CHAPTER 3 WORKSHOP TECHNOLOGY

Unit of learning code: ENG/CU/EI/CC/02/5
Related Unit of Competency in Occupational Standard: Perform workshop process (ENG/OS/EI/CC/02/5)

Introduction to the unit of learning

Industrial safety: Health and safety act, safety at work (general), personal safety, workshops safety, fire safety and First aid. Bench work: tools and measuring instrument and their applications. Bench fitting and operation sequence. Sheet metal processes. Machine tool operations and processes: lathe work, milling, drilling and grinding. Joining processes: mechanical joining, riveting, shrink fitting, welding and adhesive joining. Woodwork: Nature and types of woods, methods of construction, woodworking hand tools. Wood working machines, working principles, applications, maintenance and safety aspects. Joinery and carpentry work.

Summary of Learning Outcomes

1 Apply workshop safety

2 Use of workshop tools, Instruments and equipment's

3 Prepare workshop tools and instruments for an Electrical installation practical

4 Prepare the workshop for an Electrical practical

5 Store Electrical tools and materials after practical's

6 Troubleshoot and repair workshop tools and equipment

3.0 Learning Outcome 1: Apply workshop safety

3.1.1 Introduction to the learning outcome

All workshops and stores must be under the direct control of a supervisor, who is responsible for ensuring they are maintained and used in a safe and healthy manner. Only those authorised to do so may enter or work in workshops or stores, and must comply with the requirements of the supervisor whilst in that area.

All persons using workshops and stores should apply good housekeeping practices, wear appropriate clothing and footwear, and use the workshop or store only for its intended purpose.

A tidy workplace makes it easier to spot and avoid hazards, and does not interfere with normal work operations. Good housekeeping is fundamental to workshop safety management, and the time allocated to a job must include cleaning up afterwards. This applies to both individual and shared areas.

Personal items, food, drink or cigarettes are not to be taken into workshops and stores, unless a clean work-free area has been set aside for this purpose. Where necessary, lockers should be provided and used.

The store or workshop must be suited to the proposed task. The supervisor shall make the decision as to what tasks are appropriate for each situation.

3.1.2 Performance Standard

1.1 Meaning of PPE

- Standard operating procedure in PPE

1.2 Workshop rules

1.3 Electrical hazards e.g.

- Electric shock.

1.4 Fire

- Classes of fire
- Causes of fire
- Various methods of fire extinguishing

3.1.3 Information Sheet

- **Meaning of PPE**

  It is protective clothing helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. Protective equipment may be worn for job-related occupational safety and health purposes, as well as for sports and other recreational activities. "Protective clothing" is applied to traditional categories of clothing, and "protective gear" applies to items such as pads, guards, shields, or masks, and others. PPE suits can be similar in appearance to a cleanroom suit.

  The purpose of personal protective equipment is to reduce employee exposure to hazards when engineering controls and administrative controls are not feasible or effective to reduce these risks to acceptable levels. PPE is needed when there are hazards present. PPE has the

serious limitation that it does not eliminate the hazard at the source and may result in employees being exposed to the hazard if the equipment fails.

Any item of PPE imposes a barrier between the wearer/user and the working environment. This can create additional strains on the wearer; impair their ability to carry out their work and create significant levels of discomfort. Any of these can discourage wearers from using PPE correctly, therefore placing them at risk of injury, ill-health or, under extreme circumstances, death. Good ergonomic design can help to minimize these barriers and can therefore help to ensure safe and healthy working conditions through the correct use of PPE.

- **Standard operating procedure in PPE**

This standard operating procedure incorporates the requirements for use of Personal Protective Equipment (PPE) for project staff, co-operators, volunteers, contractors, and those under the project's operational control.

PPE listed in this SOP shall be used to provide protection and safety necessary for those participating in a project activity with PPE requirements. Additional information on the purpose and type of PPE may be available through the SOP for that activity.

Roles and responsibilities

Projects need to tailor the Roles/Responsibilities based on their staffing level

Project Manager (PM) is responsible for the overall safety of the project staff and those participating in a project activity and must provide the appropriate PPE for those activities.

Project Safety Officer (PSO) is responsible for issuing project PPE, for training project staff on the proper use and care of the PPE, and to ensure compliance with this SOP.

Supervisor is responsible for ensuring project staff and others participating in a project activity are properly wearing their issued PPE. After temporarily issuing the appropriate PPE to non-project personnel, train them on how to use the PPE and retrieve the PPE upon completion of the activity.

Project Staff is responsible for properly wearing their issued PPE for that activity. They must also properly maintain their issued PPE and when needed request a new PPE to replace worn out or damaged PPE. They will assist the Supervisor when non-project people are participating in an activity requiring specific PPE.

Others participating in the activity must be trained in the proper use of the assigned PPE and wear it properly when directed by project staff.

Training

The PSO or Supervisory staff will train project employees on the use and care of the PPE.

PPE selection

PPE shall be provided, used, and maintained wherever hazards exist (e.g., processing, environmental, chemical, mechanical) or are encountered in a manner capable of causing injury or impairment in the function of any part of the body. Injury can occur though absorption, inhalation, or physical contact with these hazards. The designated PPE person shall set a good example by donning PPE and following Program policy. The following provides guidelines for hazard assessment and PPE selection.

Eye and face protection. Appropriate eye or face protection shall be worn if exposures to potentially injurious hazards exist (e.g., flying particles, liquid chemicals, corrosives, chemical gases, vapors, UV rays). All eyewear shall provide:

- eye and side protection (detachable or permanent)
- protective devices to be worn over prescription eyewear, if needed
- a proper and comfortable fit.

Foot hazards

1 OSHA requires that staff wear protective footwear if the potential for foot injuries exist, including exposure to:

- compression, squeezing, smashing, falling, or rolling objects
- electrical hazards
- slipping
- chemicals
- temperature extremes
- repeated wetness which may result in fungal infections
- puncturing from objects which may pierce the sole of footwear

2. Engineering and work-practice solutions shall be utilized, including wearing footwear correctly (fully laced, etc.) to receive maximum protection. The Program shall prohibit the use of sandals or open shoes.

Hand and body protection

1. Glove manufacturer specification charts provide guidance in selecting proper PPE. Appropriate hand and body PPE shall be worn when potential hazards exist, including exposure to:

    - cuts and punctures—severe cuts and lacerations, abrasions or punctures from tools, machines or from handling sharp objects
    - thermal exposure—caused by extreme cold or heat or hot work
    - blood borne pathogens—caused by first-aid or clean-up of blood, body fluids, or other infectious agents.
    - chemical exposure—skin contact from working with chemicals
    - repetitive motion disorders—caused by computer use or jobs requiring repetitive motion may cause carpal tunnel syndrome
    - entanglement—caused from wearing gloves, clothing, or jewelry near moving equipment

2. Potential engineering and work-practice solutions may include:

    - machine guards—protects against cuts, punctures, abrasion, and chafing
    - job rotation—protects against repetitive motion hazards
    - good housekeeping and clean-up—protects against chemical and blood borne hazards
    - workstation design—protects against repetitive motions and provides accident prevention
    - evaluating waste prior to handling—aids staff in determining appropriate PPE and process method
    - splash guards—protects against chemical contact with skin or eyes

Head protection Head protection (e.g., hard hat) shall be worn if potential for injury from falling objects exist. All head protection shall:

Be used according to manufacturer's instructions

Not be altered in any way include bump caps as an appropriate alternative (if exposure to scalp injuries exist)

Hearing protection Facility staff shall wear hearing protection when exposed to noise levels in excess of 85 dB (A) for an eight-hour time-weighted average.
Respiratory protection Site specific ventilation or exhaust systems are effective engineering control tools.

- **Workshop rules**

  Before you can use equipment and machines or attempt practical work in a workshop you must understand basic safety rules. These rules will help keep you and others safe in the workshop.

  1. Always listen carefully to the teacher and follow instructions.
  2. Do not run in the workshop, you could 'bump' into another trainee and cause an accident.
  3. Know where the emergency stop buttons are positioned in the workshop. If you see an accident at the other side of the workshop you can use the emergency stop button to turn off all electrical power to machines.
  4. Always wear an apron as it will protect your clothes and hold loose clothing such as ties in place.
  5. Wear good strong shoes. Training shoes are not suitable.
  6. When attempting practical work all stools should be put away.
  7. Bags should not be brought into a workshop as people can trip over them.
  8. When learning how to use a machine, listen very carefully to all the instructions given by the teacher. Ask questions, especially if you do not fully understand.
  9. Do not use a machine if you have not been shown how to operate it safely by the teacher.
  10. Always be patient, never rush in the workshop.
  11. Always use a guard when working on a machine.
  12. Keep hands away from moving/rotating machinery.
  13. Use hand tools carefully, keeping both hands behind the cutting edge.
  14. Report any damage to machines/equipment as this could cause an accident.

- **Electrical hazards**

An electrical hazard is one of the most dangerous threats workers can face. It's estimated almost five percent of all workplace fatalities result from electrocution.

Electrical shock

An electric shock happens when an electric current passes through your body. This can burn both internal and external tissue and cause organ damage.

A range of things can cause an electric shock, including:

- power lines
- lightning
- electric machinery
- electric weapons, such as Tasers
- household appliances
- electrical outlets

While shocks from household appliances are usually less severe, they can quickly become more serious if a child chews on an electric cord our puts their mouth on an outlet.

Aside from the source of the shock, several other factors affect how serious an electric shock is, including:

- voltage
- length of time in contact with the source
- overall health
- electricity's path through your body
- type of current (an alternating current is often more harmful than a direct current because it causes muscle spasms that make it harder to drop the source of electricity)

If you or someone else has been shocked, you may not need emergency treatment, but you should still see a doctor as soon as possible. Internal damage from electric shocks is often hard to detect without a thorough medical exam.

Effects of electric shock

The symptoms of an electric shock depend on how severe it is.

Potential symptoms of an electric shock include:

- loss of consciousness
- muscle spasms
- numbness or tingling
- breathing problems
- headache
- problems with vision or hearing
- burns
- seizures
- irregular heartbeat

Electric shocks can also cause compartment syndrome. This happens when muscle damage causes your limbs to swell. In turn, this can compress arteries, leading to serious health problems. Compartment syndrome might not be noticeable immediately after the shock, so keep an eye on your arms and legs following a shock.

- **Electric Fire**
- Most electrical fires are caused by faulty electrical outlets and old, outdated appliances. Other fires are started by faults in appliance cords, receptacles and switches. Never use an appliance with a worn or frayed cord, which can send heat onto combustible surfaces like floors, curtains, and rugs that can start a fire.

- **Classes of fire**

There are 6 different classes of fire, and each should be attacked in a different way.

Class A (Solids)

Class A fires are fires involving solids. This type of fire could be paper and cardboard, common in offices and manufacturing. It could be furniture, or fixtures and fittings. It could even be the structure of the building.

This is one of the most common types of fire because solids are the most common type of fuel and one that is hard to eliminate. Good housekeeping should help to keep materials like packaging and waste reduced, minimizing risks Water extinguisher is one of the most popular types of extinguishers used class A fire. It can handle most fires involving solids.

Class B (Liquids)

Class B fires are fires involving liquids. Many of the fluids, liquids and chemicals used in workplaces can be flammable or explosive. Like cleaning fluids, solvents, fuels, inks, adhesives and paints.

According to statistics, in 2010/11 flammable liquids accounted for only 2% of fires, but a massive 21% of fatalities. These fires are rare but more deadly than other types of fire. So how can you protect yourself?

Make sure you know what flammable liquids are used in your workplace, and carry out a Control of Substances Hazardous to Health' (COSHH) assessment Control of Substances Hazardous to Health assessments are a legal requirement, for any hazardous substances. This about safe storage and use of these substances, keep them in labeled containers and away from sources of ignition.

Should a class B fire ignite, foam or powder extinguishers are the best types of extinguishers to attack this type of fire.

Give examples of foam extinguishers

Class C (Gases)

Class C fires are fires involving gases. This could be natural gas, Liquefied petroleum gas (LPG) or other types of gases forming a flammable or explosive atmosphere.

Work with gas is dangerous, and increases fire risk. Keep stored gases in sealed containers in a safe storage area, and ensure that gas work is carried out by competent persons.

While extinguishers can be used on class C gas fires, the only safe method to attack this type of fire is to shut off the gas supply. The best type of extinguisher to put out the fire when the supply of gas is off is a dry powder extinguisher

Class D (Metals)

Metals are not often thought of as a combustible material, some types of metal can be, like sodium. Metals are also good conductors, helping a fire spread. All metals will soften and melt at high temperature, which can be a big problem when metal joists and columns are present in a fire as structural elements.

Water can actually act as an accelerate on metal fires, so how would you tackle a class D fire? There are dry powder extinguishers developed to tackle metal fires. The powder inside the extinguisher may vary depending on the type of metal risk it is designed for. Small metal fires can sometimes be smothered with dry earth or sand.

Electrical Fires

This is not strictly a class (class E) of fire, because electricity is more or a source of ignition than a fuel. However, fires in live electrical equipment are an additional hazard. You don't want to be using water, or any other conductor as that could be fatal.

Electrical fires are not given their own full class, as they can fall into any of the classifications. After all it is not the electricity burning but surrounding material that has been set alight by the electric current.

To avoid electric fire;

Making sure electrical equipment and installations are installed correctly, and inspected and maintained, will help to reduce the risk of this type of fire.

While you shouldn't use water to attack an electrical fire, you can use other types of fire extinguishers. Like carbon dioxide, and dry powder in low voltage situations. Always turn off the power supply if you can.

Class F (Cooking Fats & Oils)

Deep fat frying and spillages of flammable oils near to heat sources in kitchens can result in a class F fire.

Never leave food or frying equipment unattended during use. The only type of fire extinguisher approved for use on cooking oils and fats is the wet chemical extinguisher. For small class F fires, you could also use a fire blanket.

- **Causes of fire**

  A house can easily catch fire from the misuse of appliances and heating equipment to smoking in bedrooms.

However you can take measures to avoid fire in home and ensure the safety of your family. Below are some of the most common causes of house fires, and some tips to take precautions.

1. **Cooking equipment**

Pots and pans can overheat and cause a fire very easily if the person cooking gets distracted and leaves cooking unattended. Always stay in the room, or ask someone to watch your food, when cooking on hotplates.

2. **Heating**

Keep portable heaters at least one metre away from anything that could easily catch fire such as furniture, curtains, laundry, clothes and even yourself. If you have a furnace, get it inspected once a year to make sure it is working to safety standards.

3. **Smoking in bedrooms**

Bedrooms are best to be kept off limits for smoking. A cigarette that is not put out properly can cause a flame, as the butt may stay a lit for a few hours. It could burst into flames if it came into contact with flammable materials, such as furniture.

4. **Electrical equipment**

An electrical appliance, such as a toaster can start a fire if it is faulty or has a frayed cord. A power point that is overloaded with double adapter plugs can cause a fire from an overuse of electricity. A power point extension cord can also be a fire hazard if not used appropriately. Double check the appliances and power points in your home.

5. **Candles**

Candles look and smell pretty, but if left unattended they can cause a room to easily burst into flames. Keep candles away from any obviously flammable items such as books and tissue boxes. Always blow a candle out before leaving a room.

6. **Curious children**

Kids can cause a fire out of curiosity, to see what would happen if they set fire to an object. Keep any matches or lighters out of reach of children, to avoid any curiosity turned disaster. Install a smoke alarm in your child's room and practice a home escape plan with your children and family in case there was a fire.

7. Faulty wiring

Homes with inadequate wiring can cause fires from electrical hazards. Some signs to see if you've bad wiring are:

1. Lights dim if you use another appliance;
2. For an appliance to work, you have to disconnect another;
3. Fuses blow or trip the circuit frequently.
4. Have a licensed electrician come and inspect you house, or contact your landlord if you have any of the above occurrences.

8. Barbeques

Barbeques are great for an outdoor meal, but should always be used away from the home, tablecloths or any plants and tree branches. Keep BBQs regularly maintained and cleaned with soapy water and clean any removable parts. Check the gas bottle for any leaks before you use it each time.

9. Flammable liquids

If you have any flammable liquids in the home or garage such as petrol, kerosene or methylated spirits, keep them away from heat sources and check the label before storing. Be careful when pouring these liquids.

10. Lighting

Lamp shades and light fittings can build up heat if they are very close to light globes. Check around the house to make sure. Lamp bases can become a hazard if they are able to be knocked over easily, and so should be removed if they are. Check that down lights is insulated from wood panelling or ceiling timbers.

The above tips are a good guide to avoiding a fire in your home. However it's a good idea to protect yourself with adequate home insurance cover to ensure you are covered in the unlikely event a fire were to happen

Various methods of fire extinguishing

If the three parts of the 'fire triangle' are kept in mind, extinguishing a small blaze should be a matter of common sense. The principles of fire extinction state that a fire will be put out if one of the three elements are removed, and this can be done using three different approaches, as detailed below.

Cooling

Removing the heat is one of the most effective methods of fire extinction available, which is why water is a popular extinguishing material. The fire will go out so long as the heat generated by the fire is less than that which is absorbed by the water.

Remember: water is not an appropriate extinguishing material to use on electrical fires, as well as those caused by cooking oils/fats or other flammable liquids.

Starving

While cooling removes the heat/ignition element of the 'fire triangle', starving the blaze of its fuel source approaches extinction from a different angle. A raging fire will burn itself out if it runs out of

flammable materials, such as a bonfire out in the open that isn't in contact with any other wood or dry grass. Similarly, a gas fire will immediately extinguish if the gas supply is cut off – you only have to look at a gas stove or Bunsen burner to see that.

Smothering

As the other key component present in the chemical reaction that causes combustion, removing oxygen from the equation is the final way of extinguishing a fire. For example, smothering a frying pan blaze with a fire blanket reduces the oxygen to below the 16% required to react, while covering a candle with a glass will snuff it out in a vacuum.

Smothering is a technique that is mostly applicable to solid fuel fires, although some materials may contain enough oxygen within their own chemical makeup to keep the blaze burning.

- **First Aid**

If the person has been injured by an electrical shock, Electrical shocks always need emergency medical attention even if the person seems to be fine afterward.

The following methods/procedures may be used to rescue the affected person

Separate the Person from Current's Source

To turn off power:

- Unplug an appliance if plug is undamaged or shut off power via circuit breaker, fuse box, or outside switch.

If you can't turn off power:

- Stand on something dry and non-conductive, such as dry newspapers, telephone book, or wooden board.
- Try to separate the person from current using non-conductive object such as wooden or plastic broom handle, chair, or rubber doormat.

If high voltage lines are involved:

- The local power company must shut them off.
- Do not try to separate the person from current if you feel a tingling sensation in your legs and lower body. Hop on one foot to a safe place where you can wait for lines to be disconnected.

  - If a power line falls on a car, instruct the passengers to stay inside unless explosion or fire threatens.

1. Is Cardiopulmonary resuscitation (CPR) if Necessary

When you can safely touch the person, do CPR if the person is not breathing or does not have a pulse.

- For a child, start CPR for children
- For an adult, start adult CPR.

2. Check for Other Injuries

- If the person is bleeding, apply pressure and elevate the wound if it's in an arm or leg.
- There may be a fracture if the shock caused the person to fall.

For All Burns:
1. Stop Burning Immediately

- Put out fire or stop the person's contact with hot liquid, steam, or other material.
- Help the person "stop, drop, and roll" to smother flames.
- Remove smoldering material from the person.
- Remove hot or burned clothing. If clothing sticks to skin, cut or tear around it.

2. Remove Constrictive Clothing Immediately

- Take off jewelry, belts, and tight clothing. Burns can swell quickly.

Then take the following steps:

For First-Degree Burns (Affecting Top Layer of Skin)

Cool Burn

- Hold burned skin under cool (not cold) running water or immerse in cool water until the pain subsides.
- Use compresses if running water isn't available.

Protect Burn

- Cover with sterile, non-adhesive bandage or clean cloth.
- Do not apply butter, oil, lotions, or creams (especially if they contain fragrance). Apply a petroleum-based ointment two to three times per day.

Treat Pain

Give over-the-counter pain reliever such as acetaminophen (Panadol, Tylenol), ibuprofen (Advil, Motrin, Nuprin), or naproxen (Aleve, Naprosyn).

When to See a Doctor

Seek medical help if:

- You see signs of infection, like increased pain, redness, swelling, fever, or oozing.
- The person needs tetanus or booster shot, depending on date of last injection. Tetanus booster should be given every 10 years.
- The burn blister is larger than two inches or oozes.
- Redness and pain last more than a few hours.
- The pain gets worse.
- The hands, feet, face, or genitals are burned.

Follow Up

- The doctor will examine the burn and may prescribe antibiotics and pain medication.

4. Wait for 911 to Arrive

5. Follow Up

- A doctor will check the person for burns, fractures, dislocations, and other injuries.
- An ECG, blood tests, urine test, CT scan, or MRI may be necessary.
- The person may be admitted to the hospital or a burn center.

3.1.4 Learning Activities

While working in busy production line in textile industry, fire erupts from one of the faulty electrical equipment. The fire gets contained but one of the workers gets minor burns on his left leg. Perform the following to relieve him from a lot of pain.

1. Cool down the burn. After holding the burn under cool, running water, apply cool, wet compresses until the pain subsides.
2. Remove tight items, such as rings, from the burned area. Be gentle, but move quickly before swelling starts.
3. Avoid breaking blisters. Blisters with fluid protect the area from infection. If a blister breaks, clean the area and gently apply an antibiotic ointment.

4. Apply a moisturizing lotion, such as one with aloevera. After the burned area has been cooled, apply a lotion to provide relief and to keep the area from drying out.
5. Loosely bandage the burn. Use sterile gauze. Avoid fluffy cotton that could shed and get stuck to the healing area. Also avoid putting too much pressure on the burned skin.
6. Take an over-the-counter pain reliever if necessary.
   Consider acetaminophen (Tylenol), ibuprofen (Advil), or naproxen (Aleve).

3.1.5 Self-Assessment

1. How should PPE be stored?
2. Can PPE be shared, reused, or altered?
3. How do you clean lead contaminated clothes?
4. **When Performing Cardio Pulmonary Resuscitation By You On An Adult, The Correct Ratio Of Compressions To Breaths Is?**
5. **How Do You Check For A Response To Determine Whether Someone Is Unconscious?**
6. **What Is The Very First Thing You Should Do When You Arrive At An Incident Scene?**
7. **How Do You Check For A Response To Determine Whether Someone Is Unconscious?**
8. **When Providing First Aid To An Unconscious Breathing Casualty, How Would You Position Them?**
9. **When Using A Defibrillator, How Do You Know Where To Place The Pads?**
10. **What Is The Best Way To Stop External Blood Loss?**

3.1.6 Tools, Equipment, Supplies and Materials

- Pliers
- Hacksaws
- Hammer
- Spirit levels
- Phase Tester
- Side cutters

3.1.7 References

1. **https://www.healthline.com/health/electric-shock**

2. **https://www.haspod.com/blog/fire/classes-of-fire**
3. **https://www.realinsurance.com.au/home-insurance/home-safety/the-most-common-causes-of-house-fires**
4. J. Craig Voelkert, A Brief Guide To Fire Chemistry And Extinguishment Theory For Fire Equipment Service Technicians, 2009 – Revised 2015, Amerex Corporation
5. John F. Riley, Standard for Fire Extinguishers, Rating and Fire Testing of, UL 711 Fifth Edition, 1995, , Institute of Gas Technology

3.1.8 Answers to self-assessment

1. While some workplaces will have PPE that is required on a daily basis or worn at all times, other personal protective equipment should be safely stored. The storage of personal protective equipment is almost as important has having it on hand, and an obligation set forth by OSHA, specifically requiring that PPE must be "maintained in a sanitary and reliable condition."

2. In many instances PPE is assigned to specific individual, and it is important to train workers on different types of personal protective equipment and what that means for sharing or reusing them. When employers purchase items specific to the employer (such as proper fitting boots), they should be assigned to that worker and not shared. On the other hand, items like safety glasses can be shared among a few employees if disinfected properly. Other pieces of equipment that can shared among others after disinfection includes hard hats, safety vests, etc. For workplaces like hospitals, some gowns are meant to be washed, disinfected, and ready to use again.

3. Through the course of day to day work, clothes get dirty. For most people, this just means they have to toss them in the washing machine and they are ready to go. When clothes are contaminated with potentially dangerous materials, such as lead, however, it requires specialized action. As an employer, it is important to ensure that the clothes that are contaminated with lead are properly washed to help ensure not only employees are safe, but the environment as well.

4. 30 Compressions and 2 Breaths.

5. Checking for a response is part of the primary survey. You should check for a response by shouting at the victim to see if they are reusable. If this does not work, a gentle tap on the shoulders can be used.

6. The first thing you should do is identify and manage any hazards to yourself or bystanders. Your safety is the most important priority!

7. Checking for a response is part of the primary survey. You should check for a response by shouting at the victim to see if they are reusable. If this does not work, a gentle tap on the shoulders can be used.
8. You should place all unconscious but breathing casualties into the recovery position (on their side with their head tilted back).
9. Look at the pads! They will have a diagram indicating exactly where on the chest they should be placed.
10. The best way to stop external blood loss is by applying direct pressure over the wound. Elevation can also help slow bleeding from a limb.

Learning Outcome 2: Use of workshop tools, Instruments and equipments

3.2.1 Introduction to the learning outcome

The Occupational Safety and Health Administration states that most injuries on construction sites involve excavation cave-ins, **power tool accidents**, falls, electrical hazards, and exposure to potentially dangerous materials

Working with power tools, you can get an electric shock, lose a finger, lose an eye, or go deaf. It's especially dangerous to use a tool that's defective, that's been modified, or that's not designed for the job. Of course, you can also get injured if you use any tool carelessly.

3.2.1 Performance Standard

- Meaning of workshop tools, instruments and equipments
- Classification of workshop tools and equipments
- Uses of workshop tools, Instruments and equipments

Care and Maintenance of workshop tools and Instruments

3.2.3 Information Sheet

3 Meaning of workshop tools, instruments and equipments

Drilling Machine

A drilling machine is a device used to cut holes into or through metal, wood, or other hard surface. This device is normally made of a tapered shank rotated by a motor or by hand (manually). Most drilling machines are made of hard elements like diamond or steel

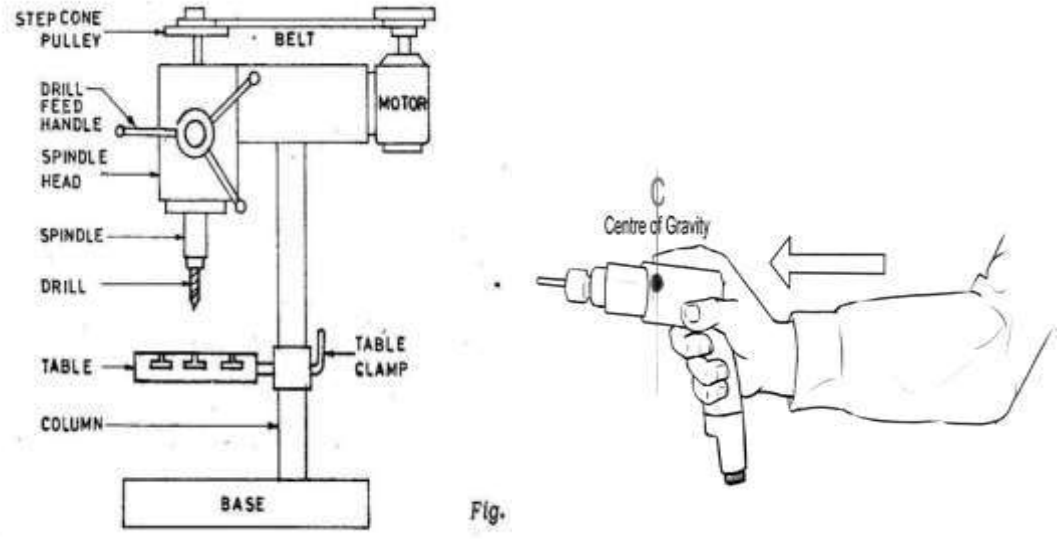

Fig.

Figure 40 Drilling machine

General Precautions for drilling machine

- Lubrication is important to remove heat and friction.
- Machines should be cleaned after use
- Chips should be removed using brush.
- T-slots, grooves, spindles sleeves, belts, pulley should be cleaned.
- Machines should be lightly oiled to prevent from rusting

Safety Precautions

- Do not support the work piece by hand – use work holding device.
- Use brush to clean the chip
- No adjustments while the machine is operating
- Ensure for the cutting tools running straight before starting the operation.
- Ease the feed if drill breaks inside the work piece.
- Do not wear loose or baggy clothing, ties, jewelry, or sandals. If you have long hair, tie it back or wear a cap — especially when drilling
- Wear eye protection when sawing and drilling. Safety glasses or goggles are inexpensive and available at any hardware store.
- Do not hold your finger on the switch button while carrying a plugged-in tool — it may start accidentally.
- Grip all tools firmly.
- Be sure to work at a safe distance from others.
- Do not use electric power tools in wet or damp locations.
- Never carry a power tool by its cord.

Never leave a running power tool unattended.

Grinding machine

The grinding machine consists of a bed with a fixture to guide and hold the work piece, and a power-driven grinding wheel spinning at the required speed. The speed is determined by the wheel's diameter and manufacturer's rating. The user can control the grinding head to travel across a fixed work piece, or the work piece can be moved while the grind head stays in a fixed position.

Safety precautions:

Grinding machines are used daily in a machine shop. To avoid injuries follow the safety precautions listed below.

- Wear goggles for all grinding machine operations.
- Check grinding wheels for cracks before mounting.
- Never operate grinding wheels at speeds in excess of the recommended speed.
- Never adjust the work piece or work mounting devices when the machine is operating.
- Do not exceed recommended depth of cut for the grinding wheel or machine.
- Remove work piece from grinding wheel before turning machine off.
- Use proper wheel guards on all grinding machines.
- On bench grinders, adjust tool rest 1/16 to 1/8 inch from the wheel.

Welding Machine:

Welding is joining metal parts (usually) together by heating the surfaces to the point of melting with a blowpipe, electric arc, or other means, and uniting them by pressing, hammering, etc.

Two popular welding types:

Arc Welding and Gas Welding

General welding Precautions

- Construction personnel that is welding should be properly trained and qualified
- Inspect work area for fire hazards before welding

- Make provisions for ventilation before welding
- Compressed gas cylinders should always be secured in an upright position when not in use and handled with extreme care
- Gas cylinders should be stored at least 20 feet away from flammable materials and heat sources
- Oxygen cylinders should be stored at least 20 feet away from gas cylinders and combustible materials.
- When not possible, use a 5 feet tall noncombustible barrier with a 30 min. fire-resistance rating or better.

- **Shearing machine :**

A shearing machine is an industrial machine that cuts metal. An industrial shearing machine generally presses blades down into metal sheets to punch out shapes. These shapes may be the desired end product or they may be the waste product. While shearing metal sheets is most common, other metallic objects may be processed in one of these machines.

Figure 41 power shearing machine

Safety Precautions

- Bench shears must be securely fastened to a bench or purpose designed stand.
- Guards or safety devices must never be removed or adjusted, except by an authorized person for maintenance purposes.

- Shearing edges should be maintained in good condition, should be distortion free and correctly adjusted.
- Working parts should be well lubricated and the blades free of rust and dirt.
- Ensure no slip/trip hazards are present in work spaces and walkways.
- Sufficient space must exist around the machine to prevent accidental contact with passersby.
- Familiarize yourself with and check all machine operations and controls.
- Never use bench shears for cutting metal that is beyond the machine's capacity with respect to thickness, shape, or type.
- Material should be properly supported during cutting and industrial type gloves should be worn to protect the hands.
- Use supports for long material - signpost if a tripping hazard.
- Manual handling tasks should be assessed and appropriate procedures put in place.
- Hold material securely to prevent it tilting during the cut.
- Ensure fingers and limbs are clear before operating the bench shears.
- When not in use this machine must be locked by, for example, a stout pin through the hole in the blades and kept in place by a padlock.
- Leave the work area in a safe, clean and tidy state.
- Closing movements between shearing surfaces and other parts can result in trapping
- Sharp edges on cutters, work pieces can cause cuts
- Squash/crush and pinch points

Safety guidelines for tools used in engineering workshop:

Hand tools are non-powered. They include hammers, hacksaw, spanners, chisels, vice, pliers...etc. The greatest hazards posed by hand tools result from misuse and improper maintenance.

General precautions

- Using a screwdriver as a chisel may cause the tip of the screwdriver to break and fly, hitting the user
- Using a tool with a wooden handle (e.g., hammer) if the handle is loose, splintered, or cracked, the head of the tool may fly off and strike the user or another worker;

- Using a spanner (wrench) if its jaws are sprung, because it might slip
- Using impact tools (e.g., chisels, wedges) if they have mushroomed heads, the heads might shatter on impact, sending sharp fragments flying.
- Hacksaw blades, knives or other tools be directed away from passage-way areas and others working in close proximity. Knives and scissors shall be sharp. Dull tools can be more hazardous than sharp ones;
- Floors shall be kept as clean and dry as possible to prevent accidental slips with or around dangerous hand tools; and
- Around flammable substances, sparks produced by iron and steel hand tools can be a dangerous ignition source. Where this hazard exists, spark-resistant tools made from brass, plastic, aluminum or wood shall be used.
- Disconnect tools when not in use, before servicing and when changing accessories such as blades, bits and cutters

➢ **Classification of workshop tools and equipments**

A tool is a device that can be used to produce an item or accomplish a task, but that is not consumed in the process. It can be considered as extension of the human hand thus increasing speed, power, and accuracy and on the other hands equipment includes any machine powered by electricity.

1. Hand tools are tools manipulated by hands without using electrical energy such as: puller, hacksaw, pull-push rule, pliers, hammer, and others.

   2. Machine/Power tools are tools manipulated by our hands and with the use of electrical energy such as: electric drill, grinding wheels, vacuum cleaner and others.

   3. Pneumatic tools are tools or instruments activated by air pressure. Pneumatic tools are designed around three basic devices: the air cylinder, the vane motor, and the sprayer

Hand tools

they include screwdrivers, hammers, pliers, wrenches and pullers. 1. Screwdrivers are used to drive, or turn screws. The common type has a single flat blade for driving screws with slotted heads. The other type has the cross slotted head.

1. Hammers are mostly used tools in the shop. They should be gripped at the end of the handle.
2. Pliers are specified types of adjustable wrenches. The two legs move on a pivot so that items of various sizes can be gripped.
3. Wrenches are used to turn screws, nuts and bolts with hexagonal heads. ―Hexagonal‖ means six-sided. A variety of wrenches are used in the shop.
4. Pullers are used to remove gears and hubs from shafts, bushings from blind holes, and cylinders' liners from the engine blocks.

Machine/Power Tools

Electric drill has an electric motor that drives a chuck. The chuck has jaws that can be opened and then closed to grip a drill kit.

Grinding tool can be either bench-mounted or installed on a pedestal. They may either have a grinding wheel, view wheel, or two grinding wheels.

Vacuum cleaner is used for cleaning the floor and car interiors after service.

Pneumatic tools

These are tools powered by compressed air. Common types of these tools that are used in industry include; buffers, nailing and stapling guns, graders, drills, jacks chipping hammers, riveting guns, sanders and wrenches.

- **Uses of workshop tools, Instruments and equipments**

Basic electrical tools, equipment, and their uses include:

Pliers

Pliers are available in different types, shape, and sizes. They are also available in both insulated and uninsulated handles. An insulated handle should be used when working on or near hot wires. It is also used for cutting big and small wires.

Figure 42 pliers

Screw Drivers

A screwdriver comes in various sizes and with several tip shapes. Screwdrivers used by electricians should have insulated handles. Using a screwdriver for a particular job, the width of the screwdriver tip should match the width of the screw slot.

Figure 43 screw drivers

Drilling Equipment

Drilling equipment is needed to make holes in building structure passages of conduits and wires.

Figure 44 driller

Sawing and Cutting

Tools Saws commonly used by electricians include the crosscut, keyhole, and hacksaw.

Figure 45 hark saw

Soldering Equipment

In doing electric wiring splices and taps (connections made to wire) should be soldered, unless you use solderless connectors. Typical equipments available for soldering are shown below.

Figure 46 soldering equipment

Hammers

Hammers are used with chisels and for nailing and fitting. Below are examples of carpenter's claw hammer, lineman's hammer, and machinist's ball-peen hammer

Figure 47 hammers

Measuring Tools

To measure wire length and other items, the electrician finds considerable use for measuring tools such as the extension or zigzag rule, push-pull rule and a steel tape as shown below.

Figure 48 Measuring tools

Care and Maintenance of workshop tools and Instruments

If you take care of your tools, they will return the favor. Proper care and routine maintenance of your hand tools and power tools makes any home improvement or repair project easier, safer and more successful. Proper tool care also saves you money because the better they're cared for, the longer they will last.

1.4.1.1 Hand Tools

Hand tools such as screwdrivers, wrenches, hammers, pliers, levels, and wire cutters are examples of common household tools that are often left out in places such as basements, garages and tool sheds. Tools are tough, but they are not indestructible and exposure to the elements can take its toll.

Below are some tips on how to take care of your tools and store them properly so that you get optimum use out of them.

- **Care and maintenance of tools**

Make it a habit to clean tools after each use before you return them to storage. Wipe them down with a rag or old towel and be sure they are free of dust, grease and debris before you put them into their proper places. This is also an opportunity to look for any damage or defects. Check your tools' handles for splinters, breaks and cracks. Also, make sure that metal parts show no signs of corrosion or rust. Repair or replace any tools that show signs of damage.

Cold chisels, log-splitting wedges and other striking tools can be very dangerous if they are not maintained properly. Because these types of tools are used for repeated striking, the surface of the metal head eventually mushrooms out and spreads to form a lip or ridge around the edge. With continued use, there is more spreading and the metal lip may continue to thin, split or curl until it finally breaks. If the metal head separates from the handle while in use, this could result in a dangerous projectile. To prevent this hazard, just grind off the metal edges with a powered grinder on a regular basis.

Store tools properly

A proper storage system is a must for hand tools. A toolbox, storage container, shelving unit, or a combination of all of these can be used to keep your tools protected and in peak condition. Ideally, your storage units should be kept somewhere with minimal exposure to moisture and temperature changes. Remember to keep tools in their respective places or hung on designated hangers when a job has been completed.

1.4.1.1.1.1 **Helpful Tips**

Use a small tool bag for the tools you use most often such as tools for simple jobs around the house. The rest of your tool arsenal can remain in your main toolbox.

You should have a space where you can inspect your tools and perform necessary maintenance tasks, such as a worktable. Cover it with newspaper or plastic sheeting to protect the table and make it easier to clean up after you're done with the job.

Hang lawn and garden tools, such as shovels and rakes, on a wall to get them off of the ground and to protect them from moisture.

1.4.1.2 Power tools

Power tools such as electric drills, saws, sanders and nailers need routine maintenance just like your hand tools. Because of their mechanical and electrical parts, power tools are more susceptible to problems caused by poor maintenance, dust and debris accumulation and general malfunction. The following are some helpful tips on how to clean and properly store your tools.

Keep power tools clean

Dust and grime can bring your power tools to a grinding halt if left unchecked over time. Wipe them clean with a rag after every job has been completed and then store them. Deep clean periodically by using a damp cloth. Get into exhausts and intakes and other hard-to-clean areas with lightly oiled cotton swabs or other slender tools.

Store power tools correctly

Keep your power tools protected from dust, moisture and other adverse conditions by storing them properly after use. Keep them in their original cases if possible, or tuck them away in storage drawers or tool chests, preferably in a garage or basement with a moderately controlled climate. This not only protects them, it also keeps them organized so you can easily find the tool you need when you need it.

Inspect for wear or damage

Periodically inspect power tools for any signs of wear or damage. Pay special attention to power cords. If you see frayed insulation or exposed wires, have the cord repaired or replaced immediately by a professional, unless you have the expertise to do it yourself. Damaged power cords can potentially lead to injury from electric shock or can cause a fire. Also, check the cord's prongs to see if they are bent or loose. If any are, repair or replace.

Lubricate moving parts

Keep moving parts lubricated for premium performance. Not only does it keep the mechanics of a tool running smoothly, it also decreases the chance of rust developing. While common machine oil is a good choice, consult your owner's manual to see if the manufacturer recommends or requires a specific type of oil.

Keep batteries in shape

Cordless, battery-powered tools are convenient and portable and have become very popular for contractors and homeowners alike. To keep them running efficiently and effectively, it is essential for their batteries to be maintained.

Batteries remain working at peak level by fully charging and then fully discharging their power once every couple of weeks. Don't let batteries sit unused for extended periods of time. Try to use batteries once every two weeks.

Care for batteries by cleaning contacts with cotton swabs and alcohol. Store batteries you won't be using for a while in a dry, clean place away from excessive heat.

3.2.4 Learning Activities

You have been appointed as a group leader during a practical lesson. Prepare workshop tools and instruments for an Electrical installation practical to install a radial power circuit.

3.2.5 Self-Assessment

a) What should you do if you find a tool defective?
b) When and how should you inspect powered hand tools
c) What should you do while using powered hand tools?
d) What are the general precautions for drilling machine that need to be observed?
e) How does one avoid injuries while using machines?
f) How do you maintain your equipment?
g) What is the importance of maintaining tools and equipment?
h) What is the importance of equipment?
i) What are the different types of maintenance?
j) What are the classification of tools and equipment?

3.2.6 Tools, Equipment, Supplies and Materials

1. Pliers
2. Hacksaws
3. Hammer
4. Spirit levels
5. Phase Tester
6. Side cutters

3.2.7 References

1. https://gltnhs-tle.weebly.com/lesson-45.html

2. Mario Gastegger and Simon Zünd, Maintenance of technical and user documentation, 201

3. https://projects.truevalue.com/maintenance_and_repair/basic_maintenance/proper_tool_maintenance.aspx

2006. Safe Operating Procedure: hand and portable powered tool safetyuniversity of Nebraska. Lincoln

3.2.8 Answers to self-assessment

1.

- 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.

- Inspect tools for any damage prior to each use.
- Check the handle and body casing of the tool for cracks or other damage.
- If the tool has auxiliary or double handles, check to see that they installed securely.
- Inspect cords for defects: check the power cord for cracking, fraying, and other signs of wear or faults in the cord insulation.
- Check for damaged switches and ones with faulty trigger locks.

3.

- Wear or use personal protective equipment (PPE) or clothing that is appropriate for the work you are doing; this may include items such as safety glasses or goggles, or a face shield (with safety glasses or goggles), hearing protection, dust mask, gloves, safety boots or shoes, or rubber boots.
- Switch off the tools before connecting them to a power supply.
- If a power cord feels more than comfortably warm or if a tool is sparking, have it checked by an electrician or other qualified person.
- Disconnect the power supply before making adjustments or changing accessories.
- Remove any wrenches and adjusting tools before turning on a tool.
- Inspect the cord for fraying or damage before each use. Tag defective tools clearly with an "Out of service" tag and replace immediately with a tool in good running order.
- During use, keep power cords clear of tools and the path that the tool will take.

- Use clamps, a vice or other devices to hold and support the piece being worked on, when practical to do so. This will allow you to use both hands for better control of the tool and will help prevent injuries if a tool jams or binds in a work piece.
- Use only approved extension cords that have the proper wire size (gauge) for the length of cord and power requirements of the electric tool that you are using. This will prevent the cord from overheating.
- For outdoor work, use outdoor extension cords marked "W-A" or "W".
- Suspend power cords over aisles or work areas to eliminate stumbling or tripping hazards.
- Eliminate octopus connections: if more than one receptacle plug is needed, use a power bar or power distribution strip that has an integral power cord and a built-in over current protection.
- Pull the plug, not the cord when unplugging a tool. Pulling the cord causes wear and may adversely affect the wiring to the plug and cause electrical shock to the operator.
- Follow good housekeeping procedures – keep the work area free of clutter and debris that could be tripping or slipping hazards.
- Keep power cords away from heat, water, oil, sharp edges and moving parts. They can damage the insulation and cause a shock.
- Ensure that cutting tools, drill bits, etc. are kept sharp, clean and well maintained.
- Store tools in a dry, secure location when they are not being used.
- Inspect the plug for cracks and for missing, loose or faulty prongs

4. The general precautions include:

- Lubrication is important to remove heat and friction.
- Machines should be cleaned after use
- Chips should be removed using brush.
- T-slots, grooves, spindles sleeves, belts, and pulley should be cleaned.
- Machines should be lightly oiled to prevent from rusting.

5. To avoid injuries follow the safety precautions listed below.

- Wear goggles for all grinding machine operations.
- Check grinding wheels for cracks before mounting.
- Never operate grinding wheels at speeds in excess of the recommended speed.
- Never adjust the work piece or work mounting devices when the machine is operating.
- Do not exceed recommended depth of cut for the grinding wheel or machine.
- Remove work piece from grinding wheel before turning machine off.
- Use proper wheel guards on all grinding machines.
- On bench grinders, adjust tool rest 1/16 to 1/8 inch from the wheel.

6. **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.

7. Good Quality tools can be a big investment, but if you take good care of them, they will last longer and return the favor. Making sure your tools are properly stored, cleaned, and well maintained will save you time and money as well as making your projects and jobs much easier.

8. Here are some of the long-term benefits of preventive equipment maintenance:
Extend equipment lifespan and reduce the need for having to purchase new equipment. Prevent unplanned downtime which can be costly and interrupt the manufacturing process. Avoid the need for expensive repairs due to negligence.

9. Types of maintenance?

- Preventive maintenance.
- Condition-based maintenance.
- Predictive maintenance.
- Corrective maintenance.
- Predetermined maintenance.
    - Gaining maintenance knowledge with interplay learning.

10. Classifications of tools and equipment according to their uses:

- Measuring tools.
- Holding tools.
- Cutting tools.
- Driving tools.
- Boring tools 6. Electrical equipment 7. Miscellaneous tools/instrument/equipment.
-

3.3 Learning Outcome 3: Prepare workshop tools and instruments for an Electrical installation practical

3.3.1 Introduction to the learning outcome

Electrical engineering is an engineering discipline concerned with the study, design and application of equipment, devices and systems which use electricity, electronics, and electromagnetism. It emerged as an identifiable occupation in the latter half of the 19th century after commercialization of the electric telegraph, the telephone, and electrical power generation, distribution and use.

3.3.2 Performance Standard

- Tools and instruments for an Electrical practical
  - Preparation of a list of tools and instruments for an Electrical practical.
  - Issuing and confirmation of tools and instruments before and after practical
- Testing of practical tools and Instruments

3.3.3 Information Sheet

- **Tools and instruments for an Electrical practical**

Electrical engineers work in a very wide range of industries and the skills required are likewise variable. These range from circuit theory to the management skills of a project manager. The tools and equipment that an individual engineer may need are similarly variable, ranging from a simple voltmeter to a top end analyzer to sophisticated design and manufacturing software.

- **Preparation of a list of tools and instruments for an Electrical practical**

Essential Electrician Tools

Wire Strippers

Professional electricians regularly strip the plastic coating on wires to expose the copper and make customized connections with other wiring or components. This essential electrical maintenance tool comes in a variety of models and types.

Fish Tape

Fish tape is one of many popular electrician tools. It's used to run wiring between gang boxes (or other electrical components) through conduit piping. Fish tape is housed in a retractable coil and can be fed through installed conduit piping. Once the end of the fish tape appears on the opposite side, wiring can be hooked to the tape and the tape can be retracted—pulling the wire along the conduit.

Fishing Rods

Fishing rods are essential electrician tools when installing wire through walls, below carpets, or above ceilings. Rods are typically fiberglass and include hooks on the end for easy manoeuvring.

Terminal Block

These modular, insulated devices assist electricians when grouping multiple wires together. They're used to connect wiring to a ground or connect electrical switches and outlets to mains.

Voltage Tester

To safely perform electrical work, electrical power must be cut off in key sections of the property (usually via the circuit breaker). A hand held voltage tester allows electricians to test outlets for power, so they know when they're safe to work on. Electricians also use this tool to confirm power has been restored.

Reaming Bit

An installing new conduit (or replacing old ones) means connecting different segments of piping together to create a wiring route between electrical components. A reaming bit attaches to an electric drill and widens the opening on one end of the piping, allowing it to connect to another segment of piping and complete a secure conduit.

Conduit Bender

When determining a wiring route, electricians often run wiring along the corner of the wall or in other mostly hidden areas. Conduit benders are electrician tools used to curve conduit piping to accommodate these routes and ensure the conduits remain non-intrusive and efficiently placed in the customer's home.

Splicing Connector

These plastic clips help electricians make quick connections with multiple pieces of wire. They can be used with multiple cables, including device wires, telephone cables, and electrical cables.

Flashlights

For an electrician, working in the dark is a potential hazard of the job. Keep essential electrician tools, like flashlights and other various work lights, handy and within reach

Issuing and confirmation of tools and instruments before and after practical

You can specify tools on job plans and work orders to indicate which tools are needed to perform a task. In the Stocked Tools application, you can issue tools to those work orders to indicate that the tools are dispatched for use with the right job

Testing of practical tools and Instruments

While planning for a practical, one needs to be sure that the tools are in the right order. Some of the things to consider while testing tools are:

1. making sure that they are working as expected
2. they can give accurate ,measurement
3. Screw drivers are not blunt
4. Stripping tools are.

3.3.4 Learning Activities

A textile manufacturing factory in Thika has organized a workshop and asked to train the electrical technicians on some new installation skills. As the lead technician, prepare workshop tools and instruments for the expected demonstration.

3.3.5 Self- Assessment

1. How can one improve my workplace safety?

2. Electrical tools need to last for a long time. What should be done to make them last for a long time?
3. There are different types of wire strippers. What are they?
4. Pliers are available in a variety of designs for different specialist tasks. Which are these types?
5. What are the best electrician's screwdrivers?
6. How do you manage tools and equipment?
7. How do you manage office equipment?
8. What are the basic maintenance of electrical tools and equipment?
9. Why is classifying tools and equipment important?
10. What equipment can be used to test electricity?

3.3.6 Tools, Equipment, Supplies and Materials

Pliers

Hacksaws

Hammer

Spirit levels

Phase Tester

Side cutters

3.3.7 References

https://www.servicetitan.com/blog/best-electrician-tools

https://www.ibm.com/support/knowledgecenter/SSWT9A_7.6.1.2/com.ibm.mbs.doc/toolinv/t_issue_stocked_tools.html.

3.3.8 Answers to self-assessment test

1. Workplace safety should be a continuous effort for any company. You will most likely never achieve perfect safety, so there will always be areas for improvement. Here are some ways you can start improving the safety or your facility:

- **Organize:** Often times a messy or cluttered facility can lead to injury. A great first step in improving your safety strategy is to organize workbenches and cells. Arranging spaces in a

logical manner, organizing tools and materials, and cleaning will make it much easier for people to do their job without worrying about slipping or tripping.

- **Develop a committee:** Workplace safety is seen as a priority when workers are brought together to form a safety committee. The safety committee is a permanent committee dedicated to identifying potential safety risks and implementing a solution. Senior management should support changes or improvements recommended by the committee.
- **Perform a JSA:** In order to fully understand the state of your facility's safety it will be important to conduct a Job Safety Analysis. It is proves use to identify safety hazards in specific jobs and use accepted best practices to make improvements; the more specific the better!
- **Go visual:** Visual cues are one of the most effective ways to remind workers of safety practices and promote a culture of safety. The best visual communication strategies include a combination of equipment labels, wall signs, floor signs, floor markings, chemical labels, and more.
- **Take a Gemba walk:** Sometimes managers and supervisors don't spend much time on the production line or the facility floor and can often overlook safety hazards. Taking a Gemba walk in the workplace and speaking with the front line workers can show you if jobs are being performed safely, if there are any glaring issues, and how people feel about current safety procedures.

There are so many different avenues to choose from when looking to improve the safety of your facility; above are just a few! The most important thing to remember when addressing occupational safety is to do it with a continuous improvement mind-set and don't forget to include everyone.

2. It's all well and good to ensure you have all the tools of the trade, but if you don't look after them, it will just end up costing hundreds, if not thousands, to continually replace them.

On top of this, tools that are in better condition are safer and a safer working environment is essential. So, here are some tips and tricks.

- Ensure they are stored correctly. Store them in bags, boxes, hang them on the wall or create a dedicated tool shelf, but either way, never leave your tools just lying around. A peg board is a fantastic way to store your small tools.
- Make sure the storage place is dry. Humidity and moisture can do a world of damage to your tools so take the required measures to protect them. There's nothing worse than rusty tools.

- Whenever you're done for the day, clear your tools prior to storing them. A clean cloth to remove any excess oils, sawdust or grease.
- Repair your tools when required. Check your tools after every job and take immediate measures to fix anything that needs fixing. If the tool is completely ruined, replace it immediately.

3. Multiple models and designs are available, including:

   Adjustable strippers - these combine stripping with crimping and wire-snipping abilities.
   Triple action wire strippers – these strippers are made for thicker cabling with tough insulation and can use a unique spiral cutting motion.
   Wire stripper pliers – these feature V-shaped stripping jaws for thicker, multicore cables.
   Sheath stripper – these use a rotary action and produce a neat ring cut.
   Pistol wire stripper – these strippers have a self-adjusting blade and use a compound stripping action with a firm grip.
   Automatic wire strippers – these use a mechanism to remove insulation and cut wire rapidly, with a single application of pressure
   Manual wire strippers – these are the standard, hand-operated model, but usually, include a spring-loaded handle and safety lock.

4. Pliers are available in a variety of designs for different specialist tasks. These include:

   Long nose pliers- these have long tapered jaws making them ideal for gripping small objects.
   Combination pliers– these feature a design that combines wire cutting, insulation stripping and gripping functions in a single tool.
   Water pump pliers– also known as slip joint pliers, tongue-and-groove pliers and adjustable pliers (among other names), these tools feature a movable lower jaw, allowing the span of the grip to be adjusted. They are ideal for use with nuts, bolts and fasteners.
   Side-cutting pliers– also known as wire cutters, these are typically used with wire. A variant called diagonal cutter applies different finishes to the cut wire.
   Mole grips/ locking pliers– these are ideal when working with metal.

5. The best electrician's screwdrivers are fully insulated against electrical shocks: an obvious safety hazard.

Properly insulated tools are a safety basic.

6. Tips for better equipment inventory management

- Know what you have.
- Track how it is used.
- Right asset, right place, right time.
- Don't spend more – spend smarter.
- Fix things before they break.
- Find underlying issues.
- Buy the best.
- Use the right **equipment** inventory system.

7. **Simple Ways to Maintain Your Office Equipment**

- Keep your machines clean. Machines should be kept clean and free from dust at all times.
- Put some thought into where you place your machines. ...
- Regularly check for small repairs and defects. ...
- Follow instruction manuals for usage. ...
- Follow required inspection and maintenance. ...
- Need help managing your print equipment?

8. Basic maintenance of electrical tools and equipment • clean out the dust. to make sure that your electric tools are ready to go when you are, keep them clean and free of dust. spend some time to clean out the dust every once in a while on your tools while they are inactive in storage.
9. Each tool is precisely designed for a specific purpose, so choosing the correct tool will also decrease the amount of effort required to get a job done right without causing damage to either the equipment or the surface being worked on.
10. Multimeters are the most versatile of the electrical testers and, as the name implies, they are capable of many different testing functions. All professional electricians own one of these tools. Most multimeters can provide precise readings of resistance, AC and DC voltage, continuity, capacitance, and frequency.

3.3 Learning Outcome 4: Prepare the workshop for an Electrical practical

3.4.1 Introduction to the learning outcome

A workshop is an informative or instructional class focused on teaching specialized skills or exploring a particular subject. Workshop presenters are usually educators, subject matter experts, managers or other leaders who possess knowledge of a particular subject or mastery of specific skills. Depending on the topic, workshops may be only one or two hours in length or extend across weeks of time. Workshop leaders can strengthen the effectiveness of their presentations through careful planning, organization, and presentation practice. Here are the steps for preparing a workshop.

https://www.youtube.com/watch?v=piYv9cdMgP8

3.4.2 Performance Standard

- Practical stations
- Interpretation of a list of practical material

3.4.3 Information Sheet

- **Practical stations**

Practical stations need good care and need to be kept clean all the time. The following steps may be followed when preparing the practical stations.

1. **Define the objective of the workshop.** Your objective may be to teach a concrete skill, such as how to create and save documents in a word processing application. Or your aim may be to deliver general information or guidance about a specific topic, such as painting or creative writing. Regardless of the focus, it's important to define the objective first.
2. **Determine the needs of workshop participants.** When teaching a particular skill, for example, understanding the participants' needs concerning skill level and learning pace will assist you in delivering appropriate content. The more you tailor the workshop to your audience, the more effective the workshop will be.
3. **Create an outline for your workshop presentation.**

- Create an introduction. Decide how you will introduce yourself, the topic and the participant members.
- List the skills and/or topics you will cover. Create a comprehensive bulleted list. Include subtopics, as needed.

- Decide on the order of the topics. Move the most important skills or information to the early part of the workshop. Depending on the subject of the workshop, it may also be useful to introduce and build on each topic, beginning with the simplest or most straight forward topic and concluding with the more difficult or complex topic.
- Determine ground rules for the workshop. Rules or guidelines such as only one person speaks at a time or raising a hand to speak, as well as shutting off any cell phones or distracting devices are good to establish at the onset of the workshop.
- Decide how you will wrap up the workshop. You might include a short review of learned skills, announce the next level in a series of workshops and/or implement a participant feedback form.

4. **Assign an estimated length of time to each item on the outline.** For particularly complicated topics or skills, allot a sufficient amount of time in case participants get stuck or have questions. It is also important to factor in scheduled breaks during the workshop to give the participants a chance to go to the bathroom or stretch their legs.
5. **Once you complete your outline, practice giving your workshop presentation.** Rehearsal is an important part of the workshop preparation process. Present your information to colleagues, friends or relatives ahead of time, and ask them to give you feedback on the clarity and effectiveness of your presentation.

- **Interpretation of a list of practical material**

Electrical Materials include;

- Electrical Conduit and Conduit Fitting. Conduit fittings, also called electrical fittings, are used to connect runs of conduit together or to connect conduit to electrical devices. Select from conduit fittings such as adapters, bushings, couplings, elbows, straps, and connectors.

- Electrical Wire and Cable. Electrical cable and wires are considered as a same thing. In fact they are quite different. A wire is made of a single electrical conductor while a cable is a group or bundle of multiple wires inside a common sheathing. Both of them are used for carrying electrical current.
- Circuit Breakers. A *circuit breaker* is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by excess current from an overload

- Electrical Connectors. An *electrical connector* is an electromechanical device used to join electrical conductors and create an electrical circuit.

Electrical Box. Electrical boxes, also known as junction boxes, enclose wire connections. They help protect against short circuits, which can cause fires. ... Per their requirements, electrical boxes must be

covered with matching electrical box covers. You can't cover them with drywall, paneling or other wall coverings.

●

3.4.4 Learning Activities

You are a team leader in a practical lesson. The trainer gives you the following circuit to install.

Interpret the circuit and prepare a list of materials to be used during the practical.

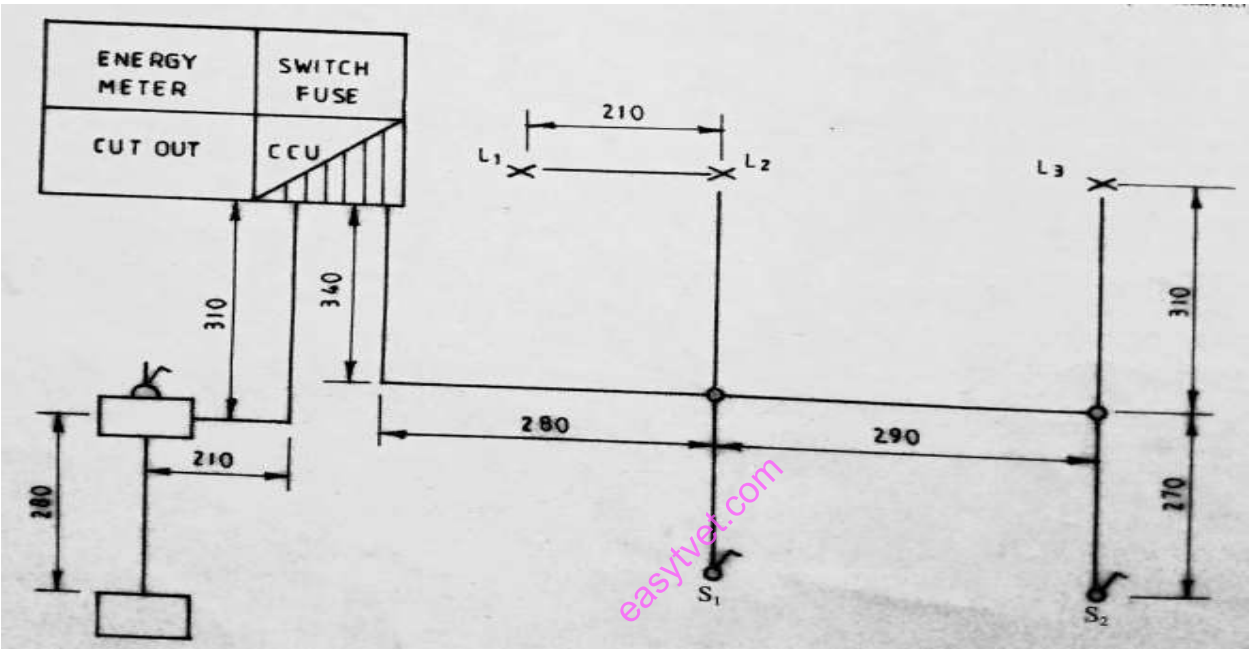

Figure 49 lighting and power circuits

3.4.5 Self-Assessment

1. What is an electrical workshop?
2. What are the other safety precautions that you apply when working?
3. What are the five safety measures while working in a workshop?
4. What is the most important rule of electrical safety?
5. How are electrical tools classified?
6. What are the basics of electrical?
7. What is an electrical workshop?
8. What are the 3 basic types of electrical circuits?
9. How do you estimate an electrical job?
10. How many amps do you need for a workshop?

3.4.6 Tools, Equipment, Supplies and Materials

- Pliers
- Hacksaws
- Hammer
- Spirit levels
- Phase Tester
- Side cutters

3.4.7 References

https://www.wikihow.com/Prepare-a-Workshop

https://www.youtube.com/watch?v=piYv9cdMgP8

3.4.8 Answers to Self-Assessment

1. Industrial Electricity Workshop This workshop specializes in maintaining and repairing power circuits, alternators, power panels, electromechanical equipment, field generators and other related equipment.

2. Here are some tips to help make your workplace safe.

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

3. The 5 safety rules at a glance

- Disconnect completely. Meaning that the electrical installation must be disconnected from live parts on all poles. …
- Secure against re-connection. …

- Verify that the installation is dead. …
- Carry out earthing and short-circuiting. …
- Provide protection against adjacent live parts.

4. What is the most important rule of electrical safety? Never work on an energized circuit except if the power cannot be disconnected. A piece of equipment can help us to think before acting. Do not depend on circuit breakers, fuses which may misguide wrongly.

5. 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. .Power tools are classified as either stationary or portable, where portable means hand-held.

6. **Basic electricity:**

- Conductors: electrons flow easily. Low resistance.
- Semi-conductors: electron can be made to flow under certain circumstances. Variable resistance according to formulation and circuit conditions.
- Insulator: electrons flow with great difficulty. High resistance.

7. Industrial Electricity Workshop This workshop specializes in maintaining and repairing power circuits, alternators, power panels, electromechanical equipment, field generators and other related equipment.

8. Types of circuits include:

- Series Circuit. A series circuit there is only one path for the electrons to flow (see image of series circuit).
- Parallel Circuit. .
- Series/parallel circuits

9. **Basic steps to estimate electrical job**

1. Choose the Right Work to Bid.
2. Review the Specifications.
3. Review the Drawings.
4. Perform a Quantity Takeoff.
5. Request Supplier Quotes.
6. Create your Estimate.
7. Add Overhead and Profit.

8. Build your Proposal.

10. Dedicate two 20-amp circuits for bench top and portable-tool outlets. Larger 120-volt machines (table saw, planer, dust-collector, etc.) require a 20- or 30-amp circuit. If you run two machines at once, such as your table saw and dust collector, then each needs a separate circuit.

3.5 Learning Outcome 5: Store Electrical tools and materials after practicals

3.5.1 Introduction to the learning outcome

The proper care and storage of tools and equipment are not only the concern of the management but of the workers who use the equipment.

3.5.2 Performance Standard

- Classification of workshop tools and instruments.
- Storage of workshop Tools and equipment
- Tools are cleaned as per the workshop standard operating procedure
- Waste disposal

3.5.3 Information Sheet

- **Classification of workshop tools and Instruments**

Basic Electrical Tools.

- **Pliers. Plier**s—often referred to as cutting pliers or lineman pliers—are a staple on any electrical tools list.
- **Screwdrivers**. A *screwdriver* is a tool, manual or powered, used for screwing (installing) and unscrewing (removing) screws. A typical simple *screwdriver* has a handle and a shaft, ending in a tip the user puts into the screw head before turning the handle.
- **Electrical Contractor Software**. Originally created for electrical contractors, 360e is an all-in-one quoting, scheduling, tracking and billing software that is designed by contractors, for contractors. 360e bolsters efficiency and profit while eliminating the daily operational headaches that kill profits.
- **Tape Measure.** A *tape measure* or *measuring tape* is a flexible ruler used to *measure* size or distance. It consists of a ribbon of cloth, plastic, fibre glass, or metal strip with linear-*measurement* markings. It is a common *measuring* tool.
- **Electrical Tape**. *Electrical tape* (or *insulating tape*) is a type of pressure-sensitive tape used to insulate electrical wires and other materials that conduct electricity.
- **Cable Ties**. They're fasteners that bundle your cables and wires together to keep them organized and prevent damage. They come in different sizes, lengths, materials and even colors.
- **Electric Drill**. A *drill* or *drilling* machine is a tool primarily used for making round holes or driving fasteners.
-

Electrical measuring equipments

Electrical instruments are classified according to the electrical quantity or the measured characteristics. It is also classified according to the type of test function, according to the current that can be measured by them.

Ammeter

An ammeter is an instrument which is used to measure the electric current in amperes in a branch of an electric circuit. In order to measure the current it must flow through the ammeter, so the ammeter must be placed in series with the measured branch and it must have very low resistance so that the alteration of the current can be avoided which is measured. Instruments which is used to measure smaller currents are micro-ammeter. The ammeter is connected in series to the device which is to be measured because objects in series have the same current.

Types of ammeter

Moving iron ammeter

In a moving iron, ammeter can measure the AC and DC; it has an iron piece instead of the spring and pointer system of the galvanometer. The iron will act by the magnetic field created in the coil.

Zero centre ammeters

Zero centre ammeters are used where the voltage needs to be monitored in two directions and they are used along with a battery. In this the charging of battery deflects the needle in one direction and discharging of the battery deflects the battery in the other.

Galvanometer

Galvanometer was the first type of ammeter, it is used to detect and measure electric current. It is an analogue electromechanical transducer which makes a rotary deflection in response to the electric current flowing through the coil. A galvanometer can read direct current flow, the magnetic field created as current flows through a coil acts on a spring, which will move the needle indicator.

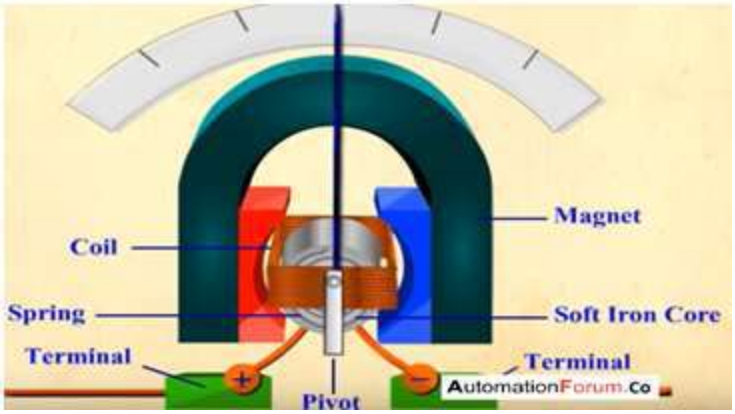

Figure 50 galvanometer

Shunt

A shunt can be used in ammeters to measure large currents, shunt acts as a resistor the known quantity of resistance is used to obtain an accurate reading. Digital ammeters use analog to digital converter to measure the current across the shunt.

Clamp meter

Clamp meters are used to measure the current flowing through a conductor, AC clamp meters have a current transformer in it. With the help of the current transformer the reading will be taken. There are two types of clamp meters AC clamp meter which is used to measure the AC and the DC clamp meter which is used to measure the DC.

Voltmeter

The voltmeter can be considered as a kind of galvanometer, which can be used to measure the voltage potential of an electrical circuit or the potential difference between two points. A voltmeter can also be considered as an ammeter they also measure the current, voltage is only measured when the current is transmitted in a circuit through resistance. Voltmeters are capable to measure the current, voltage and resistance. Voltmeters are also termed as high resistance ammeters they can also measure DC and AC. A voltmeter can measure the change in voltage by two points in an electrical circuit and they are connected in parallel with the portion of the circuit on which the measurement is made. Voltmeters must have high resistance so that it won't have any effect on the current or voltage associated with the circuit.

Types of voltmeter

Digital voltmeter

Digital voltmeters can measure the AC and DC voltages and it displays the result in converted digital form with decimal point and polarity. It can provide accurate details about the current draw and current continuity and this will help the users to troubleshoot erratic loads.

What are the advantages of digital voltmeter?

- Outputs are accurate without any error
- Readings are taken quickly
- Versatile and accurate
- Less power consumption
- Portable instrument

Electrostatic voltmeter

These voltmeters are instruments that can accurately measure the voltage without any charge transfer. Whereas conventional voltmeter needs charge transfer to the voltmeter and it will lead to loading and adjustment of the source voltage. The main advantage of an electrostatic voltmeter is that it can do the surface potential measurement on any type of material without any physical contact.

Ohmmeter

An ohmmeter is an instrument that is used to measure the resistance and they can measure the value of resistance accurately. According to their measurement and construction, these instruments are classified into the series type and shunt type ohmmeter. It can be used to check the continuity of the electrical circuits and components. Series type ohmmeters are used to measure the high resistance values while the shunt type is used to measure low resistance values.

Potentiometer

Potentiometer is instruments that can be used to measure the unknown voltage. The known voltage will be supplied from a standard cell or any other known voltage reference source. Potentiometer measurement has high accuracy because the measurement is done by the comparison method and the obtained result is not by the deflection of the pointer. Potentiometer can be used to compare the E.M.F of the two cells, it can be used to determine the E.M.F of a cell, it can be used to determine the internal resistance of a cell and to calibrate the voltmeter and ammeter.

Wattmeter

Watt-meters are used to measure power; these instruments are similar in design and construction of an ammeter. It can be used to measure the average electric power in watts. Wattmeter has two coils they are current and pressure coil. Wattmeter can be used to measure the gain in amplifiers, bandwidth in filters.

Multi-meter

Multi-meters can be used to make various electrical measurements; they can be used to measure AC and DC voltage, AC and DC current, and resistance. It is known as multi-meter because it can do the functions of various meters such as voltmeter, ammeter, and ohm-meter. Multi-meters can also be used to check the continuity. Multi-meters are of two types they are analog and digital multi-meter analog multi-meter has an analog scale and they are less accurate, while the digital multi-meter and the reading are in digital and they are more accurate.

- **Storage of workshop Tools and Equipment**

The proper care and storage of tools and equipment are not only the concern of the management but of the workers who use the equipment.

Importance of proper storage of tools and equipment

1. It is an important factor for safety and health as well as good business.
2. Improves appearance of general-shop and construction areas.
3. Reduces overall tool cost through maintenance.
4. This also ensures that tools are in good repair at hand.
5. Teaches workers principles of (tool) accountability.

Points to consider in storing tools and equipment:

1. Have a designated place for each kind of tools.
2. Label the storage cabinet or place correctly for immediate finding.
3. Store them near the point of use.
4. Wash and dry properly before storing.

5. Store knives properly when not in use with sharp edge down.

6. Put frequently used items in conveniently accessible locations.

7. Gather and secure electrical cords to prevent entanglement or snagging.

8. Cutting boards should be stored vertically to avoid moisture collection.

9. Metal equipment can be stacked on one another after drying such as storage dishes and bowls.

10. Make sure the areas where you are storing the equipment are clean, dry and not overcrowded.

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. If you are storing tools in self-storage, place small tools in plastic bins.

- **Tools are cleaned as per the workshop standard operating procedure**

To ensure tools have a longer utility and lifespan, they must be properly cared for. Cleaning your tools should be approached in the same manner that you clean any other equipment or surface in your facility.

The cleaning principles are:

1. **Dry clean.** Remove visible and gross soils and debris.
2. **Pre-rinse.** Rinse all areas and surfaces until they are visibly free of soil.
3. **Wash (soap and scrub).** Use the right detergent in the right concentration with the right level of mechanical action in the right water temperature for the right contact time.
4. **Post-rinse.** Rinse away all visible detergents and remaining soil.
5. **Inspect.** Look again at crevices and other contamination traps to ensure they're free of soils and detergents. Determine whether steps 1-4 should be performed again.
6. **Sanitize.** Foam, wipe or spray sanitizing chemicals onto surfaces as per the appropriate instructions.
7. **Dry.** Ensure adequate time is allotted for equipment to thoroughly dry.
8. **Verification.** Gather proof that the cleaning performed achieved the expected level by following facility verification protocols.

As part of the care strategy, cleaning tools should be hung to thoroughly dry. Brushes, brooms and squeegees should be stored in wall brackets and shouldn't touch the walls or other cleaning tools while drying or while being stored.

In addition to keeping tools clean, facilities should also move beyond the concept of just fixing or replacing a tool when it is broken. A tool that breaks while in use can trigger significant downtime and operational losses. Several companies have transitioned to the practice of diagnostic maintenance, where the maintenance crew sets a troubleshooting and monitoring schedule to ensure that tools and equipment are functioning as intended.

- **Waste Disposal**

Waste is any substance which is discarded after primary use, or is worthless, defective and of no use. A by-product by contrast is a joint product of relatively minor economic value.

Waste management (or **waste disposal**) includes the activities and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process.

Waste disposal methods

1.4.1.3 Recycling

Recycling refers to both the direct **reuse** of used products (e.g. used clothing and functioning parts removed from used vehicles) and **material recycling**, that is the recovery of raw materials from waste (e.g. production of new glass from fragments, the melting of scrap iron and the production of recycled building materials from construction waste). **Down cycling** refers to the transformation of waste to materials of lower quality than the initially used material.

1.4.1.4 Incineration

Combustible waste from households and waste wood that is not suitable for recycling undergo thermal treatment in waste incineration plants or waste wood furnaces. The heat released in the process **is used to generate electricity and heat buildings**. Waste with a high calorific value and low level of pollutant contamination can be used in industrial plants, e.g. cement plants, as an alternative to fossil fuels. Waste that is contaminated with organic pollutants undergoes separate thermal treatment (e.g. in hazardous waste incineration plants). Incinerators must have a flue gas treatment system. The requirements for flue gas treatment and the incineration system are based on the nature of the waste.

1.4.1.5 Chemical-physical and biological treatment

The objective of both chemical-physical and biological treatment is to enable **the removal of pollutants from waste** or its **safe land filling**. Waste water and polluted excavated material are typical of the types of waste that are managed in this way. Following chemical-physical treatment, the pollutants can be disposed of in concentrated form in facilities suitable for this purpose.

1.4.1.6 Landfills

Residues from waste incineration or waste that is not suitable for material recycling or thermal treatment are deposited in landfills that are compliant with the legal requirements. If the waste does not fulfil the requirements for land filling, it must be pre-treated

1.4.1.7 Collection and logistics

The waste management sector involves many different specialised actors. Their tasks include the collection of waste at source (industry, commerce and households) in suitable transport containers, its intermediate storage and handover to waste disposal operations. The treatment of waste is often based on a cascade of specialised plants. In all cases, **smooth logistics** are a precondition for the efficient management of waste. In the case of hazardous waste, in accordance with the Ordinance on Movements of Waste, the handover must be **documented**.

3.5.4 Learning Activities

You are provided with a number of electrical installation tools. Classify them into the following

- Measuring **tools**.
- Holding **tools**.
- Cutting **tools**.
- Boring **tools**

3.5.5 Self- Assessment

1. What is the proper way to store tools and equipment?

2. What is the importance of storing tools and equipment?

3. What are the classification of tools and equipment?

4. What are workshop tools?

5. What does waste disposal mean?

6. Why waste disposal is a problem?

7. What are the main causes of waste?

8. What is storage equipment?

9. What are the methods of waste management?

10. What are the 5 R's of waste management?

3.5.6 Tools, Equipment, Supplies and Materials

- Pliers
- Hacksaws
- Hammer
- Spirit levels
- Phase Tester
- Side cutters

3.5.7 References

https://www.storagefront.com/storagetips/auto-rv-boat/gardening-tools-storage/

3.5.8 Answers to self-assessment

1. Pointers to follow in storing tools and equipment:

Have a designated place for each kind of tools.

Label the storage cabinet or place correctly for immediate finding.

Store them near the point of use.

Wash and dry properly before storing.

Store knives properly when not in use with sharp edge down.

2. Making sure your tools are properly stored, cleaned, and well maintained will save you time and money as well as making your projects and jobs much easier. When it comes to storing your tools you have to work with the space that you have.

3. **Classifications of tools and equipment according to their uses:**

- Measuring tools.
- Holding tools.
- Cutting tools.
- Driving tools.
- Boring tools

4. There are hundreds of tools used in a workshop. Saws are some of the most common. A circular saw is attached to a table and spins round in a circle. It is used to cut large sheets of wood. ... A drill is an electric tool that spins round and is used to make holes in material so that a screw can be put in.

5. **Waste disposal**, the collection, processing, and recycling or deposition of the waste materials of human society. The term waste is typically applied to solid waste, sewage (waste water), hazardous waste, and electronic waste.

6. **Disposing** of **waste** has huge environmental impacts and can cause serious problems. ... Some waste will eventually rot, but not all, and in the process it may smell, or generate methane gas, which is explosive and contributes to the greenhouse effect. Leachate produced as waste decomposes may cause pollution.

7. **The mismanagement of landfill waste caused by garbage pollution**

- Litter on every corner or on the side of the road.
- Oil spills.
- Illegal dumping in natural habitats.
- Debris or damage caused from unsustainable logging practices.
- Pesticides and other farming chemicals.
- Nuclear accidents or radiation spills.

8. **Storage equipment** is any **equipment** used for holding or buffering materials over a period of time (and may include transport) typically they help preserve valuable work floor space.

9. **Waste disposal methods**

- Recycling. Incineration. ...
- Other thermal treatment plants. Chemical-physical and biological treatment. ...
- Chemical-physical and biological treatment. Landfills. ...
- Landfills. Collection and logistics.

10. As citizens of a society we have a responsibility to manage our waste sustainably. We can do this following the five R's of waste management: reduce, reuse, recycle, recover and residual management.

3.6 Learning Outcome 6: Troubleshoot and repair of workshop tools and equipment

3.6.1 Introduction to the learning outcome

The level of troubleshooting most often performed on tools and equipments hardware is exchanging *Field Replaceable Units* (*FRU*s). The cost of using a technician to diagnose the problem further, and repair it, can quickly exceed the cost of the new replacement unit.

3.6.2 Performance Standard

- Meaning of troubleshooting
- Common faults in Electrical equipments
    - Fault diagnosis procedure
- Repair/Replace of components in Electrical equipments

3.6.3 Information Sheet

- **Meaning of troubleshooting**

Troubleshooting is a form of problem solving, often applied to repair failed products or processes on a machine or a system. It is a logical, systematic search for the source of a problem in order to solve it, and make the product or process operational again. Troubleshooting is needed to identify the symptoms. Determining the most likely cause is a process of elimination—eliminating potential causes of a problem. Finally, troubleshooting requires confirmation that the solution restores the product or process to its working state.

In general, troubleshooting is the identification or diagnosis of "trouble" in the management flow of a system caused by a failure of some kind. The problem is initially described as symptoms of malfunction, and troubleshooting is the process of determining and remedying the causes of these symptoms.

A system can be described in terms of its expected, desired or intended behavior (usually, for artificial systems, its purpose). Events or inputs to the system are expected to generate specific results or outputs. (For example, selecting the "print" option from various computer applications is intended to result in a hardcopy emerging from some specific device). Any unexpected or undesirable behavior is a symptom. Troubleshooting is the process of isolating the specific cause or causes of the symptom. Frequently the symptom is a failure of the product or process to produce any results. (Nothing was printed, for example). Corrective action can then be taken to prevent further failures of a similar kind.

- **Common faults in Electrical equipments**

Fault-finding for electronic/electrical equipment is a skill that is neither an art nor a science, but an engineering discipline in its own right. Effective fault-finding requires:

- A good general knowledge of electricity and electronics.
- Specialized knowledge of the faulty equipment.
- Suitable test equipment.
- Experience in using such test equipment.
- The ability to formulate a procedure for isolating a fault.
- The availability of service sheets and other guides.

Common Problems

An electrical fault is the deviation of voltages and currents from nominal values or states. Under normal operating conditions, power system equipment or lines carry normal voltages and currents which results in safer operation of the system.

But when a fault occurs, it causes excessively high currents to flow which causes damage to equipment and devices. Fault detection and analysis are necessary to select or design suitable switchgear equipment, electromechanical relays, circuit breakers, and other protection devices.

There are mainly two types of faults in the electrical power system. Those are symmetrical and unsymmetrical faults.

Symmetrical faults

These are very severe faults and occur infrequently in the power systems. These are also called balanced faults and are of two types namely line to line to ground (L-L-L-G) and line to line (L-L-L).

2.Unsymmetrical faults

These are very common and less severe than symmetrical faults. There are mainly three types namely line to ground (L-G), line to line (L-L), and double line to ground (LL-G) faults.

Fault diagnosis procedure

Here are six key points to consider

1. Collect the Evidence

All the evidence collected must be relevant to the problem in hand. If one is in doubt as to whether anything is relevant, then include it. Reject it afterwards at the first opportunity if it clearly is not relevant. The quantity of information collected is unimportant, what matters are that all information collected is relevant. Observe the system running, if you consider it safe to do so. Use all your senses: smell (burning), hearing (vibration), touch (temperature), sight (for unusual conditions). Refer to any relevant documentation.

2. Analyze the Evidence

Consider all the evidence collected and, if possible, reject any which after further careful consideration is not relevant. Study the hard core of relevant evidence and – through the process of careful, logical thinking –diagnose the likely fault or at least the area or region of the fault.

3. Locate the Fault

In a sense this is a continuation of the process of 'analyses. The areas or regions are systematically reduced in size until a specific part can be identified as being faulty. For example, if a door bell does not ring when it should; it is only by means of a systematic approach that one determines that the bell itself is faulty.

4. Determination and Removal of the Cause

If the cause of a fault is not removed, the fault will recur even though the fault has been rectified. For instance, a flat bicycle tyre might be the result of a puncture (the fault) in the inner tube. If the puncture is repaired (i.e. the fault is removed) this will not be of much use if the cause of the puncture in the first place is not determined and appropriate action taken. The cause of the puncture may be a nail which has penetrated the outer cover. This must be removed

5. Rectification of the Fault

This may be a simple task, as in the case referred to above, or it may be a much bigger one. Whatever is the case, it is a specific task based on earlier findings.

6. Check the System

It is important to ensure that the machine, equipment or system is functioning normally after the cause of the fault and the fault itself has been dealt with. In the case of the puncture, it is easy to confirm that the cause of the fault – and the fault itself – has indeed been dealt with satisfactorily, assuming that the tyre remains inflated. With more sophisticated equipment or systems it may necessary to 'fine-tune' the system in order to return it to optimum working conditions.

- **Repair/Replace of components in Electrical equipments**

Any electronic instrument or piece of equipment can be considered as a system. A system can be defined as "anything formed of component parts connected together to make a regular and complete whole". An instrument or piece of equipment can have subsystems made in blocks to perform specific functions. These subsystems are made up of electronic circuits, which are forms of electronic/electrical or electromechanical component parts. The failure of a component in equipment may lead to the failure of the system. Failure is said to be the inability of a system to perform its required function. The need for continuous performance of equipment requires that it is given regular maintenance. It is, therefore imperative that the meaning of maintenance is well understood.

Maintenance

This is all the activities carried out on an equipment in terms of proper installation, good servicing, routine checks, repairs and replacement of faulty parts in order for such equipment to operate at it maximum output throughout its useful life. An equipment or instrument is considered to have failed when under any of these conditions:

a) when it becomes completely inoperative

b) when it is still in operation but unable to perform the required function any longer

c) When it becomes unsafe for its continued use.

Maintenance of tools and equipment in electrical workshop

Preventive Maintenance

This is the practice or arrangement whereby a piece of equipment or instrument are regularly checked, oiled, greased or cleaned according to manufacturer's specification for effective performance. This maintenance method is normally carried out at a specified time of a year and in that case the entire working system is shut down. Fund is normally provided to ensure that spare parts and some other materials meant for such maintenance are provided. The essence of this form of maintenance is to ensure that the equipment does not break down and thus performs to specification.

Corrective Maintenance

This method is applied to equipment that has failed and thus broken down due to either improper operations or a defective part. It is concerned with the detection, location and repairs of faults as they occur. This requires a good understanding of system fault location methods in addition to an understanding of overall system and circuit operation.

Types of Maintenance

There are five different types of maintenance and these are as follows:

1. **Fixed Time Maintenance**

This is servicing of equipment periodically at regular intervals. The particular maintenance requirements will probably vary with the level of service. For example the requirements for 12 monthly services will be different for those for 3 monthly.

2. **Condition Based Maintenance**

This type of maintenance requires the use of human senses to know when it is needed. In the cause of operating an equipment one may see signs of smoking, electrical sparks, feel for excessive heated, smells for signs of burning and some others. The condition at which the equipment is will necessitate that it should be opened up immediately for maintenance. This act will assist in preventing further damage. Some more complex systems have sensing devices built in to them, and alarm systems to detect variation from the norm.

3. **Opportunity Based Maintenance**

This is carried out when an equipment is opened up for repairs and this opportunity is used to do any other maintenance tasks which are due in the near future, such as routine servicing and the replacement of any parts which are at the end of their useful life. Also, the opportunity can be used to replace a broken part which had occurred before opening the equipment but had no effect in its operation.

4**. Design Out Maintenance**

This maintenance type is used on equipment which has a part that is failing regularly due to an apparent design weakness. It may be possible to upgrade the weak part and effectively change the design for the better. If a particular part is not available one may be able to change the design to allow a more common part to be used. In spectrophotometry, for example, it may be possible to modify a simple car headlamp bulb to enable it to function as a tungsten source.

5**. Operate To Failure Maintenance**

These are cases whereby equipment is not given general routine care but it is allowed to fail before any other maintenance is attempted. This is widely used on electronic equipment which normally is not just taken to a mechanic for servicing while still functional. They are only opened up when they have broken down. This means that equipment is operated to failure before it is opened up for maintenance.

3.6.4 Learning Activities

You are an employee of Igembe tea factory in Meru County. The production manager notices that the circuit breaker connected to the tea leafs drying section keeps on tripping. As a qualified electrician, troubleshoot the root cause of the problem.

3.6.5 Self-Assessment

1. How do you troubleshoot electrical equipment?
2. What are the three main electrical test instruments used in troubleshooting?
3. What are the six steps in the troubleshooting process?
4. **Mention what are the challenges that maintenance and repair work usually face?**

5. **What is the potential risk that repair and maintenance work usually face?**

3.6.6 Tools, Equipment, Supplies and Materials

- Pliers
- Hacksaws
- Hammer
- Spirit levels
- Phase Tester
- Side cutters

3.6.7 References

https://www.industrial-electronics.com/elec-srvc-level-3_39.html

https://www.mcptechnicaltraining.com/blog/six-step-approach-to-fault-finding

https://medium.com/@Adamu67981783/maintenance-and-repair-of-electronics-equipment-stp-221-4fe287c5208e

3.6.8 Answers to self-assessment

1. Electrical Troubleshooting in Seven Steps

- Gather information.
- Understand the malfunction.
- Identify which parameters need to be evaluated.
- Identify the source of the problem.
- Correct/repair the component.

- Verify the repair.
- Perform root cause analysis.

2. Meters and test equipment, as well as print tools, such as operating logs and schematics, will all help you diagnose and solve electrical problems. The fundamental diagnostic tools and test equipment are the voltmeter, ammeter, and ohmmeter. The basic functions of these meters are combined in a multimeter.

3.

- Identify the problem.
- Establish a theory of probably cause.
- Test the theory to determine cause.
- Establish a plan of action to resolve the problem and implement the solution.
- Verify full system functionality and if applicable implement preventative measures.
- Document findings, actions, and outcomes

4. The challenges faced include:

- Unusual working condition like bad weather or low temperature
- May have to work in an unusual shift
- May have to work in a messy area
- May sometimes be physically distressing and exhausting
- May have to work in dangerous places like working at height or working with electrical appliances and wires

5. The potential risk that repair and maintenance worker faces are

- Faulty electrical: Risk of electrocuted always remains with repair and maintenance workers, if not equipped with electric-proof tools and attires. They are prone to burns, shocks, etc.
- Lifting equipment: Workers usually have to deal with heavy metal objects and lifting equipment is not inspected or maintained then they are at risk of a fatal accident
- Maintenance of working and walking surfaces: Slippery working surfaces, sharp tools and nails scattered on working surface, slip and trip, uneven and potholed are some potential hazard that may cause an accident
- Dust: It potential risk for the workers specially working in woodworking or iron industries