BUILDING ELECTRICAL INSTALLATION LEVEL-I

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Acknowledgment

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Acronym

OHS - Occupational Health & Safety

OSHA- Occupational Health and Safety Administration

PPEs – Personal Protective Equipments

GFCI- Ground Fault Current Interrupter

QA – Quality Assurance

ISO -International Organization for Standard

RD - Requirements Document

PVC - Polyvinyl Chloride

NM- Non Metalic

NiMH - Nickel-metal hydride battery

DC – Direct Current

AC – Alternative Current

ADC- analog to digital converter

DMM-digital multimeter

Introduction to the Module

The Electrical hand tools and measuring devices helps to know hand and power tools, select hand and power tools, use hand and power tools, Use measuring devices to measure variables & to Clean-up work area and tools in building electrical installation field .

This module is designed to meet the industry requirement under the Building Electrical Installation occupational standard, particularly for the unit of competency: Electrical hand Tools and measuring devices

This module covers the units:

- Hand and power tools
- Appropriate hand tools
- Appropriate power tools
- Measuring devices
- Clean-up work area and tools

Learning Objective of the Module

- Identify hand and power tools
- Select appropriate power tools
- Use appropriate hand tools
- Select appropriate hand tools
- Use appropriate power tools
- Use measuring devices to measure variables
- Clean-up work area and tools

Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the “LAP test” giver at the end of each unit.
5. Read the identified reference book & website.

UNIT ONE: HAND AND POWER TOOLS

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

- OHS requirements
- Quality assurance requirements
- Types & functions of hand and power tools
- Sources of power tools

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

- Associate ***OHS*** requirements with the use of construction hand and power tools and adhere the workplace environment to throughout the work
- Identify & adhere quality assurance requirements for company operations.
- Identify types of hand and power tools and their functions.
- Recognize Power source and access to power supply.

1.1. OHS Requirement

OHS is an area concerned with the development, promotion & maintenance of the workplace environment, policies and procedures that ensure the **mental, physical and emotional** well-being of workers, as well as keeping the workplace environment relatively free from actual or potential hazards that could injure.

Hand and power tools are a part of our everyday lives and help us to easily perform tasks that otherwise would be difficult or impossible. However, these simple tools can be hazardous & have the potential for causing severe injuries when used or maintained improperly. Special attention toward hand and power tool safety is necessary in order to reduce or eliminate these hazards.

The Trainer is ultimately responsible for the safe condition of tools and equipment used by Trainees at training workshops. Trainees should be trained in the proper use and handling of tools and equipment.

A. General Requirements

- Use the right tool for the job. Match the tool to the task.
- Examine all tools for damage before each use. Inspect power cords. If damage is found, take the tool out of service and report the condition to your supervisor.
- Read the tool's instruction manual, and follow use and maintenance guidelines.
- All power tools shall have a 3-prong grounded plug or be double-insulated.
- Make sure all safety guards and devices are in place.
- Always wear the appropriate personal protective equipment. Safety glasses and gloves should be worn while operating most power tools. Other PPE may also be necessary.
- Avoid using power tools in wet or damp environments. Utilize a GFCI when necessary.
- Do not wear loose clothing, dangling objects, or jewelry. Long hair must be restrained.
- Unplug tools before installing, adjusting, and changing any accessory or attachment.
- Maintain solid footing and good balance when using tools. Hold or brace the tool securely. Be aware of your surrounding environment.

- Ensure power tool accessories are specific for the tool it's to be used with.

B. Specific Requirements

- Keep fingers away from saw blades. Clamp materials down and keep all guards in place.
- Do not use compressed air to clean people.
- When performing electrical work, ensure the use of insulated, rated tools.
- When using pneumatic tools, a safety clip or retainer must be installed to prevent the equipment or hoses from coming apart. Never point pneumatic tools at anyone.
- All hand grinders must be used with the guards and handles in place. Impact tools, such as drift pins, wedges, and chisels, shall be kept free of mushroomed heads.
- The wooden handles of tools shall be kept free of splinters or cracks.
- Before an abrasive wheel is mounted, it should be inspected closely to be sure that it is free from cracks or defects.
- Where flammable atmospheres exist, spark-resistant tools made from brass, plastic, aluminum, or wood will prevent ignition sources

1.1.1. Hazards of hand & power tools

Hazards: Most common hazards associated with the use of hand tools are:

- ***Misuse:*** occurs when a hand tool is used for something other than its intended purpose. Example: using a screwdriver as a chisel. This may cause the tip to break and strike someone.
- **Improper maintenance**: allows hand tools to deteriorate into an unsafe condition. Examples: cracked wooden handles that allow the tool head to fly off or mushroomed heads that can shatter upon impact.

1.1.2. Preventative Measures

The Occupational Health and Safety Administration, or OSHA, recommends that employees:

- Inspect all tools before use.
- Never carry a tool by the cord or hose.
- Never hold fingers on the switch button when carrying a tool
- Secure work with clamps or a vise so that both hands can operate the tool
- Keep cords and hoses away from heat, oil, and sharp edges

- Remain a safe distance away from anyone else working in the same area or observing your work
- Keep good footing and maintain balance
- Wear proper clothing for the task, and avoid loose clothing, ties, and jewelry
- Disconnect tools when not in use, before maintenance or cleaning, and when changing any accessories
- Never yank the cord or hose to disconnect it
- Maintain tools with care
- Follow the manufacturer's recommendations for lubricating and changing accessories
- Remove any damaged tools from use and tag them "Do Not Use"
- Never attempt to override or remove any guards

1.1.3. Environmental Health and Safety

The procedures to promote a safe working environment where hand and portable power tools are used:

- Establish regular tool inspection procedures and provide good repair facilities to ensure that tools will be maintained in safe condition.
- Establish a procedure for control of tools such as a check-out system at tool cribs.
- Provide proper storage facilities in the tool room and on the job.
- The employer is responsible for the safe condition of tools and equipment used by employees, but the employees have the responsibility for properly using and maintaining tools.

1.1.4. Use tools & Equipments

Experience shows that many accidents are caused by the employees' improper use of tools and by the use of defective tools and equipment. Employees shall use only tools and equipment that are in good condition. Tools shall be used only for the purpose for which they were designed. It shall be the responsibility of each employee to make frequent inspections of tools and other equipment used to make sure such tools and equipment are in good physical condition.

Common Causes of Accidents using hand & power tools

Typical causes of accidents using unsafe hand and power tool include:

- To use the wrong tool for the job
- tools falling from overhead
- sharp tools carried in pockets
- using cheaters on tool handles
- excessive vibration
- using tools with mushroomed heads
- failure to support or clamp work in position
- carrying tools by hand up or down ladders
- using damaged electrical cords or end connectors
- Failure to use ground fault circuit interrupters (GFCIs), especially outdoors.

1.1.5. Personal protective equipment

Personal protective equipment (PPE) is a very important safety factor that you should utilize when operating hand & power tools. There are many types of PPE, with each covering a particular form of personal protection.

Such as:

- **Goggles/face shields**: to protect your eyes from flying particles and dust



Fig 1.1: Shafety glass



Fig 1.2: Shafety google

- **Safety helmets:** to protect the upper part of workers' heads from falling or flying objects, impact, burns and electrical hazards.





Fig1.3: Safety helmet

- **Safety ear muffs:** to protect your ears from noise damage.



Fig 1.4: Safety ear muffs

- **Safety Gloves /insulating (rubber) gloves with leather protectors**: to protect the user's hands & fingers from unnecessary wounds such as cuts, electric shock, splinters, skin punctures or heat and chemical burns.



Fig 1.5: Safetyglove

- **Safety mask**: to protect the user's respiratory system.



Fig 1.6: Safety Mask

- **Safety cloths**: to protect personnel from hazards that is caused by extreme environmental conditions, or a dangerous work environment.



Fig 1.7: Safety close

- **Safety belt**: for work positioning shall consist of a waist belt, a work positioning cord and relevant connectors.



Fig 1.8: Safety belt

- **Safety shoes**: to protect foot injuries due to heavy falling or rolling objects, sharp penetrating edges, rotary machinery, hot objects, splinters, electricity, chemicals or even bad weather etc.



Fig 1.9: Safety shoes

- **Safety electrical pole climber:** Works at heights performed by teams of energy and telecommunication services requires appropriate protection against falling. Using pole climbers are one of the main pieces of equipment that ensures safety during such activities**.**



Fig 1.10: Safety pole climber

1.1.6. Use of firefighting equipment: it is a range of tools and appliances that are designed to extinguish fires. When used correctly, this equipment will protect the operator from harm. There are many different types of firefighting equipment, including portable extinguishers, professional firefighting tools, sprinkler systems, and alarms.

- **Fire Extinguishers:** Portable firefighting devices are essential in every building. It is easy to operate & can be used by anyone. A fast reaction with a portable fire extinguisher could save you thousands of birr in damage costs.



Fig 1.11: Fire extinguisher

- **Fire Hose Reels:** Every covered firefighting system should include a fire hose reel.



Fig 1.12: Fire hose reels

- **Fire Blankets:** Fire blankets are perfect for use on fires involving cooking fats and oils. They can also be wrapped around a person who is on fire. You should have a fire blanket available in all kitchen areas.



Fig 1.13: Fire blanket

- **Sprinkler Systems:** many commercial buildings have their own sprinkler systems. These systems can be activated by a number of things, depending on the type of sensor. Traditionally, sprinkler systems can detect smoke, temperature, or both.



Fig 1.14: Sprinkler systms

- **Smoke Alarms:** every building, domestic & commercial needs smoke detectors and alarms to detect smokes & send messages in order to take fast action against a fire.



Fig 1.15: smoke alarm

Note: Firefighting equipment not only the above but also includes fire-resistant protective clothing, fire-resistant gloves, respirators and communication equipment.

How to operate a fire extinguisher

There are four basic steps for using modern portable fire extinguishers. These are:

1. **Pull (Pin)** Pull pin at the top of the extinguisher, breaking the seal.
2. **Aim**. Approach the fire standing at a safe distance.
3. **Squeeze**. Squeeze the handles together to discharge the extinguishing agent inside. ...
4. **Sweep**.

1.2. Quality assurance requirements

- **Quality assurance:** it is any systematic process of determining whether a product or service meet specified requirement. It also refers to the implementation of well-defined standards practices & methods. It is a pro-active quality process. QA is focused on the process checklists, quality standards, quality audits, methodology & procedures. ISO (International Organization for Standard) is driving force behind QA practices.
- **Requirement:** It is something that someone needs in order to solve a problem or achieve an objective.

  QA is required to:

  - Know QA techniques:

    Example: Quality audit, define the processes & standards. The process shall serve as a guideline & improve our time.
  - Selecting of tools.
  - Checking that the items specified in a Requirements Document (RD) meet the desired qualities attributes. I.e. Completeness, consistency, adequacy etc.

1.3. Types & functions of hand and power tools

Hand and power tools refer to manual and electric-powered tools respectively, designed to assist construction workers, carpenters, and other manual laborers in the performance of work. While hand and power tools are a big help, they pose various physical hazards which can cause both minor and major injuries if not guarded against.

The wide variety of hand and power tools available on the market today allows us to perform more tasks more efficiently. However, if used improperly, hand and power tools can cause injury.

Use protective equipment and follow proper work practices in order to operate hand and power tools safely.

Table 1.1 types & functions of hand & power tools

No,	Type of tool	Function of tools	Name
1	Measuring tool	To measure the length To test the electrical variables (resistance, current, voltage, etc.) To measure cross section of the conductor & conduit diameter	Tap-meter Multi-meter, clamp meter, megger etc Verner-caliper
2	Marking tool	for marking on the required place	
3	Cutting tool	To cut sheath from non-metallic cable, to cut off electrical tape, and to open cardboard boxes. To cute the wire and conduit.	Pliers Hacksaw
4	Splicing tool	To join or connect the wire /cables.	Pliers
5	Drilling tool	To make holes	Mechanical & electrical driller
6	Testing tool	To test polarity, continuity	Neon tester, Circuit tester, Continuity tester etc

7	Leveling tool	It used to level the junction points	Sprit level
8	Fastening Tools	To tighten or loose screws To striking the chisel and cut the nails and screws	Screw drivers, Hammers

1.4. Sources of power tools

The two most common sources of electricity for power tools are mains electricity & rechargeable battery.

Self-check #1

I. Choose the correct answer from the give alterative

1. _____ is used to measure the internal & external diameters of conduits?

   A. micrometer B. Verner-caliper C. Tap-meter D. ruler

2. one of the following measuring instruments is used to test polarity of electrical lines

   A. multi-meter B. tap-meter C. neon tester D. all

3. While using measuring instruments, ensure that measurement is taken with:

   A. appropriate instruments B. functional instruments

   C. The correct instrument D. all

4. Which one is not categorized under had tools to measure DC current?

   A. power driller B. test light C. hacksaw D. pliers

5. Basic safety rules for hand and portable powered tools include –

   A. Keeping tools in good condition. C. Performing regular maintenance

   B. Using the right tool for the job. D. Examining for damage before use.

   E. All of the above.

II. Mach column "B" to column "A"

A	B
_____ 1: Safety Gloves	A. Inspect all tools before use
_____ 2: Preventative Measures	B. ensure the mental, physical and emotional of the worker
_____ 3: OHS	C. PPE's

III. Give short ad precise answers for the following questions

1. List at 4 basic safety Rules that can help to prevent hazards associated with the use of hand and power tools.
2. _____ used to test the electrical variables with a given electrical circuits.
3. _____ is a very important safety factor that you should utilize when operating hand & power tools.
4. List at 4 causes of accidents while using unsafe hand and power tool.

Note: Satisfactory rating – above 60% Unsatisfactory - below 60%

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

Operation sheet #1

Operation Title: identify hand & power tools

Instruction:

Purpose: to differentiate different types of hand tools

Required tools and equipment: unit one of this module, tools from workshops like screw drivers, pliers, measuring tools,

Precautions:

- use safety precaution while touching had tools
- Properly handle the tools

Procedures:

Step 1: Bring the tools from tools room

Step 2: Put each tools separately on the table

Step 3: Shaw the tools that your instructor instructs that to show named tools

Quality criteria:

LAP Test # 1

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 10 hours.

Task 1: identify hand tools

Task 2: identify power tools

Task 3: identify personal protective equipment

UNIT TWO: APPROPRIATE HAND AND POWER TOOL SELECTION

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

- Hand & power tools
- Check Hand & power tools for serviceability and safety.
- equipments to hold, position or support material

This unit 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:

- Select Hand & power tools consistent with the needs of the job.
- Check Hand & power tools for serviceability and safety and any faults reported to supervisor in accordance with workplace requirements.
- Select Equipment to hold, position or support material for hand tools application.

2.1. Hand & power tools:

They refer to manual and electric-powered tools respectively, designed to assist construction workers such as wiring installation systems, plumping's, carpenters etc.

Workers depend upon the tools for accuracy, availability, ability, comfort and safety. This contains electricians who provide our homes illuminated, connected, and energy-efficient. So, we have made the electrician tools list to guide and to know what types of tools select in the field of electrical installation.

When selecting hand & power tools you should consider size, purpose & quality.

- Always select the correct type & size of tools for the work to be done.
- Tools should be purpose specifically for electrical work.
- The select of quality tools last longer which saves replacement cost.
- Select tools that are designed for the task.
- Select comfortable tools to hold and use.
- Inspect tools before use and keep them well maintained.
- Inform, instruct and train workers in the selection, use and maintenance of hand tools.
- Replace hand tools with power tools to reduce the level of force required to do the task.

2.1.1. Hand tools: Have no power source, other than the physical force applied by the user. There are various types of hand tools. These are:

1. **Neon tester: -** It is a measuring device which measures the polarity of the wiring system.



Fig 2.1: Neon tester

2. **Fish tape**: A fish tape is used to pull stranded or solid wire conductors through metal or PVC conduit. Cable lube is available to assist you in pulling the wires through the conduit. A fish tape can also be helpful when you are pulling NM cable through wall cavities.



Fig 2.2: Fish tap

3. **Hacksaw**: a fine-tooth hand saw with a blade held under tension in a frame, used for cutting materials such as metal or plastics.



Fig 2.3: Hacksaw

4. **Pliers: T**hey are main essential hand **tools** for electricians. They are mainly used to cut wire, grip, twist, bend or straighten wires. Every professional technician puts a bunch of pliers in its toolbox or truck, including crimping pliers and stripping pliers which are used to tighten locks, fittings, and caps.

   A. **Lineman (combination) pliers**: It is a standard electrician's tool, featuring rubber sheathed grips and a plier head combined with a cutting blade. The blade is located in the two inner edges of the plier's head, by the pivot, and is used for stripping, twisting, cutting & pulling of wires will working.



Fig 2.4: Lineman (combination) plier

   B. Diagonal Cutting Pliers: Diagonal cutting pliers, sometimes called ***side snips*** or ***dikes,*** are used to cut wires. They are specially designed with a cutting edge

that goes down to the tip of the jaws, allowing you to get into tight areas to trim wires.



Fig 2.5: Diagonal cutting plier

C. **Needle-nose pliers**: Another essential specialty electrical tool is a pair of needle-nose pliers. It is used for bending and twisting wires whenever you are making screw-terminal connections. The long, narrow tip makes this a great tool for detailed work.



Fig 2.6: Needle-nose pliers

D. **Snipe Nose Plier with side cutter:** have jaws bent at an angle near the tip helping you reach tight spaces with ease.



Fig 2.7: Snipe-nose pliers with side cutter

E. **Flat Nose Plier**: it is usually used to bend the metal sheets and electric wires into the shapes you want. In repairing, they are the usual tools to install metal components and electricity and used to install and pull out the dowels and springs.



Fig 2.8: Needle-nose pliers

F. **Round Nose Plier:** It is usually used to bend circles of alloyed jewelry. Such as bend the pins to‘9’shapes and string beads.



Fig 2.9: Round Nose Plier

G. **Vice grip (locking) plier**: It can grab and move items or hold items in place like any other set of pliers, but what makes the vice grips unique is that they have a locking mechanism that can be set by the operator. Once it is set, the grips will lock in place and won't move until they are released by the operator. This helps keep objects in place when working with them.



Fig 2.10: Vice grip (locking) plier

H. **Cable Cutter**: tools that have been designed to properly cut either wire or cable with minimal damage to the insulation or internal conductors of the wire or cable. Having a clean cut on a wire or cable can improve the quality of an electrical connection.



Fig 2.11: Cable Cutter:

5. **Plastic Pipe Cutter**: it is **used in plumbing for cutting plastic pipes**. Precision with clean cutting is important in this area of work.



Fig 2.12: Plastic Pipe Cutter:

6. **Insulation Removing tools:**

   A. **Utility (Electrical) knife**: A utility knife, or *box cutter*, is handy for cutting sheathing from non-metallic (Romex) cable, to cut off electrical tape, and to open cardboard boxes.



Fig 2.13: Utility knife

   B. **Wire strippers**: it has a special hole for each size of wires & it does not slow down as easily. It is suitable type, if used correctly. Do not cause the slightest damage to the metal texture of the wire & only remove the cover.

   Professional **electricians** regularly place a plastic cover over the wires to keep the copper out of sight and to make connections with wiring or other components.



Fig 2.14: wire stripper

7. **Circuit tester (Voltage tick)**: Perhaps the most important specialty electrical tool you can own is a voltage tester. It is used for a quick safety check to make sure there's no voltage in an electrical wire or device before you start working on it. Non-contact voltage testers, powered by batteries are the simplest and safest types of testers because they can detect electricity just by being near an outlet slot or wire.



Fig 2.15: circuit tester

8. **Continuity tester**: A small, battery-operated continuity tester costs less than $10. It can be used to determine whether wiring is broken and whether electrical circuits are complete.



Fig 2.16: Continuity tester

9. **Screw drivers:** Electricians keep screwdrivers with them at all times, for loosen and fasten various pieces such as cover plates, outlets, switches and many other devices. It's best to have a few different lengths of Phillips screwdrivers, as well as #1, #2, and #3 tip sizes

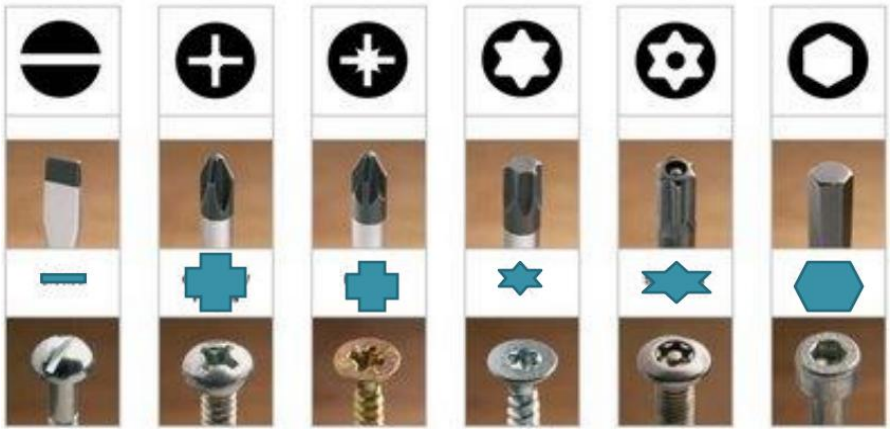


Fig 2.17: Screw drivers

- The parts of a screwdriver are the head, handle, ferrule, shank, blade, and tip. The length of the blade indicates the size of a screwdriver. Some screwdrivers may have square shanks that permit turning with a wrench when required for extra torque.

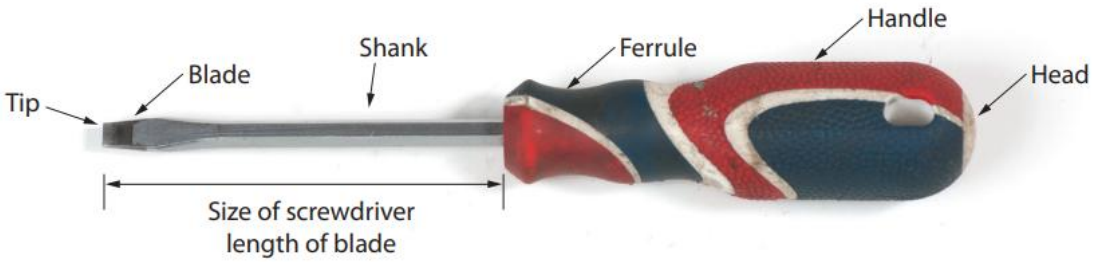


Fig 2.18: Parts of screw drivers

There are many different types of screwdrivers, identified by the type of screws they fit.

- **Some of the more common types of screwdrivers are**:-

A. Philips Screw Driver. This has a cross tip resembling a positive (+) sign. This is used to drive (to tighten and loosen Phillips head screws) screws with cross slot heads. It's ranges in size from *0 to 4, 0 being the smallest.*



Fig 2.19: Philips drivers

B. Standard/Flat Screw Driver. As with Phillips screwdrivers, you will likely need more than one size of straight-blade screwdrivers. If you have to choose just one, pick a medium blade; it will suit most projects. Straight-blade screwdrivers are also available with insulated handles for better safety when doing electrical work.

The blade tip is wedge-shaped and resembles a negative (-) sign. It is used to drive screws with a single slot head. It's ranges in size from*1/6 inch to 1/4 inch*.



Fig 2.20: Flat drivers

C. Clutch Drive Screwdriver: - It is used to tighten and loosen clutch head screws, which are shaped like an hourglass. It has extra holding power, especially for use in cars and appliances.



Fig 2.21: Clutch dive drivers

D. TORX Screwdriver: - It is used to tighten and loosen six-point star head screws. They are used in cars, appliances and lawn and garden equipment.



Fig 2.22: Torx dive drivers

- ***Robertson Screwdriver:-*** It has a square drive that yields high torque power. It is useful to reach screws sunk below the surface of the material.



Fig 2.23: Robertson drivers

- ***Spiral Ratchet Screwdriver: -*** They are used to drive or remove small screws rapidly. The spiral ratchet screwdriver automatically drives or removes screws. It can be adjusted to turn left or right, or can be locked to act as a common screwdriver. Some spiral ratchets have a spring in the handle that automatically returns the handle for the next stroke.



Fig 2.24: spiral ratchet drivers

- ***Ratchet Multi-Bit Screwdriver/Nut Driver:***
  - It provides high-torque capability and comfortable Cushion-Grip handles.
  - Shaft holds 6 universal tips; converts to 3 nut driver sizes and 1 hex driver
  - Strong, heat-treated nut drivers for improved torque.
  - 3-way ratcheting mechanism for forward, reverse and locked positions



Fig 2.24: spiral ratchet drivers

10. ***Allen Screw Driver/Wrench***: - Allen wrenches are used to tighten hex-head screws, which are sometimes found on ceiling fans, light fixtures, and appliances. It's a good idea to own both a metric and a standard set of Allen wrenches.

    It contains several sizes that are attached to and fold into a metal carrying case. It is also known as a hex key or hex wrench and is used on screws with hexagonal slots. It is useful for recessed socket head screws.



Fig 2.25: spiral ratchet drivers

11. **Hammer:** It is a tool used to deliver an impact to an object. They are mostly used to drive nails, fit parts, or break up objects. There are many types of hammers designed for specific uses, which vary in shape and structure. Most hammers include a handle and a head, with most of the weight in the head. The two main types of hammers are claw and ball peen.

- **Claw Hammer:** A hammer is used to secure electrical boxes equipped with nail-on brackets to wall studs and other framing members in a home. You'll also need one to drive wire staples when anchoring new electrical cable to framing members.



Fig 2.26: Claw hammer

- ***Bell-faced Hammer*:** It has a slightly rounded face. It takes some practice to become skilled with this hammer, but it can help you drive a nail head flush to the wood without marring the surface of the wood.



Fig 2.27: bell-faced hammer

- ***Framing (Rip) Hammer:*** Use for ripping apart wooden components & demolition work. Use only with non-hardened, common or finishing nails. Choose weights from 20 to 32 oz. for framing and ripping. Available with milled or waffled faces to grip the nail head and reduce the effect of glancing blows & flying nails.

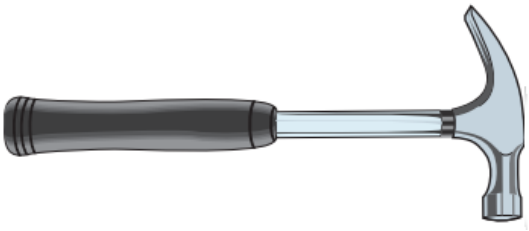


Fig 2.28: framing hammer

- ***Ball Peen (Ball Pein) Hammer:*** Use with cold chisels for riveting, center punching & forming unhardened metal work. Striking face diameter should be about 3/8" larger than the diameter of the head of the object being struck. Popular sizes are 12 and 16 oz. Variations include a cross-peen hammer & a straight-peen hammer.



Fig 2.29: Ball peen hammer

- ***Riveting Hammer:*** It has a round face on one end of the head. It is used for penning rivet heads. The other end has a tapered chisel that is used for upsetting rivets.



Fig 2.30: Riveting hammer

12. **Tap-meter:** A standard tape measure is used for all kinds of field measurements, such as setting heights for switches and outlets, centering lighting fixture boxes, and marking surfaces for cutouts.



Fig 2.31: Tap-meter

13. **Sprit level:** A small level, such as a sprit level, fits easily in a tool pouch and is used to make sure your work is level and plumb. A great installation starts with level boxes and straight switch and outlet receptacles.



Fig 2.32: Sprit level

14. **Spanners:** Spanners will almost certainly be an essential inclusion in your tool kit if you regularly need to loosen or attach nuts, bolts or similar fixings. With so many different sizes of bolt and nut, a similar variety of spanner designs are available to ensure a close fit between the head which applies torque and the fixture in question. Size is equally important in order to achieve a tight grip.



Fig 2.33: Spanner

15. **Micrometer:** A micrometer can be used to measure small and large sizes of wires, it is also used to remove the diameter of circular wires. A micrometer can measure the diameter of thin wire accurately or thickness of sheet metal.

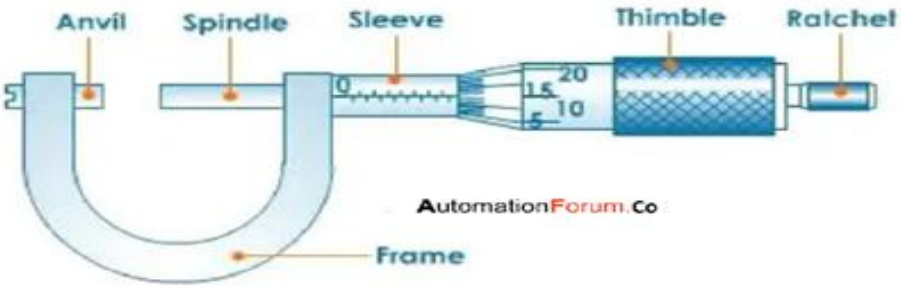


Fig 2.34: micrometer

16. **Flashlight:** Electrical repair and improvement work involves a lot of dark places, from attics and basements, to wall and ceiling cavities, to the insides of electrical boxes. A tactical flashlight is needed as much for safety as it is for convenience.



Fig 2.35: Flashlight

17. **Wrenches:** it is a tool used to provide a mechanical advantage when torque is applied to hold and turn bolts, nuts, screws, and pipes. They are divided into two categories:

- ***Nonadjustable***: - They are made to work on a particular size of bolt, nut, screw, or pipe.
  - ***Open-End Wrench: -*** All open-end wrenches have open jaws on one or both ends of the wrench. Most jaw openings are offset from the shank portion of the wrench by 15 degrees. The wrench length is determined by the size of the jaw opening. It grips on two sides of the nut or bolt head, with an opening that can access fasteners that a closed, or box, wrench might not reach. It has openings of different sizes on each end. The opening should fit the nut or bolt exactly to prevent mutilating the edges of the fastener.



Fig 2.36: Open end wrench

  - ***Closed End Wrench: -*** it surrounds the nut, bolt head, or stud on all sides. It is available with both 6- & 12-point openings. The 12-point opening is more common because it may be used on both square and hexagonal bolt heads. Some models have ratcheting capability.



Fig 2.37: Closed end wrench

- ***Combination Wrench: -*** It has a box wrench and an open-end wrench on opposite sides of the same tool. The two ends are usually the same size.



Fig 2.38: Combination wrench

- ***Adjustable: -*** They are made to tighten or loosen a particular size of bolt, nut, screw, or pipe. It has an adjustable end opening that comes in locking and non-locking styles. The locking style can secure the jaws in the desired position, so when properly adjusted, it will not slip. The non-locking style requires frequent readjustment and is prone to slipping. The adjustable wrench is used to tighten or loosen nuts and bolts, but never on a fastener that has been rounded off.



Fig 2.39: Adjustable wrench

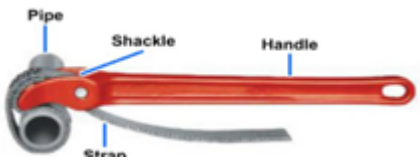
- ***Pipe Wrenches: -*** used for turning pipe and other round objects. Teeth on the jaw will dig into the material being tightened and may damage. it do not use a pipe wrench to turn a bolt or a nut unless the components is already damaged. Do not use on hardened surfaces - may dull or chip the jaw teeth. There are four basic types of pipe wrenches: Still son wrench, Spud wrench, Strap wrench & Chain wrench.



Still son wrench



Spud wrench



Strap wrench



Chain wrench

Fig 2.40: Pipe wrench

- **Socket Wrenches:** It has a socket that grips the nut or bolt and a ratchet (handle) that is used to turn the socket. The end of the socket that fits into the ratchet is usually square. The other end of the socket will have either 6 or 12 gripping points. The ratchet handle has a small lever that allows you to change the turning direction.



Fig 2.41: Socket wrench

- ***Special-Purpose Socket Wrenches:*** The four-way socket wrench has four non removable sockets attached to four arms. Each of the sockets is a different size. The four-way socket wrench is usually used to remove and/ or install the wheel stud nuts of a vehicle. The handle construction provides extra leverage for loosening and tightening the stud nuts.



Fig 2.42: Special-purpose socket wrench

18. **Pipe Cutting:** There are two sizes of pipe cutters. One size can cut from 1/8 to 2 inches, while the other can cut from 2 to 4 inches. The pipe cutter has a cutting blade and two pressure rollers which are adjusted and tightened by turning the handle. Pipe cutters are used to cut steel, brass, copper, wrought iron, and lead pipe.



Fig 2.43: Pipe Cutter

19. ***Manual Drills:*** There are a number of hand drills available to create holes in wood. They include augers, and hand drills.

- ***Auger:*** itis also known as a bit brace; it is used to drill holes in wood and, with a screwdriver bit, remove and install screws.



Fig 2.44: Auger

- ***Hand drill:*** It is used to drill holes in wood when you want total control of the drill, particularly in materials that tend to split.

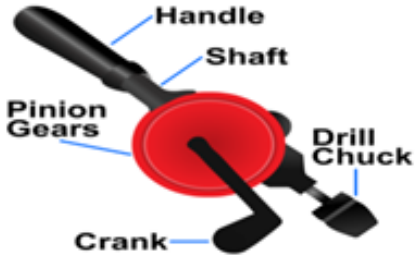


Fig 2.45: Hand drill

2.1.2. Power Tools: A power tool is a tool that is actuated by an additional power source and mechanism other than the solely manual labor used with hand tools. The most common types of power tools use electric motors. Internal combustion engines and compressed air are also commonly used.

a. Soldering Iron: Soldering is a technique used to connect different types of pieces. Usually, it is used for making connections to electrical/electronic circuits. The tools which are required for soldering are soldering iron, de-soldering pump, holder, and soldering wire. Following points should be kept in mind when picking up soldering tools:

- The wattage of soldering iron must be checked according to the type of circuit in which it will be used.
- The soldering iron should not take a lot of time to heat up.
- Disordering pump should be able to remove soldering quickly and easily.
- Holder must withstand the weight of soldering iron

b. Portable cordless (Chargeable) drill: A cordless drill is an electric drill which uses rechargeable batteries. Primarily used for drilling circular holes in material. All cordless drills come with a battery charger, with recharge times ranging from 15 minutes to three hours. But faster isn't necessarily better. A contractor might depend on fast recharges, but slower recharging isn't usually a concern at home, especially if you have two batteries.



Fig 2.46: Cordless drill

- **Chuck jaws**: Maximum capacity on most drills is 3/8 inches. Some 14.4 and 18V drills can handle 1/2-inch-diameter bits.
- **Clutch**: More settings give you greater control of the depth screws is driven.
- **Speed-range switch**: High is for drilling; low is for driving screws. Look for the widest range between them.
- **Forward/reverse switch**: Should be easy to operate with your thumb and trigger finger.
- **Hand grip**: Texture and contour should aid your grip; try out the grip before you buy.
- **Voltage**: More voltage means more power but also added weight.
- **Battery**: Two are better than one. New NiMH batteries offer some advantages.
- **Trigger**: Make sure your index finger fits around it comfortably when gripping drill. Variable speed offers the greatest control.
- **Keyless chuck**: Hand-turn it to open and close the chuck jaws.

c. Electric portable drill: it is a tool used for making holes in metallic sheets or other surfaces. In electrical systems, it is used during the construction of various electrical equipment. It is driven by an electric motor. to consider the following points before selecting a drill:

- There should be a wide range of speeds for drill.
- Texture and contour of the drill should be such that it is easy to grip.
- The drill should be of enough rating to work comfortably with voltage s of the working are



Fig 2.47: Corded drill

2.2. Check Hand & power tools for serviceability and safety.

Trainers are responsible for the safe condition of all tools in the workplace, including those furnished by their trainees. The worker must ensure that check & maintenance of hand & power tools is performed on a regular basis and according to the manufacturer's specifications. A written ***preventative maintenance program is the best solution*** for managing these responsibilities. When maintaining and inspecting tools, keep the following tips in mind:

- Check the power switch to ensure that it is OFF prior to plugging the tool in.
- Use properly sized fittings and parts for the power tools.
- When you use a hand tool, keep the tool sharp and in good condition. Keep tool cutting edges sharp and clean. This can help decrease the force you must use on the tool — and reduce the stress on your hands and wrists.
- Remove the adjustment keys and tools before operating the power tool.
- Always use safety guards and control switches to prevent accidental contact and activation. Failure to use all safety guards and devices can result in serious injury and substantial financial liability for employers.
- Damaged electrical power tools must be removed from service immediately and tagged "Do not use". Remember that the employer is ultimately responsible for seeing that defective tools are removed from the job site, replaced, and/or repaired.
- Safe electrical work practices for power tools prevent electric shock and other injuries.
- Follow these electrical safety rules:

- All electric tools must be double insulated or grounded with a grounding prong. If the prong is missing, do not use the tool.
- Electric cords must never be used for hoisting, lowering, or carrying tools. Replace cords that have damaged insulation.
- Do not cover damage with electrical tape.
- Check that power cords are intact (no nicks, frays, or kinks) to prevent shock and fire hazard.
- Keep tools turned off and unplugged when not in use.
- Unplug tools at the outlet, not by pulling the cord from the wall.
- Coil power cords out of walkways to prevent trips and falls.
- Avoid using power cords in wet areas.

What should you do if you find a tool defective?

- If a tool is defective, remove it from service, and tag it clearly "Out of service for repair".
- Replace damaged equipment immediately – do not use defective tools "temporarily".
- Have tools repaired by a qualified person – do not attempt field repairs.

2.3. Equipments to hold, position or support material

- **Positioning of equipments**: is used to handle material at a single location so that the material is in the correct position for subsequent handling, machining, transport, or storage. Unlike transport equipment, positioning equipment is usually used for handling at a single workplace. Material can also be positioned manually using no equipment.

  Example: Manual (no equipment), Lift/tilt/turn table, Dock leveler, Ball transfer table, Rotary index table, Parts feeder, Hoist

  After accomplish the task you had better & put those equipments in position for better performance for another time and to increase the life span of equipments. Equipments are needs special safety; putting equipments unsafely it may be the cause of damage. So the trainees should be takes their own measures that is position, hold & support these equipments.

- **Safe handling of tools:** The workers should be use equipments proper handle & put it on the required place to reduce risk.

How to Prepare and Store equipments:

In order to keep equipments in good working condition during storage, there are some basic steps that should be taken. It is important to follow the cleaning and storage instructions, especially for larger power tools such as power saws or drills.

- To keep equipments in order, clean them after each use.
- As you do your cleaning, check for damage or defects.
- Clean equipments surface with an approved solution & scrape away any dust.
- Do not place equipments directly on the ground for storage.
- Store equipments in their plastic box.

Self-check #2

I. Choose the correct answer from the give alterative

1. Who is responsible for hand and power tool safety?

   A. the employer B) The employee C) OSH D) Both a and b

2. Which of the following basic safety rules should you follow when using hand and power tools?

   A) Keep all tools in good condition with regular maintenance

   B) Use the right tool for the job

   C) Examine each tool for damage before use and do not use damaged tools

   D) Operate tools according to the manufacturer's instructions

   E) All of the above

3. Which of the following is NOT a safe practice when working with power tools?

   A) Keeping hoses and cords away from oil, heat, and sharp edges

   B) Yanking the hose or the cord to disconnect it from the receptacle

   C) Securing work with a vice or clamps, keeping both hands free to use the tool

   D) None of the above

II. Mach column "B" to column "A"

A	B
_____ 1: Positioning of equipments	A. cordless drill
_____ 2: Chargeable drill	B. measure cross section of wire
_____ 3: Micrometer	C. Lift/tilt/turn

III. Give short ad precise answers for the following questions

1. List at 4 basic selecting criteria's of hand and power tools.
2. List the main parts of rechargeable drill?
3. Write the types & functions of hand & power tools?

Note: Satisfactory rating – above 60% Unsatisfactory - below 60%

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

Operation sheet #2

Operation Title: select the appropriate measuring hand & power tools

Instruction:

Purpose: to differentiate different types of hand & power tools

Required tools and equipment: tools from workshops like screw drivers, pliers, measuring tools,

Precautions:

- use safety personal protective equipments properly
- Follow the selection instraction of the task.
- Check tools weather it is functional or not
- Select tools properly

Procedures:

Step 1: Prepare yourself inorder to perform the given task

Step 2: Visualize the type of tool

Step 3: If the tool has specification read it

Step 4: Collect the required tools from tools room

Step 5: Inspect tools for any damage prior to each use.

Step 6: Check the handle and body casing of the tool for cracks or other damage.

Step 7: If it is a power tool plug in to the appropriate power source & try check

Step 8: Select the appropriate measuring hand & power tools

Quality criteria:

LAP Test #2

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 10 hours.

Task 1: identify the selecting criteria of hand& power tools

Task 2: select hand tools

Task 3: select power tools

Task 4: check hand & power tools for serviceability and safety.

UNIT THREE: USE APPROPRIATE HAND AND POWER TOOL

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

- Location & hold positions of hand & power tools
- use hand & power tools safely and effectively
- location of idle hand & power tools

This unit 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:

- Locate and hold Material in position for hand & power tool application
- Use hand & power tools safely and effectively in application processes.
- Safely switch and locate hand & power tools when not in use.

3.1. Location & hold positions of hand & power tools

We've all done it at least once, working on something on site, perhaps even at a height only to realize you do not have the right tool to complete the task. But what you do have is a similar tool which can be adapted to complete the job. This is a mistake we've all made and we may have even gotten away with it but in some situations this mere act of creativeness can show extremely dangerous.

For example when conducting concrete drilling or cutting if the wrong bit is used it can snap off, not only damaging the equipment but possibly hitting into the worker or others nearby, maybe injuring someone in the process. Improper hand tool selection has been known to result in *injuries, variable quality of work and decreased efficiency and productivity*.

- **Positioning of hand & power tools**:

  After accomplish the task you had better put those tools in position for better performance for another time and to increase the life span of hand tools so as to do this you position or support it with using different equipment. Electrical hand & power tools are needs special safety may be the cause of accident so the trainees should be takes their own measures that is position, hold & support these tools.



Fig 3.1: Positions to store in the shop.

- **Handling of tools:**

  The workers should be using PPE's to handle & put tools on the required place to reduce risk. When they are misplaced or improperly handled by workers.

  To handling tools safely the National Safety Council offers:

  - Never carry tools up or down a ladder in a way that inhibits grip.

- Tools should always be carefully handed to another never tossed.
- Carrying large sharpening tools or equipment on their shoulders should pack.
- Pointed tools such as chisels & screwdrivers should never be carried in a pocket.
- Tools should always be put away when not in use.



Fig 3.2: handling tools

➢ **How to Prepare and Store Tools:**

In order to keep tools in good working condition during storage, there are some basic steps that should be taken. It is important to follow the cleaning and storage instructions, especially for larger power tools such as power saws or drills.

- To keep tools in order, clean them after each use.
- As you do your cleaning, check for damage or defects.
- Clean every metal surface with an approved solution & scrape away any soil and dirt.
- Coat the metal parts of the tools with a lubricant metal protector spray.
- Do not place tools directly on the ground for storage.
- Store short-handled tools in a plastic bin or box.
- Tie together long-handled tools in a garbage can while in storage. Otherwise hang these tools on a wall.
- Power tools should have all surfaces cleaned & completely dry before storage.

3.2. Use hand & power tools safely and effectively

➢ **Using hand tools effectively:** In TVET training programs shall provide detailed training in the proper use of hand tools for the specific area of operations in which they will be working in. Attention will be given to tool selection, tool use, and proper personal protective equipment that are required to be used when operating the specific tool as outlined in the following sections:

- **Using power tools effectively:** When it comes to using tools such as making holes, you should keep in mind some basic tips to help promote safe and proper usage. Raising awareness of basic safety practices and thinking about safety before the job starts & after the job is complete you should check the tools & shop are hazard free.

  Practicing these basic safety rules when using tools not only contributes to safer conditions for you, it can also contribute to cost savings for the installation shop through improved their works and extended consumable life.

- **Practice Basic Safety:** The following tips can help you improve safety regardless of your application or work environment.

  - Wear proper safety gear.
  - Keep aisles and work areas clear of clutter.
  - Read the manufacturer's instructions before using the tool.
  - Inspect the tool or accessory each time it is used.
  - Choose the Right Tools
  - Speed and size.
  - Pressure.
  - Time.
  - Be Aware of Your Surroundings

3.3. Location of idle hand & power tools

Ensuring that hand and power tool safety measures are in place according to their functionalities. There are two reasons that hand & power tools are idle. The first one is the activity of the work that is not required day to day activities. The other reason is in the cause of defects. So first you should be sort the tools by its functionalities, work activity using times etc. if the tools are defective attach red tags or dangers signs.

Self-check -3

I. Choose the correct answer from the give alterative

1. You should never carry a power tool by its cord because it may pull apart creating an electrical hazard.

   A. True B. False

2. Power tools must be disconnected from the power source when:

   A. Not in use. B. Changing accessories. C. Servicing. D. All of the above.

3. Never remove a safety guard when using a hand or portable powered tool.

   A. True B. False

4. The safe condition of hand tools used on-the-job is the responsibility of:

   A. The employee. B. the employer. C. both a & b D. the manufacturer.

II. Mach column "B" to column "A"

A	B
_____ 1. Handling tools	A. attach read tags or dangers signs
_____ 2. Positioning equipments	B. Lift/tilt/turn
_____ 3. Locating of idle tools	C. Never carry tools up or down a ladder in a way that inhibits grip

III. Give short ad precise answers for the following questions

1. List the result of improper hand tool uses?
2. How properly store tools?
3. List down your considerations how to locate hand & power tools?

Note: Satisfactory rating – above 60% Unsatisfactory - below 60%

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

Operation sheet #3

Operation Title: Using hand & power tools

Instruction:

Purpose: to use different types of appropriate hand & power tools for the given tasks

Required tools and equipment: unit one of this module, tools from workshops like screw drivers, pliers, measuring tools,

Precautions:

- use safety personal protective equipments properly
- Follow the instraction of the task.
- Check tools weather it is functional or not
- handle tools properly

Procedures:

Step 1: Prepare yourself inorder to perform the given task

Step 2: Collect the required tools from tools room

Step 3: Put each tools separately on the table

Step 4: Check tools weather it is functional or not

Step 5: using the selecting tools perform the task

Step 6: At the end of your work clean, return & put the tools on the previous location

Quality criteria:

LAP Test # 3

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 10 hours.

Task 1: Demonstrate how to use hand tools

Task 2: Demonstrate how to use power tools

UNIT FOUR: ELECTRO- MEASURING DEVICES

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

- Appropriate measuring device or equipment
- Appropriate connections
- Interpret measuring readings

This unit 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:

- Select appropriate ***measuring device*** or equipment and setting to achieve required outcome.
- Make appropriate connections to achieve required outcome according to standard operating procedure.
- Obtaine readings and interpreted correctly and conversion into the units of ***measurement*** made where necessary.

4.1. Appropriate measuring device or equipment

Electrical measuring device and instruments are sensitive and delicate so extra care is necessary in handling them. These are used to measure currents, voltages, resistances, wattages and other important elements in electrical works.

4.1.1. Analogue/Digital multimeter

❖ ***Analog Multi-meters***:- Analog multi-meters are instruments that are used to measure electrical quantities such as Dc voltage, DC current, AC voltage & resistance



Fig 4.1: Analog multi-meters

Operation of Analog Multimeter

The analog multimeter is very easy to use. With the knowledge of how to make voltage, current and resistance measurements, it is only necessary to know how to use the analog multimeter.

For the measurement of current and voltage, there is no need of batteries in the analog multimeter. But, if resistance is to be measured, batteries need to be installed in the multimeter.

Steps for the use of analog multimeter −

- Insert the probes into the correct connections.
- Set switch to the correct measurement types and range for the measurement to be made. While selecting the range, ensure that the maximum range is above than that is expected. The range of multimeter is then optimized for the best reading.
- Once the measurement is completed, it is wise precaution to place the probes into the voltage measurement sockets and set the range to maximum voltage. In this way if the meter is accidently connected across a high voltage point, there is a little chance of damage to the multimeter

- ***Digital Multi-meters:-*** The name implies, a digital multimeter is designed to perform a variety of measuring tasks. With multiple inputs, settings and reading types it can give accurate readings in most situations. It gives more accurate results. It is used to measure electrical quantities such as voltage, current, resistance & capacitance by rotating the knob to the labeled mark of the quantity that is to be measured. It can also be used for checking continuity of an electrical circuit by placing both probes at the two ends between which continuity is required to be observed.



Fig 4.2: digital multimeter

Measurements using Digital Multimeter

- **In AC Voltage Mode** − the applied input voltage is fed through a calibrated, compensated attenuator, to a full-wave rectifier followed by a ripple reduction filter. The resulting DC is fed to analog to digital converter (ADC) and finally to the display system.
- **For Current Measurement** −
  - ✓ **In DC Current Mode** − the drop across an internal calibrated shunt is measured directly by the ADC.
  - ✓ **In AC Current Mode** − After AC to DC conversion, the drop across the internal calibrated shunt is measured by the ADC
- **In Resistance Mode** − in the resistance range, the digital multimeter operates by measuring the voltage across the externally connected resistor, resulting from a current flowing through it from a calibrated internal current source.

Operation of Digital Multimeter

With the knowledge of how to make voltage, current and resistance measurements, the operation of DMM is quite easy. It is necessary to install a battery in the DMM to power it.

Steps for the use of digital multimeter −

- Turn the meter ON.
- Insert the probes into the correct connecting ports.
- Set the dial (rotary switch) to the correct measurement type and range for the measurement to be made. While selecting the range, ensure that the maximum range is above than that is expected. Optimize the range for the best reading. If possible enable all the leading digits to not read zero, in this way the greatest number of significant digits can be read.
- Once the measurement is completed, it is a wise precaution to place the probes into the voltage measurement ports and turn the range to maximum voltage. So that if the meter probes are accidentally connected across a high voltage point, there is a little chance of damage to the DMM.

4.1.2. ***Megger or Digital insulation tester***: - use a high voltage, low current DC charge to measure the insulation resistance of the wires to identify current leakage and faulty or damaged insulation, which can lead to arc faults, blown circuits, and risk of electrical shock or fire.



Fig4.3: Digital insulation tester

The Megger insulation tester is a small, portable instrument that gives you a direct reading of insulation resistance in ohms or mega ohms. For good insulation, the resistance usually reads in the mega ohm range.

4.1.3. ***Energy meter***: - When the electricity comes into a house, it first; all goes through a energy meter so this meter measure how many 'unit' (kwh) of electrical energy is used. The reading is either digital or analogue system.



Fig 4.4: energy meter

4.1.4. Digital Watt meter: An instrument for measuring in watts the power flowing in a circuit. An instrument for measuring in watts the power in an electric. It is used to measurements of power in distribution and transmission power.



Fig 4.5: Digital watt-meter

4.1.5. **Oscilloscopes**: it is a laboratory instrument commonly used to display and analyze the waveform of electronic signals. In effect, the device draws a graph of the instantaneous signal voltage as a function of time. A device that gives a visual graph of amplitude versus time of a measured signal, as voltage or current.



Fig 4.6: Digital watt-meter

4.1.6. Digital devices: it means an electronic device that can create, generate, send, share, communicate, receive, store, display, or process information, and such electronic devices shall include, but not limited to, desktops, laptops, tablets, peripherals, servers, mobile telephones, smartphones, and any similar storage device

4.1.7. Tong testers/Clamp meters: are ammeters that can measure line current without the need to disconnect the wires where the measurement occurs. They provide information about current draw and current continuity in order to help users troubleshoot unpredictable loads and trends. In addition to measure line current, it measures continuity, Voltage, Insulation resistance of the conductor & it does not measure DC current.



Fig 4.7: Clamp-meter

4.2. Appropriate connections

In electrical wiring system, there are two types of connections. These are series & parallel connections. Residential wiring system always advised the parallel connection systems. Therefore to take a correct value of measurement first you know types of installation connections, know measuring equipments and how to connect this equipments to the system. To measure resistance & voltage connect the measurement equipments in parallel to the load but to measure current connect the measuring equipments in series to the load.

4.3. Interpret measuring readings



Fig:4.8: Reading measurings

4.3.1. **Voltage**: an electro motive force or potential difference expressed in volt. Measured by volt meter.



Fig 4.9: Voltage testing

4.3.2. **Current**: It refers to the simple flow of electrons in a circuit or electrical system. It expressed in Ampere. Measured by Ammeter & clamp meter.





Fig 4.10: Curint testing

4.3.3. **Continuity:** Continuity testers are used to test for a complete flow path in any de-energized low-resistance device. A continuity tester is a common test tool to use when testing single-pole, 3-way, and 4-way switches. For example, a 3-way switch has one terminal that is the "common" terminal.

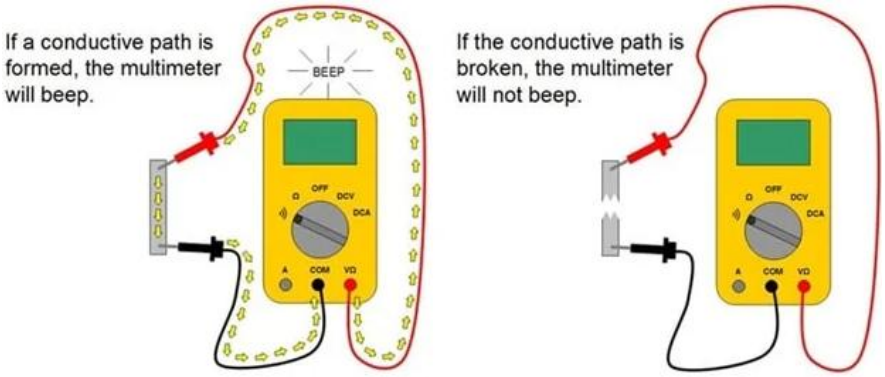


Fig 4.: Continuoty testing

4.3.4. **Insulation resistance**: to measure the insulation heat resistance capability is essential to get quality measurement of the wire/cables. This measurement is taken by digital insulation tester (megger) & its unit expressed by ohm. While taking a measurement the final ring circuit, all controlling & protection device must be at “ON” position.



Self-check -4

I. Choose the correct answer from the give alterative

1. _____ is used to measure the internal & external diameters of conduits?

2. When using any measuring instruments, ensure that measurement is:

A. accurate B. precise C. The correct scales D. all

3. _____ is used to measure electrical quantities such as voltage, current, resistance, frequency & capacitance.

A. energy meter B. multi-meter C. Ammeter D. Megger

4. ____ is used to measure electrical energy or consumed power?

A. energy meter B. multi-meter C. Ammeter D. Clamp-meter

5. Which one is not used to measure DC current?

A. Clamp meter B. multi-meter C. Ammeter D. Voltmeter

6. As an electrician one of the following measuring instruments must be you have:

A. multi-meter B. tap-meter C. neon tester D. all

II. Mach column "B" to column "A"

A	B
_____ 1: Current	A. Checking the complete flow path in the circuit
_____ 2: Voltage	B. The flow of electrons through the conductors
_____ 3: Resistance	C. the wires heat resistance capability
_____ 4: Insulation resistance	D. electro motive force or potential difference
_____6: continuity	E. The opposition of excessive flow of current in the conductors

III. Give the Name their uses of the following measuring equipments

1. 

2. 

3. 

4. 

5. 

Note: Satisfactory rating – above 60% Unsatisfactory - below 60%

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

Operation sheet #4

Operation Title: Using Measuring devices

Instruction:

Purpose: to use different types of appropriate measuring devices for the given tasks

Required tools and equipment: unit one of this module, measuring devices from workshops like multi meter, clamp meter & energy meter

Precautions:

- use safety personal protective equipments properly
- Follow the instraction of the task.
- Check measuring devices weather it is functional or not
- handle measuring devices properly

Procedures:

Step 1: Prepare yourself inorder to perform the given task

Step 2: Collect the required measuring devices from tools room

Step 3: Put each measuring devices separately on the table

Step 4: Check measuring devices weather it is functional or not

Step 5: using the selecting measuring devices perform the task

Step 6: At the end of your work clean, return & put the measuring devices on the previous location

LAP Test # 4

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 10 hours.

Task 1: identify measuring devices

Task 1: Demonstrate how to use measuring devices

UNIT FIVE: CLEAN-UP WORK AREA AND TOOLS

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

- Working area
- Clean, check, maintain & sore hand & power tools.
- Documentation for completed work.

This unit 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:

- Clear work area in accordance with workplace procedures.
- Clean, check, maintain and store tools and equipment in accordance with manufacturers' recommendations and workplace procedures.
- Complete documentation in accordance with workplace requirements.

5.1. Working area

Keeping workshop and storage spaces unwanted things can helps save us training tools for accidents. Sparks can ignite scraps, sawdust and solvents. Water can conduct electricity. Do not stand in water, on damp floors or in the rain when working with electrical tools. Keep hands and tools dry.

Make sure workshops and storage areas have:

- Proper electrical wiring & outlets needed to run power tools.
- Install adequate wiring to handle the electrical load required.
- All outlets should have three pronged plugs or be double-insulated.
- Any outlets that may come in contact with water should have ground fault circuit interrupters.
- Never use indoor tools outside.
- Use only approved outdoor extension cords.
- Use one long extension cord instead of several short ones.
- Do not damage or cut extension cords.
- When working on ladders or scaffolding rest power tools on a flat surface or in a bin secured to the ladder itself.
- A falling tool can seriously injure a co-worker or bystander.
- Never carry heavy power tools up and down ladders.
- Stop working and turn off the power tool you are working with if distracted by something or someone.
- Never look away from your work when operating a power tool.
- Cutting tools can be particularly dangerous.
- If one stalls, switch off the power and unplug the tool before trying to restart it.
- When using a power saw, let the saw reach full speed before cutting and support the work firmly so it won't shift.
- Never use your hands to clear scraps from a sawing worktable.
- Use a long stick instead.
- When working with metal, secure the metal material with clamps or in a machinist's vise to keep it from moving.

- Take extra care when working with hazardous materials.
- Its particles can irritate the skin, eyes and respiratory system.
- When soldering, remember that lead solder is toxic.
- The work area should be ventilated and flammable material properly stored.

5.2. Clean, check, maintain & sore hand & power tools.

Before, during & after performing our tasks all tools & measuring equipment must be properly cleaned, checked & maintained. Building electrical installation regulations require inspections & testing of tools & measuring equipment before use. Preventive maintenance is the systematic care and protection of tools, equipment & machines in order to keep it in a safe, usable condition limit downtime and extend productivity.

We must always be aware that maintenance tasks themselves are potentially hazardous and can result in injury.

The successful maintenance program is:

- well organized and scheduled,
- controls hazards,
- defines operational procedures, and
- Trains key personnel.

The degree of detail equipment maintenance will depend on the kinds of tools/equipment used. Some installation equipment has very specific inspection and maintenance requirements. Power Tools should be maintained in good working order. This may be limited to ensuring that blades/bits are replaced when needed and those guards or other safety devices are operable and any damaged electrical cords/plugs are repaired or replaced. Damaged or defective equipment/tools should be tagged and removed from service. The trainees must have their own cleaning, checking and maintenance schedule.

5.2.1. Requirements

General requirements for equipment maintenance include:

- Obtaining a copy of the maintenance schedule recommended by the manufacturer.
- Ensuring that maintenance is performed as required.
- Ensuring that the person(s) performing the maintenance are competent.
- Retaining records of maintenance/service conducted.

- Specifying who is responsible for overseeing equipment maintenance and where the records are kept.
- Set up a system for removal and tagging of damaged or defective tools and equipment.

5.3. Complete documentation for work.

Definitions: Documentation refers to a set of records that exist online, on paper or on hard drives. It is material that provides evidence or information to serve as a record. In the workplace, documentation is retained records of employment and company actions and events as required by legal mandates and company policy. The best human resource practices involve maintaining both formal and informal records about employment events. This can include items such as:

- Actions
- Contributions
- Disciplinary actions
- Disputes
- Investigations
- Performance evaluations
- Policy violations

Documentation gives substance to a workplace's activities not only for legal matters, audits or disputes, but also for rules and regulations. It keeps an training running systematically and ethically. It would be difficult for trainees in a training program to remember everything if it was only presented orally. During an emergency, staff might not remember the proper procedure to exit the building without documentation.

Self-check #5

Directions: Answer the questions below. Say true or false

1. Keeping workshop and storage spaces clean and dry can help prevent many accidents.**(2points)**
2. Do not stand in water, on damp floors or in the rain when working with electrical tools. (2points)
3. Which one is the general requirement for equipment maintenance .(2 points)

A. service conducted B. Ensuring that maintenance is performed as required. C. a$b

4. Documentation provides standards to a workplace.. (2 points)
5. Posting documentation is important for employees to understand their rights and obligations to maintain a safe workplace.(2 points)

Note: Satisfactory rating – above 60% Unsatisfactory - below 60%

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

Reference Materials

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MINISTRY OF LABOR AND SKILLS

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