



# **BUILDING ELECTRICAL INSTALLATION**

## **Level-III**

**Based on November 2018, Version 5**

**Occupational Standards**

Module Title: Installing Electrical System

Protection

LG Code: EIS BEI3 M08 LO (1-4) LG (28-31)

TTLM Code: EIS BEI3 TTLM 12 20V5

December 2020

ETHIOPIA



## Contents

LG #28 .....	4
LO #1- Plan and prepare for fault findings .....	4
Instruction sheet .....	4
Information Sheet-1 .....	5
Communicating and confirming instructions for the preparation of work activity .....	5
Information sheet-2 .....	8
Identifying tools, equipment and PPE needed to install electrical wiring .....	8
Information sheet -3 .....	13
Self-check 1 .....	17
Information sheet -4 .....	18
Self-check 1 .....	21
LG #29 .....	25
LO #2-Install electrical protection system .....	25
Instruction sheet .....	25
Self-check 1 .....	33
Written test .....	33
Information-3 .....	34
Enough clearance for cover opening for flush and surface mounted .....	34
Self-check 1 .....	39
Test I: Choose the best answer (4 point) .....	39
Information sheet-5 .....	40
High/Low Voltage Switch Gear (HLVSG) .....	40
Self-check 1 .....	42
Written test .....	42
Information sheet-6 .....	43
Earth Leakage Circuit Breaker (ELCB) .....	43
Self-check 1 .....	46
Information sheet -7 .....	47
Self-check 1 .....	49



Information sheet -8 .....	50
Following schedule of work .....	50
Self-check 1 .....	52
LG #30 .....	59
LO3. Notify completion of work Install electrical protection system .....	59
Instruction sheet .....	59
Information sheet-1 .....	60
Information sheet 2 .....	62
Cleaned work area .....	62
LG #31 .....	63
LO3. Clean up .....	63
Instruction sheet .....	63
Information sheet-1 .....	64
Cleaning, Checking, maintaining and storing Plant, tools and equipment .....	64
Self-check 1 .....	65
Operation sheet 1- . Plan and prepare for fault findings .....	66
Operation sheet – 2 .....	66
Install electrical protection system .....	66
LAP TEST .....	68
Reference Materials .....	68



LG #28

LO #1- Plan and prepare for fault findings

### Instruction sheet

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

- ❖ Communicating and confirming instructions for the preparation of work activity
- ❖ Identifying tools, equipment and PPE needed to install electrical wiring
- ❖ Using tools, equipment for testing faults
- ❖ protecting Personal equipment (PPE)
- ❖ Obtaining materials needed

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- ❖ Communicate and confirm instructions for the preparation of work activity
- ❖ Identify tools, equipment and PPE needed to install electrical wiring
- ❖ Use tools, equipment for testing faults
- ❖ Protect Personal equipment (PPE)
- ❖ Obtain materials needed

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.



1.1 Introduction

**1.2 Communicating and confirming instructions for the preparation of work activity**

Fundamental and vital to all administrative functions, communication is a means of transmitting information and making oneself understood by another or others. Communicating effectively is an art and must be practiced effectively at workplace for better output and successful achievement of goals of an organization.

Communication is a major challenge for administrators because they are responsible for providing information, which results in efficient and effective performance in organizations. The study of communication is important, because every administrative function and activity involves some form of direct or indirect communication. Whether planning and organizing or leading and monitoring, administrators communicate with and through other people. This implies that every person’s communication skills affect both personal and organizational effectiveness. It seems reasonable to conclude that one of the most inhibiting forces to organizational effectiveness is a lack of effective communication (Good communication skills are very important to ones success as an administrator . It is therefore essential for administrators to Endeavour to become effective communicators.

This paper discusses the communication process and the importance of communication in the workplace and provides guidelines on how administrators can improve their communication skills and effectiveness.

**Communication**

Communication can be defined as the process of transmitting information and common understanding from one person to another .It is the creation or exchange of thoughts, ideas, emotions, and understanding between Sender and receiver(s). It is essential to building and maintaining relationships in the workplace. Although administrators spend most of their time communicating (sending or receiving information), one cannot assume that

Meaningful communication occurs in all exchanges once a memorandum, letter, fax, or e-mail has been sent, many are inclined to believe that communication has taken place. However, communication does not occur until information and understanding have passed between sender and the intended receiver.



To make oneself understood as intended is an important part of communication. A receiver may hear a sender but still not understand what the sender's message means. Being constantly engaged in encoding and decoding messages does not ensure that an administrator is an expert in communication. Understanding is a personal matter between people, and different people may interpret messages differently.

Effective communication is essential in the workplace. The average worker spends 50 percent of the day communicating, and one-fourth of all workplace mistakes are the result of poor communication. As an emergency management professional, you need to be a skillful communicator to achieve your objectives. Your role may involve communicating one-on-one or in small-group discussions; making public presentations at briefings, community meetings, and press conferences; taking part in media interviews; and issuing announcements and warnings. You must be able to reach a broad audience that includes response partners and other colleagues, private sector and nonprofit organizations, the media, and a very diverse public. Effective communication is essential before, during, and after an incident. During routine operations, strong communication skills enable you to engage in collaborative planning and promote safety awareness in the community. During an incident, communicating clearly and accurately can help to reassure survivors and assist them in making responsible choices.

## Effective Communication



Figure 1

Page 6 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
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Self-check 1	<b>Written test</b>
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Name..... ID..... Date.....

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

Test I: Choose the best answer (6 point)

1. Which One of the following is not to use effective communication  
The average worker spends 50 percent of the day communicating,

A/ Workplace planning

B/ from the given alternatives which one is best Communication.

C/ Exchange ideas

D/ Effective communication

C/ Sending idea D/ all

2. -----can be defined as the process of transmitting information and common understanding from one person to another

A/ Communication

B/ effective

C/ sender

D/ all

Answer Sheet

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_



Information sheet-2	Identifying tools, equipment and PPE needed to install electrical wiring
---------------------	--

## 2.1 Introduction

### 2.2 Identifying tools, equipment and PPE needed to install electrical wiring

Personal Protective Equipment Personal Protective Equipment is an integral part of any employer’s safety program. OSHA has determined that PPE although a good way to protect employees, should be used as a last line of defense and its important to understand the limitations of PPE in the workplace. Prior to using PPE, the employer must determine if other mans of protection are available. OSHA uses the following sequence for employee protection

- Engineering Controls (deals with equipment)
- Administrative Controls (deals with people or processes)
- Personal Protective Controls (deals with what you wear) If no other method is available to protect employees, then PPE is an acceptable method. For those employees working in areas where there are potential electrical hazards, they must be provided with (and must use) electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.

#### PPE for the Head

Employees must wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized”

During an arc flash event the temperatures can reach an excess of 35,000 degrees. Even at temperatures much lower, typical daily wear clothing would do little to protect the worker from being seriously injured. In fact, at such high temperatures, the clothing will ignite and continue to burn on the body well after the arc flash has dissipated.

#### Electrical Tools and Equipment

Electrical task can be accomplished systematically to save time, effort, and resources. Most of the work cannot be done using bare hands. To do the task, electrical tools or equipment are needed to perform the job. This lesson will discuss the function/use of each tool or equipment used in electrical wiring installations. The following are common electrical tools and equipment needed in the installation of electrical wiring.

Page 8 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
--------------	---	---	----------------------------





**SCREW DRIVERS.** These tools are made of steel hardened and tempered at the tip used to loosen or tighten screws with slotted heads. They come in various sizes and shapes.

**Standard/Flat Screw Driver.** The blade tip is wedge-shaped and resembles a negative (-) sign. This is used to drive screws with a single slot head.

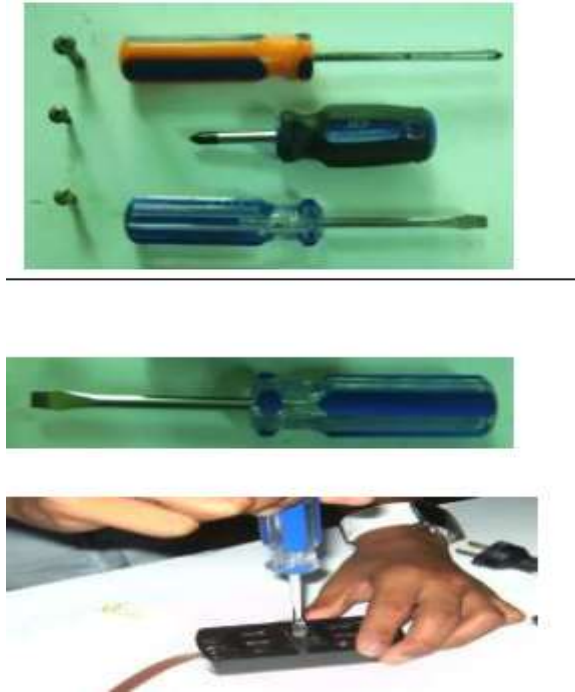


Figure 1.1

**II. HAMMERS.** These are tools used in driving or pounding and pulling out nails. They are made of hard steel, wood, plastic or rubber. The following are types of hammer:

- A. Claw hammer
- B. Mallet (rubber head)
- C. Ball peen hammer

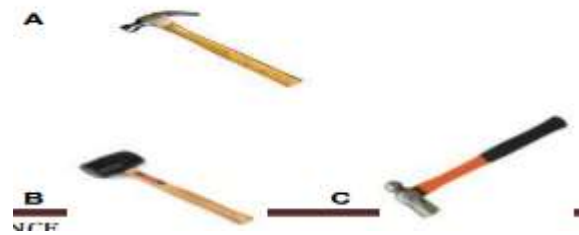


Figure 1.1.1

Electrical Supplies and Materials Electrical materials are developed and constructed for a special purpose such as to:

1. Control the flow of current in an electrical circuit;
2. Carry electrical current from the source to the load or current consuming apparatus;
3. Hold and secure wires to its fixtures inside and outside houses and buildings; and
4. Protect the houses, buildings, appliances' and instruments from any destruction and damage. The following are the most commonly used electrical materials.

### MATERIALS AND DESCRIPTION PICTURES

Convenience outlet- a device that acts as a convenient source of electrical energy for current consuming appliances. It is where the male plug of an appliance is inserted and usually fastened on the wall or connected in an extension cord. It maybe single, duplex, triplex or multiplex and could be surface type or flush type.

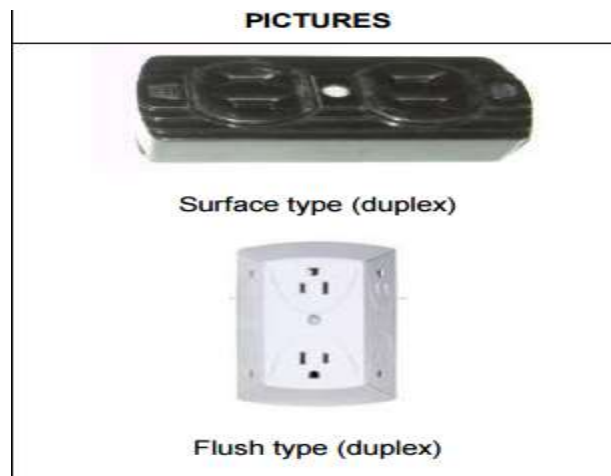


Figure 1.1.2

Male plug- a device inserted to a convenience outlet to conduct electric current. A flat cord is attached to it on one end and the other end is connected to a current consuming instrument or appliance.



Figure 1.2.2



Self-check 1	<b>Written test</b>
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (4 point)**

1. -----a device inserted to a convenience outlet to conduct electric current.

- A/ Male plug
- B. fuses
- C. earthling
- D/ term relay
- E/ all

2. ----- These are tools used in driving or pounding and pulling out nails.

- A. Hammers.
- B.Two way switch
- C. Dimmer switch
- D. intermediate switch
- E. all

3. These tools are made of steel hardened and tempered at the tip used to loosen or tighten Screws with slotted heads

- A/ SCREW DRIVERS
- B/ PLIER
- C/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_ Date: \_\_\_\_\_



. 3.1 Introduction

**3.2 Tools, equipment used for testing faults**

Electronic test equipment is used to create signals and capture responses from electronic devices under test . In this way, the proper operation of the DUT can be proven or faults in the device can be traced. Use of electronic test equipment is essential to any serious work on electronics systems.

Practical electronics engineering and assembly requires the use of many different kinds of electronic test equipment ranging from the very simple and inexpensive (such as a test light consisting of just a light bulb and a test lead) to extremely complex and sophisticated such as automatic test equipment (ATE). ATE often includes many of these instruments in real and simulated forms.

The following items are used for basic measurement of voltages, currents, and components in the circuit under test.

- ❖ Voltmeter (Measures voltage)
- ❖ Ohmmeter (Measures resistance)
- ❖ Ammeter, e.g. Galvanometer or Millimeter (Measures current)
- ❖ Millimeter e.g., VOM (Volt-Ohm-Millimeter) or DMM (Digital Millimeter) (Measures all of the above)
- ❖ LCR meter - inductance (L), capacitance (C) and resistance (R) meter (measure LCR values)

**Electronic Testing Equipment and Their Types**

The testing equipment used to detect faults in the operation of **electronic devices** by creating stimulus signals and capture responses from electronic devices under test is known as electronic test equipment. If any faults are detected, then identified faults can be traced a rectified using electronic testing equipment. Most often all electrical and **electronic circuits** are tested and troubleshooter to detect faults or abnormal functioning if any.



3.1 figure

### Types of Electronic Testing Equipments

The Basic Electronics Testing Equipments under this Category Include the Following

#### Voltmeter

A basic electronics device or instrument used to measure voltage or electrical potential difference between two points in electrical circuits is known as voltmeter. There are two types of voltmeters: analog and digital. An analog voltmeter moves a pointer across a scale in proportional to the voltage of the electrical circuit. A digital voltmeter measures an unknown input voltage by converting the voltage to a digital value by using a converter and then displays the voltage in numeric form.



3.2 Voltmeter

#### Ohmmeter

An electrical instrument that measures electrical resistance is known as an ohmmeter. The instrument used to measure small value of resistance is micro-ohmmeters. Similarly meg-

ohmmeters are used to make large resistance measurements. Resistance values are measured in ohms ( $\Omega$ ). Originally, ohmmeter is designed with a small battery to apply a voltage to a resistance.



Ohmmeter

Figure 3.4

It uses a galvanometer to measure the electric current through the resistance. The scale of the galvanometer was marked in ohms ( $\Omega$ ), because the fixed voltage from the battery assures that the resistance decreases and the current through the meter increases.

### Ammeter

A measuring instrument which is used to measure the electric current in a circuit is known as an ammeter. The units of measurement for electric current is amperes (A) Earlier ammeters were laboratory instruments which depend on the earth's magnetic field for operation. In an era of the 19th century, improved instruments were designed which could be placed in any position and allows accurate measurements in electric power systems.



*Ammeter*

### Multi meter

A multi meter is an electronic instrument used to measure the three basic electrical characteristics: voltage, current and resistance. It has multiple functions and acts like ohmmeter, voltmeter and ammeter and also used for household wiring, electric motors, testing batteries and power supplies. The millimeter is a handheld device with a needle over a numeric LCD digital display for indication purpose. It is also used to test continuity between two points in an electrical circuit. There are three types of millimeters made available in the market such as: digital millimeter, analog millimeter and fluke millimeters.



*Multimeter*

Figure 3.5





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

Name..... ID..... Date.....

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

**Test I: Choose the best answer (4 point)**

1. One of the following to use measuring ampere

- A/ Circuit Barker
- B/ fuses
- C/ Ammeter
- D/ all

2. from the given alternative which are electrical mesarmrnt dices.

- A/ Single pole switch
- B/ Two way switch
- C/ Dimmer switch
- D / digitalmilitmeter
- E. / all

3. ----- is an electronic instrument used to measure the three basic electrical characteristics: voltage, current and resistance.

- A/ multi meter
- B/ Ammeter
- C/ digital volte meter
- D/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_



Information sheet -4	Personal protective equipment (PPE
----------------------	------------------------------------

#### 4.1 Introduction

#### 4.2 Personal protective equipment (PPE

The Requirement for PPE to ensure the greatest possible protection for employees in the workplace, the cooperative efforts of both employers and employees will help in establishing and maintaining a safe and healthful work environment. In general, employers are responsible for: n performing a “hazard assessment” of the workplace to identify and control physical and health hazards. Identifying and providing appropriate PPE for employees.

Training employees in the use and care of the PPE. n Maintaining PPE, including replacing worn or damaged PPE. Periodically reviewing, updating and evaluating the effectiveness of the PPE program. In general, employees should: n Properly wear PPE The Hazard Assessment

A first critical step in developing a comprehensive safety and health program is to identify physical and health hazards in the workplace. This process is known as a “hazard assessment.” Potential hazards may be physical or health-related and a comprehensive hazard assessment should identify hazards in both categories. Examples of physical hazards include moving objects, fluctuating temperatures, high intensity lighting, rolling or pinching objects, electrical connections and sharp edges. Examples of health hazards include overexposure to harmful dusts, chemicals or radiation. The hazard assessment should begin with a walkthrough survey of the facility to develop a list of potential hazards in the following basic hazard categories: Impact, Penetration, Compression (roll-over), Chemical, Heat/cold, Harmful dust, Light (optical) radiation, and Biologic. In addition to noting the basic layout of the facility and reviewing any history of occupational illnesses or injuries, things to look for during the walkthrough survey include: Sources of electricity. Sources of motion such as machines or processes where movement may exist that could result in an impact between personnel and equipment. Sources of high temperatures that could result in burns, eye injuries or fire. Types of chemicals used in the workplace. Sources of harmful dusts. Sources of light radiation, such as welding, brazing, cutting, furnaces, heat treating, high intensity lights, etc. n The potential for falling or dropping objects. Sharp objects that could poke, cut, stab or puncture. Biologic hazards such as blood or other potentially infected material. When the walkthrough is complete, the employer should organize and analyze the data so that it may be efficiently used in determining the proper types of PPE required at the

Page 18 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
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worksite. The employer should become aware of the different types of PPE available and the levels of protection offered. It is definitely a good idea to select PPE that will provide a level of protection greater than the minimum required to protect employees from hazards. The workplace should be periodically reassessed for any changes in conditions, equipment or operating procedures that could affect occupational hazards. This periodic reassessment should also include a review of injury and illness records to spot any trends or areas of concern and taking appropriate corrective action. The suitability of existing PPE, including an evaluation of its condition and age, should be included in the reassessment. Documentation of the hazard assessment is required through a written certification that includes the following information: Identification of the workplace evaluated; Name of the person conducting the assessment; Date of the assessment; and n Identification of the document certifying completion of the hazard assessment.

**Selecting PPE** All PPE clothing and equipment should be of safe design and construction, and should be maintained in a clean and reliable fashion. Employers should take the fit and comfort of PPE into consideration when selecting appropriate items for their workplace. PPE that fits well and is comfortable to wear will encourage employee use of PPE. Most protective devices are available in multiple sizes and care should be taken to select the proper size for each employee. If several different types of PPE are worn together, make sure they are compatible. If PPE does not fit properly, it can make the difference between being safely covered or dangerously exposed. It may not provide the level of protection desired and may discourage employee use.

**Training Employees in the Proper Use of PPE** Employers are required to train each employee who must use PPE. Employees must be trained to know at least the following: n When PPE is necessary. What PPE is necessary? How to properly put on, take off, adjust and wear the PPE. The limitations of the PPE. Proper care, maintenance, useful life and disposal of PPE. Employers should make sure that each employee demonstrates an understanding of the PPE training as well as the ability to properly wear and use PPE before they are allowed to perform work requiring the use of the PPE. If an employer believes that a previously trained employee is not demonstrating the proper understanding and skill level in the use of PPE, that employee should receive retraining. Other situations that require additional or retraining of employees include the following circumstances: changes in the workplace or in the type of required PPE that make prior training obsolete. The employer must document the training of each employee required to wear or use PPE by preparing a certification containing the name of each employee trained, the date of training and a clear identification of the subject of the certification. Eye and Face Protection Employees can be exposed to a large number of hazards that pose danger to their eyes and face. OSHA requires employers to ensure that employees have appropriate eye or face protection if they

Page 19 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
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are exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, potentially infected material or potentially harmful light radiation.

Types of Eye Protection Selecting the most suitable eye and face protection for employees should take into consideration the following elements: Ability to protect against specific workplace hazards. n Should fit properly and be reasonably comfortable to wear. Should provide unrestricted vision and movement. Should be durable and cleanable. Should allow unrestricted functioning of any other required PPE. These are tight-fitting eye protection that completely cover the eyes, eye sockets and the facial area immediately surrounding the eyes and provide protection from impact, dust and splashes. Some goggles will fit over corrective lenses. Welding shields. Constructed of vulcanized fiber or fiberglass and fitted with a filtered lens, welding shields protect eyes from burns caused by infrared or intense radiant light; they also protect both the eyes and face from flying sparks, metal spatter and slag chips produced during welding, brazing, soldering and 12 cutting operations. OSHA requires filter lenses to have a shade number appropriate to protect against the specific hazards of the work being performed in order to protect against harmful light radiation. Laser safety goggles. These specialty goggles protect against intense concentrations of light produced by lasers. The type of laser safety goggles an employer chooses will depend upon the equipment and operating conditions in the workplace. Face shields. These transparent sheets of plastic extend from the eyebrows to below the chin and across the entire width of the employee’s head. Some are polarized for glare protection. Face shields protect against nuisance dusts and potential splashes or sprays of hazardous liquids but will not provide adequate protection against impact hazards. Face shields used in combination with goggles or safety spectacles will provide additional protection against impact hazards. Each type of protective eyewear is designed to protect against specific hazards. Employers can identify the specific workplace hazards that threaten employees’ eyes and faces by completing a hazard assessment as outlined in the earlier section.

Page 20 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
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Self-check 1	Written test
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (6 point)**

1. One of the following to use personnel protect dives

- A/ Switch
- B/ Glove
- C/ Max
- D/ Except A all are answer

2. From the given alternative which one are control dices.

- A/ Single pole switch
- B. Two way switch
- C. Dimmer switch
- D. intermediate switch
- E. all

3. -----to ensure the greatest possible protection for employees in the workplace,

- A/ PPE
- B/ fuse
- C/ barker
- D/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_ Date: \_\_\_\_\_



Information sheet-5	Obtaining materials needed
---------------------	----------------------------

There are two essential methods for determine the type of luminaries to be use. The two key methods are called the point by point method and the lumen method.

The Point by Point method which is also known as inverse square law can be used to determine what is needed to produce a given level of illumination on a given area. This approach is not used often because of its complexity and its limitations. It is mostly used when there is need to determine the illumination levels

produced by single or multiple fixtures for flood lighting and recess lighting, while the Lumen method of lighting design is a frequently used approach of lighting design, which is acceptable, if the lighting luminaries are to be installed overhead in a conventional pattern. In this project the lumen method was used to calculate the lighting point needed in each room and the total lumen is expressed mathematically as follows

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## 5.1 INTRODUCTION

### 5.2 Obtaining materials needed

The task of a practical assignment is to develop wiring for a residential building and to include an auxiliary building in the plan. The feeder link is an overhead or cable line that enters the house from East/West/South/North. Supply voltage: 400/230 V. Step-by-step plan:  
*f* draw up the general plan; draw the electric supply part of the axonometric drawing of the

Page 22 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



residential house; *f* select fixed and mobile power using equipment and include a tankless water heater (17 kW); draw up the abridged circuit diagram of the residential building; calculate design power for each of the groups of the main switchgear and the house lead; select the necessary elements of the wiring system; calculate voltage deviation at one of the electrically most distant installation points and assess its admissibility; draw wiring plans for all floors of the residential building (in the basement, the wiring shall be installed above the plaster, while on all other floors — under the plaster); *f* write down the step-by-step plan for mounting a lamp / socket on a brick/wooden surface. Additional task: draw connection circuit of a meter. Figure 1 represents the structure of an electricity supply project of a residential house.

### What Are Raw Materials?

Raw materials are materials or substances used in the primary production or manufacturing of goods. Raw materials are commodities that are bought and sold on commodities exchanges worldwide. Traders buy and sell raw materials in what is called the factor market because raw materials are factors of production as are labor and capital.

### Raw Materials Explained

Raw materials are used in a multitude of products. They can take many different forms. The kind of raw materials inventory a company needs will depend on the type of manufacturing they do. For manufacturing companies, raw materials inventory requires detailed budgeting and a special framework for accounting on the balance sheet and Income statement.

Page 23 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
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Self-check 1	<b>Written test</b>
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (6point)**

1. Which one of the following building electrical materials

- A/ electrical wire
- B. electrical cable
- C. conduit
- D/ all

2. From the given alternative which one is residential building raw material?

- A/ fixable conduit
- B/ rigid conduit
- C. AC motor
- D. DC circuits
- E. A&B

3. ----- are used in a multitude of products.

- A/ Raw materials
- B/ machine
- C/ Equipment
- D/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_





LG #29

LO #2-Install electrical protection system

### Instruction sheet

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

- ❖ Performing correct procedures for *installation of electrical protection system*
- ❖ Installed with clearance to wall/other boxes for cover to open freely
- ❖ Enough clearance for cover opening for flush and surface mounted
- ❖ *electrical protection system components*
- ❖ Following schedule of work
- ❖ Soughing further instructions from a supervisor
- ❖ Checking on-going of quality of work done

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- ❖ Perform correct procedures for installation of electrical protection system
- ❖ Install with clearance to wall/other boxes for cover to open freely
- ❖ Enough clearance for cover open for flush
- ❖ electrical protection system components
- ❖ Follow schedule of work
- ❖ Sough further instructions from a supervisor
- ❖ Check on-going of quality of work done

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.



Information sheet -1.	Performing correct procedures for <i>installation of electrical protection system</i>
-----------------------	---

1. introductions

**1.2 Performing correct procedures for *installation of electrical protection system***

A company that specializes in the development of supermarket, high rise commercial building as an electrician. Today your supervisor gives you a single line diagram and a working drawing of electrical protection system. You are to install electrical protection system for lighting, power outlet, and grounding system in one residential building project of your company. In order for you to install electrical protection system, you need to determine the following:

1. the most suitable Personal Protective Equipment to be used in the installation of electrical protection system.
2. The electrical tools, equipment, needed for the installation of electrical protection system.
3. The component of the different electrical protection system.
4. The Philippine Electrical Code provisions in installing electrical protection system and the occupational health and safety procedure.
5. The steps in installing the different electrical protection system.
6. The information that will be included in the completion report to your supervisor.

Your performance on this job will help your supervisor decide to give you a more complicated work or advance work in preparation for your promotion later on.

**Types of Fuses**

Non-Time-Delay Fuse -a single-element fuse which may have one or more links under normal operation, when it is operating at or near its ampere rating, and if an overload current occurs and persist for more than a short interval of time, it simply function as a conductor

Dual-Element Time-Delay Fuses - it can be applied in circuits subject to temporary motor overloads and surge currents to provide both high performance short-circuit and overload protection contains two distinctly separate types of elements which are electrically connected in series Edison

Page 26 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



### Base Plug Fuse

- is allowed only in existing installation where there is no evidence of over fusing or tampering
- rated at 125 volt and 0 to 30 amp unless the system has a grounded neutral if it does, they are rated at 150 volt
- sizes 15 A and smaller are identified by a hexagonal configuration of the window, cap or other prominent part to distinguish them from the other Edison base fuse of higher rating

### Type Fuses

- can be considered as an improvement on the Edison base plug fuses have a design that prevents a larger fuse from being inserted in circuits designed for lower ratings
- each type requires a special adapter that accept only a fuse of equal rating and is so designed that it cannot be removed easily once it has been installed
- shall be classified at not over 125 volt and 0 to 15 A, 16 to 20 A, and 20 to 30 A Cartridge Type Fuses -are the ferrule type and knife-blade type -maybe of the non renewable type, where the complete fuse must be change each time it opens or the renewable type, where only the fuse link must be change. The renewable type was cost efficient in the long run when they were installed -maximum voltage is 500 volt and they are classified according to voltage and amperage ranges.



Self-check 1	<b>Written test</b>
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (4 point)**

1. One of the following is not protect dives

- A. Circuit Barker
- B. fuses
- C. control dives

2. From the given choose which one is control dices.

- A. Single pole switch
- B. Two way switch
- C. Dimmer switch
- D. intermediate switch
- E. all

3. One of the following is service circuit.

- A/ fuse
- B/ Two switch
- C/ Intermediates switch
- D/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**2.1 Introduction**

**2.2 Installation methods**

**Electrical wiring** is an electrical installation of cabling and associated devices such as switches, distribution boards, sockets, and light fittings in a structure.

Wiring is subject to safety standards for design and installation. Allowable wire and cable types and sizes are specified according to the circuit operating voltage and electric current capability, with further restrictions on the environmental conditions, such as ambient temperature range, moisture levels, and exposure to sunlight and chemicals.

Associated circuit protection, control and distribution devices within a building's wiring system are subject to voltage, current and functional specification. Wiring safety codes vary by locality, country or region.

Wiring methods



Figure 1.2.4

Installing electrical wiring by "chasing" grooves into the masonry structure of the walls of a building



Materials for wiring interior electrical systems in buildings vary depending on:

Intended use and amount of power demand on the circuit

Type of occupancy and size of the building

National and local regulations

Environment in which the wiring must operate.

Test project design requirements

General requirements All technical terms and descriptions used in the Test Project must be in accordance with

- Internationally recognized standards; Cable and conduit measurements are to the centre of the cable/conduit;
- Duct and equipment measurements are to the centre or edge of the duct/equipment
- All dimensions must be from specific reference lines (datum/centre lines);
- At least three different cable types must be used. For example
  - :• Plastic sheath cable
  - ,• Flexible cable,
  - Steel wire armor;
- At least five different cable support systems must be used. For example
  - :• Metal conduit
  - ,• PVC conduit
  - ,• Metal cable tray
  - ,• PVC trucking.
- The Test Project will consist of the following modules Module one – Domestic and Commercial installation module 17 hours maximum including commissioning and equipment setup
- ;• The Competition Organizer must supply materials for the competition only

Page 30 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



- Module one to begin on day
- Measurement marks will be measured progressively each day as indicated by the Test Project;
- Module one must be completely finished and marked by the end of C3
- Module one will be installed on three walls and the ceiling of the Competitors cubicle;
- Module one will include programming of a small smart relay, this will be programmed as part of
- Module one and included in the module timeframe; Module one will include home and building automation devices;
- For this module, function for home and building automation will be limited to manual functions.
- Equipment to be used for Module two is to be circulated at least five months prior to the Competition; Competitors are to be provided with descriptions, other necessary documentations and associated
- Product files (product data base); The Infrastructure List must state the languages that the software, software version and databases
- Will be available in; Programming exercise is to be completed in front of the general public; Final function tasks decided upon at the Competition;
- Programming will be limited to switches controlling lighting, dimming and blind control only;
- Competitors will be forbidden to have electronic storage devices in their work station during this
- Module.

*electrical wires* must be laid in metal  *cable* trays that have been hot The identification and location of the  *cables* must be done at each end, in  *horizontal and vertical* routes and *Wiring* cross-sections must be  *defined* by the circuit breakers.

This guide is designed to help you install residential wiring safely in any electrical wiring or in any improper installation of electrical wiring resulting from the use of this Guide. You can view A luminaries controlled by a wall switch shall be be installed in an attached garage.

Page 31 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



Installed with clearance to wall/other boxes for cover to open freely

Advantages of Steel City Boxes & Covers Notched Ears on Switch Boxes • Steel City® Switch Boxes feature a longer ear and a special notch. This provides clearance for the screws that are used to attach wall plates to GFCI or rocker-type light switches.

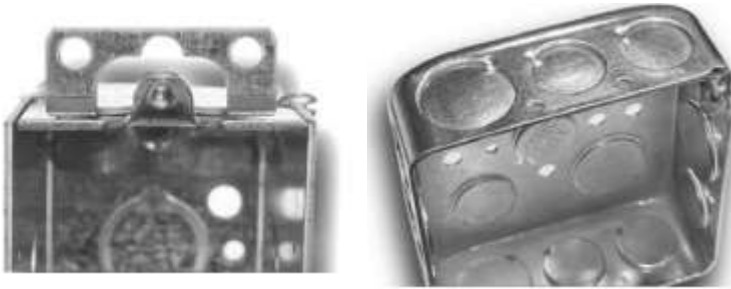


Figure 1.2.5





Self-check 1	Written test
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (4 point)**

1. One of the following to use lighting circuit.

- A/ 1.5mm<sup>2</sup>
- B. 2.5mm<sup>2</sup>
- C. 2mm<sup>2</sup>

2. From the given choose which one is control devices.

- A/ Single pole switch
- B.Two way switch
- C. Dimmer switch
- D. intermediate switch
- E. all

3. -----is an electrical installation of cabling and associated devices such as switches,

- A/ Electrical wiring
- B/ Cable
- C/ conduit
- D/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_

<b>Information-3</b>	<b>Enough clearance for cover opening for flush and surface mounted</b>
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### 3.1 Introduction

#### 3.2 Enough clearance for cover opening for flush and surface mounted

Shall mean not only the items of electrical cable warning covers, cable warning tapes and ... Contractor shall ensure adequate protection on site be provided, and there shall be a clearance of not glands shall be used at the open-circuit end or ends flush or surface mounting, as indicated.

Power transformers are defined as. the transformer is short circuited, and just enough voltage is applied to the other ... which they are mounted must have sufficient space for entrance, for attached outside the enclosure to increase surface area for ... under clearance, open the inspection port on top of the conservator.



Flush mounting, figure 1.3.1

#### Reliability of Protection Factors affecting reliability are as follows;

Quality of relays

Component and circuits involved in fault clearance e.g. circuit breaker trip and control circuits, instrument transformers

Maintenance of protection equipment

Page 34 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



Quality of maintenance operating staff Failure records indicate the following order of likelihood of relays failure, breaker, wiring, current transformers, voltage transformers and D C. battery. Accordingly local and remote back up arrangement are required to be provided.

- ❖ Electrical protection system components
- ❖ Safety switch fuse cut-out
- ❖ High/Low Voltage Switch Gear (HLVSG)
- ❖ Earth Leakage Circuit Breaker (ELCB)
- ❖ Conventional atmospheric lightning protection  
Grounding system

Primary function of the protective system is to detect and isolate all failed or faulted components as quickly as possible, thereby minimizing the disruption to the remainder of the electric system. Accordingly the protection system should be dependable (operate when required), secure (not operate unnecessarily), selective (only the minimum number of devices should operate) and as fast as required. Without this primary requirement protection system would be largely ineffective and may even become liability. System protection is the art and science of detecting problems with power system components and isolating these components.

**Problems on the power system include:**

1. Short circuits
2. Abnormal conditions
3. Equipment failures



Self-check 1	<b>Written test</b>
--------------	---------------------

Name..... ID..... Date.....

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

**Test I: Choose the best answer (4 point)**

1. One of the following to use flush mounted dives

- A/ Circuit Barker
- B. fuses
- C. SDB
- D/ A/ & B

2. From the given alternative which is feeder loads.

- A/ Single pole switch
- B.Two way switch
- C. Dimmer switch
- D. intermediate switch
- E. all

**3. Problems on the power system include:**

- A/ Short circuits
- B/ Abnormal conditions
- C/ Equipment failures
- D/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_



Information sheet-4	Safety switch fuse cut-out
---------------------	----------------------------

#### 4.1 Safety switch fuse cut-out

In **electrical distribution**, a fuse cutout or cut-out fuse is a combination of a **fuse** and a switch, used in primary overhead feeder lines and taps to protect

From **current** surges and overloads. An over current caused by a fault in the transformer or customer circuit will cause the fuse to melt, disconnecting the transformer from the line.

A cutout consists of three major components:

The cutout body, an open "C"-shaped frame that supports the fuse holder and a ribbed porcelain or polymer insulator that electrically isolates the conductive portions of the assembly from the support to which the insulator is fastened.

The fuse holder also called the "fuse tube" or "door", an insulating tube which contains the replaceable fuse element. When the contained fuse melts ("blows"), it opens the circuit, and the fuse holder drops out of the upper contact and hangs from a hinge on its lower end. This hanging fuse holder provides a visible indication that the fuse has operated and assurance that the circuit is open. The circuit can also be opened manually by pulling out the fuse holder using a hot stick.

The fuse element, or "fuse link", is the replaceable portion of the assembly that melts and breaks the circuit when the electric current through it exceeds its rated current value.

In electrical distribution, a fuse cutout or cut-out fuse is a combination of a fuse and a switch, used in primary overhead feeder lines and taps to protect distribution transformers from current surges and overloads. An over current caused by a fault in the transformer or customer circuit will cause the fuse to melt, disconnecting the transformer from the line. It can also be opened manually by linemen standing on the ground and using a long insulating stick called a "hot stick".



Components

Construction

Standards

Page 37 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



## External links

A cutout consists of three major components:

The cutout body, an open "C"-shaped frame that supports the fuse holder and a ribbed porcelain or polymer insulator that electrically isolates the conductive portions of the assembly from the support to which the insulator is fastened.

The fuse holder also called the "fuse tube" or "door", an insulating tube which contains the replaceable fuse element. When the contained fuse melts ("blows"), it opens the circuit, and the fuse holder drops out of the upper contact and hangs from a hinge on its lower end. This hanging fuse holder provides a visible indication that the fuse has operated and assurance that the circuit is open. The circuit can also be opened manually by pulling out the fuse holder using a hot stick.

The fuse element, or "fuse link", is the replaceable portion of the assembly that melts and breaks the circuit when the electric current through it exceeds its rated current value.

The fuse holder may be replaced by a solid blade, which would allow the fuse holder assembly to be used as a switch only.

Page 38 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



<b>Self-check 1</b>	<b>Written test</b>
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (4 point)**

1., a fuse cutout or cut-out fuse is a combination of a fuse and a switch,

- A/ Electrical distribution
- B. fuses
- C. earthing
- D/ all

2. From the given choose which one is control dices.

- A/ Single pole switch
- B.Two way switch
- C. Dimmer switch
- D. intermediate switch
- E. all

3. -----, a fuse cutout or cut-out fuse is a combination of a fuse and a switch

- A/ electrical distribution
- B/ Intermediate
- C/ Dimmer
- D/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_



<b>Information sheet-5</b>	<b>High/Low Voltage Switch Gear (HLVSG)</b>
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### 5.1 Introduction

## 5.2 High/Low Voltage Switch Gear (HLVSG)

In an electric power system, switchgear is composed of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment. Switchgear is used both to de-energize equipment to allow work to be done and to clear faults downstream. This type of equipment is directly linked to the reliability of the electricity supply.

The earliest central power stations used simple open knife switches, mounted on insulating panels of marble or asbestos. Power levels and voltages rapidly escalated, making opening manually operated switches too dangerous for anything other than isolation of a de-energized circuit. Oil-filled switchgear equipment allows arc energy to be contained and safely controlled. By the early 20th century, a switchgear line-up would be a metal-enclosed structure with electrically operated switching elements, using oil circuit breakers. Today, oil-filled equipment has largely been replaced by air-blast, vacuum, or SF<sub>6</sub> equipment, allowing large currents and power levels to be safely controlled by automatic equipment.

High-voltage switchgear was invented at the end of the 19th century for operating motors and other electric machines.

Typically, switchgear in substations are located on both the high- and low-voltage sides of large power transformers. The switchgear on the low-voltage side of the transformers may be located in a building, with medium-voltage circuit breakers for distribution circuits, along with metering, control, and protection equipment. For industrial applications, a transformer and switchgear line-up may be combined in one housing, called a unitized substation (USS). According to the latest research by vision gain, the worldwide switchgear market is expected to achieve \$152.5 billion by 2029 . Growing investment in renewable energy and enhanced demand for safe and secure electrical distribution systems are expected to generate the increase

In an electric power system, switchgear is composed of electrical disconnect switches, fuses or The switchgear on the low-voltage side of the transformers may be located in For circuits of a higher rating, a high-rupturing capacity (H.R.C.) fuse in conjunction with a switch may serve.

In an electric power system, switchgear is composed of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment. Switchgear is used both to de-energize equipment to allow work to be done and to

Page 40 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------





clear faults downstream. This type of equipment is directly linked to the reliability of the electricity supply.

The earliest central power stations used simple open knife switches, mounted on insulating panels of marble or asbestos. Power levels and voltages rapidly escalated, making opening manually operated switches too dangerous for anything other than isolation of a de-energized circuit. Oil-filled switchgear equipment allows arc energy to be contained and safely controlled. By the early 20th century, a switchgear line-up would be a metal-enclosed structure with electrically operated switching elements, using oil circuit breakers. Today, oil-filled equipment has largely been replaced by air-blast, vacuum, or equipment, allowing large currents and power levels to be safely controlled by automatic equipment.

Page 41 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



Self-check 1	Written test
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (4 point)**

1. one of the following based on Ethiopian standard for single phase voltage.

- A/ 380V
- B. / 250V
- C/ 220V
- D/ 1000V

3. ---is composed of electrical disconnect switches, fuses or circuit breakers used to Control, protect.

- A/ Switchgear
- B.Two way switch
- C. Dimmer switch
- D. intermediate switch

3. ----- is composed of electrical disconnect switches, fuses or circuit breakers used to control, protect.

- A/ Switchgear
- B/ one way switch
- C/ fuse
- D/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_ Date: \_\_\_\_\_



## Information sheet-6

## Earth Leakage Circuit Breaker (ELCB)

### 6.1 Introduction

### 6.2 Earth Leakage Circuit Breaker (ELCB)

An Earth-leakage circuit breaker (ELCB) is a safety device used in electrical installations with high Earth impedance to prevent shock. It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected. Once widely used, more recent installations instead use residual-current devices (RCDs, RCCBs or GFCIs) which instead detect leakage current directly.

#### Earth Leakage Circuit Breaker or ELCB

If any current leaks from any electrical installation, there must-be any insulation failure in the electrical circuit, it must be properly detected and prevented otherwise there may be a high chance of electrical shock if-anyone touches the installation. An earth leakage circuit breaker does it efficiently. Means it detects the earth leakage current and makes the power supply off by opening the associated circuit breaker. There are two types of earth leakage circuit breaker, one is voltage ELCB and other is current ELCB.

#### Voltage Earth Leakage Circuit Breaker

The working principle of voltage ELCB is quite simple. One terminal of the relay coil is connected to the metal body of the equipment to be protected against earth leakage and other terminal is connected to the earth directly.

Early earth leakage circuit breakers are voltage detecting devices, which are now switched by current sensing devices (RCD/RCCB). Generally, the current sensing devices termed as RCCB and voltage detecting devices named as Earth Leakage Circuit Breaker (ELCB). Forty years ago, the first current ECLBs were introduced and about sixty years ago the first voltage ECLB was introduced. What is an Earth Leakage Circuit Breaker (ELCB?)

An ECLB is one kind of safety device used for installing an electrical device with high earth impedance to avoid shock. These devices identify small stray voltages of the electrical device on the metal enclosures and intrude the circuit if a dangerous voltage is identified. The main purpose of Earth leakage circuit breaker (ECLB) is to stop damage to humans & animals due to electric shock

An Earth-leakage circuit breaker (ELCB) is a safety device used in electrical installations with high Earth impedance to prevent shock. It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected. Once widely used, more recent installations instead use residual-current devices (RCDs, RCCBs or GFCIs) which instead detect leakage current directly.

If any insulation failure occurs or live phase wire touches the metal body, of the equipment, there must be a voltage difference appears across the terminal of the coil connected to the equipment body and earth. This voltage difference produces a current to flow the relay coil.

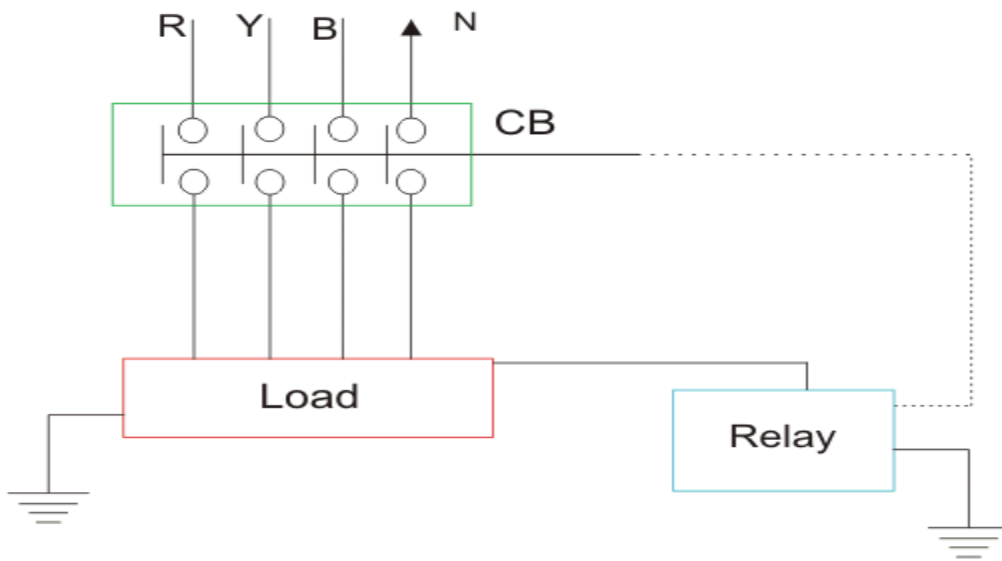


Figure 1.3.2

If the voltage difference crosses, a predetermined limit, the current through the relay becomes sufficient to actuate the relay for tripping the associated circuit breaker to disconnect the power supply to the equipment. The typicality of this device is, it can detect and protect only that equipment or installation with which it is attached. It cannot detect any leakage of insulation in other parts of the system. Study our Electrical MCQs to learn more about the operation of ELCBs.

#### Current ELCB or RCCB or Residual Current Circuit Breaker

The working principle of current earth leakage circuit breaker or RCCB is also very simple as voltage operated ELCB but the theory is entirely different and residual current circuit breaker is more sensitive than ELCB.



## What is an Earth Leakage Circuit Breaker (ELCB)

An ECLB is one kind of safety device used for installing an electrical device with high earth impedance to avoid shock. These devices identify small stray voltages of the electrical device on the metal enclosures and intrude the circuit if a dangerous voltage is identified. The main purpose of Earth leakage circuit breaker (ECLB) is to stop damage to humans & animals due to electric.

Page 45 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



<b>Self-check 1</b>	<b>Written test</b>
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (6 point)**

1. -----is a safety device used in electrical installations with high Earth impedance to prevent shock.

- A/ an Earth-leakage circuit breaker (ELCB)
- B. / switch
- C. /earthling
- D/ all

2. -----is one kind of safety device used for installing an electrical device

- A/ ECLB
- B/ Two ways
- C/ Dimmer switch
- D/ intermediate switch

3..... is a safety device used in electrical installations with high Earth impedance to prevent shock.

- A/ Earth-leakage circuit breaker (ELCB)
- B/ fuse
- C/ switch
- D/ none

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_



Information sheet -7	Conventional atmospheric lightning protection
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## 7.1 Introduction

### 7.2 Conventional atmospheric lightning protection

The loss of historic buildings as a result of lightning strikes makes local front page news every year. Lightning strikes make no distinction between historic properties and other types of structures. Historic barns, churches, museums, homes, stores, factories, lighthouses, schools, and other buildings, as well as structures such as tall monuments, may be at unnecessary risk of damage or loss as a result of a strike by lightning. The insurance industry reports that 5% of all claims are lightning-related in the U.S., with annual building damage estimated as high as \$1 billion according to Underwriters Laboratories, Inc. Certain types of structures are especially susceptible to damage, particularly churches where lightning accounts for nearly one-third of all church-building fires each year

. Old systems that have survived in whole or in part on historic structures may be historic features in their own right and deserve preservation. Such historic lightning protection systems may still be operating properly or can be repaired and upgraded. Some old systems simply are too deteriorated, incomplete, or archaic to repair and make fully functional, raising the question whether they should be saved in place or removed in whole or in part for safety. For historic structures that have none and are located in areas that are prone to lightning strikes, or are of special significance and deemed irreplaceable, a modern lightning protection system may merit installation. This Preservation Brief is designed for owners, property managers, architects, contractors, and others involved in the preservation of historic structures. It includes information on the care, maintenance, and repair of historic and older lightning protection systems; discusses factors to consider in assessing the need for a lightning protection system where none exists; and includes historic preservation guidance on the design and installation of new systems. What Causes a Lightning Strike? During violent storms, ice particles form in the atmosphere and collide with each other, resulting in a transfer of negative ions among ice particles. Smaller ice particles or crystals tend to lose negative ions, becoming positively charged, and are then carried through updrafts to the upper levels of the clouds. Heavier ice particles gain negative charges and settle below within the clouds. Lightning is produced when these oppositely charged cloud values create high electric fields—nature’s way of reducing the imbalance. The more typical negative electrical charges travel in leaders or about 150-foot segments. During thunderstorms, bursts of negative charges extend closer to the ground. Under such conditions, higher exposed

Page 47 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



objects on the ground in turn may send positively charged leaders upward. When two oppositely charged Instrumentation for Detecting Atmospheric Electrical. Hazards protection of especially sensitive systems. Development of new standards for lightning protection that incorporate these conventional, sharply-pointed, lightning rods frequently fail to. Necessary; a blunt rod termination would better define the attachment.

### Grounding system

An **earthling system** (UK) or **grounding system** (US) connects specific parts of an electric power system with the ground, typically the Earth's conductive surface, for safety and functional purposes. The choice of earthling system can affect the safety and electromagnetic of the installation. Regulations for earthling systems vary considerably among countries, though most follow the recommendations of the International Electro technical Commission. Regulations may identify special cases for earthling in mines, in patient care areas, or in hazardous areas of industrial plants.

Page 48 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------





<b>Self-check 1</b>	<b>Written test</b>
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (4 point)**

1 connects specific parts of an electric power system with the ground,.

- A/ earthing system
- B/ switch
- C/ intermediates switch
- D/ all

2. The insurance industry reports that -----% all claims are lightning-related in the U.S.

- A/ 5%
- B/ 10%
- C/ 0.5%
- D/ 50%
- E/ all

3. ----- connects specific parts of an electric power system with the ground,

- A/ grounding **system**
- B/ switch
- C/ Load
- D/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_ Date: \_\_\_\_\_



Information sheet -8	Following schedule of work
----------------------	----------------------------

## 8.1 Introduction

## 8.2 Following schedule of work

A Project Schedule is often confused with or referred to as a Project Plan. From the definitions above, it can be seen that the Project Schedule, whilst a key deliverable, is only one component of a Project Plan. The Project Plan assists a Project Manager in communicating with business work streams and gaining support for the project. A business manager with no technical knowledge should be able to understand the essence of the project through the project leader, the project concept and the project plan.

A Project Plan is prepared which is defined as a management summary document that describes the essentials of a project in terms of its objectives, justification and how the objectives are to be achieved. It describes how all of the major activities under each project management function are to be accomplished, including that of overall project control. The project plan will evolve through successive stages of the project life cycle.

**Process** The project Schedule outlines the tasks and activities of the project; the duration; start and end dates for each individual task and the project as a whole; and the resources and effort required. Developing a project Schedule involves a number of defined steps.

Work Breakdown Structure (WBS)

Work Packages

Activities and tasks

Schedule

For most projects there will be at least two separate Schedules developed. One will be for the Initiation Phase (Initial Schedule) and the other for the Planning, Execution and Closure phases. All schedules are added to Eclipse for tracking and updating. The Initial Schedule is developed in the Initiation Phase of the project to help produce the Project Charter. At this point, the Schedule is not expected to be very accurate or contain firm dates; rather it gives the Project Manager (PM) a rough idea of the project timeline and the assignment of resources. When the Charter is approved, a second Schedule is developed, with the

Page 50 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



approval date as the Project “start date”. In the Planning Phase, a Project Management Plan is created (from the Charter), and the second Schedule is updated with a more accurate and realistic timeline. In effect, the start and end dates of the first Schedule will be replaced by the start and end dates of the second Schedule. Eclipse allows for the development and saving of multiple schedules. This feature can help in creating “what if” schedules without disturbing the “active” schedule

**Work Breakdown Structure (WBS)** The WBS provides a clear description of the project’s deliverables. It describes the “what is to be done” not the process or schedule. Therefore the WBS: Is a deliverable breakdown structure

Is a hierarchical decomposition of the work – the deliverables are decomposed to a level where a

Work package can be defined (see work package below) Is a graphical representation or textual outline of the project scope

Represents 100% of the work defined by the project scope and captures ALL deliverables, internal, external, and interim, including project management The WBS helps: Develop the work packages

Define the project tasks

Develop the schedule

As a tool to communicate the project to stakeholders

**Work Packages** Work packages are the lowest level in a WBS decomposition where activity duration can be reliably estimated and managed. A Work Package can be created where a Project Manager (PM) deems it necessary to help develop the project Schedule. A work package details a level of work to be completed. It would contain a description of the work, details of constraints, and agreement between the PM and the team or individual doing the work, that the work can be done within the constraints. Assumptions would be defined in the work package depending on the needs of the project.



<b>Self-check 1</b>	<b>Written test</b>
---------------------	---------------------

Name..... ID..... Date.....

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

**Test I: Choose the best answer (4 point)**

1. The project Schedule outlines the tasks and activities of-----

- A/ duration the project
- B/ end date of the project
- C/ start date of the project
- D/ all

2. Project management The WBS helps-----

- A/ Develop the work packages
- B/ Define the project tasks
- D/ Develop the schedule      E/ all

3. ----- are the lowest level in a WBS decomposition where activity duration can be reliably estimated and managed.

- A/ Work packages
- B/ Develop the schedule
- C/ Define the project tasks
- D/ none

Score = _____
Rating: _____

Name: \_\_\_\_\_ Date: \_\_\_\_\_



Information sheet -9	Soughing further instructions from a supervisor
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### 9.1. Introduction

### 9.2 Soughing further instructions from a supervisor

Definitions and functions of supervision Definitions of supervision tell us something about what supervision aims to achieve or the function(s) it intends to fulfill. Although there are various definitions of supervision there are commonalities between them. Some place more emphasis on the organizational purpose of supervision while others focus more on the individual. When analyzing the different aspects of supervision, some authors identify three functions, while others see the process<sup>10</sup> as having four (or more) functions. When reading this section, you will want to consider which definition has resonance in your practice context including how this has influenced your organization’s supervision policy.

Team or project group. It provides accountability for both the supervisor and supervisee in exploring practice and performance. It also enhances and provides evidence for annual performance review or appraisal; it sits alongside an organization’s performance management process with particular focus on developing people in a way that is centered on achieving better outcomes for people who use services and their careers.’

### **How to Communicate with Your Supervisor**

Good communication with your supervisor is important to both of you. There are five important aspects to remember when communicating with your supervisor:

- ❖ You must be able to follow instructions.
- ❖ You need to know how to ask questions.
- ❖ You should report any problems and results of your work.
- ❖ You should accurately record and give messages to your supervisor.
- ❖ You need to discuss your job performance.

Everything you need to know about supervision. Supervision is direction, guidance and control of working force with a view to see that they are working according to plan and are keeping time schedule.

Page 53 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
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Good communication with your supervisor

Figure 1.3.2



Self-check 1	Written test
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Name..... ID..... Date.....

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

**Test I: Choose the best answer** (6 point)

1. When communicating with your supervisor

- A/ to follow instructions
- B. to ask questions
- C. to discuss your job performance.
- D/ all

2. From the given alternative which one is supervisor active .

- A/ Good communication
- B/ poor communication
- C. / deal get task work
- D. all

3. -----with your supervisor is important to both of you.

- A/ Good communication
- B/ supervisor
- C/ poor communication
- D/ none

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_



## 1.1 Introduction

## 1.2 Checking on-going of quality of work done

There have been many changes in the labor market in recent decades, such as the delocalization of production, the development of non-permanent and part-time work, the introduction of new technologies and an increased demand of flexible employees with varied skills. In order to deal efficiently with these new labor market developments, the European Union (EU) has devised different directives (for example Europe 2020), which are meant to promote a healthy and qualified labor force, high quality jobs and advanced training to ensure that employees are able to respond to these new challenges. These directives also point out the necessity of extending purely economic work quality indicators like employment rates by psychosocial indicators that focus on the work itself. Thus, it seems timely to address these changes in the labor market in order to remedy the absence of such indicators. Therefore, we aimed to develop a new instrument that reflects an altered work reality: The Measuring Quality of Work questionnaire (MQW). In the following, we will present this new trilingual instrument and analyze its psychometric properties.

The Concept of Quality of Work Clearly defining quality of work remains a challenge and the terms job quality, quality of work, and employment quality are often used interchangeably. Quality in this sense refers to an appeal “to promote rising standards”. Thus, measures of job quality, quality of work or quality of employment should not simply provide researchers with an existing overview of the employment situation, but also allow for an evaluation of the conditions uncovered. While conceptualizations vary within the social sciences, psychologists tend to focus on non-economic work factors such as intrinsically meaningful or challenging work, and in particular on the “goodness” of work when considering job quality. Thus, definitions of job quality are often based on determinants of high-quality jobs. For example, Barling, Kelloway and Iverson define: “High-quality work provides the employee with the means (through extensive training) and the opportunity to do great work” [8]. Job quality thus often focuses on salary, job security and fringe benefits, as they allow employees to pay bills and accumulate savings, as well as autonomy and control, as they provide employees with the opportunity to fulfill their own needs at work (e.g., fulfillment). On a general level, job quality is often assessed by aggregating different job components. This way, one can explore whether job quality increases or decreases over time or if certain countries or work sectors produce a higher quantity of good jobs [10]. However, the disadvantage of this approach is that this clustering of job components that constitute a “good” job is a simplification and cannot show how jobs might differ on a broad array of characteristics. For





example, two jobs might be classified as “good” jobs, but might be good due to completely different characteristics. Thus, the concept of job quality to date seems to be too narrow.

Measuring Quality of Work Previous research on work quality has resulted in a plethora of indicators. The number of instruments somewhat reflects the diversity of conceptualizations of quality of work. Munoz de Bustillo and colleagues reviewed 18 existing work quality indicators. evaluation of labor market characteristics not directly related to work. Since work components and labor market components rarely change at the same pace, indicators including both components may oversee or misinterpret important information. Furthermore, certain work quality dimensions that have shown to be important in research (e.g., intensity, wages) are absent in most of the indicators reviewed. This is problematic, as recent labor market research has called specifically for a survey of work intensification, the investigation of its origins, and its implication for workers [9]. Thus, while other indicators are useful for their specific purposes, a short worker-oriented instrument that bridges the gap between employment quality and job quality indicators, yet including previously neglected work components, is needed.

## Contents

Initial testing of an installation

Put in out of danger the existing electrical installations

Periodic check-testing of an installation

Conformity assessment (with standards and specifications) of equipment used in the installation

In so far as control procedures are respected, quality and safety will be assured only if:

The design has been done according to the latest edition of the appropriate wiring rules

The electrical equipment comply with relevant product standards

The initial checking of conformity of the electrical installation with the standard and regulation has been achieved

The periodic checking of the installation recommended is respected. Initial testing of an installation

Before a utility will connect an installation to its supply network, strict pre-commissioning electrical tests and visual inspections by the authority, or by its appointed agent, must be satisfied.

Page 57 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
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Self-check 1	<b>Written test</b>
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (4 point)**

1. Checking on-going of quality of work done

- A/ Initial testing of an installation
- B/ Periodic check-testing of an installation
- C/ the installation recommended is respected
- D/ all

2. The Measuring Quality of Work questionnaire (MQW)

- A/ initial testing work
- B/ check on going work
- C/ feedback
- D/ all

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_



LG #30

LO3. Notify completion of work Install electrical protection system

### Instruction sheet

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

- ❖ Making final checks
- ❖ Notifying supervisor
- ❖ Cleaning, checking and returning Tools, equipment
- ❖ Cleaned work area

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

- ❖ Making final checks
- ❖ Notifying supervisor
- ❖ Cleaning, checking and returning Tools, equipment
- ❖ Cleaned work area

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.



<b>Information sheet-1</b>	<b>Making final checks</b>
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### 1.1 Introduction

### 1.2 Making final checks

Most companies use checking accounts to handle their cash transactions. The company deposits its cash receipts in a bank checking account and writes checks to pay its bills. Keep in mind, a bank account is an asset to the company BUT to the bank your account is a liability because the bank owes the money in your bank account to you. For this reason, in your bank account, deposits are credits (remember, liabilities increase with a credit) and checks and other reductions are debits (liabilities decrease with a debit).

The bank sends the company a statement each month. The company checks this statement against its records to determine if it must make any corrections or adjustments in either the company's balance or the bank's balance. Bank reconciliation is a schedule the company (depositor) prepares to reconcile, or explain, the difference between the cash balance on the bank statement and the cash balance on the company's books. The company prepares a bank reconciliation to determine its actual cash balance and prepare any entries to correct the cash balance in the ledger.

Decision-making (also spelled decision making and decision-making) is regarded as the cognitive process resulting in the selection of a belief or a course of action among several possible alternative options; it could be either rational or irrational. Decision-making process is a reasoning process based on assumptions of values, preferences and beliefs of the decision-maker.<sup>[1]</sup> Every decision-making process produces a final choice, which may or may not prompt action.

Decision-making can be regarded as a problem-solving activity yielding a solution deemed to be optimal, or at least satisfactory. It is therefore a process which can be more or less rational or irrational and can be based on explicit or tacit knowledge and beliefs. Tacit knowledge is often used to fill the gaps in complex decision making processes.<sup>[3]</sup> Usually both of these types of knowledge, tacit and explicit, are used together in the decision-making process.

Human performance has been the subject of active research from several perspectives:

Psychological: examining individual decisions in the context of a set of needs, preferences and values the individual has or seeks.

Page 60 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



Cognitive: the decision-making process regarded as a continuous process integrated in the interaction with the environment.

Normative: the analysis of individual decisions concerned with the logic of decision-making, or communicative rationality, and the invariant choice it leads to.

What are the duties of an electrical supervisor?

Electrical supervisors play an important role within a mining operation. They are not only responsible to the manager of the mine for electrical safety but are also responsible for meeting electrical regulatory obligations to Resources Safety as well as Energy Safety in the Department of Mines, Industry Regulation and Safety (DMIRS).

Consequently, an electrical supervisor should be in a position to understand and be able to apply relevant legislation and standards as well as codes of practice, guidelines, industry agreements and company standards.

Cleaning, checking and returning Tools, equipment

Proper tools and equipment are essential for the effective operation of any civil works site. Equipping the construction site with the correct tools and equipment plays an essential role in achieving timely and good quality results. For every construction activity there is an optimal combination of tools, equipment and labor. Depending on the nature and content of the works, the technical staff needs to know which tools to use and how to effectively combine them with manual labor. Once on site, equipment requires trained operators and supervisory staff who are proficient in its operation and maintenance. Faulty equipment is a common reason for delays on construction sites. A major responsibility of the project management is to ensure that tools and equipment are maintained in a good condition and are readily available when required for the various work activities.



Information sheet 2	Cleaned work area
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## 2.1 Cleaned work area

Focus on the ability in a certain work area, responsibility or function. Each manual Housekeeping Supplies and equipment for environmental cleaning Environmental cleaning services **area**: a dedicated space for preparing period and might not be **cleaned** before use by a different person. ... It is also essential that IPC programs advocate for and **work** with facility administration

Cleaning equipment may include: Pressure and high pressure washers Steam cleaners

Ride-on equipment, including scrubber dryers,

Sweepers and combination units Floor polishers,

Burnishes and buffers Portable spotters/extractors Industrial vacuum cleaners,

Including wet and dry Vacuum litter collectors and blowers High speed surface cleaners

Mops and brooms Buckets Cloths and dusters Pans Garbage receptacles.

Chemicals may include:

Acid cleaners and brighteners Bowl cleaners Carpet care products Rust inhibitors, phosphatisers and rinse additives Detergents of all types and strengths including pre-treatment agents Emulsion cleaners,

Secluding drain cleaners, degreasers Floor cleaners

Allocated Assessment Tools There are a number of assessment tools that are used to determine competency in this subject: Work projects Written questions Oral questions Third Party Report Observation Checklist. Instructions on how assessors should conduct these assessment methods are explained in the Assessment Manuals. Alternative Assessment Tools whilst this subject has identified assessment tools, as indicated above, this does not restrict the assessor from using different assessment methods to measure the competency of a participant. Evidence is simply proof that the assessor gathers to show participants can actually do what they are required to do. Whilst there is a distinct requirement for participants to demonstrate competency, there are many and diverse sources of evidence available to the assessor.

Page 62 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
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LG #31	LO3. Clean up
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**Instruction sheet**

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

- ❖ Clearing work area and materials disposed ,
- ❖ Reusing or recycling of materials
- ❖ Cleaning, Checking, maintaining and storing Plant, tools and equipment

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

- ❖ Clear work area and materials disposed ,
- ❖ Reus or recycling of materials
- ❖ Clean , Checking, maintaining and storing Plant, tools and equipment

**Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.



<b>Information sheet-1</b>	<b>Cleaning, Checking, maintaining and storing Plant, tools and equipment</b>
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### 1.1 Cleaning, Checking, maintaining and storing Plant, tools and equipment

This document is intended to establish standard practice as well as to give general advice and guidance in the maintenance of electrical equipment owned and operated by the Bureau of Reclamation. Maintenance recommendations are based on industry standards and experience in Reclamation facilities. However, equipment and situations vary greatly, and sound engineering and management judgment must be exercised when applying these recommendations. Other sources of information must be consulted (e.g., manufacturer’s recommendations, unusual operating conditions, personal experience with the equipment, etc.) in conjunction with these maintenance recommendations.

#### Preventive Maintenance

Preventive maintenance (PM) is the practice of maintaining equipment on a regular schedule, based on elapsed time, run-time meter readings, or number of operations. The intent of PM is to “prevent” maintenance problems or failures before they take place by following routine and comprehensive maintenance procedures. The goal is to achieve fewer, shorter, and more predictable outages. Some advantages of preventive maintenance are:

It is predictable, making budgeting, planning, and resource leveling possible.

When properly practiced, it generally prevents most major problems, thus reducing

Forced outages, “reactive maintenance,” and maintenance costs in general. It gives managers a level of assurance that equipment is being maintained.

It is easily understood and justified. Preventive maintenance does have some drawbacks:

It is time consuming and resource intensive.

It does not consider actual equipment condition when scheduling or performing the maintenance.

- It can cause problems in equipment in addition to solving them (e.g., damaging seals, stripping threads).

Page 64 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
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Self-check 1	Written test
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Name..... ID..... Date.....

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

**Test I: Choose the best answer (6 point)**

1. Maintenance recommendations are based on-----?

- A/ industry standards
- B. module standard
- C. maintain standard
- D/ all

2. From the given alternative which one is correct cleaning?

- A/ good skill
- B.fullunderstanding
- C. good attitude
- D. morality
- E. all

3. ----- is the practice of maintaining equipment on a regular schedule, based on elapsed time,

- A/ Preventive maintenance (PM)
- B/ safety
- C/ dangers
- D/ all

Name: \_\_\_\_\_

Date: \_\_\_\_\_



## Operation sheet 1-. Plan and prepare for fault findings

### Steps / Procedures for Checking for Planning and preparing for fault findings

**Steps 1** - Establishing Standards and Methods for instructions the preparation of work Activity.

**Step 2** – identifying /selecting electrical faults

**Step 3** – inspecting / diagnosing, and electrical faults.

**Step 4** – Taking Corrective Actions

## Operation sheet – 2

## Install electrical protection system

### Operation title: Installing electrical protection system

**Purpose:** To develop the ability to perform electrical protection operations in accordance with operational standards

**Material:** electrical wire, electrical cable, rigid conduit lamp holder, different Lamps & wire clip etc

**Tool and measurements:** digital melitemeter, different type's pliers, screw driver etc

### Description of Technical data and Standard Quality

Electrical wire parallel to color code standard e.g. read, blue green & yellow etc.

Thickness, width are the given standard 1.5 mm<sup>2</sup> ,2.5mm<sup>2</sup>, 2mm<sup>2</sup> 4mm<sup>2</sup> etc

Accuracy for the given standard used for Lighting circuit 1.5 mm<sup>2</sup>, stove circuit 2.5mm<sup>2</sup>, normal socket outlet 2mm<sup>2</sup> and electrical mittad 4mm<sup>2</sup>

### Use:

### Parallels are used in selecting wiring system operations, to accurately support

a clamped work piece from underneath, to eliminate the work piece being pushed down by the force of the cutting tool, to give hand tools i.e. side cut pliers companion pliers screw driver size of electrical wire capacity of current i.e 10A, 6A, 16A 20 A 25 A and 32 A etc..



**Condition for the operation:** Fully organized work shop, good working condition

**Precautions:** - Wear protective clothing

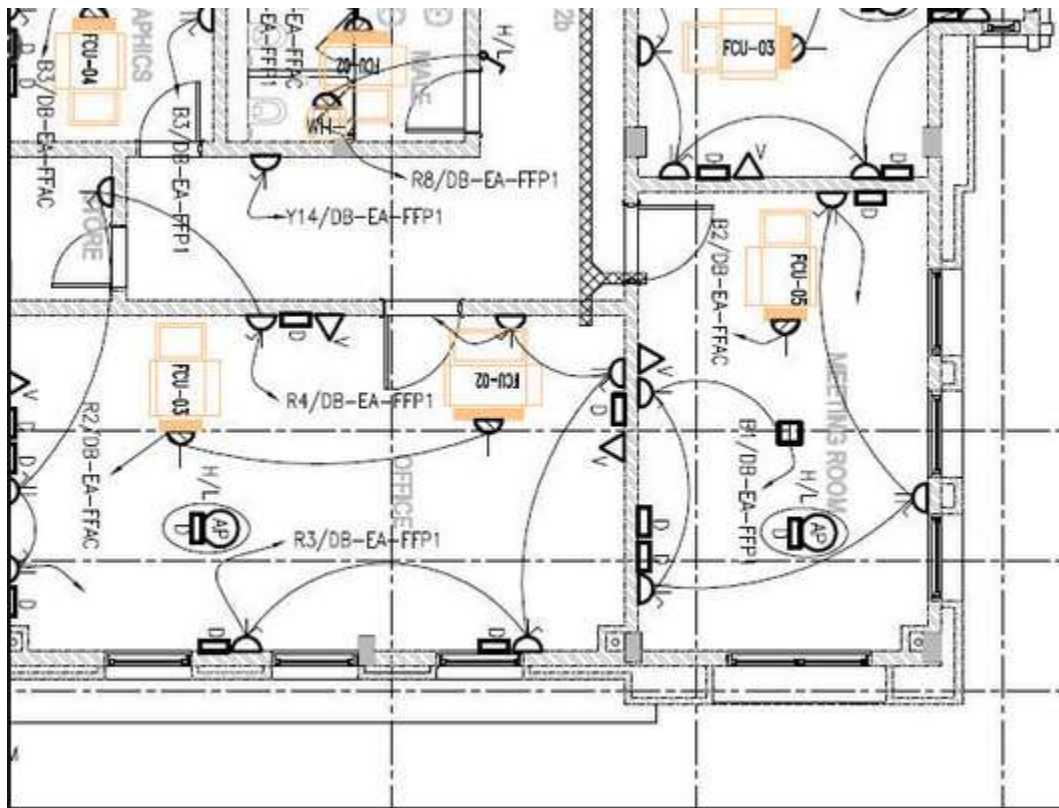
Tools and equipment:

Pliers

Students Guide

Goggles

### Working drawing



**Procedures for Preparing to select wiring systems and cables for general  
Electrical installations**

Page 67 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
---------------	---	---	----------------------------



**Quality criteria:** The electrical tools and materials must be made to the given standard and dimensional accuracy.

<b>LAP TEST</b>	<b>Performance Test</b>
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Name..... ID.....

Date.....

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within **2:30** hour. The project is expected from each student to do it.

**Task-1** selecting and preparing electrical wire according to the given circuit diagram?

**Task-2** installing electrical wire, rigid conduct fixing junction box and scatola?

**Task-3** terminating and connecting electrical apparatus?

**Task-4** inspecting electrical circuit without electrical power?

**Task-5** checking each circuit with feeding electrical power?

<b>Reference Materials</b>
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**Book:**

<http://www.gurus.com/courses/mod/forum/discuss.php?d=1557> [https://www.youtube.com/watch?v=Ya\\_Zz1J0aYA](https://www.youtube.com/watch?v=Ya_Zz1J0aYA).quality

[https://www.youtube.com/watch?v=Kj2m7Hwy\\_Lo](https://www.youtube.com/watch?v=Kj2m7Hwy_Lo)

<https://www.youtube.com/watch?v=vZcJuKqSfvY>

<http://www.iitg.ac.in/spal/Methods%20of%20mounting%20of%20jobs%20and%20cutting%20tools.ppt>

<http://www.iitb.ac.in/saf> [https://youtu.be/fk2uJM\\_KITk?t=93](https://youtu.be/fk2uJM_KITk?t=93)

[ety/sites/default/files/Machine%20Safety\\_0\\_0.pdf](ety/sites/default/files/Machine%20Safety_0_0.pdf)

<https://www.fda.gov/media/109408/download>

Page 68 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1 October 2020
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[https://www.flexiblemachining.com/pdf/quality\\_policy.pdf](https://www.flexiblemachining.com/pdf/quality_policy.pdf)

## AKNOWLEDGEMENT

We wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this Teaching, Training and Learning Materials (TTLM).

We would like also to express our appreciation to the TVET instructors and respective industry experts of Regional TVET barrios, TVET college/ Institutes, Amhara Federal Technical and Vocational Education and Training Agency (FTVET) who made the development of this Teaching, Training and Learning Materials (TTLM) with required standards and quality possible.

This Teaching, Training and Learning Materials (TTLM) was developed on December 2020 at Adama, comforte International Hotel.



## Answer sheet

Module Title: **Installing Electrical System Protection**

LG28-LG31

LG	LO	Self-check	Question number and answer				
			1	2	3	4	5
#28	LO 1	1	D	D	A		
		2	E	E	A		

Page 69 of 70	Federal TVET Agency Author/Copyright	TVET program title- Building Electrical installation LEVEL-3	Version -1
			October 2020



		3	C	D	D		
		4	D	E	A		
		5	D	E	D		
# 29	LO2	1	C	E	A		
		2	A	E	D		
		3	D	E	D		
		4	A	E	A		
		5	C	A	A		
		6	D	A	A		
		7	A	A	A		
		8	D	E	A		
		9	D	D	A		
		10	D	C			
#30		1	A	B	E		
#31		1	A	E	D		