

CHAPTER 3: WORKSHOP TECHNOLOGY /PERFORM WORKSHOP PROCESSES

3.1. Introduction of the Unit of Learning / Unit of Competency

Workshop Technology processes is the use of electrical skills gained from various electrical workshop practices to install and troubleshoot electrical instrument and devices in electrical wiring, or distribution and power generation. These skills are applied in various industries e.g. in telecommunication, electrical manufacturing. This unit covers electrical safety, use and storage of workshop tools/instruments /equipment/materials, installation of electrical instruments and devices, and troubleshooting and repair/replacement of electrical tools and equipment. Upon completion of this unit of competency, a trainee should be able to perform installation, troubleshooting and maintenance of electrical instruments and devices while observing the appropriate safety measures. This unit prepares trainees to pursue electronics as a gainful career in the field of electrical engineering.

3.2. Performance Standard

Calibrate, operate safely and maintain the workshop tool and equipment as per standard operating procedures, manufacturer's recommendations, perform first aid procedures as per standard operating procedures, dispose waste materials as per the EHS requirements, identify and diagnose faulty tools as per diagnostic procedures and the standard operating procedures, repair/replace faulty tools/equipment as per the workplace procedures, and test& troubleshoot repaired or replaced tool/equipment as per the standard operating procedures. Observe safety as per IEE Standards

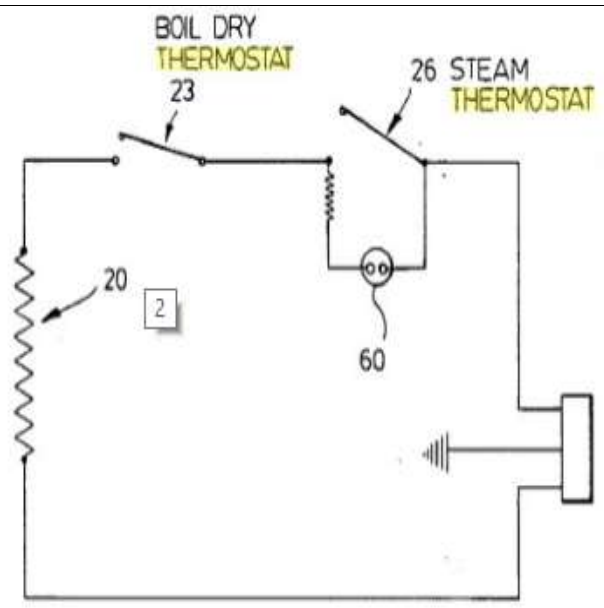
3.3. Learning outcomes

3.3.1. List of Learning Outcomes

- a) Apply workshop safety
- b) Use of workshop tools, Instruments and equipment.
- c) Prepare workshop tools and instruments for an electrical installation practical
- d) Prepare the workshop for an Electrical practical
- e) Store Electrical tools and materials after practical.
- f) Troubleshoot and repair workshop tools and equipment

3.3.2. Learning Outcomes No. 1 Apply workshop safety

3.3.2.1 Learning activities

| Learning Outcome No. 1. Apply workshop safety | |
|--|---|
| Learning Activities | Special Instructions |
|  <p>Activity: Obtain and an electrical kettle to be connected to a power supply</p> <ul style="list-style-type: none"> • Wear PPEs • Obtain the necessary tools for inspecting/testing the functionality of the kettle. • Check safety of power supply socket/system as per the standard operating procedures. • Perform safety inspection of the electrical kettle as per standard operating procedures | <ul style="list-style-type: none"> • Observe manufacturer's manual instructions for the specific electrical kettle • Observe IEE regulations • Observe organizational procedures manual • Provide the trainee with varied opportunities to learn safety precautions taken in handling different electrical appliances, equipment, and machines. |

3.3.2.1. Information Sheet No. 3/ LO1

Introduction

This learning outcome entails the trainee observing electrical safety and procedures, safety regulations in obtaining electrical equipment, earthing concepts in electrical safety, electrical machine, handling electric power systems, and demonstrating knowledge of workshop rules, electrical hazards and treatment/first aid procedures in accordance with the need of an activity. Also, it covers, various technical facilities in the electrical workshop including mechanical and electrical equipment.

Definition of key terms

Classes of fires: These are the types of fires based on the burning material e.g. wood, charged electrical device, etc.

Electrical equipment: These are the essential requirements for electrical workshop practices to take place. They include; set of screw drivers, pliers, phase testers, multimeter, etc.

Recommended sources for further information; *Electrical Safety Handbook 3E* by Cadick. J. et al.

Set up procedure for an electrical equipment;

1. Wear PPE
2. Obtain the electrical equipment, set of screw drivers, pliers, phase testers, multimeter
3. Check the condition of the equipment components, thermostat, heating element, switch, and the indicator light
4. Connect power cable to the equipment and to the power supply socket.
5. Ensure the electrical equipment is set up properly, and the power cable is in good condition.

Recommended sources for further information; *Electrical Safety Handbook 3E* by Cadick. J. et al. 2016 IEEE IAS Electrical Safety Workshop (ESW)

Watch an 8.42 min video on electrical safety and electrical safe work from the web link: <https://slideplayer.com/slide/8724303/>

Content

Safety: types of electrical hazards and safety precautions, use of PPE, working environment, classifications of fires, first aid for electrical operator, overview of OSHA regulations and workplace procedures. Electrical, tools & equipment: types of screw drivers, pliers, and electrical measuring instruments and measure various electrical parameters like current, voltage, power

Personal protective equipment in electrical workshop practices:

- Safety cloth
- Gloves
- Shoes



Source: *Electrical Protection Handbook* (©1990) Bussman, Cooper Industries, Inc



Figure 3: damaged insulation

Source: *Electrical Protection Handbook* (©1990) Bussman, Cooper Industries, Inc.

Conclusion

This outcome covered electrical safety, symbols in electrical circuit diagrams, electrical tools & equipment.

Trainees' assignment;

- Observe safe working of electrical circuit protective devices.
- Perform safety procedures for conducting, insulating materials, capacitors, inductors, and resistors.
- Perform fire safety inspection of the working area.
- Perform safety procedures of first aid in case of electrical hazards.
- Perform testing of electrical appliance for safety

Trainer

Check that the trainee working behaviour exhibit evidence of application of safety practices and electrical housekeeping procedures and policies. Ensure assignments are completed on time. Observe trainees' working behaviour on an on-going basis.

Recommended sources for further information; *Electrical Safety Handbook 3E* by Cadick. J. et al.

3.3.2.3 Self-Assessment

1.



This sign means Highly Flammable.

- A. True
- B. False

2.



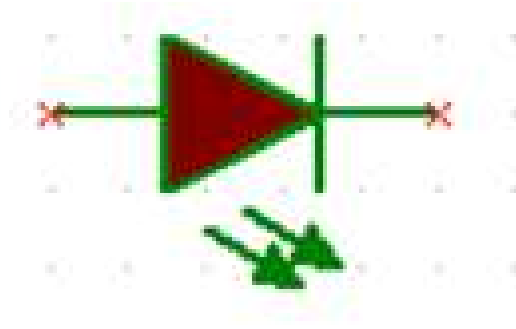
- a. 25000 ohms +- 10%
 - b. 27000 ohms +- 10%
 - c. 250000ohms +- 5%
 - d. 27000 ohms +- 5%
3. To clean the tip of of the soldering iron, use
- a. A PCB eraser
 - b. A cloth
 - c. A dry sponge
 - d. A wet sponge
4. The first stage in PCB fabrication is
- a. Preparing the artwork
 - b. Exposure
 - c. Developing and rinsing
 - d. Tinning
5. Identify the component



- a. Edge rounder
- b. PCB mega station
- c. PCB cutter

d. UV exposue unit

6. Identify the component



- a. Diode
- b. LED
- c. LDR
- d. CAPACITOR

7. An oscilloscope is a device that is used to generate different waveforms.

- a. True
- b. False

8. The edge rounder is an equipment used to drill holes on the PCB.

- a. True
- b. False

9. Developing and rinsing is the last stage in PCB fabrication.

- a. True
- b. False

10. Solder wire is an alloy made up of tin and lead.

- a. True
- b. False

11. It is not possible to measure voltage values across resistances in a circuit using a function generator.

- a. True
- b. False

Practical question

1. Adhere to proper use of PPE as per standard operating procedure
2. Follow workshop rules as per standard operating procedure
3. Follow proper use of safety equipment as per the manufacturers recommendations
4. Adhere to first aid procedures

3.3.2.4. Tools, Equipment, Supplies and Materials for the specific learning outcome

- Set of screw drivers
- Pliers
- Phase testers
- Multimeter
- Electrical measuring instruments
- Lab coat
- Gloves

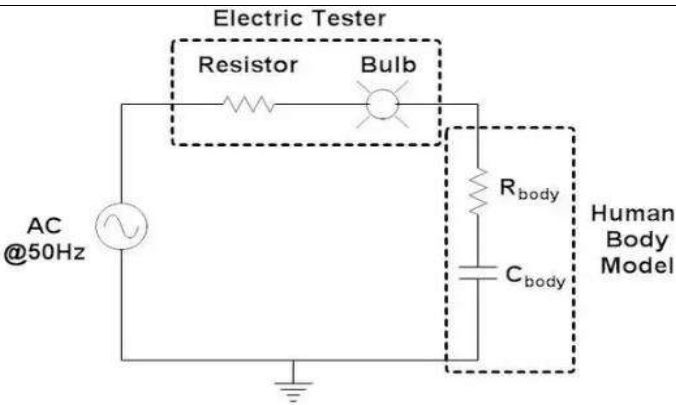
3.3.2.5. References

1. Cadick, J. (2012). Electrical safety handbook. McGraw-Hill Professional.
2. Brian Scaddan, Electric Wiring: Domestic
3. Peter J. Seebacher, Home Infrastructure (Project 3) (PDF)

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3.3.3. Learning Outcomes No. 2 Use of Workshop Tools, Instruments and Equipment

3.3.3.1 Learning activities

| Learning Outcome No. 2. Use of workshop tools, Instruments and equipment. | |
|--|---|
| Learning Activities | Special Instructions |
|  <p>Activity 1: Use circuit testers or electrical tester</p> <ul style="list-style-type: none"> • Obtain a specific circuit tester e.g. a phase, continuity tester, etc. • Check safety/ inspect the specific tester as per the standard operating procedures. • Use the tester as per the manufacturer's instructions <p>Activity 2: Use cordless drills</p> <ul style="list-style-type: none"> • Obtain a specific circuit drill. • Check safety/ inspect the specific drill as per the standard operating procedures. • Use the drill as per the manufacturer's instructions <p>Activity 3: Use voltmeters or multimeters</p> <ul style="list-style-type: none"> • Obtain a specific voltmeters/ multimeters. • Check safety/ inspect the specific drill as per the standard operating procedures. • Calibrate the specific instrument as per the standard operating procedures. • Use the instrument as per the manufacturer's instructions | <ul style="list-style-type: none"> • Observe manufacturer's manual instructions for the specific electrical kettle • Observe IEE regulations • Observe organizational procedures manual • Provide the trainee with varied opportunities to learn use of various electrical testers. |

3.3.3.2. Information Sheet No. 3/ L02

Introduction

This learning outcome involves the safety, classification, use, care, and maintenance of various workshop tools, instruments, and equipment. It also, involves demonstration of knowledge of workshop rules, electrical hazards and first aid procedures in accordance with the need of an activity. It also covers, wiring regulations, types of cables and electric accessories including switches, plugs, circuit breakers, fuses etc., symbols for electrical wiring schematics e.g. switches, lamps, sockets etc., drawing and practice in simple house wiring and testing methods, wiring schemes of two-way and three-way circuits and ringing circuits, voltage and current measurements. Electric soldering and soldering tools; soldering methods and skills, drilling and soldering components.

Definition of key terms

Ampere: The SI unit of electrical current.

Electrical equipment: These are the essential requirements for electrical workshop practices to take place. They include; set of screw drivers, pliers, phase testers, multimeter, etc.

Apparent Power: Apparent power is the product of the rms voltage and the rms current. Measured in volt-amperes.

Recommended sources for further information;

- Electrical Safety Handbook 3E by Cadick. J. et al.
- Watch a 1.04min on use of an electrical tester - circuit tester from the link:
<https://youtu.be/Moad9c1wTwk?t=41>
- Watch a 5.24min on use of an electrical circuit testers from the link:
<https://youtu.be/togB4pyjdUA?t=98>

Electrical principles

An electric circuit is formed when a conductive path is established to allow free electrons to move continuously. This free movement of electrons through an electric conduct is called current. Voltage motivates electrons to flow in a circuit. Voltage is the measure of how much of potential energy exists to move electrons from one specific point in a circuit to another specific point the circuit. While the electrons move in a circuit, they experience some friction or opposition motion. This is called resistance. It is the force resisting the flow of electrons across two points in a circuit. Resistance and voltage determines the amount of current in a circuit,

Recommended sources for further information;

Electrical Safety Handbook 3E by Cadick. J. et al. 2016 IEEE IAS Electrical Safety Workshop (ESW)

Watch a 22.10 min video on electrical principles from the web link:

<https://youtu.be/49Zle15XaDU?t=474>

Watch a 13.44 min video on electrical principles from the web link:

<https://youtu.be/ytATo6tS9yE?t=192>

Content

Safety: safety and care precautions in using various electrical tools. Electrical tools, equipment and instruments: use of screw drivers, pliers, electrical testers, and electrical measuring instruments and measure various electrical parameters like current, voltage, power.



Figure 4: Electric drill

Source: Electrical Safety Handbook 3E by Cadick. J. et al.

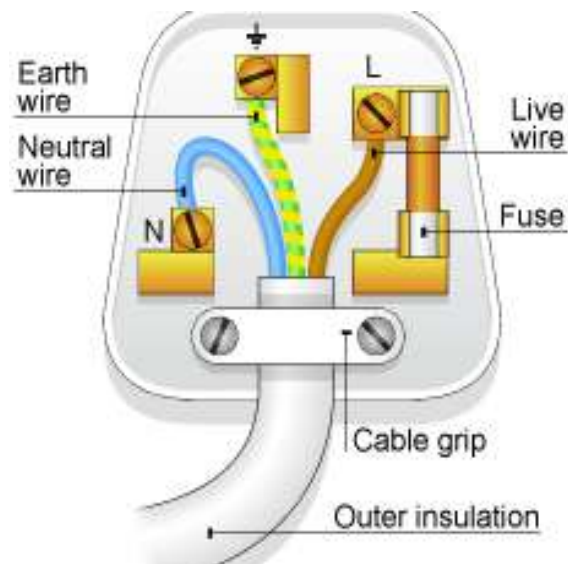


Figure 5 : cable head

Source: Electrical Safety Handbook 3E by Cadick. J. et al.



Figure 6: receptacle

Source: Electrical Safety Handbook 3E by Cadick. J. et al.

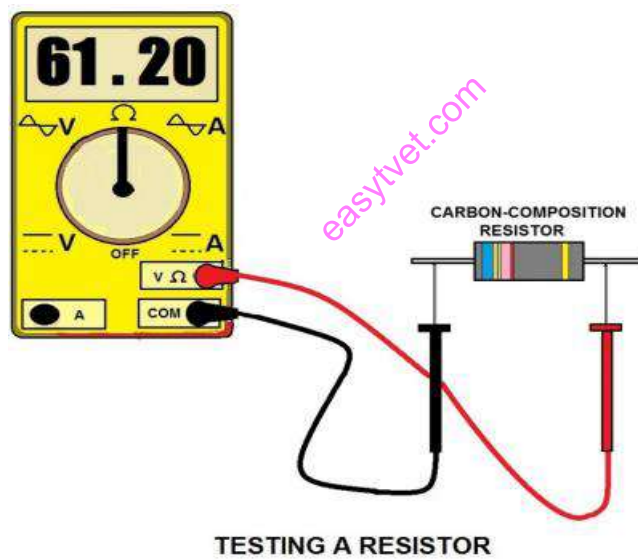


Figure 7: testing a resistor

Source: Electrical Safety Handbook 3E by Cadick. J. et al.

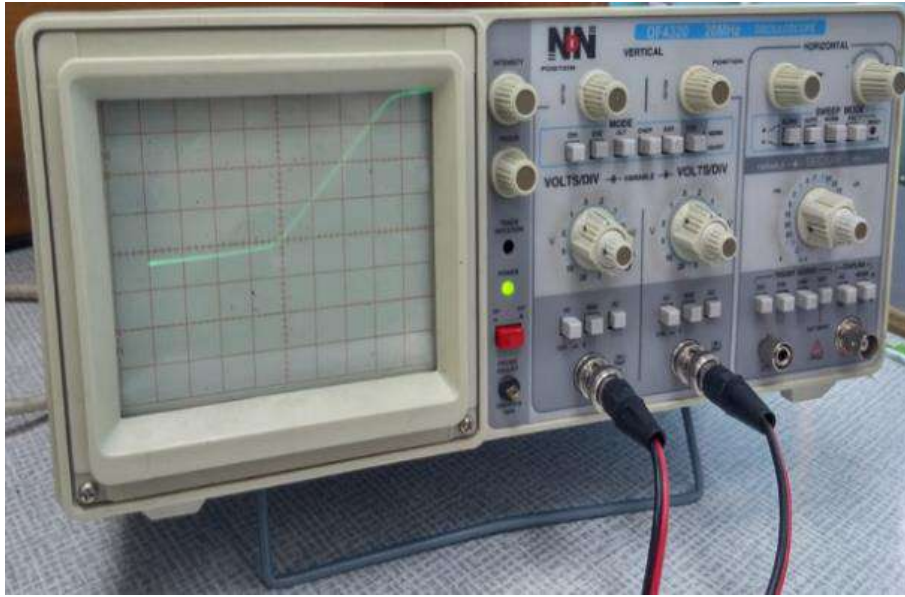


Figure 8: Continuity tester Multimeter, Oscilloscope
 Source: Electrical Safety Handbook 3E by Cadick. J. et al.

Conclusion

This outcome covered electrical safety, classification, use, care, and maintenance of various workshop tools, instruments, and equipment.

Trainees' assignment;

- i. Set and use oscilloscope

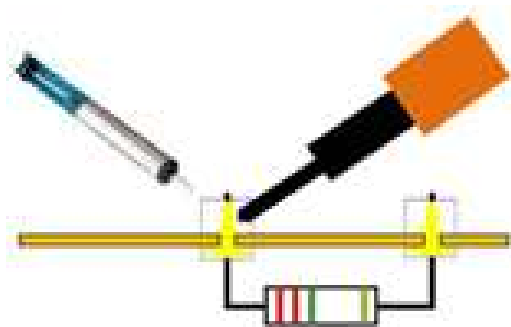
Trainer

Check that the trainee working behaviour exhibit evidence of application of safety practices and electrical housekeeping procedures and policies. Ensure assignments are completed on time. Observe trainees' working behaviour on an on-going basis.

Recommended sources for further information; *Electrical Safety Handbook 3E by Cadick. J. et al.*

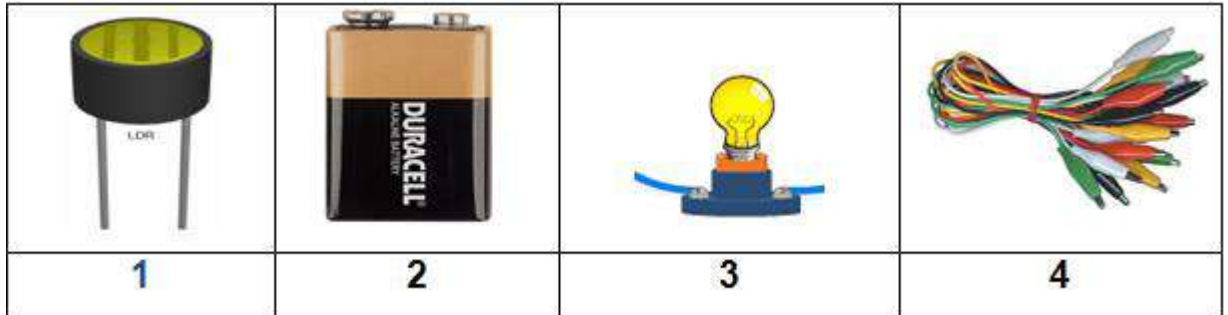
3.3.3.3. Self-Assessment

- 1. The process shown below is called



- a. Soldering
- b. Desoldering
- c. Tinning
- d. Drilling

2. Name the following



3. Ampere is the SI unit of electrical voltage. TRUE OR FALSE?
4. Real power is the product of the rms voltage and the rms current. Measured in volt-amperes. TRUE OR FALSE?

Practical question;

1. Identify Workshop tools, Instruments and equipment
2. Use Tools, Instruments and equipment as per the manufactures manuals
3. Perform Calibration of workshop instruments as per the standard operating procedure
4. Follow Proper handling of workshop tools, Instruments and equipment
5. Adhere to Care and Maintenance of workshop tools, Instruments and equipment

3.3.3.4. Tools, Equipment, Supplies and Materials for the specific learning outcome

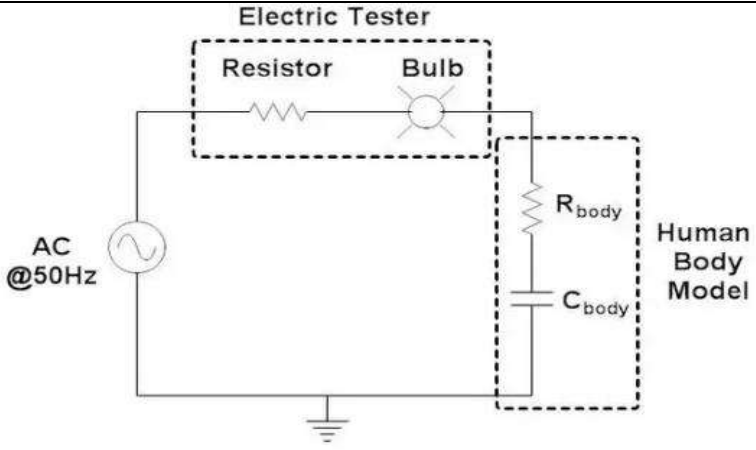
- Hacksaws
- Pliers
- Phase testers
- Multimeter
- Set of screw drivers
- Side cutters, etc.
- Lab coat
- Hammers

3.3.3.5. References

1. Cadick, J. (2012). Electrical safety handbook. McGraw-Hill Professional.
2. Brian Scaddan, Electric Wiring: Domestic
3. Peter J. Seebacher, Home Infrastructure (Project 3) (PDF)

3.3.4. Learning Outcomes No. 3. Prepare workshop tools, Instruments and equipment

3.3.4.1. Learning activities

| Learning Outcome No. 3. Prepare Workshop Tools For An Electrical Installation. | |
|--|--|
| Learning Activities | Special Instructions |
|  <p>The diagram illustrates a safety circuit for testing. It features an AC source labeled 'AC @50Hz' connected to a series combination of a resistor and a bulb, which together form the 'Electric Tester'. This series combination is connected in parallel with a 'Human Body Model' consisting of a resistor R_{body} and a capacitor C_{body}. The entire circuit is grounded at the bottom.</p> <p>Activity 1: Use circuit testers or electrical tester</p> <ul style="list-style-type: none"> • Obtain a specific circuit tester e.g. a phase, continuity tester, etc. • Check safety/ inspect the specific tester as per the standard operating procedures. • Use the tester as per the manufacturer's instructions <p>Activity 2: Use cordless drills</p> <ul style="list-style-type: none"> • Obtain a specific circuit drill. • Check safety/ inspect the specific drill as per the standard operating procedures. • Use the drill as per the manufacturer's instructions <p>Activity 3: Use voltmeters or multimeters</p> <ul style="list-style-type: none"> • Obtain a specific voltmeters/ multimeters. • Check safety/ inspect the specific drill as per the standard operating procedures. • Calibrate the specific instrument as per the standard operating procedures. • Use the instrument as per the manufacturer's instructions | <p>Observe manufacturer's manual instructions for the specific electrical kettle</p> <p>Observe IEE regulations</p> <p>Observe organizational procedures manual</p> <p>Provide the trainee with varied opportunities to learn use of various electrical testers.</p> |

3.3.3.1. Information Sheet No. 3/ L03

Introduction

This learning outcome involves the selection, classification, use, care, and maintenance of various workshop tools, instruments, and equipment. It also, involves application of procedures in accordance with the need of an activity for an electrical installation. It also covers, wiring regulations, types of cables and electric accessories including switches, plugs, circuit breakers, fuses etc., symbols for electrical wiring schematics e.g. switches, lamps, sockets etc., drawing and practice in simple house wiring and testing methods, wiring schemes of two-way and three-way circuits and ringing circuits, voltage and current measurements. Electric soldering and soldering tools; soldering methods and skills, drilling and soldering components.

Definition of key terms

Cable – A cable is made up of one or more conductors and their insulated surrounding

Hammers – Voltage is the difference in electrical potential between two different points, it can be thought of as electrical pressure, and it is denoted by the letter V or U.

Circuit breaker – A type of protective device for circuits, it will protect a circuit from overload and fault currents.

Main switch – Although not a protective device, in a typical household, the mains switch is located in the consumer unit. Its purpose is to disconnect the supply of electricity to the installation.

How to proceed with an Electrical Installation;

Prepare a detailed electrical wiring diagram to start with.

Then calculates the Electrical Loads, Currents, Cable sizes and the Protective devices for the Electrical Installation.

Based on this information, worked out the quantities of material and components needed for the job.

There are specifications for carrying out Electrical Installation Work so that the completed installation will abide to rules and regulations of the Electrical Industry. The Electrical Conductors [cables or wires] needed to be selected according to the current rating [Capacity] and Voltage Drop when the rated current flows in the conductors. This selection of the conductor is called Conductor Sizing. The conductors can be of Copper or Aluminium. Copper is the material used mostly for indoor installations and Aluminium for mostly Power Transmission. The outer Insulation of the conductors are selected according to the Temperature, the conductors are used for when carrying current. The over current protection for conductors are very important and there are Fuses and Circuit Breakers incorporated to safeguard current carrying conductors. Ground Fault Circuit Interrupters or Earth Leakage Circuit Breakers or Residual Current Circuit Breakers will safeguard people from getting Electric Shock from Live or Hot Circuit conductors or equipment.

Power point

Power points (receptacles, plugs, wall sockets) need to be installed throughout the house in locations where power will be required. In many areas the installation must be done in compliance with standards and by a licensed or qualified electrician. Power points are typically located where there will be an appliance installed such as telephone, computers, television, home theater, security system, CCTV system.

Light fittings and switches

The number of light fitting does depend on the type of light fitting and the lighting requirements in each room. A lighting designer can provide specific recommendations for lighting in a home. Layout of lighting in the home must consider control of lighting since this affects the wiring. For example, multiway switching is useful for corridors and stairwells so that a light can be turned on and off from two locations. Outdoor yard lighting, and lighting for outbuildings such as garages may use switches inside the home.

Electrical this is cabling installed from the electrical switchboard to the light fitting or any other device that is to be controlled by the automation system. For example, if you have four down lights in a room and you wish to control each light individually, then each light will be wired back using electrical cabling back to the electrical switchboard. This means you will have four electrical cables installed from the electrical switchboard to the location where the light fittings will be installed. Each cable will be a three core active, neutral and earth cable. If in that room you also have a free standing lamp plugged into a power point and you also want to control this from your automation system, you will need to have that power point individually wired back to the electrical switchboard. So if you want to individually control every light fitting and every power point or power outlets then each one of these devices must be individually wired back to the electrical switchboard. As you can see this start to become quite a lot of electrical cabling so planning is essential.



Figure 9: industrial main switch

Source: Electrical Safety Handbook 3E by Cadick. J. et al.

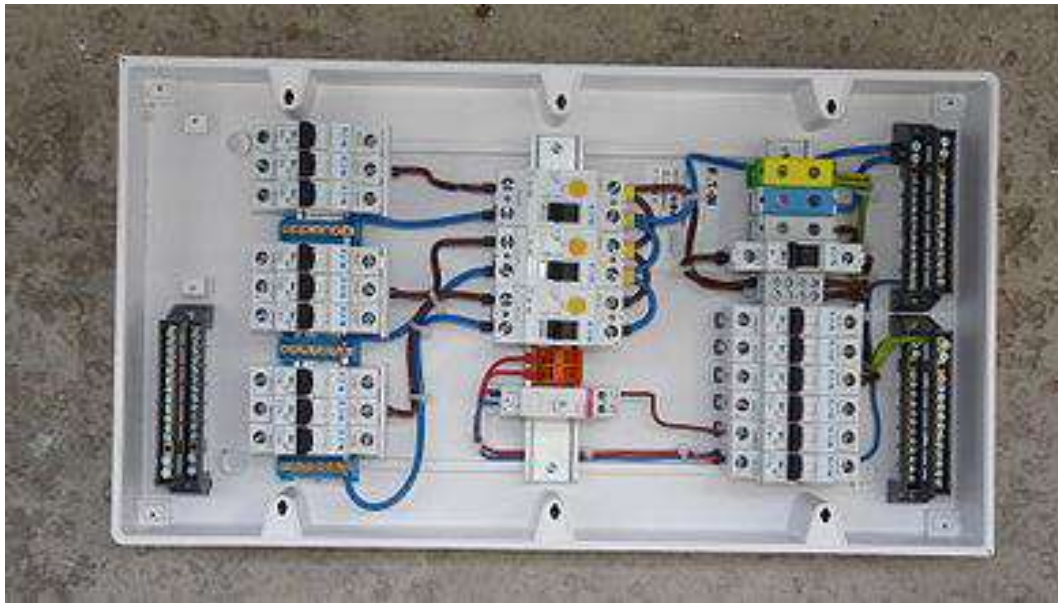


Figure 10: Single-phase ~230 V/40 A/9 kW fuse box for apartment rewiring
Source: Electrical Safety Handbook 3E by Cadick. J. et al.

Source; Brian Scaddan, Electric Wiring: Domestic; Peter J. Seebacher, Home Infrastructure (Project 3) (PDF)

Recommended sources for further information;

Brian Scaddan, Electric Wiring: Domestic

Peter J. Seebacher, Home Infrastructure (Project 3) (PDF)

Electrical Safety Procedures

1. Avoid loose wires, cables, and connections.
2. Assume any exposed wire/metal is live with electricity unless otherwise verified.
3. Familiarize oneself with all ON/OFF buttons on equipment, circuit breakers, and disconnect switches of a bench.
4. Only make changes to the experimental setup when the circuit power is turned off and all power sources read zero voltage and zero current, as applicable.
5. Use wires of suitable length for their appropriate applications. Long wires or connections can cause clutter on a bench, and very short wires or connections can be too tight and may be easily disconnected.
6. Separate higher power equipment and connections from lower power equipment, such as microcontrollers, to avoid both interference and electrical interconnections between sensitive electronic devices and higher power devices.
7. Make sure that all DC power supplies, AC sources, and other power sources start from a zero voltage and zero current output or as directed in an experiment. Starting from a non-zero voltage is possible in certain applications where a voltage source should have a specific initial condition.

8. Turn off all equipment before leaving the lab once an experiment concludes.
9. Do not allow a single user to perform an experiment alone. Make sure at least two users perform an experiment when operating more than 50 V DC and three-phase AC.

Energy management

Energy management is a new and upcoming topic in particular at the home. Older systems tended to be cable however all new systems use one of a variety of wireless solutions. This enables them to be effectively retrofitted into existing homes with the minimum of disruption.

If a cabled system is selected cabling needs to be deployed to the major appliances in the home. The cabling is installed as part of the data cabling as per detailed in this article in the section titled "Data Network Cabling". In addition to a cable being installed to every major appliance you also need to install a data cable near the electricity meter.

The major appliances being considered at this stage are:

- Electric hot water system
- Air Conditioning
- Pool pump
- Fridge / freezer
- Electric vehicle charger
- Battery energy storage systems (BESS)

Conclusion

Should a wireless system be selected the need for such disruption is removed. Smart plugs or switches can be used to connected the major appliances to the electricity supply and the home energy management system will wirelessly control them

Content

Safety: Safe working habits and precautions in setting up electrical work stations.
Electric Supply: Power sources, Electric wirings, signs, symbols and data.

3.3.3.2 Self-Assessment

1. The meter shown in the picture
 - A. Multimeter
 - B. Voltmeter
 - C. Power meter

D. None of the above



2. The shown above figure is called

- A. Consumer unit
- B. MCB
- C. RCD
- D. LCD



Practical question

1. Prepare List of required tools and instruments
2. Perform issuing of required tools and instruments
3. Perform confirmation of the issued tools and instruments
4. Check functioning of the issued tools and instruments in line with the standard operating procedure
5. Perform Sharpening of the cutting tools

3.3.3.3 Tools, Equipment, Supplies and Materials for the specific learning outcome;

- Hacksaws
- Pliers
- Phase testers
- Multimeter
- Set of screw drivers
- Side cutters, etc.
- Lab coat
- Hammers
- Oscilloscope
- Soldering tools, etc.

3.3.3.4 References

1. Cadick, J. (2012). Electrical safety handbook. McGraw-Hill Professional.
2. Electrical Safety Handbook 3E by Cadick. J. et al.
3. 2016 IEEE IAS Electrical Safety Workshop (ESW)
4. Brian Scaddan, Electric Wiring: Domestic
5. Peter J. Seebacher, Home Infrastructure (Project 3) (PDF)

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3.3.5. Learning Outcomes No. 4. Prepare workshop for an electrical practical

3.3.5.1. Learning Activities

| Learning Outcome No. 4. Prepare workshop for an Electrical practical. | |
|---|---|
| Learning Activities | Special Instructions |
| <p>Activity: Disassembling & re-assembling an electrical equipment</p> <ul style="list-style-type: none">• Study the original connection of movable switch board• Remove the connection• Take out the equipment• Reinstall and reconnect the wire• Do the safety test | <p>Observe manufacturer's manual instructions for the specific electrical kettle</p> <p>Observe IEE regulations</p> <p>Observe organizational procedures manual</p> <p>Provide the trainee with varied opportunities to learn preparation procedures required for electrical practices.</p> |

3.3.5.2 Information Sheet No. 3/L04

Introduction

This learning outcome involves the setting up of workstations, making provisions for power supply and availing tools, equipment and materials for a specific practice. It also, involves demonstration of knowledge of workshop rules and safe working procedures in accordance with the need of the practical and the standard operating procedures.

Definition of key terms

Configuration -Arrangement of nodes, elements, etc. to create an electronic circuit with a particular function.

Terminal -It is a point at which a conductor from an electrical component, device or network comes to an end and provides a point of connection to external circuits.

Recommended sources for further information; *Electrical Safety Handbook 3E* by Cadick. J. et al.

Watch a 1.39min on electrical wiring from the link:

<https://youtu.be/9uMIQycxygQ?t=59>

Electrical Safety Procedures

1. Avoid loose wires, cables, and connections.
2. Assume any exposed wire/metal is live with electricity unless otherwise verified.
3. Familiarize oneself with all ON/OFF buttons on equipment, circuit breakers, and disconnect switches of a bench.
4. Only make changes to the experimental setup when the circuit power is turned off and all power sources read zero voltage and zero current, as applicable.
5. Use wires of suitable length for their appropriate applications. Long wires or connections can cause clutter on a bench, and very short wires or connections can be too tight and may be easily disconnected.
6. Separate higher power equipment and connections from lower power equipment, such as microcontrollers, to avoid both interference and electrical interconnections between sensitive electronic devices and higher power devices.
7. Make sure that all DC power supplies, AC sources, and other power sources start from a zero voltage and zero current output or as directed in an experiment. Starting from a non-zero voltage is possible in certain applications where a voltage source should have a specific initial condition.
8. Turn off all equipment before leaving the lab once an experiment concludes.
9. Do not allow a single user to perform an experiment alone. Make sure at least two users perform an experiment when operating more than 50 V DC and three-phase AC.

Content

Safety: Safe working habits and precautions in setting up electrical work stations.

Electric Supply: Power sources, Electric wirings, signs, symbols and data.

Illustrations

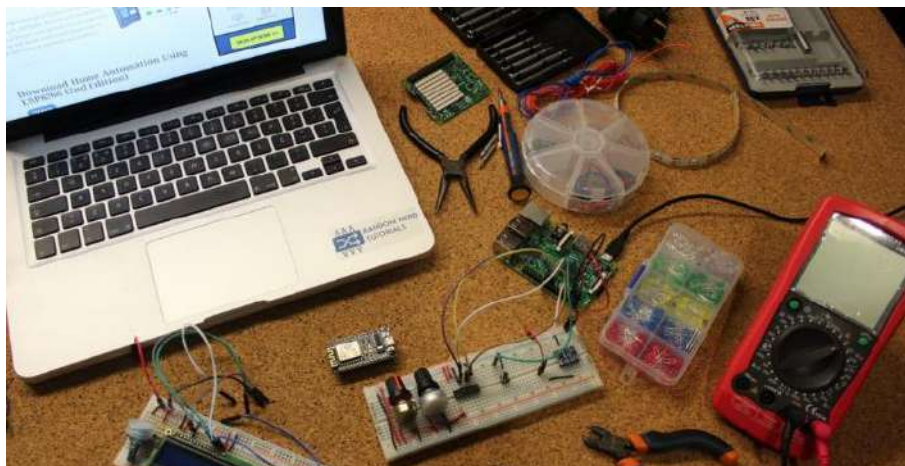
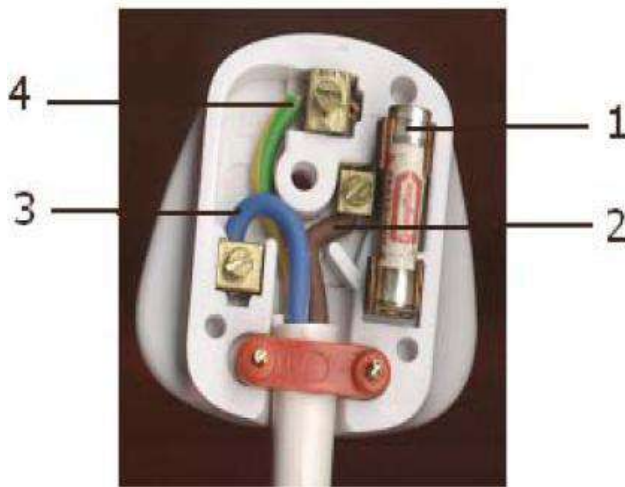


Figure 11: Electric supply

Source: Brian Scaddan, Electric Wiring: Domestic

3.3.5.3. Self-Assessment

1. Arrangement of nodes, elements, etc. to create an electronic circuit with a particular function is called Configuration. TRUE OR FALSE?



2. The pin number 2 is connected to
 - a. Earth
 - b. Live
 - c. Neutral
 - d. Fuse
3. The pin number 4 of the plug is connected to
 - a. Earth
 - b. Live
 - c. Neutral
 - d. Fuse
4. Termination is a point at which a conductor from an electrical component, device or network comes to an end and provides a point of connection to external circuits. TRUE OR FALSE?
5. Schematic is Symbolic and simplified diagram of an electric or electronic circuit. TRUE OR FALSE

Practical question

1. Arrange Practical working section as per the number of practical to be carried out.
2. Confirm Power supply availability in every practical section as per the practical to be carried out
3. Supply Tools and materials required as per the practical to be carried out.

3.3.5.4. Tools, Equipment, Supplies and Materials for the specific learning outcome

- Hacksaws
- Pliers
- Phase testers

- Multimeter
- Set of screw drivers
- Side cutters, etc.
- Lab coat
- Hammers
- Oscilloscope


3.3.5.5. References

1. Cadick, J. (2012). Electrical safety handbook. McGraw-Hill Professional.
2. Electrical Safety Handbook 3E by Cadick. J. et al. 2016 IEEE IAS Electrical Safety Workshop (ESW)
3. Brian Scaddan, Electric Wiring: Domestic
4. Peter J. Seebacher, Home Infrastructure (Project 3) (PDF)
5. Watch a 22.10 min video on electrical principles from the web link:
<https://youtu.be/49Zle15XaDU?t=474>
6. Watch a 13.44 min video on electrical principles from the web link:
<https://youtu.be/ytATo6tS9yE?t=192>

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3.3.6. Learning Outcomes No. 5 Store Electrical tools and materials after practical

3.3.6.1 Learning Activities

| Learning Outcome No. 5. Store Electrical tools and materials after practical | |
|---|----------------------|
| Learning Activities | Special Instructions |
|  | |
| <p>Activity: Return tools and materials for storage</p> <ul style="list-style-type: none"> • Checklists of tools and materials • Sorting of tools and materials • Functional tools in store • Non-functional tools in the store | |

3.3.6.2. Information Sheet No. 3/ L06

Introduction

This learning outcome involves the classification of tools and materials, storage of workshop tools & equipment, disposal of waste and demonstration of knowledge of workshop rules and safe working procedures in accordance with the need of the practical and the standard operating procedures.

Definition of key terms

5S: Sort, Systematize, Sweep, Sanitize, and Self-Discipline

Lubricant: A substance introduced to reduce friction between moving surfaces.

Pneumatic tool: Instrument activated by air pressure.

Recommended sources for further information;

Electrical Safety Handbook 3E by Cadick. J. et al.

Watch a 1.39min on electrical wiring from the link:

<https://youtu.be/9uMIQycxygQ?t=59>

Procedure for taking the inventory of inventory of tools and equipment

- i. Secure inventory forms of tools and equipment.
- ii. Study the parts of the inventory form.
- iii. Check whether the list of tools and equipment in the form tallies with the existing tools and equipment found in the workshop including their specifications and condition.
- iv. List down any losses and damages you find while conducting the inventory
- v. Fill out the remarks column of the inventory forms for any losses/ damages.
- vi. Recommend for replacement of lost tools and equipment and repair/ replacement of damaged tools and equipment.

Recommended sources for further information;

Electrical Safety Handbook 3E by Cadick. J. et al. 2016 IEEE IAS Electrical Safety Workshop (ESW)

Watch a 22.10 min video on electrical principles from the web link:

<https://youtu.be/49Zle15XaDU?t=474>

Watch a 13.44 min video on electrical principles from the web link:

<https://youtu.be/ytATo6tS9yE?t=192>

Content

Safety: Safe handling of electrical tools and equipment. Tools and Equipment: checklists of tools and materials, sorting of tools and materials, Conditions of PPE, functional tools in store, and non-functional tools in the store.

Illustrations

Table 2 Sample of inventory form of tools and equipment

| Item No. | Quantity | Unit | Description | Condition | Remarks |
|----------|----------|------|-------------|-----------|---------|
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |
| 6. | | | | | |
| 7. | | | | | |
| 8. | | | | | |
| 9. | | | | | |
| 10. | | | | | |

Prepared by: _____ Date: _____ Name and
Signature

Conclusion

This outcome covered electrical safety, inspection, set up and powering of workstations.

Trainees' assignment;

Arrange and store tools and equipment accordingly in a specific tool cabinet and a tool rack assigned to you.

Trainer

Check that the trainee working for evidence of application of safety practices, classified tools and equipment according to their types, arranged the tools by their types in the shelves and placed equipment in designated location as per the standard operating procedures. Ensure assignments are completed on time. Observe trainees' working behaviour on an on-going basis.

Recommended sources for further information;

Electrical Safety Handbook 3E by Cadick. J. et al. Cardenas, Elpidio.1989,

Fundamental and Elements of Electricity. Philippines: national Bookstore.

Max B. Fajardo Jr. & Leo R. Fajardo. 2nd edition, Electrical Layout and Estimate

3.3.6.3. Self-Assessment

1. Is a device for making, breaking, or changing connections in an electric circuit under the conditions of load for which it is rated? It is not designed for interruption of a circuit under short-circuit conditions?
 - a. Generator
 - b. Switch
 - c. Fuse
 - d. Transformer
2. A large single panel, frame, or assembly of panels on which are mounted, on the face or back or both, switches, over current and other protective devices, buses. This panel is generally accessible from the rear as well as from the front and are not intended to be installed in cabinets?
 - a. Panelboard
 - b. Switchboards
 - c. Panelbox
 - d. Substations
3. A single panel or a group of panel units designed for assembly in the form of a single panel, including buses and with or without switches and/or automatic over current protective devices for the control of light, heat or power circuits, designed to be placed in a cabinet or cutout box placed in or against a wall or partition and accessible only from the front.
 - a. Panelboard
 - b. Switchboards
 - c. Outletbox

- d. Substations
- 4. An electrical shock is received when passes through the body.
 - a. Magnetic field
 - b. Water
 - c. Electric current
- 5. It is safe to use electrical appliances in a wet area.
 - a. True
 - b. False
- 6. The component inside a 3-pin plug is called a fuse.
 - a. True
 - b. False
- 7. Lubricant is a substance introduced to reduce friction between moving surfaces. TRUE OR FALSE?
- 8. Pneumatic tool is an instrument activated by air pressure. TRUE OR FALSE?
- 9. Explain inventory tools.

Practical question

1. Check Tools against the issuing list after practicals
2. Store out Tools as per their standard operating procedure
3. Clean Tools as per the workshop standard operating procedure
4. Dispose Waste materials as per the EHS
5. Store Tools in their respective sections as per the workshop procedures

3.3.6.3. Tools, Equipment, Supplies and Materials for the specific learning outcome

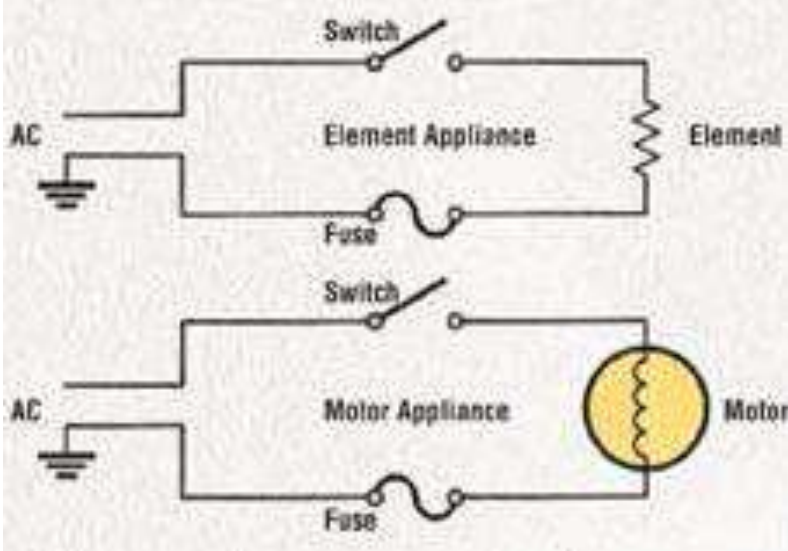
- Hacksaws
- Pliers
- Phase testers
- Multimeter
- Set of screw drivers
- Side cutters, etc.
- Lab coat
- Hammers
- Oscilloscope
- Soldering tools, etc.

3.3.6.4.References

1. Cadick, J. (2012). Electrical safety handbook. McGraw-Hill Professional.
2. Electrical Safety Handbook 3E by Cadick. J. et al. 2016 IEEE IAS Electrical Safety Workshop (ESW)
3. Brian Scaddan, Electric Wiring: Domestic
4. Peter J. Seebacher, Home Infrastructure (Project 3) (PDF)

3.3.7. Learning Outcome No. 6. Troubleshoot and repair/replace workshop tools and equipment

3.3.7.1. Learning Activities

| Learning Outcome No. 6. Troubleshoot and repair/replace workshop tools and equipment | |
|--|--|
| Learning Activities | Special Instructions |
|  <p>Activity: Carry out troubleshooting on electric kettle not heating</p> <ul style="list-style-type: none"> • Check the power socket if cable is properly plugged • Ensure sure the power switch is pushed ON • Check if the lead connector is properly pushed in • Check the power fuse and replace if possible • Check if there is power inside the kettle • Check the power switch or fuse which needs to be replaced. • Check the heating element and replace if possible. | <p>Manufacturer's manual instructions should be followed</p> |

3.3.7.2. Information Sheet No3/L07

Introduction

This learning outcome covers common fault in electrical equipment, troubleshooting, safety in troubleshooting, rules and procedures on troubleshooting equipment, repair/replacement of the equipment, and safe testing of the equipment.

Definition of key terms

Troubleshooting: Troubleshooting is process of analysing the operation of a faulty circuit to determine what is wrong with the circuit, and identifying the defective component(s) and carrying out appropriate repair.

Recommended sources for further information;

Electrical Safety Handbook 3E by Cadick. J. et al.

Watch a 6.44min on Electric Kettle Repair from the link:

<https://youtu.be/NyJXPTCEcu4?t=5>

Procedure for investigating an electrical problem

- Gather the 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

Recommended sources for further information;

Electrical Safety Handbook 3E by Cadick. J. et al.

2016 IEEE IAS Electrical Safety Workshop (ESW)

Watch a 22.10 min video on electrical principles from the web link:

<https://youtu.be/49Zlel5XaDU?t=474>

Watch a 13.44 min video on electrical principles from the web link:

<https://youtu.be/ytATo6tS9yE?t=192>

Content:

Safety in troubleshooting, common electrical faults, testing procedures, methods to troubleshoot electrical equipment, and procedure for repair/replacement of electrical tools and equipment.



Source: Cadick, J. (2012).



Source: Cadick, J. (2012).

Conclusion

This outcome covered electrical safety, inspection, set up and powering of workstations.

Trainees' assignment;

Carry out troubleshooting residential house wiring using fuse, switch, indicator, and lamp and energy meter.

Trainer

Check that the trainee working for evidence of application of safety practices, and adherence to manual instructions of the specific equipment as per the standard operating procedures. Ensure assignments are completed on time. Observe trainees' working behaviour on an on-going basis.

Recommended sources for further information;

Electrical Safety Handbook 3E by Cadick, J. et al.

Cardenas, Elpidio.1989, Fundamental and Elements of Electricity. Philippines: national Bookstore.

3.3.7.3. Self-Assessment

1. Explain the terms
 - A. Service entrance
 - B. Service head
 - C. Service point
 - D. Service mast
2. A factory assemble cable of one or more conductors each individually insulated and enclosed in a metallic sheath of interlocking tape of smooth or corrugated tube. This type of cable is especially used for service feeders, branch circuit and for indoor, outdoor work. What is this cable?
 - A. Metal Clad Cable (MC)
 - B. Armor Cable (AC)
 - C. Mineral Insulated Cable (MI)
 - D. Underground Feeder (UF)
3. Fabricated assembly of insulated conductors enclosed in flexible metal sheath. It is used both on exposed and concealed work. Identify what type of cable.
 - A. Metal Clad Cable (MC)
 - B. Armor Cable (AC)
 - C. Mineral Insulated Cable (MI)
 - D. Non Metallic Sheathed Cable (NM)
4. Is a moisture resistant cable used for underground connections including direct burial in the ground as feeder or branch circuit?
 - A. Metal Clad Cable (MC)
 - B. Armor Cable (AC)
 - C. Mineral Insulated Cable (MI)
 - D. Underground Feeder (UF)
5. Moisture and Heat Resistant Thermoplastic used for dry and wet locations?
 - A. T
 - B. XHHW
 - C. THHN
 - D. THW
6. Minimum vertical clearance of an overhead service drop measured from the ground, at the electrical service entrance or above areas or sidewalks accessible only to pedestrian lanes, measure from final grade line or other accessible surface only for service drop cabled together with a grounded bare messenger wire and limited to 300 volts to ground?
 - A. 3.5 mts
 - B. 3.00 mts
 - C. 5.00 mts
 - D. 5.50mts
7. A Machine which converts Electric Power into Mechanic all Power?
 - A. Motor

- B. Generator
 - C. Alternator
 - D. Rectifier
8. The Flow of Electricity in a circuit; rate of which electricity flows thru a conductor?
- A. Voltage
 - B. Current
 - C. Energy
 - D. Power

Practical question

1. Identify Faulty tools as per their expected functioning
2. Diagnose Faulty component as per the fault diagnosis procedures
3. Repair/Replace faulty components as per the expected functioning
4. Test Repaired/Replaced tool as per the expected functioning

3.3.7.4. Tools, Equipment, Supplies and Materials for the specific learning outcome

- Hacksaws
- Pliers
- Phase testers
- Multimeter
- Set of screw drivers
- Side cutters, etc.
- Lab coat
- Hammers
- Oscilloscope
- Soldering tools, etc.

easyvet.com

3.3.7.5. References

1. Cadick, J. (2012). Electrical safety handbook. McGraw-Hill Professional.
2. Cardenas, Elpidio. 1989, Fundamental and Elements of Electricity. Philippines: national Bookstore.
3. Max B. Fajardo Jr. & Leo R. Fajardo. 2nd edition, Electrical Layout and Estimate