameters of the equipment

Preventive maintenance includes measures such as systematic and routine cleaning, adjustment and replacement of equipment parts at scheduled intervals.

2.2 Cleaning maintained machinery and equipments

Cleaning is a routine activity that should be always performed after completion maintenance work. Here integrated with cleaning is the proper lubricating of parts of machines and equipments with high friction areas Cleaning is usually being termed as part of a preventive maintenance. To clean machines, proper detergents should be selected as per their application requirements.

The cleaning tools commonly used include:

1. Basics (basic compounds)
2. Brooms
3. Cotton Mops.
4. Scrub brushes.
5. Scrub brushes.

NOTE: After use the cleaning tools should be properly cleaned. Use the following tool technique as a guide line.

1. Basics. Clean brooms, brushes and mops after that day's use. ...
2. Brooms. Comb out broom fibers regularly to remove any debris. ...

3. Storage. Always use a holder to keep brooms stored off the floor or store with the bristles upright.
4. Cotton Mops. After each use, rinse cotton mops in hot water and white vinegar
5. Scrub brushes. Wash immediately after use of it.

2.3 Storing maintained machinery and equipments

The term storing is to mean that machines should be put at a common standard place so that they can be accessed easily. Storing is done at predesigned machine and equipment foundations. While storing the machine, it has to be cleaned and lubricated as per the machinery cleaning requirements.

As modern approaches of workshop management, Kaizen should be applied to make work of cleaning and storing effective.

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. What do we mean by adjusting ?(**1pt**)
2. Mention at list 2 equipment cleaning tools.(**1pt**)
3. Describe the techniques used to clean equipment cleaning tools ?(**3pt**)

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

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

Score = _____

Rating: _____

Operation Sheet-1	**Performing preventive maintenance of on a gemstone slab saw.**

Procedures to perform preventive maintenance of trim saw

steps	operations
1	Schedule and perform regular inspections on the machine
2	Conduct regular cleaning of machinery, equipments and other related facility
3	Lubricating moving parts to reduce wear and tear
4	Adjust controls for optimal performance and energy efficiency
5	Repair and replace any defective parts of the machine
6	Finally Clean and store the machine again for further operation

LAP Test 1	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Use all necessary tools, equipment and materials that you require to perform the following tasks within **1hour**

Task 1: perform preventive maintenance on a trim saw.

LG #31	LO #2- Rectify common mechanical faults

Instruction sheet

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

- Diagnosing mechanical faults
- Selecting tools appropriate to each task
- Seeking assistance for complex faults

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

- Diagnose mechanical faults
- Select tools appropriate to each task
- Seek assistance for complex faults

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
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Information Sheet 1- Diagnosing mechanical faults

1.1 Mechanical faults/failures

The terms 'failure' or 'fault' may be viewed from different angles according to the effect which the lack of performance has on the overall functional capability. Such aspects as economic viability, safety, engineering complexity, speed, causal influences all provide classifications leading to a description of failure.

A. Engineering Failure Classifications

There are two distinct classes of failure:

- Intermittent failure: failures which result in a lack of some function of the component only for a very short period of time, the component reverting to its full operational standard immediately after failure;
- Permanent failure: failures which result in a lack of some function which will continue until some part of the component is replaced.

B. Degree of Failure Classification

Permanent failures may be further subdivided into the following two types:

- Complete failure: failure which causes the complete lack of a required function. (It should be noted that in certain cases the limit when a lack of function is said to be complete is open to interpretation, which depends upon the application);
- Partial failure: failure which leads to a lack of some function but not such as to cause a complete lack of the required function.

C. Speed of failure classification

Both complete and partial permanent failure may be further classified according to the suddenness with which the failure occurs:

- Sudden failure: failure which could not be forecast by prior testing or examination;

- Gradual failure: failure which could have been forecast by testing or examination.

D. Degree and Speed Of Failure Classification

Both failure forms can be combined to give the following further classifications:

- Catastrophic failures: failures which are both sudden and complete;
- Degradation failures: failures which are both partial and gradual.

E. Cause-Of Failure Classification

According to the manner by which failure develops, so it be further classified:

- Wear-out failures: failure attributable to the normal processes of wear as expected when the device was designed;
- Misuse failure: failure attributable to the application of stresses beyond the item's stated capabilities;
- Inherent weakness failure: failure attributable to a lack of suitability in the design or construction of the system or component itself when subjected to stresses within its stated capabilities.

F. Hazard Classification

Possible faults (major or minor failures) may be divided into two broad hazard groups, namely dangerous-failures or safe-failures.

- Dangerous faults: (a) protection system - failure to protect when needed, (b) machine tool - failure causing damage to work and/or operator, (c) traction system - failure to brake;
- Safe faults: (a) protection system - failure to operate when not needed, (b) machine tool - failure to start, (c) traction system - failure of brakes to apply when not needed.

1.2 Causes of failure

- Defects may be broadly classified into those which result in a fracture and those for which fractures do not occur. These may in tum be sub-classified according to the causes due to chemical, thermal and mechanical influences. Further sub-

classification results in the identification of creep, corrosion, fatigue and mechanical fracture with a considerable further sub-classification of such causes of failure.

1.3 Service failures

The failures experienced most frequently in machinery are fracture, excessive deformation and surface failure, particularly corrosion deterioration. Typical review of failures and their causes are given in the following:

- Corrosion
- Excessive deformation
- Contamination
- Fatigue
- Overheating
- Overstressing
- Seizure
- Wear

1.4 Diagnosing mechanical faults

Diagnostic work helps identify potential failures before they occur. The following are several ways it can be applied.

- **Early detection** – longer major component life can be obtained by early detection of minor problems that could lead to premature failures.
- **Component replacement** – by reviewing records, the anticipated failure points can be developed on some components. Replacing these components prior to their expected failure can reduce road calls and unscheduled repairs.
- **Diagnostic equipment** – proper test equipment is another way of diagnosing problems.

- **Failure analysis** – finding the cause of a failure is a critical step in preventing a recurrence. Mechanics must be more than “parts changers” – they need to look for the initial cause, so it doesn’t happen again.
- **Logical inspections** – a logical sequence will reduce inspection time and machine down time. In a logical sequence, an inspector does everything possible prior to moving to another area.
- **Preventive maintenance repairs** – the preventive maintenance inspection consists of inspecting, servicing, adjusting, and performing minor repairs. It is not advisable to perform major repairs during the actual preventive maintenance inspection if the repair requires a changeable part or will take more than 15 minutes. All safety related items should be repaired prior to placing the machine back in service.

1.4.1Principles of Systematic Fault Diagnosis

Diagnosis of faults requires a logical and disciplined approach. Frequently, past experience or detailed knowledge will help. Also an intuitive approach can be used but must be accompanied by a deductive technique. Faults can be classified as:

- Positive fault - sustained fault
- Intermittent fault - irregular, harder to find

1.4.2Tools for diagnosis

The standard of work is related to the quality and completeness of the tools available to you. Traditionally this has been:

- Trade skill
- Knowledge of plant
- Problem solving ability

Today the ability to diagnose and repair faults largely depends on levels of documentation and test results.

A. Documentation

Documentation should be:

- Aimed at the level of the maintenance
- Structured in a standard format
- Logical, precise and factual - no irrelevant material

B. Test Facilities

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.
Plant manufacturers will often build test points into the system. To do so later becomes very expensive. Built in test facilities are generally for first line maintenance staff, such as lamps, pressure gauges, multi meters etc.

1.4.3The Logical Diagnostic Process

Experience shows, paradoxically, that the faster a maintainer acts to identify a fault the more likely that he/she:

- fails to find it
- disguises it
- makes it worse

The first golden rule of fault diagnosis therefore is: **STOP AND THINK!**

Consider the problem then collect and evaluate the facts. The fundamental steps in the logical diagnostic process for all type of equipment are:

1) Symptom analysis

2) Equipment Inspection

3) Fault stage location

4) Circuit checks

5) Repair or replace

6) Perform test

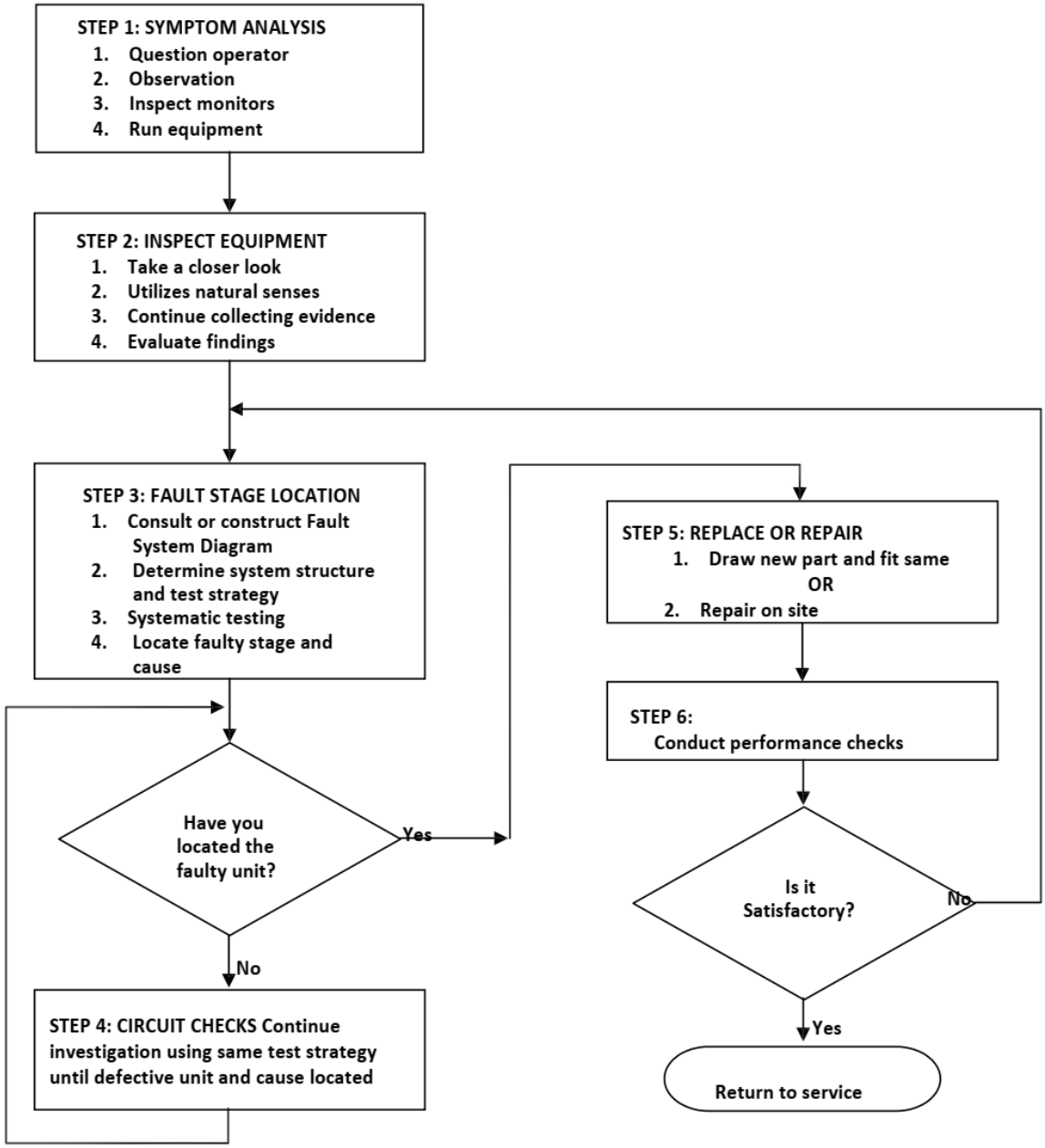

Figure. Diagnostic process flow chart

1.4.4 Fault finding procedures

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. A sound knowledge of the technical concepts and the operation of the system may assist in locating the fault but sometimes the testing will be extensive and an overall procedure should be adopted. The testing and maintenance tasks should be performed after properly shutting down the machine. Machines which are with the problem and even thought as with a problem should be shut tagged and securely stored after shutting down.

Locking out/Tagging out machinery and equipment

One work practice that is extremely important to the trouble-shooter because of the testing and repair work performed is Lockout/Tag out. Here is what OSHA says about Lockout/Tag out. Proper lockout/tag out procedures protect you from the dangers of the accidental or unexpected start-up of electrical equipment and are required for general industry by OSHA (Occupational Safety and Health Authority) Standard. These procedures ensure that electrical equipment is de energized before it is repaired or inspected to protect you against electrocution or shock.

The first step before beginning any inspection or repair job is to turn the current off at the switch box and padlock the switch in the OFF position. This applies even on so-called low-voltage circuits. Securely tagging the switch or controls of the machine or equipment being locked out of service clarifies to everyone in the area which equipment or circuits are being inspected or repaired.

Only qualified electricians who have been trained in safe lockout procedures should maintain electrical equipment. No two of the locks used should match, and each key should fit just one lock. In addition, one individual lock and key should be issued to each maintenance worked authorized to lock out and tag the equipment. All employees who repair a given piece of equipment should lock out its switch with an individual lock.

Only authorized workers should be permitted to remove it.

Fig: Locking out and Tagging machinery for diagnosis

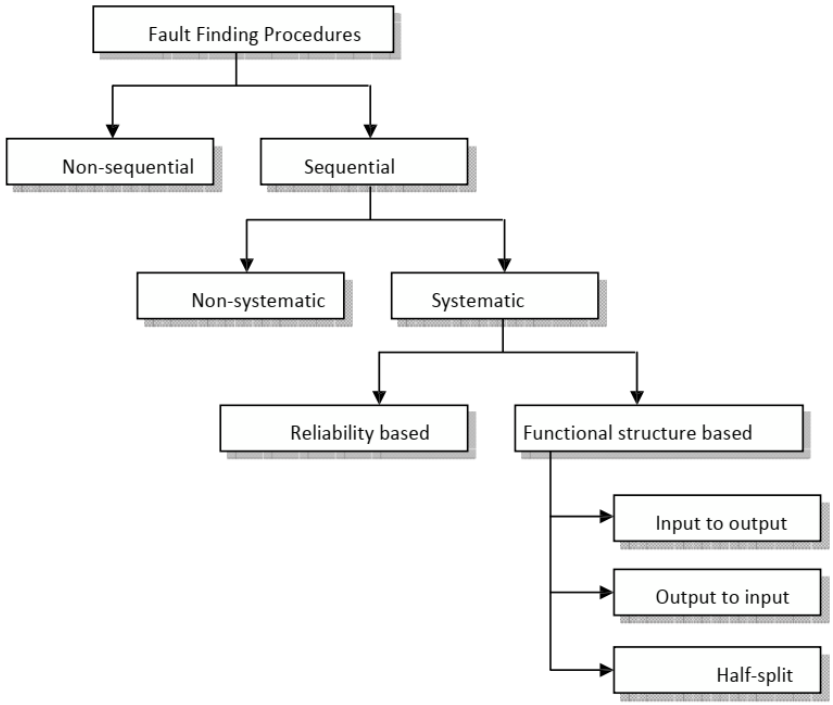

Fig: fault finding procedures' flow chart

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. List at least 4 causes that contribute to service failures of the equipment?(2pts)
2. What is the importance of diagnostic work ?(2Pts)
3. What is catastrophic failure of equipments ?(1pts)

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

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

Score = _____

Rating: _____

Information Sheet 2- Selecting tools appropriate to each task

2.1 Maintenance tools

Maintenance tools are those which are used to inspect, test and maintain machinery and equipment.

The maintenance work requires a well-organized and complete tool kit. It basically consists of:

- set of screw drivers to tighten or loosen screws
- Set of Spanners and wrenches to tighten and loosen bolt and nut
- Set of Pliers to cut, hold , or make wire splices
- Set of Allan keys used to tighten or loosen secured fasteners/screws
- Tweezers to hold and pick materials/ to manipulate small parts
- Flashlight for illuminating hidden complex areas which are difficult to reach
- Goggles for safety
- Multi-meters to measure electrical quantities
- Sprit level to measure alignment level of mating parts
- Magnifying equipments to see micro cracks and other mechanical failures of machinery and equipment parts
- Socket wrench to tighten and loosen secured bolts and nuts

1.2 selection and handling of maintenance tools

Maintenance tools should be selected as per the requirements of the tasks that the maintenance is crew is going to work on. . The following are the basic approaches to select tools used to perform the work of maintenance.

- First, know and understand in detail the scope of work to be accomplished.
- Second, plan for the scope taking into account the sequence of tasks.

Selecting the best tool for each task requires training in the proper use of the tools, field experience in their safe use, and following the manufacturer's guidance and instructions for that specific tool.

- When obtaining the tool all the associate tooling and consumable parts, as recommended by the manufacturer, must be included. In addition, related consumable parts must also be selected and used according to their manufacturer's instruction.
- Safe use of tools once selected, use the tool for the purpose for which it was designed. Not all tools come with detailed instructions, but there are those that do spell out the safety "Do's and Don'ts" for your safety. If there are set-up/use options, operator judgment must always be based on what is the safest way to use the tool.
- All tools should be kept in good condition with regular maintenance.
- The right tool should be used for the job.
- Each tool should be examined before use and damaged or defective tools not to be used
- Tools should be operated according to manufacturer's instructions.
- The right protective equipment for the tool and activity should be used

Fig: maintenance crew

 Fig: set of spanners	 Fig : adjustable wrench
 Fig: Allen keys	 Fig: sprit level
 Fig: set of screw drivers	 Fig: pipe wrench used to maintain fluid lines

Fig: pliers

Fig: Multi-meter

Fig: Thermocouple, used to measure the temperature of the body

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. What is the importance of assessing risk?(2)
2. What are the major steps for risk assessment?(1)
3. Mention the four areas that hazards are likely to be found.(4)

Note: Satisfactory rating - 7 points Unsatisfactory – below7 points

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

Score = _____

Rating: _____

Information Sheet 3- Seeking assistance for complex faults

3.1 Complex faults of machinery and equipments

Complex faults are faults which are not simple to interpret and also difficult to overhaul. These kinds of faults cannot be inspected and corrected by operators at the low level. They need assistance from senior experienced experts to solve the problem.

Common complex faults include:

- Failure of the motor
- Failure of sensors
- Failure at the machine control systems

3.2 The need for assistance

Cooperation is in dispensable in the world of work especially in manufacturing industries involving complex electro mechanical systems as an individual cannot respond to all changes of the system because of different reasons. Operators which are at lower levels cannot inspect and clearly interpret the complex faults of the machinery and equipment. Therefore, the one who is incapable of solving these kinds of failure problems should ask help well experienced personnel for assistance and make solve the problem. The probable reasons for seeking assistance may be different. The reasons include:

- Lack of sufficient knowledge
- Shortage of time to solve the problem within time
- Lack of physical effort to handle
- Lack of permission for the work
- etc.

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. What do we mean by complex fault? (2)
2. What are the probable reasons for an operator to seek assistance to make the complex faults to be erected?(1)
3. What are the probable reasons to seek assistance to handle complex faults of the machinery and equipment?(4)

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

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

Score = _____

Rating: _____

Operation Sheet-1	Carry out diagnosis on machinery to know faults

Procedures to carry out diagnosis machinery to know faults

steps	operations
1	Symptom analysis
2	Inspect the equipment
3	Locate the stage Fault
4	Check Circuit
5	Repair or replace the worn out part
6	Perform test
7	Record the result
8	Analyze the result
9	Make decisions

LAP Test 1	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Use all necessary tools, equipment and materials that you require to perform the following tasks within **2hour**

Task 1: Carry out Carry out diagnosis on machinery to know faults and fix the problem

LG #32	LO #3: Maintain a clean and tidy workshop and document operational maintenance

Instruction sheet

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

- Maintaining workshop clean and free from contaminants
- Identifying and removing hazardous materials
- Documenting procedures and updated equipment log books

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

- Maintain workshop clean and free from contaminants
- Identify and remove hazardous materials
- Document procedures and updated equipment log books

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.
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6. If your performance is satisfactory proceed to the next learning guide,
7. If your performance is unsatisfactory, ask your trainer for further instructions

Information Sheet 1- Maintaining workshop clean and free from contaminants

1.1 Workshop contaminants

Contaminants are chemicals or any materials that can adversely react with other components and thus decrease their functional requirements.

In lapidary workshop, there are different chemicals and materials that used commonly used for different purposes related to the occupation. These include:

- Different mineral oils
- Fuel oils
- Different glues
- Gases
- Waxes
- Slurry of coolants

And other contaminants including:

- ♦ Dust
- ♦ Moisture
- ♦ etc.

As have been stated in previous sections, cleaning of workshop should be a routine work like cleaning of machines and equipments after completion of work. Everybody working in the work shop is responsible to carry out the cleaning work as per schedule of hygiene rule and regulation of the workshop. The consumables used to clean work area include:

- Different detergents
- Brush
- Water
- Chemicals (Some examples of alkaline cleaning agents include (but may not be limited to): Potassium hydroxide. Sodium hydroxide. Bleach)
- Bucket
- Picker

- Cotton clothes etc.

1.2 Effects of contaminants

Contaminants have the following negative effects:

- ♦ Can be mixed with sewerage system and pollute the aquatic environment
- ♦ Contaminate the grinding and polishing grit and reduce its effectiveness
- ♦ Creates stains on the body of active cutting surface of the tool and thus affects its action
- ♦ Stains workshop floor
- ♦ Pollutes the workshop environment

1.3 Benefits of removing contaminants

The following are the general benefits that can be obtained by properly removing contaminants.

- Healthy workshop and environment
- Motivates operators
- Increase of active life of cutting tools
- Increases neatness of workshop floor
- Reduce hazards etc.

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 1: short Answer Questions

1. What are contaminating chemicals in the lapidary workshop?(2 pts)

2. Why moisture is considered as contaminant?(2pts)

3. How can contaminants from lapidary workshop affect the environment?(2pt)

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

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

Score = _____

Rating:

Information Sheet 2- Identifying and removing hazardous materials

1.1 Hazardous materials

A **hazardous** material is any item or agent (biological, chemical, radiological, and/or physical), which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors.

The major health hazards lapidaries' face is dust (inhalation, ingestion, and contact with the eyes) and dermatitis due to improper skin protection. Proper ventilation is necessary for any lapidary or jeweler's workshop. Between dust and odorous chemicals, there's good reason to invest in a ventilation system. Use goggle and safety wearing to eliminate these problems.

Types of workplace hazards include chemical, ergonomic ,physical and psychosocial.

In order to control workplace hazards and eliminate or reduce the risk, you should take the following steps:

1. Identify the hazard by carrying out a workplace risk assessment;
2. Determine how employees might be at risk;
3. Evaluate the risks;
4. Record and review hazards earlier if something changes

As has been discussed in level 1, common hazards in lapidary workshop are

- **Asbestosis, silicosis**- lung diseases caused by inhaled silica dusts from gemstones that contain silica (e.g., quartz, granite, sandstone, soapstone) and asbestos
- **Cancer**- caused by asbestos and crystalline silica.
- **Skin/eye burns**- caused by calcium oxide, lime, silica, aluminum, iron compounds, and small amounts of magnesia, sodium, chromium, sulfur, and potassium compounds respiratory effects if inhaled, and gastrointestinal burns if ingested.
- **Chips** may be hazardous to the eyes. Wear eye protection and carve away from the body.

- **Overload**s- Lifting heavy stones can be hazardous. Lift carefully to avoid injuries.
- **Chemical hazards** caused from direct contact with polishing chemicals, cooling oils, gases, glues, etc. may damage our skin, eye, and their diffusion is very dangerous for our respiratory system.

1.2 Removing hazardous materials

Hazardous materials are those which have the potential to cause harm, including injury, disease, death, environmental, property and equipment damage. Therefore hazardous materials should be properly managed to control their negative effects on the life, environment and the property. Thus, the following materials are hazardous and they should be removed following safe procedures.

- Silica dust from grinding action
- Slurry of coolant containing used chemicals
- Glues which are used etc.

These and other occupationally integrated hazardous materials should be removed by the following techniques:

- Chemicals should burned in burrow
- Silica sand should be stabilized by using sufficient coolant and safely cleaning the workshop wearing the eye protection equipment and burying it designed burrow to prevent its spread into the environment
- Removing flammable chemicals at distant places from areas which easily produce fire and thus can cause burning hazard.
- etc.

Self-Check – 2	Written test

Name…… ID…… Date…….

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

Test 1: short Answer Questions

1. Mention at least 3 types of work place hazards.(3pts)
2. What is hazardous material?(1pt)
3. What are the procedures to control hazardous and thus reduce risk?(4pts)

Note: Satisfactory rating -8 points Unsatisfactory - below 8 points

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

Score = _____

Rating:

Information Sheet 3- Documenting procedures and updated equipment log books

3.1 Documenting maintenance information

After completion of the maintenance of the machinery and equipment, documenting of the important information of all rounds about the task, the equipment and the events that have happened should be all recorded and documented as per the standard maintenance work requirements. Records of all maintenance, the activity and any findings and actions taken should be kept for the period equipment is owned and operated. They should be specific to a particular piece of equipment and provide sufficient detail to be used as evidence that all reasonably practicable steps have been taken to ensure equipment has been maintained in an efficient state, in efficient working Order and good repair. Now a days computers are used for documenting the data as they have various advantages over traditional documentation. The advatages of computerized documentation include:

- Economical for a long term
- Ease of accessibility
- Ease of revision etc.

3.2 Record of maintenance documentation

Records are the types of data to be documented on the standard data format.

Maintenance records should include the following information:

- Name and model of equipment.
- Where equipment is usually kept.
- Unique identifier.
- Each task on the maintenance schedule.
- Frequency of each task.

- What is involved in each task?
- Result of maintenance and any actions resulting from the maintenance.
- Sign off by the person carrying out the maintenance.

The following three forms are examples of the type of records that should be kept. They can be used as templates but are not mandatory; alternatives can be used if they capture all necessary information.

Example of inspection sheet for a week of daily inspections of a single piece of workshop equipment

Equipment				Frequency											
Model		Serial number				Location									
Name of inspector		Period of inspections				Any issues found?				Yes		No			
Checklist	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		
Check 1	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
Check 2	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
Check 3	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
...continue to enter checks required to ensure the equipment is safe to use.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
Signature															
Comments (please date and initial comments)					Actions (please date and initial actions)										

Equipment	Slab saw		Frequency		Daily	
Model	**Serial number**	**Location**	**Model**		**Serial number**	**Location**
Name of inspector		Period of inspections			Any issues found?	**Yes** / **No**

Is the top guard in good condition, free from damage?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Can the top guard be easily adjusted?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Are all the adjustable fixings for the top guard in place?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Once adjusted can the top guard be firmly secured during work?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Is the blade in good condition, clean, not dull or badly ground?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Is the blade set properly?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Is the area around the equipment clean, free from build-up of dust?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Is the guide screw normal?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Is the belt-pulley system ok?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Is the limit switch working?	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Signature																

Comments (please date and initial comments)	Actions (please date and initial actions)

Table: weekly sheet for the daily inspections of a slab saw.

Table: record format for several pieces of similar equipment

Example of inspection sheet for several pieces of similar equipment

Equipment		Frequency			Location		
Name of inspector		Date of inspection			Any issues found?	Yes	No

Unique identifier for each piece of equipment / Checklist	Unit 1		Unit 2		Unit 3		Unit 4		Unit 5		Unit 6		Unit 7	
Check 1	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check 2	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Check 3	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
...continue to enter checks required to ensure the equipment is safe to use.	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Signature														

Comments (please date and initial comments and specify unit)	Actions (please date and initial actions and specify unit)

3.3 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 it is important 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.) Locks and Sentinels in operation or other applicable special precautions.
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.
5. Pass on findings in regard to component condition or potential weaknesses found during dismantling and other information necessary for the person taking over to make informed decisions.
6. Where practical, carry out a tour of inspection with the new person of the affected plant, pointing out areas of concern and activities under way.
7. Ensure they have understood you and have a clear picture of the situation and its implications.

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 1: short Answer Questions

1. Mention at least 5 records that a maintenance documentation includes?(2)
2. What is the use of documentation?(2)
3. What are the advantage of using computers for documentation ?(3pt)

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

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

Score = _____

Rating:

Reference Materials

- Basic machine operation and maintenance manual
- Documentation_maintenanceDocumentation & Maintenance
- Equipment-management-preventative- Maintenanance
- Gemstone technical training manual - Levin Sources
- GEMSTONE TECHNICAL TRAINING MANUAL - Levin Sources
  http://www.levinsources.com › assets › pages › W...
- Handbook of Maintenance Management-Levitt Joe

  http://www.levinsources.com › assets › pages ›
- https://www.globalsecurity.org/military/library/policy/navy/nrtc/14310_ch1.pdf

  httpswww.kau.edu.saFiles0057850Subjectsmechanical%20fault%20diagnosis%20%20part%201.pdf

  httpwww.dcs.fmph.uniba.sk › ~lukotka › PTS

  httpwww.fkm.utm.my › ~shari › download › int...
- Introduction to maintenance
- Lapidary machinery manufacturer manual (Lapidary Equipment and Supply Catalogue)
- maintaining Health and Safety at Workplace: Employee - ERIC
  https://files.eric.ed.gov › fulltext
- Managing Maintenance Resources-A.Kelly, Butterworth-Heinemann.
- mechanical fault diagnosis part 1

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The trainers who developed this learning guide