BUILDING ELECTRICAL INSTALLATION

LEVEL II

Learning Guide-27

Unit of Competence: Install Electrical Apparatus

Module Title: Installing Electrical Apparatus

LG Code: EIS BEI2 M08 LO1-LG-27

TTLM Code: EIS BEI2 M08 TTLM 0919v1

LO 1: Plan and Prepare

Instruction Sheet	Plan and Prepare

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

- Planning & preparing installation to ensure OH&S policies and procedures
- sequencing work appropriately
- consulting appropriate personnel to ensure the work
- checking Apparatus
- Obtaining apparatus with established procedures
- Determining location of apparatus from job requirements
- Obtaining necessary materials to complete the work
- Obtaining Tools, equipment and testing devices to carry out the installation work
- Checking safety preparatory work to ensure no unnecessary damage

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

- Plan & prepare installation to ensure OH&S policies and procedures
- sequence work appropriately
- consulate appropriate personnel to ensure the work
- check Apparatus
- obtain apparatus with established procedures
- Determine location of apparatus from job requirements
- obtain necessary materials to complete the work
- Obtain Tools, equipment and testing devices to carry out the installation work
- Check safety preparatory work to ensure no unnecessary damage

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page -6, 9, 12 and 14** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -15.**
6. Do the “LAP test” **in page – 16** (if you are ready).

Information Sheet-1	Planning & preparing installation to ensure OH&S policies and procedures

1.1 Introduction Planning and preparing for the installation

Before you install the installation server products, you must prepare your system and plan for choices and make during the installation process.

1.1.1. Installation Planning

Installation Planning is the planning involved in case the system requires replacement or upgrade. It is always necessary to assess the status of the current system of equipment whether there is need for upgrade or replacement of the system

1.1.2 Steps Involved in Installation Planning

- Assessment - The performance of the current system in terms of reliability or productivity.
- Readiness- Review existing installation to identify the roadblocks,
- Benchmark- Record data on current system in order to measure the improvement in the new system to be installed,
- Design or Plan- Identify and map all work necessary to make migration and upgrades.
- Shutdown- Check and shutdown all the allied system,
- Replacement- Replace or put a new installation at the designated location.
- Testing- Do all the routine test specified in the installation guide. Also perform stress test related to the system.
- Monitoring- Monitoring the system for a specified period to evaluate performance and check issues which might arise due to installation errors

1.2 Concepts of Occupational Health and Safety (OHS)

The term of Occupational health and safety (OHS) relates to health, safety, and welfare issues in the workplace.

OHS includes the laws, standards, and programs that are aimed at making the workplace better for workers, along with co-workers, family members, customers, and other stakeholders.

Improving a company's occupational health and safety standards ensures good business, a better brand image, and higher employee morale**.**

Occupational health and safety is concerned with addressing many types of workplace hazards, such as:

- Chemicals
- Physical hazards
- Biological agents
- Psychological fallout
- Ergonomic issues
- Accidents

Occupational health and safety standards are in place to mandate the removal, reduction, or replacement of job site hazards. OHS programs should also include material that helps minimize the effects of the hazards.

Employers and company management are obliged to provide a safe working environment for all of their employees.

1.2.1 Concepts of Health and Safety Policy

A health and safety policy describes a course of action that has been chosen to influence workplace decision-making and guide actions related to workplace health and safety

Health and safety policies commonly exist as a body of regulations that are defined at the level of government and are implemented by individual workplaces. In some jurisdictions, public intermediary corporations may also be used to develop policies

1.3 Occupational health and safety procedure

- occupational health and safety procedures
- A planned system of working to prevent illness and injury where you work by recognizing and identifying hazards and risks.

- A hazard is anything that could hurt you or someone else
- It means working out how likely it is that a hazard will harm someone and how serious the harm could be
- For example, you can pick up things from the floor and put them away to eliminate a trip hazard.
- A hazard is a situation in the workplace that has the potential to harm the health and safety of people or to damage plant and equipment.
- One of the most common physical hazards
- When working on electronic equipment always be alert.
- Always read the warnings and instructions on the label**.**
- Inside computers and electronic equipment, there is a range of voltages from 3.volts to 25 volts, most of which are harmless.
- Protect people from injury • Protect equipment from damage • Protect the environment from contamination
- Know the location of fire extinguishers, how to use them and which to use for electrical fires and for combustible fires.
- Find an escape route in case a fire gets out of control. • Know how to contact emergency services quickly • Keep the workspace clean. • Keep most solvents in a separate area.
- Thanks you for listening

1.4 The purpose of OHS policies and procedures

The purpose of the Health and Safety policies and procedures is to guide and direct all employees to work safely and prevent injury, to themselves and others. All employees are encouraged to participate in developing, implementing, and enforcing Health and Safety policies and procedure.

1.5 The Importance of planning and Preparing Installation OH&S policies and procedures

- Consulting Appropriate/Technical Personnel to Ensure That Work is Coordinated with Others Who are Involved in the Activity.
- Determining the Location of the Devices/Systems to be used
- Obtaining Materials Necessary to Complete the Work in Accordance with Established Procedures
- Checking of Materials Received Against Job Requirements
- Complying with the Requirements in Installing Devices/Systems, and Peripherals
- Installing wiring system and Peripherals in Accordance with Job Requirements
- Performing Variations in Installing Devices and Systems in Accordance with Customer/Client's Requirements Obtaining Approval from Appropriate Personnel before Implementing Contingency Procedures
- Responding to Unplanned Events or Conditions in Accordance to Established Procedures
- Checking the Quality of the Work Undertaken in Accordance with the Established Procedures
- OHS Policies and Procedures in Conducting Tests.
- Checking Circuits and Systems Being Isolated Using Specified Testing Procedures.
- Testing Devices, Systems and/or Installation to Determine its Conformity with the Requirements
- Conducting Final Inspections on the Installed Devices, Systems to Ensure Conformity with the Requirement.
- Accomplishing Technical Reports on the Tests Conducted.
- Procedures in Forwarding Documentation to Appropriate Personnel and/or Authority on the Test Conducted
- Obtaining Approval from Appropriate Personnel before Implementing Contingency Procedures.
-

1.6 Planning and preparing for the installation

Fig 1.1 Planning and preparing for the installation

- OHS Policies and Procedures in Planning for Installation Activity in Accordance with Requirements Procedures, Correct Operation and Safety on equipment / Devices/Systems
- Consulting Appropriate/Technical Personnel to Ensure That Work is Coordinated with Others Who are Involved in the Activity.
- Determining the Location of the Devices/Systems to be used
- Obtaining Materials Necessary to Complete the Work in Accordance with Established Procedure
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- Checking the Quality of the Work Undertaken in Accordance with the Established Procedures
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- Accomplishing Technical Reports on the Tests Conducted.
- Procedures in Forwarding Documentation to Appropriate Personnel and/or Authority on the Test Conducted.

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1.Occupational health and safety (OHS) relates to (2 points)

A. health

C. welfare issues in the workplace

B. safety

D. all

2.The Importance of planning and Preparing Installation OH&S policies andprocedures.(4 points)

A. Testing Devices

B. Checking the Quality of the Work

C .Checking of Materials

D. all

3. Steps Involved in Installation Planning(2 point)

A, assessment B. readiness

C,benchmark D. All

4------ Review existing installation to identify the roadblocks(2 point)

A .assessment B. Readiness

C , benchmark D, all

Note: Satisfactory rating 5 points Unsatisfactory - below 5 points

Score = _____

Rating: _____

Information Sheet- 3	consulting Appropriate personnel to ensure the work

3.1 Introduction

Consultation involves sharing of information, giving workers a reasonable opportunity to express views and taking those views into account before making decisions on health and safety matters.

A person conducting a business or undertaking must consult, so far as is reasonably practicable, with workers who carry out work for the business or undertaking and who are (or are likely to be) directly affected by a work health and safety matter.

If the workers are represented by a health and safety representative, the consultation must involve that representative.

Consultation with workers and their health and safety representatives is required at every step of the risk management process. By drawing on the experience, knowledge and ideas of your workers you are more likely to identify all hazards and choose effective risk control.

For example, if you engage an electrical contractor to carry out electrical work at your workplace you should consult with the contractor on how (in general) the work is to be carried out and in particular how risks to their health and safety and that of others at the workplace are to be managed while the work is carried out. You should also cooperate with the electrical contractor (e.g. instructing on and ensuring compliance with 'no go' zones') to ensure electrical safety of everyone at the workplace

3.2 The important of consulting appropriate personnel to ensure the work

3.2.1Managing electrical risks

A person conducting a supervisor or undertaking must manage risks to health and safety associated with electrical risks at the workplace.

In order to manage risk under the WHS Regulations, a duty holder must:

- identify reasonably foreseeable hazards that could give rise to the risk
- eliminate the risk, so far as is reasonably practicable

- if it is not reasonably practicable to eliminate the risk, minimize the risk so far as is reasonably practicable by implementing control measures
- maintain the implemented control measure so that it remains effective
- review, and if necessary revise, all risk control measures so as to maintain, so far as is reasonably practicable, a work environment that is without risks to health and safety
- identifying hazards „
- if necessary, assessing the risks associated with these hazards
- implementing and maintaining risk control measures (e.g. inspecting and testing electrical equipment, using RCDs), and
- Reviewing risk control measures.

3.2.2 Implementing risk control measures

In implementing risk controls, you may develop a safe work method statement that:

- specifies the determined risk controls
- sets out the steps that need to be taken to implement the risk controls
- identifies and allocates the resources necessary to implement the measures (i.e. time and expenses)
- allocates responsibilities and accountabilities (e.g. who does what and when)
- Sets a date for reviewing the risk controls.

3.3 RISK CONTROLSWORKING NEAR ENERGISED ELECTRICAL PARTS

Electrical work on any installation, equipment, machinery, plant or appliance may pose a risk of direct or indirect contact with nearby exposed energized electrical parts (e.g. installing or testing circuits on a switchboard adjacent to exposed live electrical parts).

In some circumstances the risks associated with undertaking electrical work near exposed live parts can be equivalent to those associated with live electrical work. Risks to be considered, but not limited to, are those arising from:

- energized parts
- exposed high temperature parts

- Moisture entering the electrical equipment. Identifying and assessing the risks and developing risk control measures as described in the How to manage work health and safety risks code of practice 2011 will provide further assistance in developing safe work practices

3.4 Consultation between duty holders

All persons conducting a business or undertaking at a workplace have a duty to manage electrical risks at the workplace while electrical work is being carried out, not just those carrying out the electrical work. Electrical work will often be carried out at a place that is not under the management or control of the person conducting the business or undertaking carrying out the electrical work. For example, the place where work is carried out may be under the management or control of:

- if the place is a permanent workplace—the person conducting a business or undertaking from that workplace
- if the place is a public place—the relevant local or state authority. These persons will also have duties in relation to the health and safety of the electrical worker(s) and other persons at the place where the electrical work is being carried out.

All duty holders must, so far as is reasonably practicable, consult, cooperate and coordinate activities with each other to ensure compliance with their work health and safety duties. In addition to the general duty to consult, the person conducting a business or undertaking carrying out the electrical work must ensure the electrical work is only authorized (among other things) after consulting with the person with management or control of the workplace. Consultation should ensure that all relevant persons are aware of any scheduled electrical work to be carried out and also any relevant risks to health and safety arising from that work.

Arrangements should also be put in place to ensure, so far as is reasonably practicable, that all persons at the place receive suitable and adequate information and instruction, for example about the need to comply with warning or safety signs and stay out of any ‘no go’ zones.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1._____Risk controls working near energized part electrical part **(2 point)**

A. energized parts

C. moisture entering the electrical equipment

B. exposed high temperature parts D. all

2.AS trainer what is you responsible before the practical work(2 point)

A .consulting appropriate personnel B. allocates responsibilities

C. exposed any idea D.A&B

3. The important of Managing electrical risks.(2 point)

A. exposed high temperature parts B. Identifying and assessing the risks

C developing risk control measures D. All

Note: Satisfactory rating - 3 points Unsatisfactory - below 3 points

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

Score = _____

Rating: _____

Information Sheet-4	checking Apparatus

4.1 Definition of terms

- **Electrical apparatus**

Electrical apparatus means any appliances, fittings, lamps or other apparatus designed for operation by or in connection with electricity, and any articles or fittings of any kind for use in connection with any such apparatus.

- **multimeter**

A multimeter is the combination of a DC voltmeter, AC voltmeter, ammeter, and ohmmeter. An un-amplified analog multimeter combines a meter movement, range resistors and switches; VTVMs are amplified analog meters and contain active circuitry.

For an analog meter movement, DC voltage is measured with a series resistor connected between the meter movement and the circuit under test. A switch (usually rotary) allows greater resistance to be inserted in series with the meter movement to read higher voltages. The product of the basic full-scale deflection current of the movement, and the sum of the series resistance and the movement's own resistance, gives the full-scale voltage of the range. As an example, a meter movement that required 1 mA for full-scale deflection, with an internal resistance of 500 Ω, would, on a 10 V range of the multimeter, have 9,500 Ω of series resistance.[7]

For analog current ranges, matched low-resistance shunts are connected in parallel with the meter movement to divert most of the current around the coil. Again for the case of a hypothetical 1 mA, 500 Ω movements on a 1 A range, the shunt resistance would be just over 0.5 Ω.

Contemporary multimeters can measure many values. The most common are:

- Voltage, alternating and direct, in volts.
- Current, alternating and direct, in amperes.

  The frequency range for which AC measurements are accurate is important, depends on the circuitry design and construction, and should be specified, so users can evaluate the readings they take. Some meters measure currents as

low as milliamps or even microamps. All meters have a burden voltage (caused by the combination of the shunt used and the meter's circuit design), and some (even expensive ones) have sufficiently high burden voltages that low current readings are seriously impaired. Meter specifications should include the burden voltage of the meter.

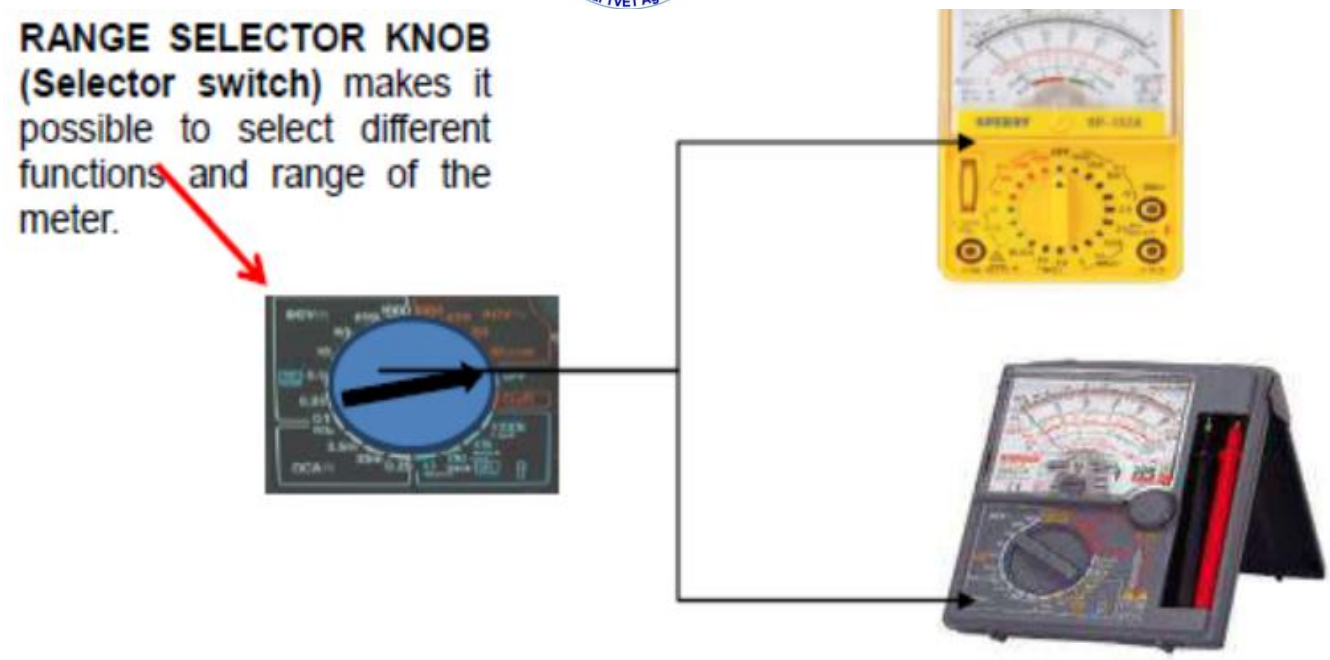
- Resistance in ohms.

A. PARTS OF A MULTI TESTER

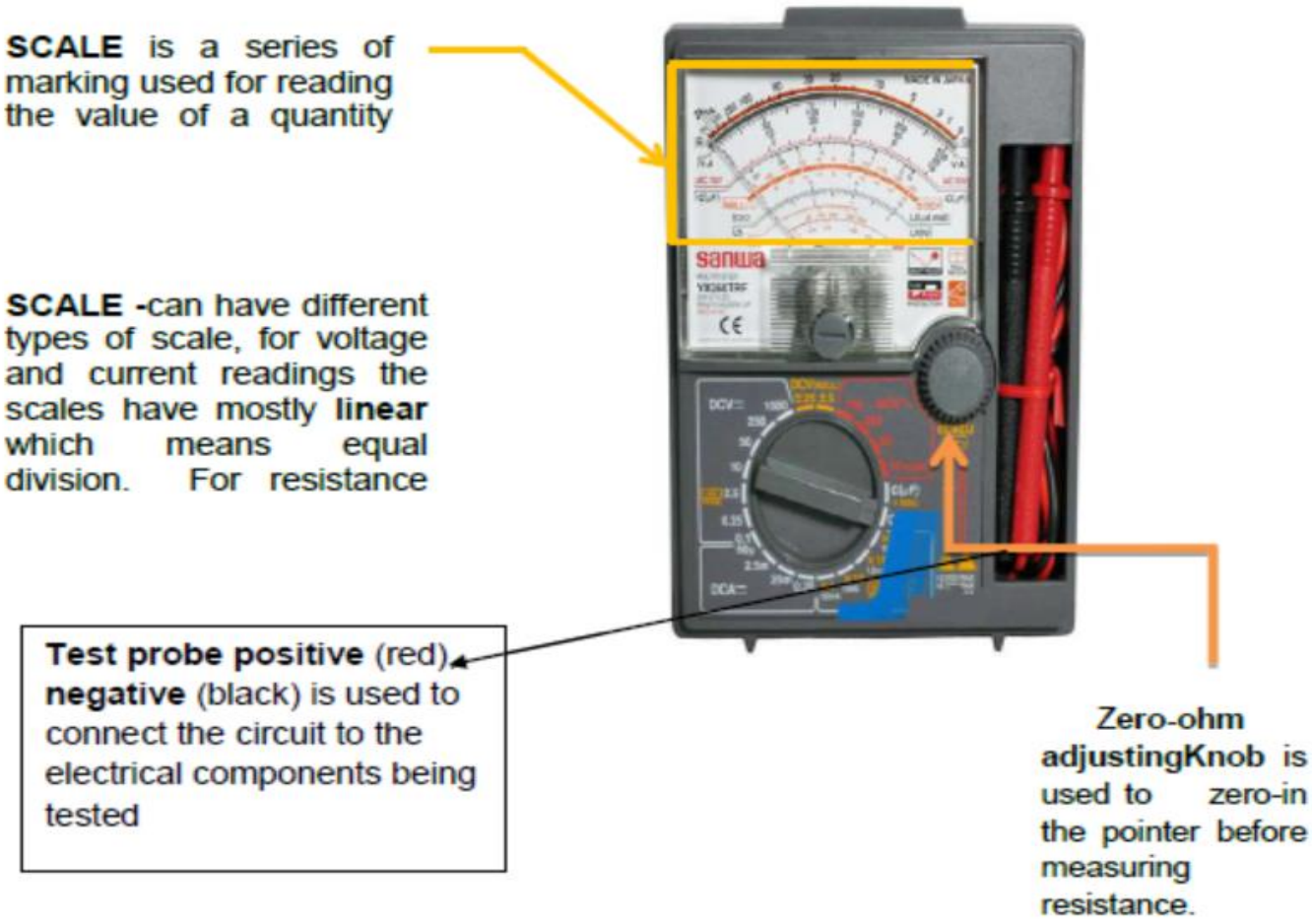
POINTER. The needle-shaped rod that moves over the scale of a meter.

Pointer It is mechanically connected to the moving coil. it indicates the measured values on the multimeter

RANGE SELECTOR KNOB (Selector switch) makes it possible to select different functions and range of the meter.



Adjustment screw makes it possible to adjust the pointer to the zero position of the scale.



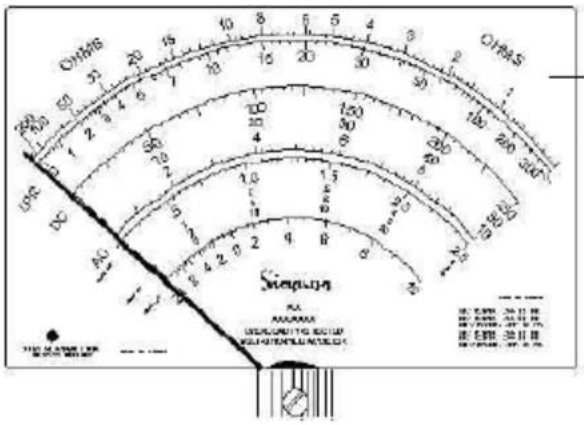
A. Proper care and maintenance of the multi tester

1. Read manual of instructions on how to operate the multi-tester.
2. In reading the amount of voltage, always start with the highest range to avoid reading voltage higher than the tester setting.
3. Be sure that the tester is set to the correct range setting: resistance range when measuring the ohm, voltage range when measuring voltage and ammeter range when measuring the value of electric current.
4. Always check the condition of its battery. Worn out batteries will damage the internal setting of the tester.
5. When the tester is not in used or will be stored, set the selector switch to 1000V or to OFF position.
7. Never drop the tester.

B. How to read the meter scale of the multi tester

To read the resistance range of the multi-tester, the given table below will be used. The unit of measurement to be used to determine its resistance is **ohm**.

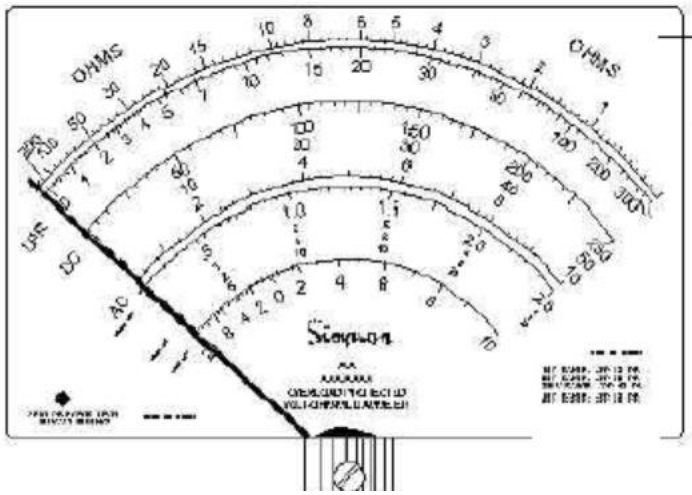
Range	0-2	2-10	10-20	20-50	50-100	100-200
Range x1	0.2	0.5	1	2	5	20
Range x10	2	5	10	20	50	200
Range x1k	20	50	100	200	500	2K
Range x 10k	200	500	1K	2K	5K	20K



Pointer deflection

Range setting is X1

Reading is 2.5ohms



Pointer deflection

Range setting is X10

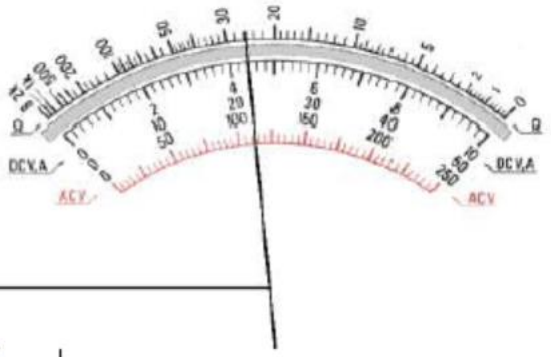
Reading is 25 ohms

Voltage scale

Range	Value/div
Range 10V	0.2V
Range 50V	1V
Range 250V	5V
Range 100V	20V

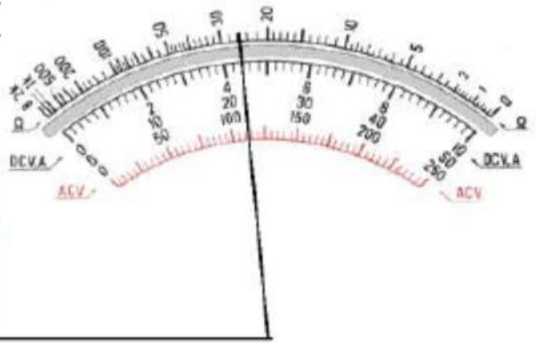
Voltage scale
Range setting is 10 V
(used 0-10 scale)
Reading is 4.4V

Range	Value/div
Range 10V	0.2V
Range 50V	1V
Range 250V	5V
Range 100V	20V



Voltage scale
Range setting is 50V (used 0-10 scale)
Reading is 24V

Range	Value/div
Range 10V	0.2V
Range 50V	1V
Range 250V	5V
Range 1000V	20V



Voltage scale

Range setting is 250V (used 0-10 scale)

Reading is 110V

Information Sheet-5	Obtaining apparatus with established procedures

5.1 Obtaining apparatus

5.1.1 Electrical lights or lamps

A. Incandescent Lamps

Incandescent bulbs are standard bulbs and many people are quite familiar with these bulbs. These incandescent bulbs are available in a broad range of sizes and voltages. An incandescent bulb glows and produces heat when electricity passes through the tungsten filament present inside the bulb. The filament of this bulb is placed either in a mixture of nitrogen gas or in a vacuum. These bulbs are being gradually replaced by LEDs, fluorescent lamps, and other service based new technologies.

The reason for this is that when this bulb is switched on, the sudden flow of current, energy and heat penetrate the thin areas, which in turn heat up the filament; once the filament heats up, it tends to break and burns out the bulb. Incandescent bulbs can last for 700 – 1000 hours and can also be used with a dimmer. Incandescent bulbs generate steady heat, which is quite good for house hold applications. Luminous efficiency of incandescent lamp is about 15 lumens per watt.

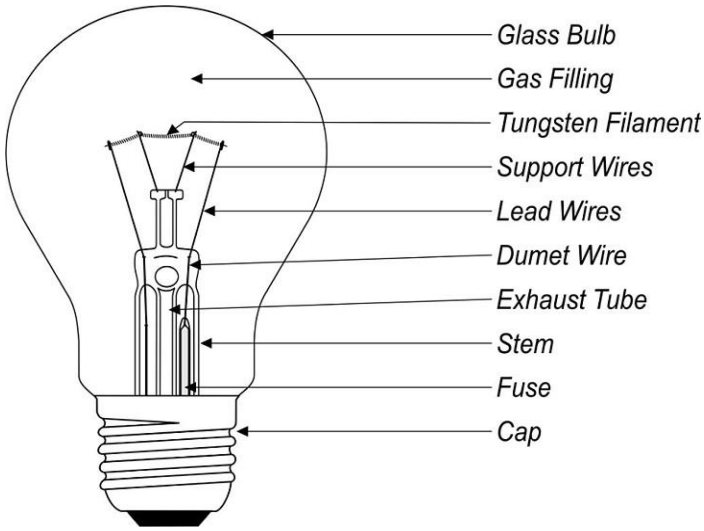


Fig. 5.1 incandescent lamp

B. LED light bulb

An LED light bulb is a solid-state lighting (SSL) device that fits in standard screw-in connections but uses LEDs (light-emitting diodes) to produce light.

LED light bulbs are a more environmentally-friendly alternative to incandescent bulbs. LED bulbs use a semiconductor device that emits visible light when an electric current passes through it. That property is known as electroluminescence, Compact fluorescents, the most common alternative to incandescent bulbs, use electricity to excite mercury gas until it emits ultraviolet (UV) light. That light is then passed through a phosphor, which causes it to emit more visible light.

LEDs themselves have been around for some time, but only recently have improvements in efficiency, cost and output made them viable for the larger-scale lighting used in households, businesses and other environments. Due to the rapid progress in LED technologies, products exist with wide ranges of efficiencies and life spans.

The bulbs can work for 50000 hours, if not run outside of the specified temperature range. They use about 8-11 watts of power to replace a 60-watt incandescent with at least 806 lumen and 9.5 watts for a 75-watt equivalent. This capacity provides an efficiency gain of up to 80% over incandescent bulbs.

Other benefits of LED light bulbs:

- Cooler than incandescent bulbs in operation.
- Instant on, unlike compact fluorescent bulbs.
- Broad range of color possibilities.
- Customizable lights can be controlled through a Bluetooth connection.
- Lowest cost over ownership of all lights.

- No mercury and minimal toxic materials required.
- A single lamp represents a reduction of hundreds of pounds of CO2, compared to use of incandescent.

Fig.5.2 LED light bulbs

C. Spotlight

A **spotlight** is a powerful stage lighting instrument which projects a bright beam of light onto a performance space. Spotlights are controlled by a spotlight operator who tracks actors around the stage. Spotlights are most commonly used in concerts, musicals and large scale presentations where highlighting a specific mobile individual is critical. Spotlights are sometimes located overhead on catwalks. In some theatres, they may also be located in the control booth or purposely built "spot booths" in addition to the catwalk.

Characteristics of a typical spotlight include:

- A strong light source, often a high-intensity discharge lamp with a high colour temperature.
- A lens which can be manually focused.
- A manual device to change the intensity of the beam, especially when an HID source which cannot be electronically dimmed, is used.
- An "iris" to adjust the size of the spot/angle of the beam.
- A color magazine or "boomerang" consisting of several gel frames which can be swung in front of the beam.

- Some sort of physical sight to assist in aiming is sometimes added onto the lamp by the operator.

Fig.5.3 spotlight

D. **Fluorescent lamp**

A **fluorescent lamp** is a low weight mercury vapour lamp that uses fluorescence to deliver visible light. An electric current in the gas energizes mercury vapor which delivers ultraviolet radiation through discharge process and the ultraviolet radiation causes the phosphor coating of the lamp inner wall to radiate visible light.

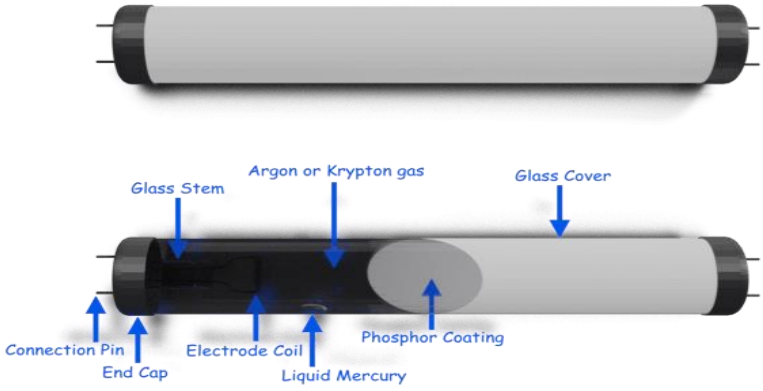


Fig.5.4 fluorescent lamp

5.1.2 DOMESTIC SWITCHES

The transportation of electrical energy from the source ti the load is done through the control devices call switching devices.

Any switch device is made for establishing and interrupting of electric circuit.

- **Switching device are categorized in to two**

1) Mechanical switching devices; are those which function mechanically.

2) Semi-conductor The transportation of electrical energy from the source ti the load is done through the control devices call switching devices.

Any switch device is made for establishing and interrupting of electric circuit.

- **Switching device are categorized in to two**

1) Mechanical switching devices; are those which function mechanically.

2) Semi-conductor switching devices; are those which function electrically.

Switch a switch is a mechanical device which closes or opens an electrical circuit during normal functioning. The quality of the switch contacts must be such that there should not be any formation of arc b/n the switch contacts during make and break.

Types of switches

A. Domestic switch

B. Industrial switch

Domestic switch; are those which are used for lighting and socket outlet control.

They are classified as;

1. Single pole one way switching
2. Series switching
3. Two way switching
4. Intermediate switching

- **pole Single one way switching**; with single pole one way switching it should be possible to switch appliances(e.g. light);ON;OFF;
- **Series switching;** with series switching, it should be possible from a switching point to switch two lamps or group of lamps selectively, ON, or ‘OFF, individually,
- **Two way switch;** with two ways switching it should be possible to switch a lamp or group of lamps, ON ‘or, OFF, from two switching points,

- **Intermediate switching;** The purpose of intermediate switching is to enable a current consuming device (lamp)or a group of devices (lamps) to be switched On & OFF From at least three switching points,

5.1.3 Bell

A. Electric bell

An **electric bell** is a mechanical bell that functions by means of an electromagnet. When an electric current is applied, it produces a repetitive buzzing or clanging sound. Electric bells have been widely used at railroad crossings, in telephones, fire and burglar alarms, as school bells, doorbells, and alarms in industrial plants, since the late 1800s, but they are now being widely replaced with electronic sounders. An electric bell consists of one or more electromagnets, made of a coil of insulated wire around an iron core, which attract a springy iron armature with a clapper. When an electric current flows through the coils, the electromagnet creates a magnetic field which pulls the armature towards it, causing the clapper to strike the bell.

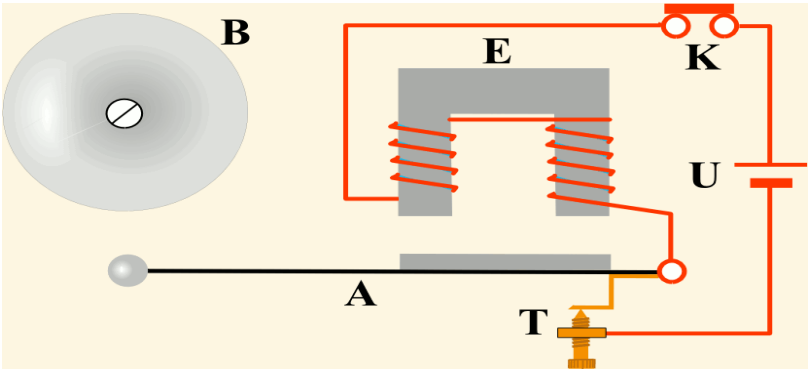


Fig.5.5 electric bell

B. Fire alarms bell

Fire alarm bells are divided into two categories: vibrating, and single-stroke. On a vibrating bell, the bell will ring continuously until the power is cut off. When power is supplied to a single-stroke bell, the bell will ring once and then stop. It will not ring again

until power is turned off and on again. These were frequently used with coded pull stations.

5.6 Fire alarms bell

C. Buzzers

An electric buzzer uses a similar mechanism to an interrupter bell, but without the resonant bell. They are quieter than bells, but adequate for a warning tone over a small distance, such as across a desktop.

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

With the development of low cost electronics from the 1970s onwards, most buzzers have now been replaced by electronic 'sounders'. These replace the electromechanical striker of a bell with an electronic oscillator and a loudspeaker, often a piezoelectric transducer.

Fig.5.7 Buzzers

5.1.4 Smoke detector

A **smoke detector** is a device that senses smoke, typically as an indicator of fire. Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, while household smoke detectors, also known as **smoke alarms**, generally issue a local audible or visual alarm from the detector itself.

Smoke detectors are housed in plastic enclosures, typically shaped like a disk about 150 millimetres (6 in) in diameter and 25 millimetres (1 in) thick, but shape and size vary. Smoke can be detected either optically (photoelectric) or by physical process (ionization); detectors may use either, or both, methods. Sensitive alarms can be used to detect, and thus deter, smoking in areas where it is banned. Smoke detectors in large commercial, industrial, and residential buildings are usually powered by a central fire alarm system, which is powered by the building power with a battery backup. Domestic smoke detectors range from individual battery-powered units, to several interlinked mains-powered units with battery backup; with these interlinked units, if any unit detects smoke, all trigger even if household power has gone out.

Fig.5.8 Smoke detector

5.1.5 ceiling fan

A **ceiling fan** is a mechanical fan mounted on the ceiling of a room or space, usually electrically powered, suspended from the ceiling of a room, that uses hub-mounted rotating blades to circulate air. Ceiling fans typically rotate more slowly than other types of circulating fans, such as electric desk fans. They cool people effectively by introducing slow movement into the otherwise still, hot air of a room. Fans never actually cool air, unlike air-conditioning equipment; they in fact heat the air due to the

waste heat from the motor and friction, but use significantly less power (cooling air is thermodynamically expensive). Conversely, a ceiling fan can also be used to reduce the stratification of warm air in a room by forcing it down to affect both occupants' sensations and thermostat readings, thereby improving climate control energy efficiency.

Fig.5.9 ceiling fan

5.1.6 Lamp holder

Lamp holder adapters are devices used to convert gas lamps, socket, outlets or parts of lamps to those of an otherwise incompatible device or system of lamp parts. The porcelain function of lamp holder is specially designed for use with shielded metal halide lamps.

A device for securing a lamp to its support; specifically, a socket or holder fitted with electric terminals, into which the top of the glass globe of an incandescent lamp is fitted, or from which it hangs.

Fig.5.10 Lamp holder

What's the function of lamp holder?

What's the **function of lamp holder**? Lights are often inserted in lamp holders which offer electrical connections to the lamp and help it inside the lighting fixture. The usage of lamp bases allows lights to become safely and conveniently replaced (re-lamping) in the end of life, or to transform power, color, lighting technology or and so on. There are plenty of different standards for these lamp bases, created by de facto and by many standards bodies. A basic coding system is a letter or abbreviation followed by a number.Some miniature lights have wire leads suitable for direct connection to wires; some reflector equipment and lighting have screw terminals for wire connections.

The function of lamp holder defines and limits its intended use. Porcelain insulation can withstand considerably higher operating temperatures than bake lite or other plastics.

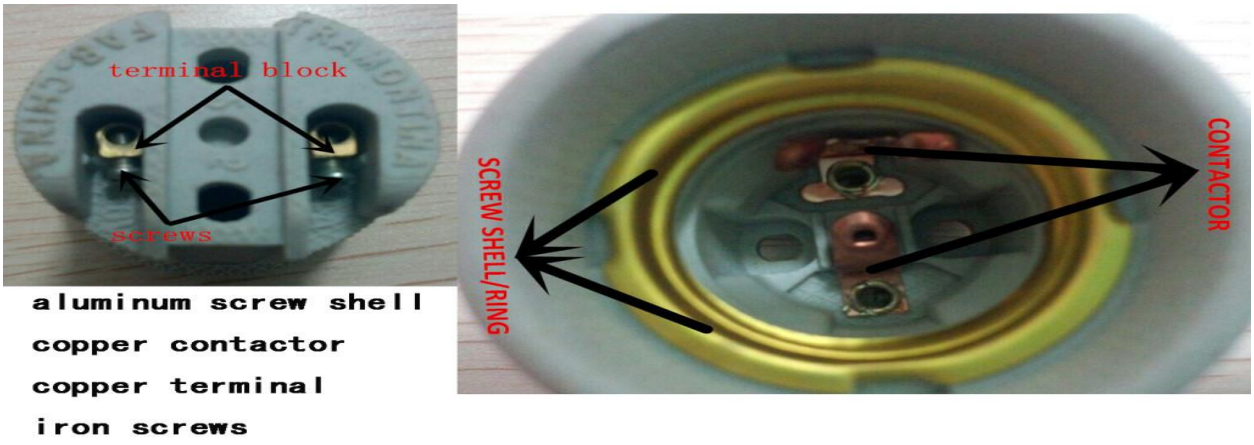


Fig.5.11 lamp holder

5.1.7 SOCKET OUTLET

A socket is a software object that acts as an end point establishing a bidirectional network communication link between a server-side and a client-side program.

- **Socket Types**

There are four types of sockets available to the users. The first two are most commonly used and the last two are rarely used.

Processes are presumed to communicate only between sockets of the same type but there is no restriction that prevents communication between sockets of different types.

- **Stream Sockets** − Delivery in a networked environment is guaranteed. If you send through the stream socket three items "A, B, C", they will arrive in the same order − "A, B, C". These sockets use TCP (Transmission Control Protocol) for data transmission. If delivery is impossible, the sender receives an error indicator. Data records do not have any boundaries.

- **Datagram Sockets** − Delivery in a networked environment is not guaranteed. They're connectionless because you don't need to have an open connection as in Stream Sockets − you build a packet with the destination information and send it out. They use UDP (User Datagram Protocol).

- **Raw Sockets** − these provide users access to the underlying communication protocols, which support socket abstractions. These sockets are normally datagram oriented, though their exact characteristics are dependent on the interface provided by the protocol. Raw sockets are not intended for the general user; they have been provided mainly for those interested in developing new communication protocols, or for gaining access to some of the more cryptic facilities of an existing protocol.

- **Sequenced Packet Sockets** − they are similar to a stream socket, with the exception that record boundaries are preserved. This interface is provided only as a part of the Network Systems (NS) socket abstraction, and is very important in most serious NS applications. Sequenced-packet sockets allow the user to manipulate the Sequence Packet Protocol (SPP) or Internet Datagram Protocol (IDP) headers on a packet or a group of packets, either by writing a prototype header along with whatever data is to be sent, or by specifying a default header to be used with all outgoing data, and allows the user to receive the headers on incoming packets.

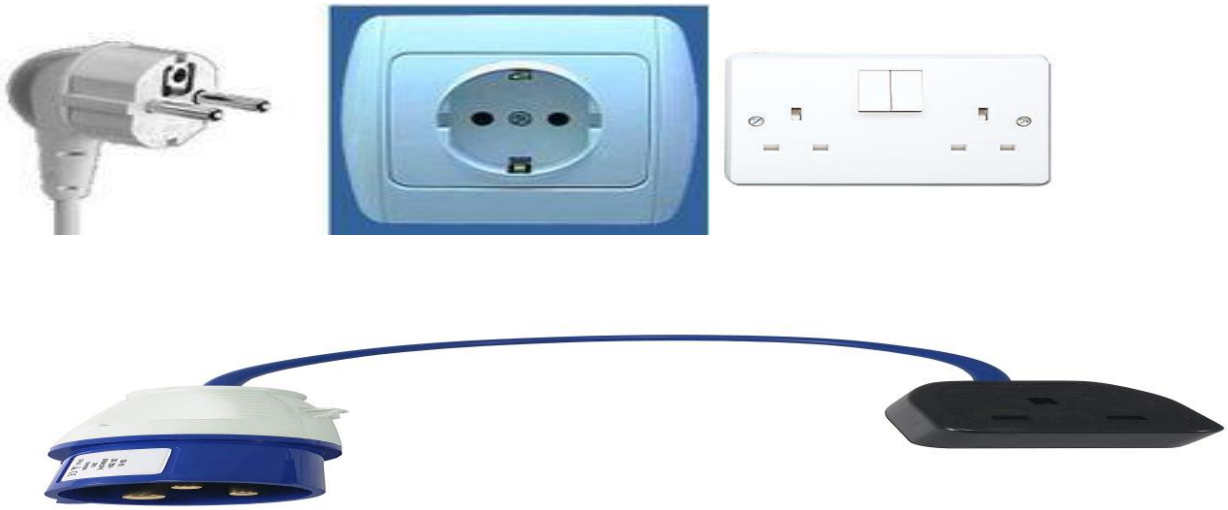


Fig.5.12 socket outlet

5.1.8 Distribution board

A **distribution board** (also known as **panel board**, **breaker panel**, or **electric panel**) is a component of an electricity supply system that divides an electrical power feed into subsidiary circuits, while providing a protective fuse or circuit breaker for each circuit in a common enclosure. Normally, a main switch, and in recent boards, one or more residual-current devices (RCD) or residual current breakers with overcurrent protection (RCBO), are also incorporated

Fig.5.13 **distribution board**

5.1.9 TELE PHONE

A **telephone** (derived from the Greek: τῆλε, *tēle*, "far" and φωνή, *phōnē*, "voice", together meaning "distant voice"), or **phone**, is a telecommunications device that permits two or more users to conduct a conversation when they are too far apart to be heard directly. A telephone converts sound, typically and most efficiently the human voice, into electronic signals that are transmitted via cables and other communication channels to another telephone which reproduces the sound to the receiving user

Fig.5.14 telephone

Types of phones

There are four categories of phones:

The **classic corded telephone** (which could utilize a rotary dial or have buttons), the cordless or **wireless phone**, the **standard cell phone**, and the **smartphone**. Today, the landline version of the telephone is widely being replaced by cell phones and smartphones as they are much more convenient and service prices have come down drastically.

The master phone socket is the main socket where the phone line enters your home, usually found in the hallway near the front door. If you can't find it, have a look outside for any wires entering your home, then look for a white box on the wall inside.

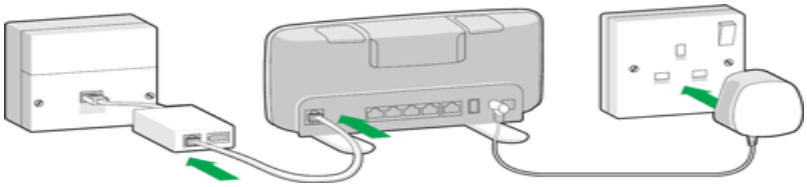
If you have more than one socket, the master socket is the one that will feed any extension sockets. **It's always best to connect your BT Hub to the master socket if you can**. This is where the broadband signal is strongest, before it goes through any other home wiring which could cause interference.

This is usually what an extension socket looks like. If all your sockets look like this, then one of them will be your master socket. It's most likely to be the one nearest where your line comes into your home.

If your master socket has one socket, like this:

You **must** use a micro filter for every phone socket in your home with any phone or broadband equipment plugged in (including your Hub, phones, answer machines, digital TV boxes, and alarm systems).

A micro filter is a device that allows broadband to work at the same time as your phone service.



5.1.10 ANT ENNA

An antenna is a transducer that converts radio frequency (RF) fields into alternating current or vice versa. There are both receiving and transmission antennas for sending or receiving radio transmissions. Antennas play an important role in the operation of all radio equipment. They are used in wireless local area networks, mobile telephony and satellite communication.

Fig.5.15 antenna

Types of Antennas

1. Log Periodic Antennas
- Bow Tie Antennas
- Log-Periodic Dipole Array

2. Wire Antennas
- Short Dipole Antenna
- Dipole Antenna
- Monopole Antenna
- Loop Antenna

3. Travelling Wave Antennas
- Helical Antennas
- Yagi-Uda Antennas

4. Microwave Antennas
- Rectangular Micro strip Antennas
- Planar Inverted-F Antennas

5. Reflector Antennas
- Corner Reflector
- Parabolic Reflector

Properties of Antennas

- Antenna Gain
- Aperture
- Directivity and bandwidth
- Polarization
- Effective length
- Polar diagram

Information Sheet-6	Determining location of apparatus from job requirements

6.1 Determining location of apparatus from job requirements

6.1.1 Sockets

Sockets may be wired on ring circuits or radial circuits. Mostly rings are used, as they use less copper for most circuit layouts, they have safety advantages over radial circuits (sometimes debated), can provide more power, and cover more floor area per circuit.

- **Ring**

Sockets are on 32A ring circuits in most house installations. These use a ring of cable (i.e. a loop), so that at the CU 2 cables are connected to the MCB instead of 1. An unlimited number of sockets may be connected on each ring.

One ring circuit per floor is a fairly common arrangement, but by no means the only option. Larger houses generally have more rings. It's also common to have a ring dedicated just for sockets in the kitchen since that is where you will find many of the highest power consuming appliances in a modern house.

2.5mm² cable is usually used for ring circuits. 4mm² is used when cable will be under insulation or bunched with other cables.

- **Spurs**

Spurs are permitted, but sockets should be included in the ring rather than spurred wherever practical. Spurring is best only used for later additions to circuits.

Rules apply to the loading and number of sockets allowed on the end of a spur.

Spurring sockets prevents the easy later addition of more sockets in some positions, as a spur may not be spurred off a spur. Spurs also prevent the addition of more sockets at existing spurred positions, whereas a practically unlimited number of sockets can be added where a socket is in the ring. Bear in mind the number of sockets wanted has risen greatly over the years, and can only be expected to rise further.

- **Radial**

Radial socket circuits are used less often. These use a single cable from CU to socket, then a single cable to the next socket along the line etc. Radials use more copper on most circuits, though less cable on physically long narrow shaped circuits. Connection faults have greater consequences than with ring circuits. (Confusion over the relative safety of ring & radial circuits is widespread.)

- 20A radials use 2.5mm² or 4mm² cable.
- 32A radials use 4mm² cable
- **Number of Sockets**

Minimum and desirable numbers of sockets recommended per room are given. Recommended numbers are inevitably a matter of opinion, and are only recommended as a starting point for consideration.

- **Bedroom**
  - Minimum: 1 double socket at each of 2 locations
  - Recommended: 2x double sockets at each of 4 locations (in or near corners) + a double socket at side of single bed, or a double socket at each side of double bed. 2 way lighting switches controllable at door & bedside.
- **Corridor**
  - Minimum: none
  - Recommended: 1 double socket for a short corridor, 2 or possibly more in a long one. Put one where a hall table might go.
- **Kitchen**
  - Minimum:
  - Recommended: Under worktop: 4 or 5 double sockets. Over worktop: 1 double socket per 2 meters. All sockets on ring circuit, no spurs. 2A or 5A sockets on lighting circuit: one above each set of cupboards, one below each set of cupboards, one away from cupboards & worktop.

- **Lounge:**
  - Minimum: 1 double socket at each of 2 locations
  - Recommended: 2x double sockets at each of 4 locations (in or near corners) + 1-3 double sockets where PC or AV equipment is to be used. If the room has 2 or more doors, 2 way lighting switches controllable at each door. 4-6x 2A or 5A sockets on lighting circuit.
- **Utility room:**
  - Minimum: 1 double socket
  - Recommended: 2 or 3 double sockets, all on ring circuit
- **Bathroom:**
  - Minimum: no sockets
  - Recommended: none. 1 socket somewhere out of easy reach in zone 3 if you wish to use an appliance in the bathroom (eg washing machine or dehumidifier). A shaver socket at the sink is an option, but plugging items in outside the room is probably better practice.
- **Home Office:**
  - Minimum: a double socket at 2 locations
  - Recommended: 2x double sockets at each of 4 locations (generally near corners), plus anything from 2 to 6 double sockets where computer or other business appliances will go.
- **Small shed:**
  - Minimum: no electricity supply
  - Recommended: if far from the house, a double socket can be useful. If you'll spend time in it, a light too.
- **Large shed:**
  - Minimum: no electricity supply
  - Recommended: plenty of lighting & sockets according to size & proposed use. Given the tendency for electricity use to rise over the years, an overrated feed cable may prove useful in time.
- **Greenhouse:**

- Minimum: no electricity supply
- Recommended: A splash proof double socket above head height can be handy. For a dedicated horticulturalist, fluorescent lighting, a couple of splash proof double sockets positioned at head height or above, and a 13A socket for discharge lighting can all come in useful.

6.1.2 Lighting

Radial circuits are used for lighting. There is one lighting circuit on each lighting MCB. Lighting circuits are usually on a 10A MCB 10A can be used (with some extra restrictions (now removed in the 17th edition of the wiring regs)) for large circuits. However if the area served is large, more 5A or 6A circuits would in most cases be preferable.

Lighting circuits are typically wired in 1.5mm² T&E cable (1.5mm² allows a longer cable run, before suffering too much voltage drop).

- **Fuse or MCB**

Filament lamp failures can trip MCBs, so fuses have an advantage over MCBs for lighting circuits, as they rarely nuisance trip on bulb failure. (Less sensitive type C and D MCBs can often be used to help reduce this problem.)

- **Loop-in Wiring**

The power feed cable may go to either the switch or the bulb holder. If it goes to the bulb holder, this is called loop-in wiring, and the ceiling rose (a junction box with a downward facing cable outlet) then uses four sets of connections instead of 3, the extra one being a switched live.

With loop-in wiring, the cable from the ceiling rose to the switch has 3 conductors, namely earth, unswitched live and switched live. Regs conformance requires that brown sleeving be fitted over the neutral coloured conductor at each end of the switch cable since it is being used as a live.

A typical view inside a ceiling rose:

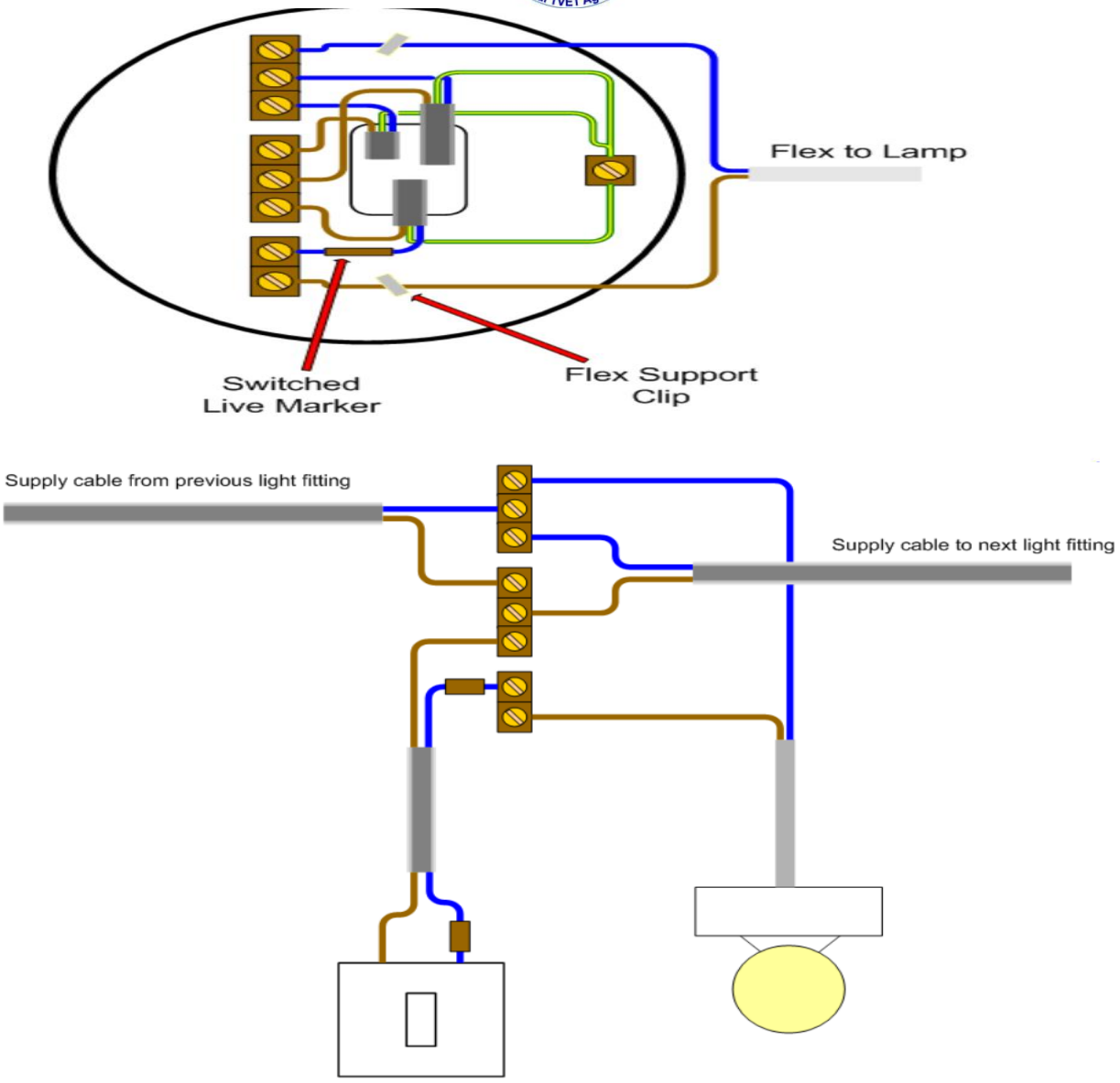


Fig. 6.1 Radial circuits are used for lighting

All cable colours are as expected **except** for the switched live. Light switches are usually wired with standard T&E, which means the switched live wire will be black (existing installs) or blue (new installs) - this **should** be marked with live coloured tape or sleeving (though alas this is often missing).

So beware, if you take down a rose without paying attention to which wire is which, and you re-connect all the blacks or blues together, your fuse or MCB will trip.

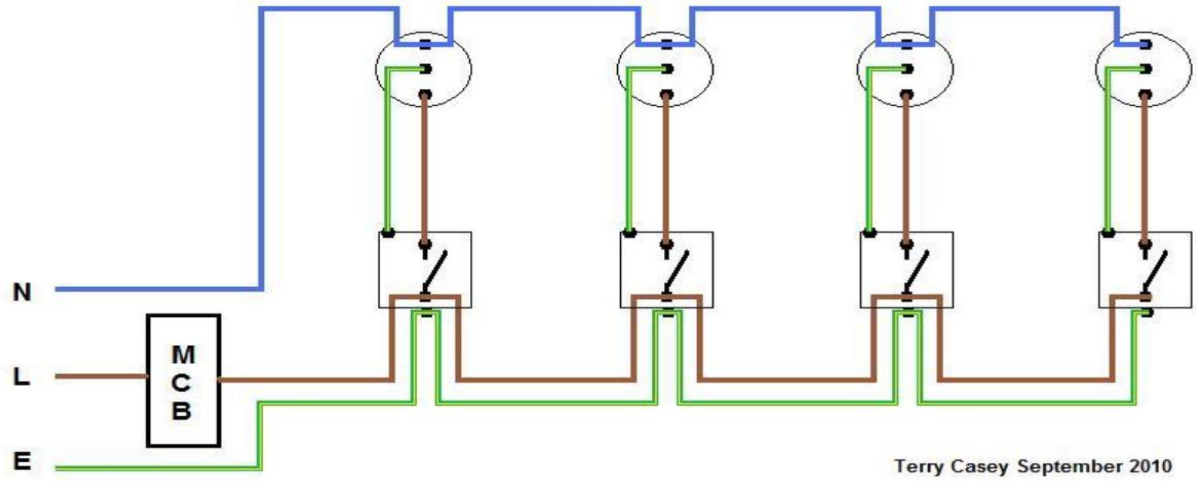
- **Single & Earth**

A less commonly met system of wiring lighting circuits.

The permanent lives and switched lives of the circuit use the single core and earth cable (type 6241Y).

This run starts from the MCB and loops between the lightswitches to provide a permanent live and earth to the lightswitches. Another length of 6241Y is then used from the lightswitch to the light fitting to provide a switched live and earth at the light fitting.

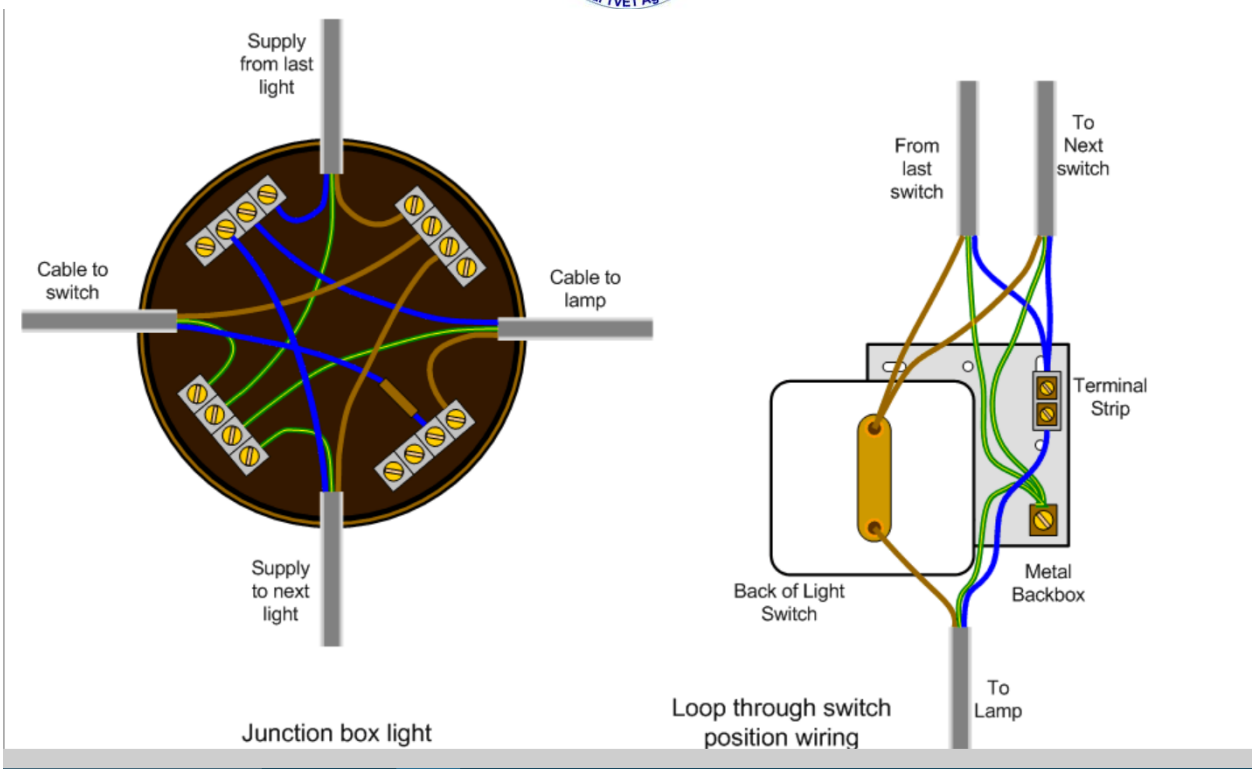
The neutral cable is a double sheathed cable (6181Y with a blue inner sheath) that runs from the CU neutral busbar and from light fitting to light fitting (there will only be one neutral at the end of the circuit).



It makes it easier to put light fittings up as there are less cables to mess with at the fitting.

- **Other Wiring Options**

In addition to the common Loop In scheme shown above, other systems are also often used. These are Switch loop through which makes all the connections at a switch. There is also junction box wiring which is basically the same as the ceiling rose system except there is no local connection to a lamp - so its better suited to remote lamps like wall lights. All combinations of these can exist on the same circuit if necessary :



- **Two Way Switching**

Two way switching means having two or more switches in different locations to control one lamp. They are wired so that operation of either switch will control the light(s).

- **Light circuit earthing**

In some older properties (typically wired in or before the mid 1960s), its not uncommon to find lighting circuits without an earth wire. Care should be taken if you have such a circuit to ensure that only appropriate light fittings and switches are used. Most metal light fittings and switches will require earthing, but those marked with the double insulated symbol do not need an earth connection. Most plastic switches and light fittings are also safe for use on circuits with no earth.

Note the earth wire in the T&E must be run to all switches, junction boxes & light fittings, including those that are currently plastic. It is not permitted to borrow an earth from another circuit. Ideally the non-earthed circuit ought to be re-wired, or at least have a RCD installed to protect it.

For more information about unearthed lighting circuits see Lighting Circuits Without an Earth

- **Outdoor Lighting**

Outdoor lighting is usually run on its own radial circuit off its own MCB in the CU. Usually this is a 10A MCB, but lighting is less likely to cause problems if run on a 10A fuse. Exterior cabling must be appropriate for use outside (many cable types degrade under prolonged exposure to sunlight for example).

6.1.3 Bathroom Electrics

Bathrooms (or rooms with showers) are "special locations" in the language of the wiring regulations. This is because they are places where people are particularly vulnerable to serious injury from electric shock (due to being wet and barefoot). In modern designs **all** bathroom electrics are supplied by RCD protected circuits.

Zones

Bathrooms are divided into 3 zones, with different rules for each zone.

- Electrical fittings in the bathroom in zone 0 must conform to IPX7 or better, and must be of an extra low voltage type.
- Electrical fittings in the bathroom in zones 1 & 2 must conform to IPX4 or better.
- Electrical fittings in the bathroom outside of the zones do not need to confirm to any specific IP rating, but must be appropriate for the circumstance in which they are used.

There are also limitations to the type of electrical equipment permitted in each zone. See the Bathroom electrics article for more details.

- **Equipotential Bonding**

All metal items that enter a bathroom from outside of the room (e.g. copper pipes, electric circuit cables) are connected together using 4mm² green/yellow insulated wire. Connection is also made to each of the protective earth wires in each circuit that feeds an appliance in the bathroom (e.g. lamps, heaters, towel rails etc). This is called equipotential bonding and is designed to minimize exposure to dangerous

voltages that may be present during electrical fault conditions. The wire is connected to metal pipes using BS 951 earth clamps. The wire is connected to radiators using connectors. It is permitted to place equipotential bonding connections immediately outside the bathroom if necessary. Note equipotential bonding can be omitted if all the circuits that enter the bathroom are protected by RCD(s) with trip thresholds of 30mA or less.

- **Sockets**

Until the introduction of the 17th edition of the wiring regulation, sockets were not permitted in a bathroom at all, unless they were either a transformer isolated shaver socket, or sockets to power extra low voltage devices, both of which are permitted in Zone 2 or outside. For more information on bathroom electrics, see Bathroom electrics.

- **Showers**

An electric shower will be fed on its own high current cable, fed from its own MCB on the RCD protected side of the CU. For more information on electric showers, see Installing an electric shower

6.1.4 Kitchens

Modern kitchens often have a high concentration of electric appliances, many of them high power consumption devices. Hence they are worthy of special mention.

- **Cookers**

All in one electric cookers (oven, hob & grill in one unit) are fed by a high current cable from the CU, typically on a 32A MCB. Single cavity ovens with no hob are more often put on a 20A plug. Most hobs require their own high current feed, but some are available that incorporate load limiting switching, and are designed to be run on a 20A plug. Combi cookers (microwave & fan oven, with or without grill) are always on a 20A plug.

- **Equipotential Bonding**

Contrary to popular belief kitchens do not need equipotential bonding.

- **Number of Rings**

Most kitchens are supplied by one ring circuit. However this may be insufficient for large or all-electric kitchens.

Information Sheet-7	Obtaining necessary materials to complete the work

7.1 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.	 Surface type (duplex)  Flush type (duplex)
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.	  Male plugs

Lamp holders- devices that hold and protect the lamp and are also called as "Lamp Sockets/Receptacles". These come in many designs and sizes. They are classified as flush, hanging (weather proof/chain) and surface types.	  Flush type Hanging (chain)   Surface type Hanging (weather)
Switch - a device that connects and disconnects the flow of electric current in a circuit. There are many shapes, designs, and types and they are classified as hanging, flush, and surface types.	 Surface type  Flush type Hanging type
Fuse - a circuit protective device that automatically blows and cut the current when and over load or short circuit happens.	 Knife blade Cartridge Plug type

Circuit Breaker - a protective device used to automatically blows and cuts the current when trouble in the circuit such as short circuit or overload occurs.	 Circuit breaker
Junction Box - an octagonal shaped electrical material where the connections or joints of wires are being done. It is also where the flush type lamp holder is attached. This could be made of metal or plastic (PVC) *Polyvinylchloride*.	 Plastic  Metal
Utility Box - a rectangular shaped metallic or plastic (PVC) material in which flush type convenience outlet and switch are attached.	 METAL  PLASTIC
Flat Cord- Is a duplex stranded wire used for temporary wiring installation and commonly used in extension cord assembly. It comes in a roll of 150 meters and with sizes of gauge # 18 and gauge # 16 awg (American wire gauge).	  Flat cord

Electrical Wire/Conductor- electrical material that could be: a. **Stranded** wire which is made of multiple strands joined together to make a single wire. *b.* **Solid** wire is made of a single strand of copper or aluminum wire. These are used in wiring installation inside and outside the buildings.	 a. Stranded wire  b. Solid wire
Conduits/Pipes- electrical materials used as the passage of wires for protection and insulation. These could be rigid metallic, flexible metallic conduit (FMC), rigid non-metallic (PVC), and flexible non-metallic or corrugated plastic conduit (CPC)	 Metallic conduit  Flexible Non-metallic conduit or corrugated plastic conduit (CPC)  Rigid Non-metallic conduit (PVC)
Clamps- electrical materials used to hold and anchor electrical conduits in its proper position.	 Metal clamp  Plastic clamp
Connectors- used to attach metallic or non-metallic conduit to the junction or utility boxes.	 Metal connector  Flexible non metallic connector

Information Sheet-8	Obtaining Tools, equipment and testing devices to carry out the installation work

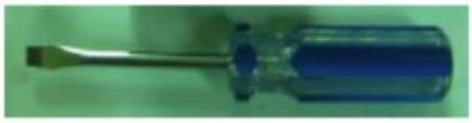
Electrical Tools and Equipment

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.

I. **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.

A. **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.

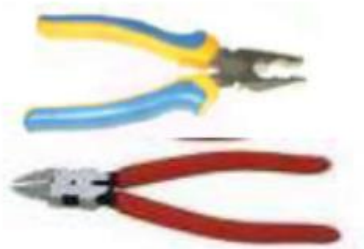


B. **Philips Screw Driver.** This has a cross tip resembling a positive (+) sign. This is used to drive screws with cross slot heads.

C. **Stubby Screw Driver.** It comes in either Standard or Philips screw driver with short shank or blade and a shorted handle used to tum screws in tight space where standard screw driver cannot be used.

D. **Allen Screw Driver/Wrench.** This could be in the shape of a screw driver or a wrench. Its function is to drive screw with hexagonal slot head.

III. **PLIERS**. These made from metal with insulators in the handle and are used for cutting, twisting, bending, holding, and gripping wires and cables.



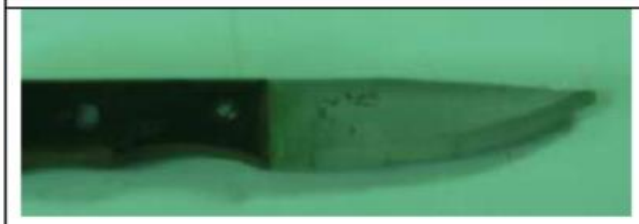
A. Combination Pliers (Lineman's Pliers). This is used for gripping, holding, and cutting electrical wires and cables and even small nails. They are usually used by linemen in doing heavy tasks.

B. Side Cutting Pliers. This type of pliers is used for cutting fine, medium and big wires and cables.

C. Long Nose Pliers. This is used for cutting and holding fine wires. This can reach tight space or small opening where other pliers cannot reach and also used in making terminal loops of copper wires.

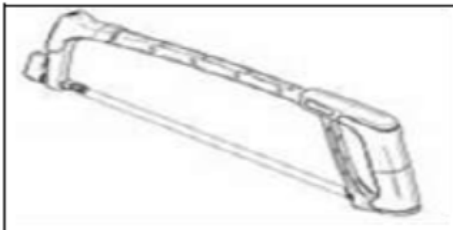
IV. Wire Stripper- A tool used for removing insulation of medium sized wires ranging from gauge #10 to gauge #16.

V. Electrician's Knife. This is used by linemen to remove insulation of wire and cables in low and high voltage transmission lines.



VI. Portable Electric drill. A small drilling machine with a chuck capacity of ¼" to 3/8". It is used in making holes on metal sheets and concrete walls.

VII. Hacksaw. This tool is used to cut metal conduit and armored cable.



Hacksaw

Information Sheet-9	Checking safety preparatory work to ensure no unnecessary damage

9.1 Safety

- This article cannot practically cover everything.
- The writing of this article may be incomplete when you read it.
- Laws and regulations change over time.
- Interpretation of regulations and law may change over time
- The article may assume knowledge that some readers might not possess
- Unexpected situations may change the specific requirements for some circuits.
- For these reasons and more, one should not carry out safety critical work based solely on wiki content. Information and plans should be independently checked and verified before action.
- Anyone installing wiring should also understand some basic safety issues not discussed here. This article is an introductory overview rather than a complete A to Z on rewiring, and assumes some basic electrical knowledge.

BUILDING ELECTRICAL INSTALLATION

LEVEL II

Learning Guide-28

Unit of Competence: Install Electrical Apparatus

Module Title: Installing Electrical Apparatus

LG Code: EIS BEI2 M08 LO1-LG-28

TTLM Code: EIS BEI2 M08 TTLM 0919v1

LO: 2 Install Apparatus

Instruction Sheet	Install Apparatus

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

- Following OH&S policies and procedures for installing electrical apparatus
- Installing Apparatus without damage or distortion
- Carrying out variation to apparatus installation to customer/client requirements
- Terminating and connecting Apparatus
- responding to unplanned events or conditions
- Obtaining approval from appropriate personnel before any contingencies
- undertaking On-going checks of the quality of the work
- Installing electrical apparatus with several wire (green/yellow) for protection

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

- Following OH&S policies and procedures for installing electrical apparatus
- Installing Apparatus without damage or distortion
- Carrying out variation to apparatus installation to customer/client requirements
- Terminating and connecting Apparatus
- responding to unplanned events or conditions
- Obtaining approval from appropriate personnel before any contingencies
- undertaking On-going checks of the quality of the work
- Installing electrical apparatus with several wire (green/yellow) for protection

Learning Instructions:

8. Read the specific objectives of this Learning Guide.
9. Follow the instructions described below 3 to 6.
10. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
11. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page -6, 9, 12 and 14** respectively.
12. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -15.**
13. Do the “LAP test” **in page – 16** (if you are ready).

Information Sheet-1	Following OH&S policies and procedures for installing electrical apparatus

2.1 Applying OH&S policies and procedures

2.1 Purpose

The purpose of Work Health and Safety Policy and Procedure is to establish and maintain an effective health and safety management system.

The Skills Quality is committed to implementing a structured approach to workplace health and safety to achieve a consistently high standard of safety performance.

This will assist meet its obligations in accordance with the Work Health and Safely

This policy applies to all workers and to other people at risk from the work carried out at workplaces. Failure to comply with the requirements of the plan may lead to disciplinary action.

2.1.1 Work Health and Safety Policy

The following Statement of Commitment and the Implementation of Policy Commitment provide the overarching direction for in pursuit of workplace health and safety outcomes. These commitments are as follows:

Statement of Commitment

Committed to providing a workplace that enables all work activities to be carried out safely. We will take all reasonably practicable measures to eliminate or minimize risks to the health, safety and welfare of workers, contractors, visitors, and anyone else who may be affected by our operations.

We are committed to complying with the *Work Health and Safety.* We will also comply with any other relevant legislation, applicable Codes of Practice and Australian Standards as far as possible.

WHS Policies and Procedures set out the safety arrangements and principles which are to be observed by and its workers to ensure compliance with the WHS Act and to provide appropriate mechanisms for continuing consultation and management of WHS matters.

Implementation of Policy Commitment

- is committed to ensuring, so far as is reasonably practicable, the health and safety of its workers (employees, contractors, labor hire workers, outworkers, apprentices, students or volunteers) while they are at work, and that the health and safety of other persons (e.g. visitors) is not put at risk from our operations. This will be achieved by:
- Providing and maintaining a healthy and safe work environment through the implementation of safe work practices, safe systems of work and the provision of safe work equipment

- Ensuring that workplaces under the control of are safe, without risk to health, and have safe means of access and egress
- Routinely consulting in order to maintain effective and co-operative relationships between and its workers, and with other duty holders, on health and safety matters in the workplace
- Reviewing, via appropriate mechanisms, the effectiveness of the safety measures taken.

  ’s commitment to providing safe and healthy working environments for workers includes:
- Providing relevant, up-to-date WHS information to all workers on matters such as workplace safety and their responsibilities
- Providing expert assistance in WHS matters where necessary
- Providing instruction and/or training in work processes where appropriate

- Developing and implementing strategies which include workplace assessment, hazard identification, and appropriate remedial action to eliminate or control hazards
- Implementing and maintaining appropriate information and reporting methods

Information Sheet-2	Installing Apparatus without damage

2.1 Installing Apparatus without damage

You should implement a safe system of work to deal with potentially unsafe electrical equipment at the workplace. This could include:

- requiring workers (if competent to do so) to undertake a check of the physical condition of the electrical equipment, including the lead and plug connections, prior to commencing use
- taking the electrical equipment out of service if in doubt as to safety, including at any time during use
- Putting reporting arrangements in place to ensure, so far as is reasonably practicable, that supervisors or line managers are advised if a worker takes electrical equipment out of service for safety reasons.

Unsafe electrical equipment must be disconnected or isolated from its electricity supply. It must not be reconnected unless it is repaired by a competent person or tests by a competent person have confirmed it is safe to use. Alternatively, it could be replaced or permanently removed from use.

Unsafe electrical equipment should be labelled indicating it is unsafe and must not be used. This is to prevent inadvertent use before the electrical equipment can be tested, repaired or replaced.

2.1 The Electrician's Tool Pouch

- The Electrician's tool pouch is essential in that it helps kept electrical tools organized. The tool pouch allows the right tools at hand which makes the job more efficient.
- The electrician must have proper tools for the job.
- Tools must be maintain and kept in good working condition.

- Certain tools are essential, and without them the electrician should not attempt to do any type of wiring.
- Listed are the basic hand tools that are essential to electrical wiring

Rules for care of hand tools

- There are many more hand and power tools that electricians will use in residential and commercial wiring.
- All tools should be used only for the purpose intended.
- It is the electrician's responsibility to keep his or her tools sharp, clean, and lubricated.
- A well maintained tool has a longer life and is safer than an improperly maintained tool.
- Repair tools when possible, but discard worn or damaged tools.

Information Sheet-3	**Carrying out variation to apparatus installation to customer/client requirements**

What type of variations occurs?

Low voltage conditions occasionally, sometimes as a result of a vehicle colliding with a strobe pole or other electrical equipment, low voltage conditions may occur. This may cause:

- Lights to glow at less than full power and fridges and air conditioners to appear to be working harder, or making strange sounds. In these cases it is wise to turn off any appliance that is not behaving normally; however lights can be left on.
- Lights to dim momentarily due to electric motors within large appliances cycling in and out.

Information Sheet-4	**Terminating and connecting Apparatus**

Cable Joint and Cable Termination

1. **Cable joint**

Cable joints of any type along cable runs in final circuits are not allowed. “Looping-in” wiring system should be used such that the cables or conductors are properly terminated at the junction box or equipment.

2. Boxes for cable joint and cable termination

- Boxes for the termination and for joining of cables may be of cast iron, or plastic shell with compound filled and of adequate size.
- Where hot compound filling is used, the box should be warmed thoroughly before the compound is poured to allow total adhesion between the compound and the box. The compound should then be allowed to cool and be topped up before the box is closed. No air pockets should be allowed to form inside the box.
- Where cold compound with plastic shell is used, the complete jointing kit, including plastic shell, compound, insulating tape etc. should be from the same proprietary manufacturer. The jointing method and procedure as laid down by the manufacturer should be strictly adhered to.
- Where the box is of cast iron, it should be fitted with suitable armouring clamps and glands; where the box is of plastic shell, it should be fitted with suitably sized armour bond.

(3) *General requirements for jointing and termination of cable*

- All joints and terminations should have durable electrical continuity and adequate mechanical strength.
- (*b*) Ferrules, compression connectors and bare portions of cable core resulting from a jointing or terminating process should be insulated with an insulating tape or heat shrinkable tubing after completion the jointing or terminating process. Such insulating tape or heat shrinkable tubing should have equal or better electrical and mechanical properties than those of the original insulation removed, and should be adhered to the cores etc. securely and permanently. The final thickness should be in smooth contour throughout the whole length of the joint or termination.

(4) *Straight-through joint*

- In a straight-through joint for copper conductors, the two conductors should be butted together after the strands have been soldered solid and should be jointed by means of a weak-back ferrule, soldered to the cores. Soldering should be carried out by pouring tinman's solder over the cores and the weak-back ferrule. In no circumstances should direct flame from a blow lamp be used for soldering.
- Prior to making a soldered joint for aluminium conductors, each conductor should be cleaned by means of steel wool or similar abrasive and then tinned by pouring solder, especially made for use with aluminium, over the cores. Both cores should then be inserted in a weak-back aluminium ferrule which should be closed. The two aluminium cores to be jointed may be butted together. The.soldering should be completed by pouring the solder over the

ferrule, after applying a layer of flux recommended by the cable manufacturer for this purpose.

- A compression joint should be made by inserting the conductor cores to be jointed into the opposite ends of a suitable type of compression jointing tube, which should have the correct size for the conductors. The tube should then be compressed onto the cores by means of a compressing tool. The tool used and the working procedure adopted should be as recommended by the compression joint or cable manufacturer.
- Where specialist jointing kits are used, the complete kit should be from the same manufacturer who specialises in manufacturing products for this purpose. The method and procedure adopted should be strictly in accordance with the manufacturer's recommendations.

(5) ***Jointing of protective conductors***

- Protective conductors should be looped into earthing terminals of exposed conductive parts or extraneous conductive parts. Straight joints in protective conductors should be avoided as far as practicable. Tee-joints in protective conductors are acceptable.
- Tapes should be jointed by:

1. double riveting, or

2. suitable tape clamps (when clamps are used, the tape clamps shall each be provided with at least 4 screws or bolts), or
3. means of exothermic or thermic welding utilizing the high temperature reaction of powdered copper oxide and

aluminium, provided that the proper material and equipment are used in accordance with the manufacturer's recommended process, orof suitable size.

(6) *Joints and terminations of non-armoured cables*

- Non-armoured cables terminated at a moulded box or pattress, a luminaire or other fittings should have the overall protective sheaths carried into the moulded box or pattress, luminaire or other fittings for a minimum distance of 13 mm.
- The circuit protective conductor should be terminated at the earthing terminal provided in the moulded box or pattress housing the wiring accessories.
- Where it is not required to terminate the circuit protective conductor in an accessory, the circuit protective conductor should be coiled away from the live terminals or any bare conductors and should be insulated and sleeved with a green-and-yellow PVC sleeve(*d*) Jointing of circuit protective conductors of non-armoured cable should be in the same manner as jointing live conductors.

(7) *Jointing and termination of armoured cables*

- Cable armours should be terminated at the armouring clamps and the inner sheath should pass through the gland.
- Earth continuity across joints of a circuit protective conductor having adequate cross-sectional area and of same material as the phase conductors should be installed and connected to maintain the effectiveness of the earth continuity across every cable joint of the armoured cable.
- PVC insulated armoured cables with copper or aluminium conductors should be terminated in a gland fitted with an amour clamp. Provision should be made to enable a watertight seal between the gland and inner PVC sheath. The gland body should be provided with an internal conical seating to receive the armour clamping cone and a clamping nut which should secure the armourn clamping

cone firmly to the armour wires ensuring that the armour wires are tightly clamped between the armour cone and conical armour seating. The spigot on the gland body should be threaded to suit standard conduit accessories. A PVC shroud should be fitted to cover the body of the gland and the exposed armour wires.

1. Terminating gland and armour clamp for cables with aluminium conductors should be made from aluminium. Cores should be terminated in a hot tinned brass or copper lug, which should be shaped to suit the sector shape of the conductor. The core should be tinned, and then soldered into the lug. Alternatively a compression termination may be used. In such cases, the cores should be inserted into the sleeve of an aluminium compression type cable lug. The sleeve should then be compressed onto the cores by means of a compressing tool. The tool used and the working procedure adopted should be as recommended by the cable manufacturer.
2. Prior to connection to the terminal, the cable lug should be painted with an anti-oxidising paste. The anti-oxidising paste should be suitable for preventing electrolytic action due to contact between the aluminium lug and copper or brass terminal, for an indefinite period. Alternatively, copper/ aluminium bimetal cable lugs may be used.

(8) *Termination of bonding conductors*

1. A purpose-designed copper connector clamp should be used to bond the main equipotential bonding conductor to extraneous conductive parts of the non-electrical services, and should be used to bond supplementary bonding conductors to exposed conductive parts or extraneous conductive parts.
2. All contact surfaces should be clean and free from nonconducting materials, such as grease or paint, before the connector clamp is installed.

- For steel surface conduit installations, the supplementary bonding conductors should be terminated at the nearest conduit or conduit box forming an integral part of the conduit installation.

- For concealed steel conduit installations, the supplementary bonding conductors should be terminated at a copper earthing terminal fitted inside a metal box forming an integral part of the conduit installation. For access to the concealed conduit, an arrangement similar to a telephone cord outlet is acceptable.
- The metal conduit box should be located as near as possible to the bonding position and the exposed part of the

supplementary bonding conductor should be made as short as possible.

(9) *Joint and termination for high voltage cables*

Regarding the joint and cable termination for high voltage cables, the manufacturer's recommendation should be referred.

Installation of Socket Outlets

- Wall-mounted socket outlets should be installed with a minimum clear height of 150 mm from floor and 75 mm from surface top measured from the bottom of the socket outlet.
- Socket outlets installed on floor surface should be suitably protected from ingress of water and from mechanical damage.
- Socket outlets for household or similar use should be of shuttered type.
- A socket outlet should be installed as far away as practicable from water tap, gas tap or cooker in order to avoid danger.

Installation of Fluorescent Lamps

- Capacitors and chokes should normally be fitted inside the luminaire. Where they are fitted separately, they should be mounted in a metal box. Precautions should be taken to prevent the components from overheating, e.g. by the provision of adequate ventilation.
- The type and size of cables should be properly selected with due regard to the ambient temperature, the inrush current and high voltages generated during starting. The neutral conductor in every discharge lamp circuit should have a cross-sectional area not less than that of the phase conductor.

Information Sheet-5	**Responding to unplanned events or conditions**
Information Sheet-6	**Obtaining approval from appropriate personnel before any contingencies**

6.1 Approvals of Electrical Equipment

Electrical equipment which is to be taken into an explosives facility for purposes related to the storage or processing of explosives shall be formally assessed against the requirements of this Chapter by a competent person. Evidence of compliance shall be kept within the Potential Explosion Site (PES) logbook. Where the required equipment is essential but is not deemed to fully comply with this Chapter and an alternative compliant version is not available the IE shall be contacted to arrange assessment by a competent person.. Where risks can be mitigated to as low as is reasonably practical (ALARP) as described in the equipment may be approved. Such approvals should detail any caveats or controls which are required to maintain OME safety and this shall be logged within the PES logbook, and copied to the relevant IE.

Retrospective Action

It is not intended that works services action should always be undertaken immediately to modify existing installations to achieve conformance with any amendments to this . Neither is it normally necessary to carry out surveys to establish the extent to which existing installations fail to meet the latest standards.

Such work and surveys should only be considered when they are necessary and arise for other reasons. For example.

When there has been a change to electro-technical legislation which has a direct or indirect impact to the safety adopted at the installation which is intolerable and requires retrospective action.

- When CIE MOD directs improvements on safety grounds.
- When building refurbishment or modification is being carried out.
- When the installation fails to pass the periodic inspection or test and it is more economic to replace all or part of the installation than to rectify the defects.

- When the installation is inadequate for meeting the purpose for which the building is being used due to insufficient power capacity or illumination levels.
- When the installation has reached the end of its economic life.
- Where it has been highlighted through a near miss or realized event.

Provided installations pass periodic inspections and tests, and comply with the version of this document or regulations that were in force at the time of installation, it is considered that they are adequate for continued use and not unsafe. However, any extensive work on the electrical system or Lightning Protection System (LPS) should warrant an upgrade to the latest standard.

Information Sheet-7	Installing electrical apparatus with several wire (green/yellow) for protection

Installing the Fixture

Cut openings for the wiring. Cut openings into the ceiling, or wall surfaces for the boxes, for the switch(es), and for the fixture support by first tracing around the box on the wall or ceiling surface.[6] Be sure to match the switch box height to those in the rest of your home.

- If a fixture is to be installed in the ceiling, the box should be a 4" octagon box. It is important to note that even if a small light fixture is planned to be installed here, consider installing a *fan-rated box*, as a paddle fan might be installed here in the future.
- If installing recessed light fixtures, no box is installed as a wiring compartment is provided on the fixture itself. The open to be cut in the ceiling is provided by the template included with the fixture by most manufacturers or by tracing around the rough-in housing opening.

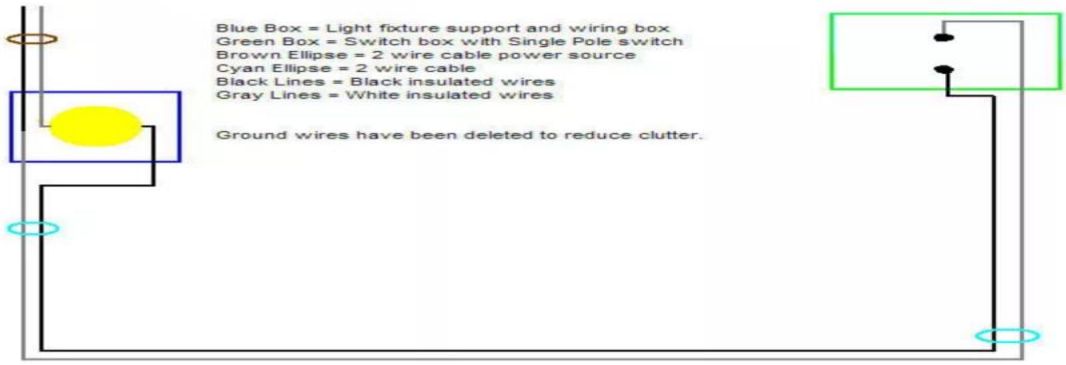
1. **Install the wiring.** Install the Romex or other cable between the power source and boxes in the voids of the walls, ceilings, and floors with a snake or fish tape.[7] After determining there is enough ampacity in the circuit to support the additional load, extend wiring of the same size from the power source to the switch and fixture locations. If running a new circuit directly from the electrical panel, the new wire should be sized according to the fuse or circuit breaker size.

2. **Make sure your wiring is up to code.** National Electrical Code Requirements for wiring need to be followed closely when you're installing a new fixture. When you're selecting wire for the job, make sure it fits the following constraints:

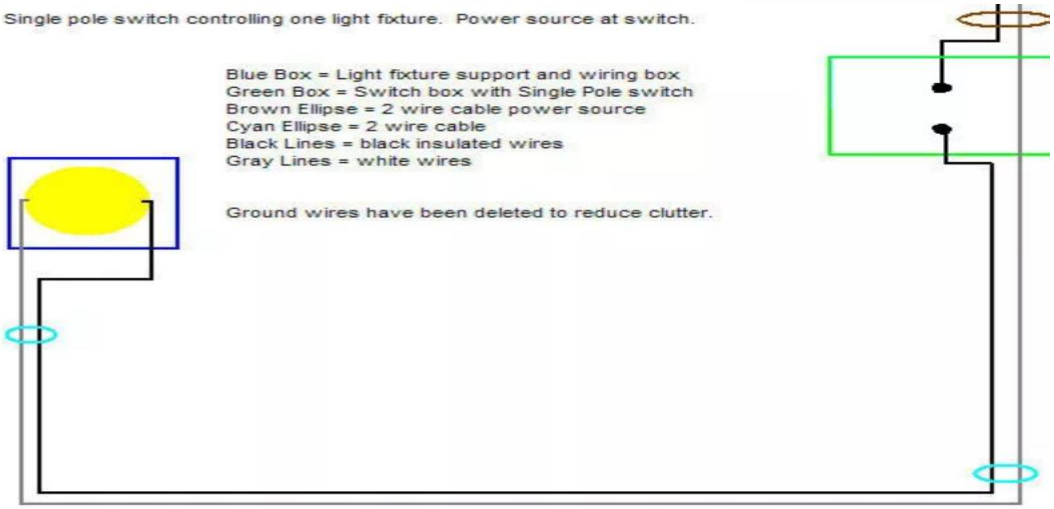
- A wire smaller than #14 copper is not permitted for power wiring. Smaller wires (#28 through #16) are permitted for low voltage applications such as thermostats and zone valves in gas & oil fired heating systems, door bells and buttons, alarm systems, telephones, networking, etc. These wires never enter electrical panels.
- A 15 amp circuit breaker or fuse should have no less than a #14 gauge copper wire connected. A 15 amp circuit is designed to safely carry up to 12 amps *continuously* on a #14 copper wire. Intermittent loads of up to 15 amps can be carrier for *up to* several hours.[8] If the load of any device or appliance is greater than 12 amps, a larger size wire and circuit breaker is *required*.
- A 20 amp circuit breaker or fuse should have no less than a #12 gauge copper wire connected. A 20 amp circuit is designed to safely carry up to 16 amps *continuously* on a 2.5mm copper wire.[9] Intermittent loads of up to 20 amps can be carrier for *up to* several hours. If the load of any device or appliance is greater than 16 amps, a larger wire and circuit breaker is *required*.

3. **Connect the devices as shown in the diagram that matches your application.** If you'd prefer to follow detailed instructions to wire the fixture to just two 3-way switches*, please see the 3-way switch wiki.*

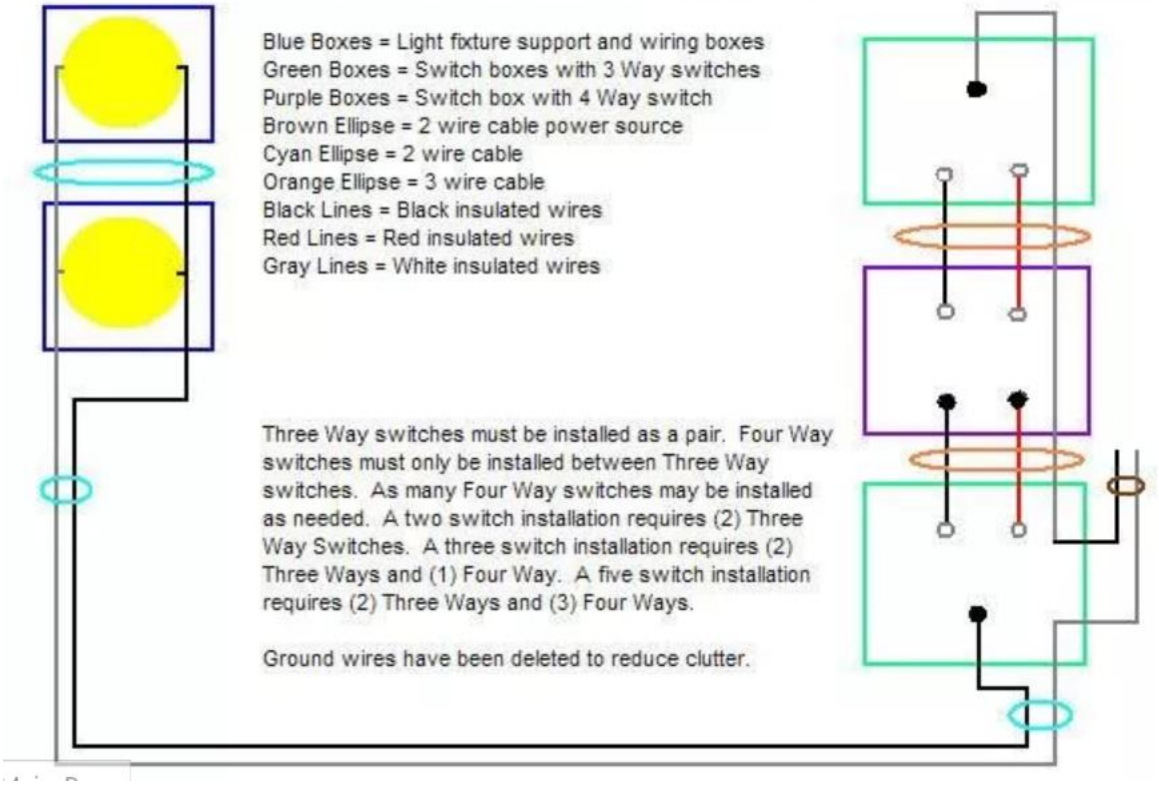
Single Pole switch controlling one light fixture. Power source at fixture.



Single pole switch controlling one light fixture. Power source at switch.



Two 3 way switches and one 4 way switch controlling 2 lights. Power source and load at switch.

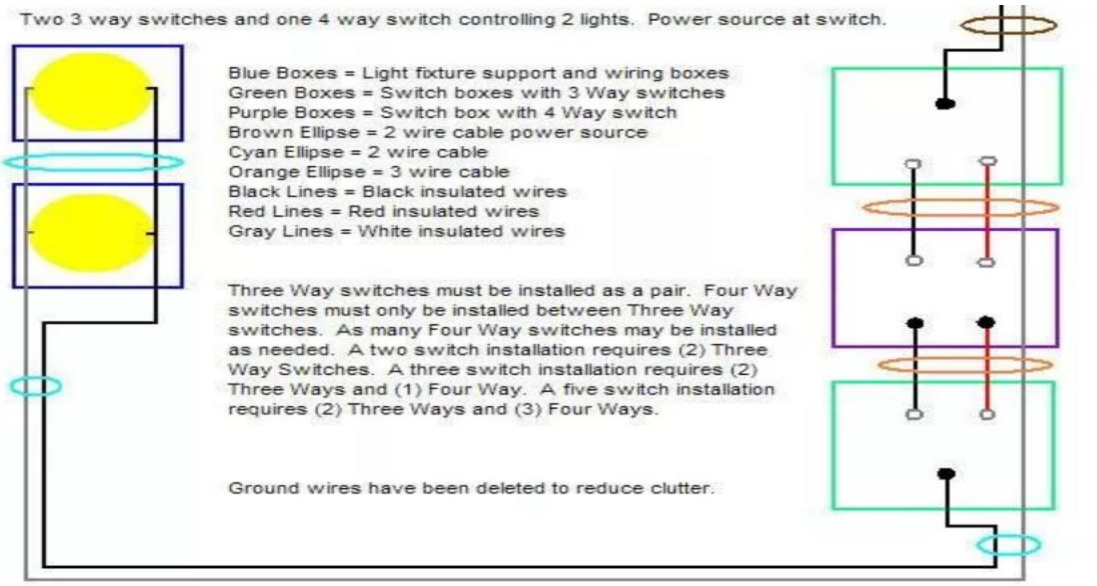


Blue Boxes = Light fixture support and wiring boxes
Green Boxes = Switch boxes with 3 Way switches
Purple Boxes = Switch box with 4 Way switch
Brown Ellipse = 2 wire cable power source
Cyan Ellipse = 2 wire cable
Orange Ellipse = 3 wire cable
Black Lines = Black insulated wires
Red Lines = Red insulated wires
Gray Lines = White insulated wires

Three Way switches must be installed as a pair. Four Way switches must only be installed between Three Way switches. As many Four Way switches may be installed as needed. A two switch installation requires (2) Three Way Switches. A three switch installation requires (2) Three Ways and (1) Four Way. A five switch installation requires (2) Three Ways and (3) Four Ways.

Ground wires have been deleted to reduce clutter.

Two 3 way switches and one 4 way switch controlling 2 lights. Power source at switch.



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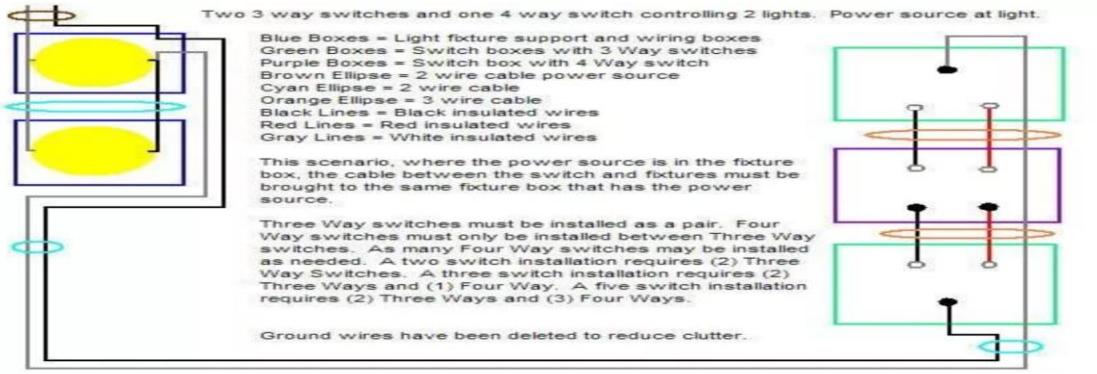
Ground wires have been deleted to reduce clutter.



EARTHING OF ELECTRICAL INSTALLATIONS

Earthing

Earthing is a connection system between the metallic parts of an electrical wiring system and the general mass of the earth. This will provide an path with a low impedence or resistance to earth to enable the protection system to operate effectively. It will thus ensure safety to human beings/consumers from the dangers of electric shocks if earth leakage currents are present. In general, an electrical installation is earthed because of: -

i. Safety reasons.

ii. Protection system requirements.

iii. Need to limit over voltages.

iv. Need to provide a path for electrical discharge.

v. Legal requirements

Classification of Earthing

Generally, earthing can be divided into 2 parts, namely: -

i. **System Earthing**

a. To isolate the system under fault conditions;

b. To limit the potential difference between conductors which are

Not insulated in an area;

c. To limit the occurrence of over voltages under various

Conditions.

ii. **Equipment Earthing**

Equipment earthing is undertaken to protect humanbeings/consumers. If a live source comes into contact with the equipment body, electrical energy will flow to the earth, without flowing through the human being/ consumer's body. This is because of the fact that the human body has a greater resistance compared with the resistance to earth.

Types and Functions of Earthing Accessories

Earthing accessories are as follows: -

i. **Earthing Electrode**

Copper jacketed steel core rods are used as electrodes for domestic wiring.

ii. **Equipotential Bonding**

This is the conductor which is connected between the consumer earthing point and the exposed metallic part. The minimum cable size for this purpose is 10 mm2.

iii. **Protection Conductor**

This is the conductor which connects the consumer earthing point with other parts of the installation which needs earthing. Its size is as follows:-

a) Same size as the phase cable up to a size of 16mm2,

b) 16 mm2, if the phase cable size is between 16 mm2, and 35 mm2,

c) Half the size of the phase cable if the size of the phase cable exceeds 35 mm2.

Earthing Arrangements Using aTT System

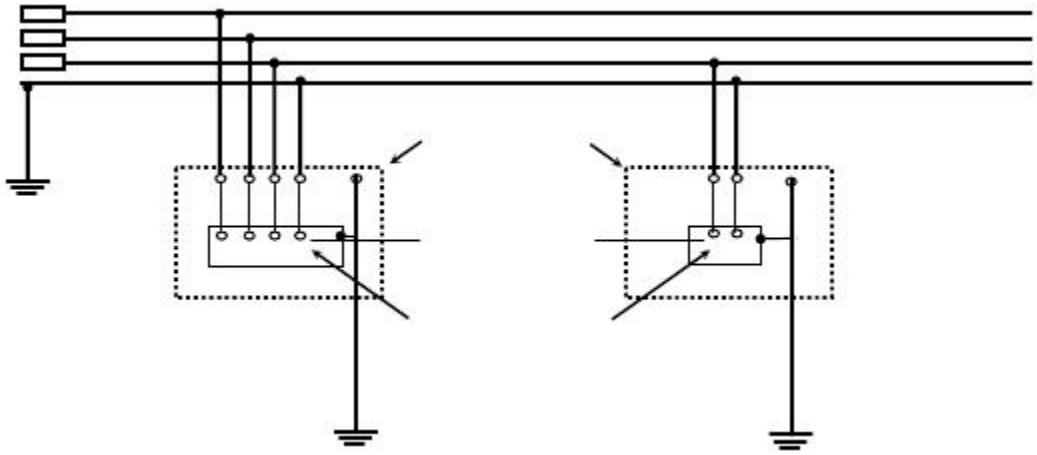
i. The first alphabet indicates the earthing arrangements from the supply side.

ii. The second alphabet indicates the earthing arrangement in the consumer's installation.

T – First: Indicates that the supply system has its own earthing arrangements

T – Second: Indicates that all metallic frames of the electrical appliances, etc. are connected directly to earth.

The earthing arrangement using a TT system is as shown in.



Earth Electrode

Installation

Parts that are Required to be Earthed

i. All metallic structures in the wiring system (non current carrying) such

as metallic covers, conduits, ducts, the armour of catenary wires,

etc.;

ii. A secondary winding point in a transformer; and

iii. Frame of metal roof truss

Parts that are not Required to be Earthed

i. Short, isolated metallic parts for mechanical protection of cables which have non metallic sheaths other than conduits which are connected at entry points between the building and conduits which protect discharge lamp cables;

ii. Cable clips for installing cables;

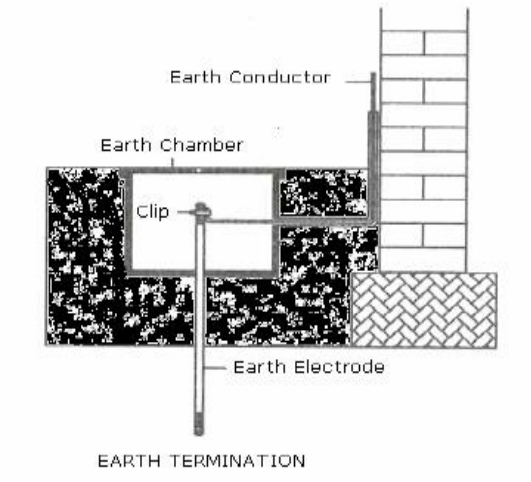
iii. Metallic covers for lamps;

iv. Small metallic parts such as screws and name plates which are isolated by means of insulation;

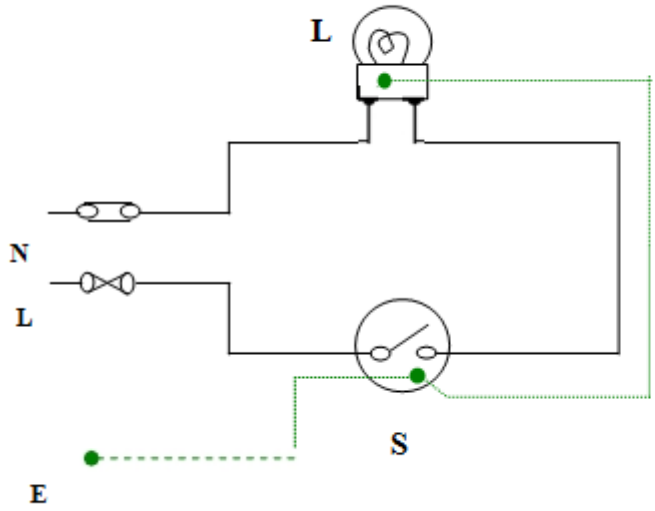
v. Metallic lamp parts for filament lamps in water proof floors.

Termination to Earth

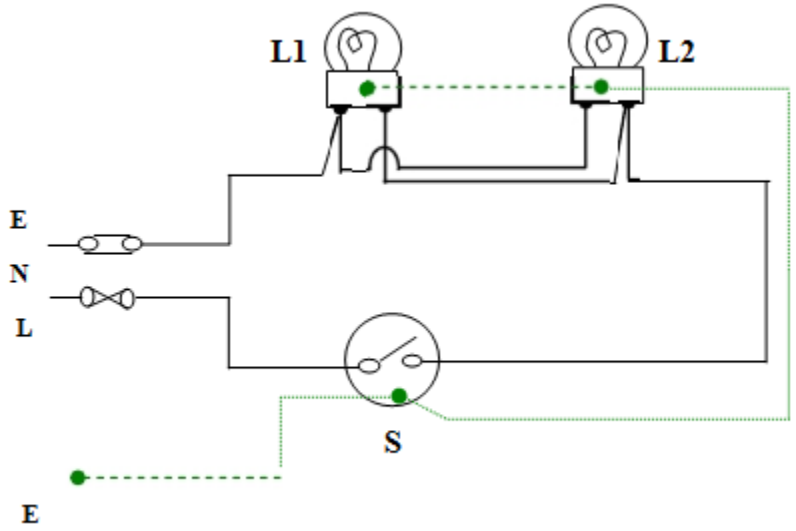
The termination to earth is done as shown in Figure 7.2



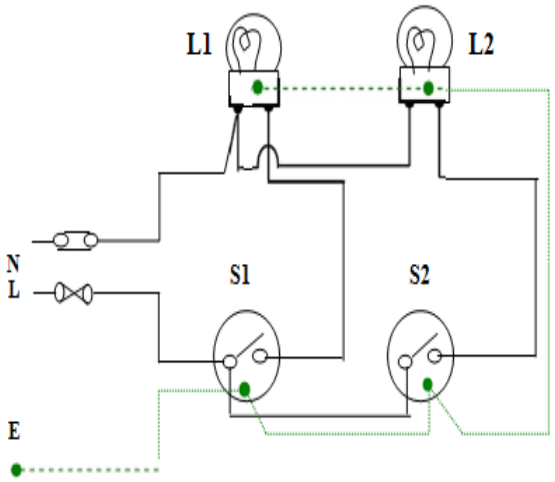
3.4 Examples of Lighting Circuits Schematic Wiring



1 Single light point controlled by a one way switch

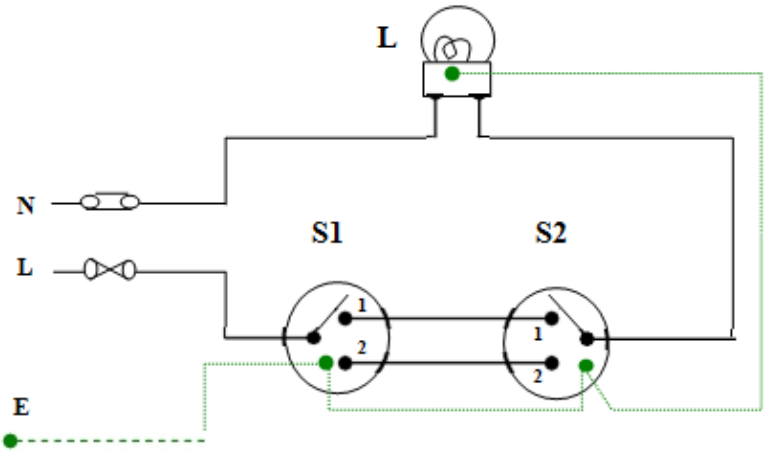


2 Two light points controlled by a one way switch

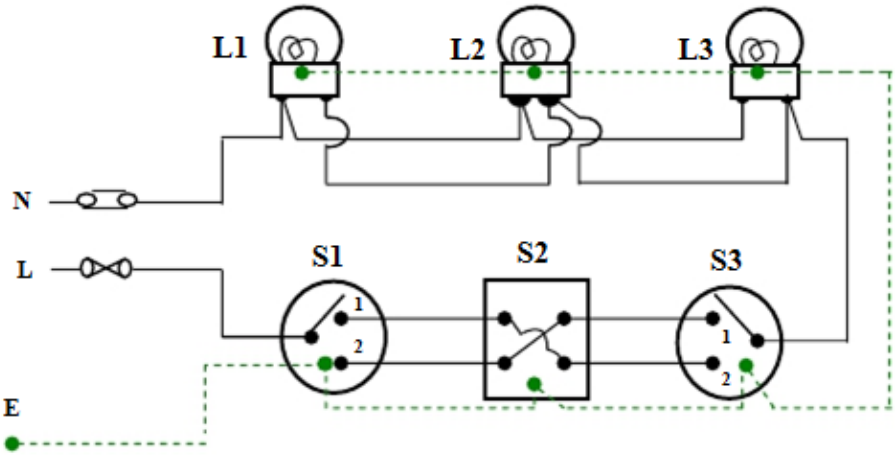


separately by two one way switches

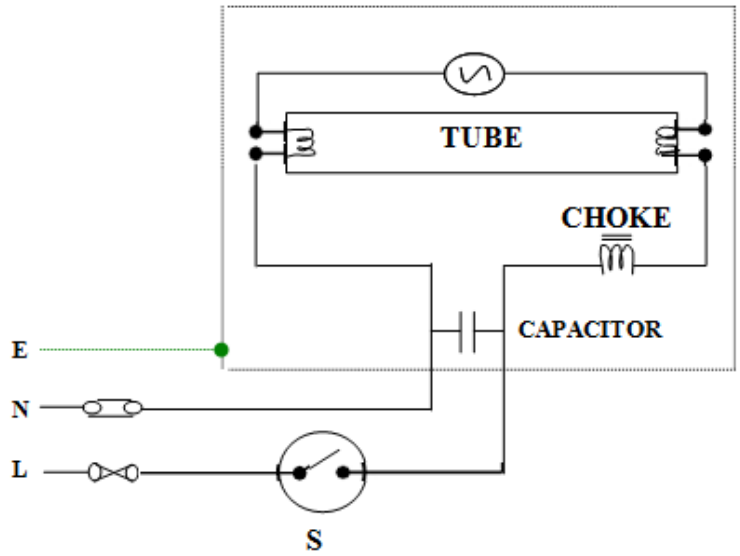
3 Two light points controlled



4 Single light point controlled by a two way switch



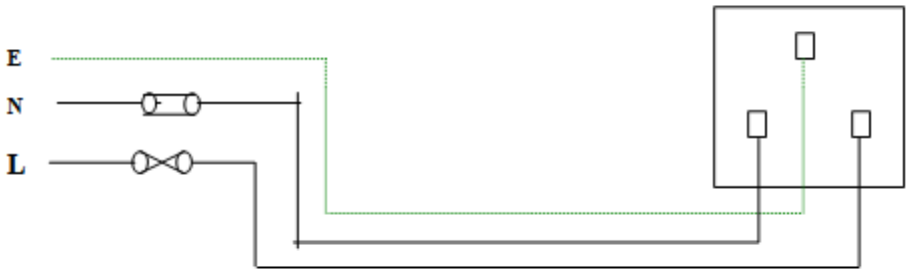
5 Three light points controlled by two way switches and intermediate switch



56 Single fluorescent light point controlled by a one way switch

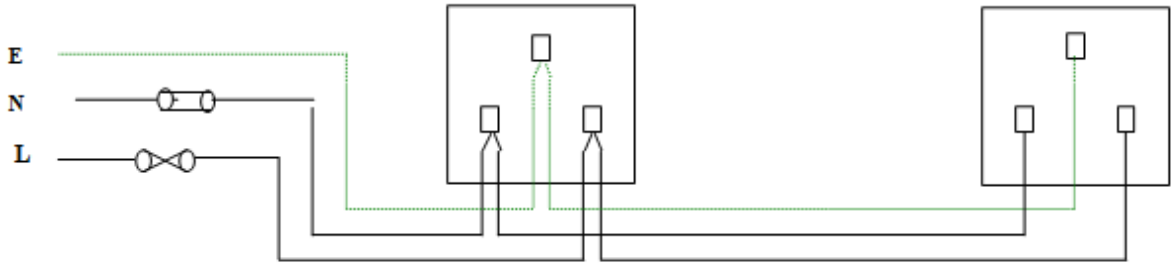
Examples of Socket Outlet Schematic Wiring

7 Socket Outlet – Single Socket

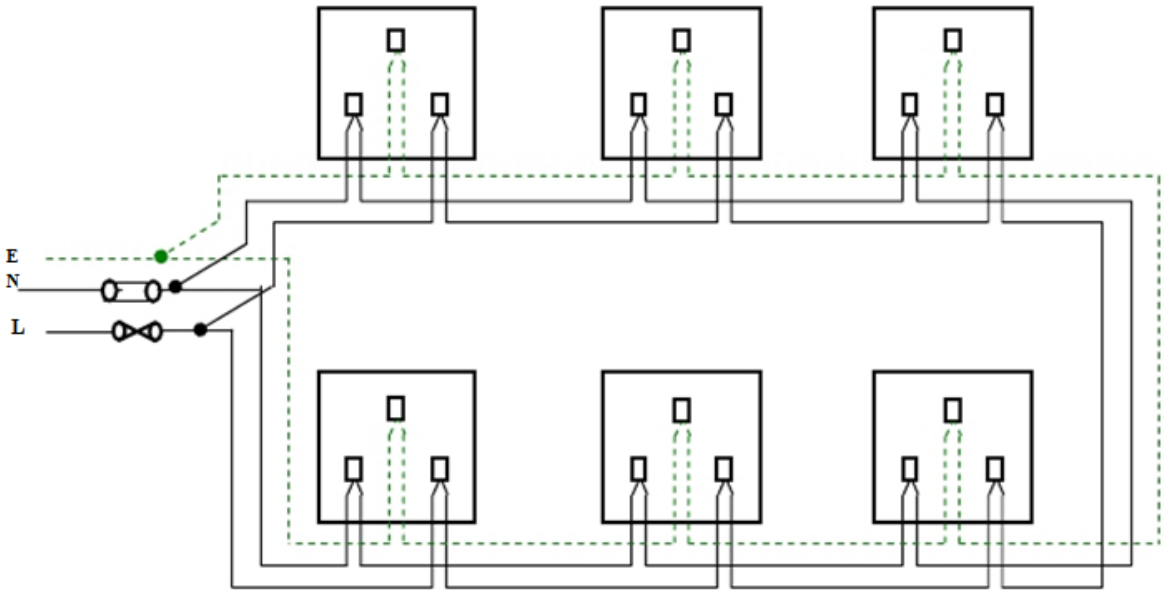


8 Socket Outlets – Radial Connection

8 Socket Outlets – Radial Connection



9 Socket Outlets – Ring Circuit Connection



BUILDING ELECTRICAL INSTALLATION

LEVEL II

Learning Guide-1

Unit of Competence: Install Electrical Apparatus

Module Title: Installing Electrical Apparatus

LG Code: EIS BEI2 M08 LO1-LG-01

TTLM Code: EIS BEI2 M08 TTLM 0219v1

LO 1: Plan and Prepare

Instruction Sheet	Plan and Prepare

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

- Planning & preparing installation to ensure OH&S policies and procedures
- sequencing work appropriately
- consulting appropriate personnel to ensure the work
- checking Apparatus
- Obtaining apparatus with established procedures
- Determining location of apparatus from job requirements
- Obtaining necessary materials to complete the work
- Obtaining Tools, equipment and testing devices to carry out the installation work
- Checking safety preparatory work to ensure no unnecessary damage

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

- Plan & prepare installation to ensure OH&S policies and procedures
- sequence work appropriately
- consulate appropriate personnel to ensure the work
- check Apparatus
- obtain apparatus with established procedures
- Determine location of apparatus from job requirements
- obtain necessary materials to complete the work
- Obtain Tools, equipment and testing devices to carry out the installation work
- Check safety preparatory work to ensure no unnecessary damage

Learning Instructions:

14. Read the specific objectives of this Learning Guide.
15. Follow the instructions described below 3 to 6.
16. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
17. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page -6, 9, 12 and 14** respectively.
18. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” **in page -15.**
19. Do the “LAP test” **in page – 16** (if you are ready).

Information Sheet-1	Undertaking final inspections

1.1 Introduction Undertaking final inspections

Electrical testing

The electrical contractor is charged with a responsibility to carry out a number of tests on an electrical installation and electrical equipment. The individual tests are dealt with in Part 6 of the IEE Regulations and described later in this chapter.

The reasons for testing the installation are:

- to ensure that the installation complies with the Regulations,
- to ensure that the installation meets the specification,
- to ensure that the installation is safe to use.

Those who are to carry out the electrical tests must first consider the following safety factors:

- An assessment of safe working practice must be made before testing begins.
- All safety precautions must be put in place before testing begins.
- Everyone must be notified that the test process is about to take place, for example the client and other workers who may be affected by the tests.
- ‘ Permits-to-Work ’ must be obtained where relevant.
- All sources of information relevant to the tests have been obtained.
- The relevant circuits and equipment have been identified.
- Safe isolation procedures have been carried out – care must be exercised here, in occupied premises, not to switch off computer system switch out first obtaining permission.
- Those who are to carry out the tests are competent to do so.

The electrical contractor is charged by the IEE Regulations for Electrical Installations to test all new installations and major extensions during erection and upon completion before being put into service. The contractor may also be called upon to test installations and equipment in order to identify and remove faults. These requirements imply the use of appropriate test instruments, and in order to take accurate readings consideration should be given to the following points:

- ✓ Is the instrument suitable for this test?
- ✓ Have the correct scales been selected?
- ✓ Is the test instrument correctly connected to the circuit?

Many commercial instruments are capable of making more than one test or have a range of scales to choose from. A range selector switch is usually used to choose the

appropriate scale. A scale range should be chosen which suits the range of the current, voltage or resistance being measured.

For example, when taking a reading in the 8 or 9 V range the obvious scale

Inspection and testing techniques

The testing of an installation implies the use of instruments to obtain readings. However, a test is unlikely to identify a cracked socket outlet, a chipped or loose switch plate, a missing conduit-box lid or saddle, so it is also necessary to make a visual inspection of the installation .All new installations must be inspected and tested during erection and upon completion before being put into service. All existing installations should be periodically inspected and tested to ensure that they are safe

and meet the regulations of the IEE The method used to test an installation may inject a current into the system. This current must not cause danger to any person or equipment in contact with the installation, even if the circuit being tested is faulty. The test results must be compared with any relevant data, including the IEE Regulation tables, and the test procedures must be followed carefully and in the correct sequence, as indicated. This ensures that the protective conductors are correctly connected and secure before the circuit is energized.

VISUAL INSPECTION

The installation must be visually inspected before testing begins. The aim of the visual inspection is to confirm that all equipment and accessories are undamaged and comply with the relevant British and European Standards, and also that the installation has been securely and correctly The aim of the *visual inspection* is to confirm that all equipment and accessories are undamaged and comply with the relevant British and European Standards, and also that the installation has been securely and correctly erected.

Regulation 611.3 gives a checklist for the initial visual inspection of an installation, including:

● connection of conductors;

● Identification of conductors;

● routing of cables in safe zones;

● Selection of conductors for current carrying capacity and volt drop;

● Connection of single-pole devices for protection or switching in phase conductors only;

● Correct connection of socket outlets, lamp holders, accessories and equipment;

● Presence of fire barriers, suitable seals and protection against thermal effects;

● Methods of 'Basic protection ' against electric shock, including the insulation of live parts and placement of live parts out of reach by fitting appropriate barriers and enclosures;

● Methods of 'Fault Protection ' against electric shock including the presence of earthling conductors for both protective bonding and supplementary bonding.

- prevention of detrimental influences (e.g. corrosion);
- presence of appropriate devices for isolation and switching;
- presence of under voltage protection devices;
- choice and setting of protective devices;
- labeling of circuits, fuses, switches and terminals;
- selection of equipment and protective measures appropriate to external influences;
- adequate access to switchgear and equipment;
- presence of danger notices and other warning notices;
- presence of diagrams, instructions and similar information;
- appropriate erection method

The checklist is a guide, it is not exhaustive or detailed, and should be used to identify relevant items for inspection, which can then be expanded upon.

For example, the first item on the checklist, connection of conductors, might be further expanded to include the following:

- Are connections secure?
- Are connections correct? (conductor identification)
- Is the cable adequately supported so that no strain is placed on the connections?

- Does the outer sheath enter the accessory?
- Is the insulation undamaged?
- Does the insulation proceed up to but not *into* the connection?

1.1.2 **Summary of the condition of the installation**

The summary should adequately describe the general condition of the installation in terms of electrical safety, taking into account the specific observations made. It is essential to provide a clear summary of the condition of the installation having considered, for example:

- The adequacy of the earthling and bonding arrangements
- The suitability of the consumer unit and other control equipment
- The type(s) of wiring system, and its condition
- The serviceability of equipment, including accessories
- The presence of adequate identification and notices
- The extent of any wear and tear, damage or other deterioration
- Changes in use of the premises that have led to, or might lead to, deficiencies in the installation.

Minimal descriptions such as ‘poor’, and superficial statements such as ‘recommend a rewire’, are considered unacceptable as they do not indicate the true condition of an installation. It will often be necessary or appropriate to explain the implications of an electrical installation condition report in a covering letter, for the benefit of recipients who require additional advice and guidance about their installation.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. The reasons for testing the installation are:(5point)

A. to ensure that the installation complies with the Regulations,

B. to ensure that the installation meets the specification,

C. to ensure that the installation is safe to use

D. all

2.Checklist for the initial visual inspection of an installation,(5 points)

A. identification of conductors;

B. routing of cables in safe zones;

C. selection of conductors for current carrying capacity and volt drop

D. all

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

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

Information Sheet- 2	Preparing work accomplishment report

2.1 Introduction of Prepare work accomplishment report

Every work must be Prepare work accomplishment report to an employer and minor accidents reported to a supervisor, safety officer or first aider and the details of the accident and treatment given suitably documented.

- The report should also include the following information:

- your name
- the address of the property to be inspected
- reason for the inspection
- the date of inspection
- the scope of the inspection
- a list of any area or item that wasn't inspected, the reasons why it wasn't inspected and if necessary, a recommendation for further investigation
- a summary of the overall condition of the property
- a list of any significant problems that need fixing
- if necessary, a recommendation that a further inspection or assessment be carried out by a suitably accredited specialist, e.g. pest inspector, electricity supply authority, water supply authority, structural engineer, geotechnical engineer, surveyor or solicitor.
- *The summary*

The summary is possibly the most important part of the report. It should give you a brief summary of the major faults found in the property and its overall condition considering its age and type

2.2 Type of Prepare work accomplishment report

1. An Electrical Installation Condition Report (EICR)
2. Accident reports

1. An Electrical Installation Condition Report (EICR) will provide a full summary of the condition of the electrics in your home and determine whether it complies with the current .It will record a number of observations in line with BS 7671 and make various recommendations where improvement may be necessary or beneficial to improving safety in your home. Once the EICR is completed the registered contractor will provide you with a certificate outlining the overall condition of the electrical installation. Generally, an EICR will provide coding against the condition of the installation. The classification codes are as follows:

- ✓ Code C1 - This code should indicates that danger exists, requiring immediate remedial action. The persons using the installation are at immediate risk.
- ✓ Code C2 - This code indicates that, whilst an observed deficiency is not considered to be dangerous at the time of the inspection, it could become a real and immediate danger if a fault or other foreseeable event was to occur in the installation or connected equipment.
- ✓ Code C3 - This code indicates that, whilst an observed deficiency is not considered to be a source of immediate or potential danger, improvement would contribute to a significant enhancement of the safety of the electrical installation. You are under no obligation to have any of the issues fixed, though it is recommended that corrective action to rectify any C1 and C2s is completed as soon as possible. If you do

The purpose of a condition report

An electrical Condition Report is a periodic test and inspection of an electrical installation. The purpose of the report is to check the condition of an installation, detecting and recording any factors that might affect safety. One of the reasons a report of this kind is necessary is to determine that the installation has not deteriorated or been damaged over time. An electrical condition report will determine the following aspects:

- how safe the installation is for the protection of people against electric shocks and burns
- the potential for fire and heat damage arising from electrical defects.
- check that the installation has not become unsafe through deterioration or damage
- check for defects or evidence of non- compliance with current regulations which may be dangerous

The NICEIC recommend that the installation of domestic properties are periodically inspected and tested every 10 years, however there may be other reasons why an inspection would need to be carried out more often, including:

- The age of the installation (over time, the condition of an electrical installation can deteriorate)
- Environmental factors (external locations for example, can affect the speed of deterioration and lead to corrosion of electrics)
- Damage to the installation (through vandalism for example)
- Type of property (caravan parks and swimming pools for example, should be tested annually)
- Use of property (change of occupancy for rental for example)
- Changes in legislations
- general concerns the occupant may have regarding the install

2. Accident reports

Every accident must be reported to an employer and minor accidents reported to a supervisor, safety officer or first aider and the details of the accident and treatment

given suitably documented. A first aid logbook or accident book such as that shown in containing first aid treatment record sheets could be used to effectively document accidents which occurring the workplace and the treatment given. Failure to do so may influence the payment of compensation at a later date if an injury leads to permanent disability. To comply with the Data Protection Regulations,

If the accident results in death, serious injury or an injury that leads to an absence from work of more than 3 days, then your employer must report the accident to the local office of the HSE. . They will require the following information:The name of the person injured.

- ●A summary of what happened.
- ●A summary of events prior to the accident.
- ●Information about the injury or loss sustained.
- ●Details of witnesses.
- ●Date and time of accident.
- ●Name of the person reporting the incident.

The Incident Control Centre will forward a copy of every report they complete to the employer for them to check and hold on record. However, good practice would recommend an employer or his representative make an extensive report of any serious accident that occurs in the workplace. In addition to recording the above information, the employer or his representative should

2.3 Factors affecting the report

There are certain conditions you should be aware of that will affect the final report. These include:

- problems that are difficult to detect due to weather or other conditions such as rising damp and leaks
- the information you provide to the consultant
- the specific areas of the consultant's 'expertise' as specified in the report
- problems that may have been deliberately covered up to make an area appear problem free.

It may be difficult to detect leaks and other problems if services, such as water, have not been used for some time. For example, if the shower has not been used recently, leaks or dampness may not be obvious

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. _____Type of Prepare work accomplishment report (3 points)

B. An Electrical Installation Condition Report (EICR)

C. Accident reports

D. all

2.EICR means(3point)

A .Electrical Installation Condition Report.

B. Electrical Installation Report Condition.

C. Electrical Condition Installation Report.

D. Electrical Condition Report Installation.

Note: Satisfactory rating - 3points Unsatisfactory - below 3 points

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

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

BUILDING ELECTRICAL INSTALLATION

LEVEL II

Learning Guide-1

Unit of Competence: Install Electrical Apparatus

Module Title: Installing Electrical Apparatus

LG Code: EIS BEI2 M08 LO1-LG-01

TTLM Code: EIS BEI2 M08 TTLM 0219v1

LO 1: Plan and Prepare

Instruction Sheet	Plan and Prepare

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Information Sheet-1	Clearing Work area and disposing of, reusing or recycling materials

1.1 Introduction of Disposing and storing waste materials

1.1.1 Storing Materials

The Contractor shall supply, erect, maintain and clear away on completion, suitable workshops, storerooms, offices and sheds as necessary for the sub-contract works. All materials are to be stored in a manner to avoid damage and/or deterioration thereto.

1.1.2 Waste Disposal

The regular collection, grading and sorting of scrap contribute to good housekeeping practices. It also makes it possible to separate materials that can be recycled from those going to waste disposal facilities.

Allowing material to build up on the floor wastes time and energy since additional time is required for cleaning it up. Placing scrap containers near where the waste is produced encourages orderly waste disposal and makes collection easier. All waste receptacles should be clearly labeled (e.g., recyclable glass, plastic, scrap metal, etc.)

1.2 The Importance of Proper Waste Disposal

- Home → environmental cleanup → The Importance of Proper Waste Disposal

Proper waste disposal is critical due to the fact that certain types of wastes can be hazardous and can contaminate the environment if not handled properly. These types of waste also have the potential to cause disease or get into water supplies. There are rules and regulations in place for how specific types of waste should be disposed of. Following them allows for toxic waste to be safely discarded without the risk of environmental contamination.

- Proper Waste Disposal and the Government

The majority of the laws associated with waste disposal are regulated and enforced by the Environmental Protection Agency (EPA). The general health of the public . This Act is what gave the EPA the necessary authority to monitor hazardous waste disposal.

- Proper Waste Disposal and Environmental Health

Hazardous wastes that are not properly disposed of can leak and contaminate soil and water, which can lead to issues with both the environment and human health. Burning the wrong types of waste can release gases into the atmosphere. When waste is properly discarded, special liners are used to prevent toxic chemicals from leaking out and precautions are taken so that any methane related to burning trash is safely contained.

- Proper Waste Disposal and Public Health

When waste is disposed of properly, it helps to prevent additional pollution which can improve public health. Polluted air increases the risk of respiratory illness. Waste that is properly disposed of has a lesser chance of getting into the water supply and causing illness. In the 1980s, there was an incident in New Jersey in which unregulated dumping led to a chromium poisoning epidemic in a local school

1.3 **PRINCIPLES OF Disposing and storing waste materials**

Proper waste disposal begins with good waste management by the researcher, including

- ✓ minimum waste generation
- ✓ reusing surplus materials, and
- ✓ recycling of appropriate (*i.e.*, uncontaminated) waste.

The generated waste must be properly collected and stored, paying close attention to labeling, segregating according to chemical compatibility, and accumulating in a well-ventilated location. This location should be well labeled. Other laboratory waste items such as sharps and glass must also be disposed of with care in appropriately labeled and compatible containers.

1.4 PROCEDUREOF Disposing and storing waste materials

1. Waste Management

1. Users should make an effort to keep waste to a minimum. The best way to do so is by reducing the scale of operation, which minimizes the quantity of waste generated. Whenever possible, chemicals used should be substituted with less hazardous chemicals.

2. Chemical quantities should be kept to a minimum. Store only what will be used in the near term.

3. Besides preventing or minimizing waste generation, chemicals should be recycled or recovered for reuse.

4. When waste is generated, it must be disposed of properly. Sink disposal may not always be appropriate and may end contaminating drinking water. Alternative methods of disposal should be considered including incineration, treatment, and land disposal. The institute's EHS office should be consulted to determine the proper disposal method for different waste types.

2. Waste Collection and Storage

1. When generating or managing any chemical waste, appropriate personal protective equipment (PPE) must be worn, and engineering controls should be implemented as necessary.

2. Collect and store chemical waste at or near the point of generation in a designated satellite accumulation area. This accumulation area should be well marked for easy identification.

3. Chemical waste must be stored in compatible containers with closed and properly fitted caps.

4. Waste containers must be labeled mentioning chemical compositions, the accumulation start date, and hazard warnings as appropriate. The institute's EHS office typically provides these required labels.

5. Incompatible waste types should not be mixed and should be kept separate in order to avoid any reaction, heat generation, and/or gas evolution.

6. Waste containers should be stored in secondary containers in a ventilated, cool, and dry area.

7. In the central accumulation area, waste containers should be grounded to avoid fire and explosion hazards.

8. Trained laboratory researchers who are most familiar with the waste generated should work with EHS to ensure proper waste management.

3. Sharps Disposal - Syringes and Needles

1. Chemically contaminated needles, syringes, and razor blades should be disposed of inside a proper sharps container.

2. Syringes or needles must never be disposed of in a laboratory waste bin or a general waste container.

4. Glass Recycling

1. Recycling glass is friendly to the environment as it reduces pollution caused by the waste ending up in landfill sites. Every laboratory should have a separate recycling bin dedicated to glass.

2. Clean empty glass bottles and broken glassware may be recycled. To clean an empty glass bottle, it must be "triple rinsed" with water or another suitable solvent and air-dried before disposal.

3. Chemically contaminated laboratory glassware such as sample tubes, droppers, and glass wool must be disposed of as controlled waste.

1.5 Six Waste Disposal Methods

1. Preventing or reducing waste generation: Extensive use of new or unnecessary products is the root cause of unchecked waste formation.

2. Recycling: serves to transform the wastes into products of their own genre through industrial processing. Paper, conduit, wires, and plastics are commonly recycled. It is environmentally

friendly to reuse the wastes instead of adding them to nature. However, processing technologies are pretty expensive.

3. Incineration: Incineration features combustion of wastes to transform them into base components, with the generated heat being trapped for deriving energy lines

4. Composting: It involves decomposition of organic wastes by microbes by allowing the waste to stay accumulated in a pit for a long period of time

5. Sanitary Landfill: This involves the dumping of wastes into a landfill. The base is prepared of a protective lining, which serves as a barrier between wastes and ground water, and prevents the separation of toxic chemicals into the water zone. Waste layers are subjected to compaction and subsequently coated with an earth layer. Soil that is non-porous is preferred to mitigate the vulnerability of accidental leakage of toxic chemicals.

6. Disposal in ocean/sea: Wastes generally of radioactive nature are dumped in the oceans far from active human habitats. However, environmentalists are challenging this method, as such an action is believed to spell doom for aquatic life by depriving the ocean waters of its inherent nutrient.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1.The important o f disposing and storing waste material.(3 points)

A .environmental cleanup C. Proper Waste Disposal and the Government

B. Proper Waste Disposal and Environmental Health

D. all

2.List out the *procedure of* disposing and storing waste material.(**5 points)**

3.the principles of Disposing and storing waste materials(2point)

A. recycle ling of appropriate B refusing of surplus material C .all

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

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

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet- 2	**Cleaning, checking maintaining and storing plant, tools & equipment**

2.1 Concepts of Maintaining plant, tools & equipment

2.1.1 Maintenance

Electrical maintenance covers all aspects of testing, monitoring, fixing, and replacing elements of an electrical system. Usually performed by a licensed professional with a complete knowledge of the National Electric Code and local regulations, electrical maintenance covers areas as diverse as

2.1.2 Plant and equipment maintenance

Maintenance on plant and equipment is carried out to prevent problems arising, to put faults right, and to ensure equipment is working effectively.

Maintenance may be part of a planned programmed or may have to be carried out at short notice after a breakdown. It always involves non-routine activities and can expose those involved (and others) to a range of risks.

2.1.3Maintaining plant, equipment

Maintenance of Electrical Equipment In Buildings (photo credit: Critical Power Testing and Maintenance, LLC. - cptam.com)

While it is appreciated that breakdown of plant may result in costly interruption of normal building operation, it must also be borne in mind **that stopping plant for maintenance canalso cause a loss in production.**

Equipment on continuous and arduous duty, e.g. switchboards, motor control centers (MCCs), air-handling units, chiller plant etc., require more attention than that which is lightly loaded and rarely used

2.2 Important maintenance of plant and equipment

An effective maintenance programmed will make plant and equipment more reliable. Fewer breakdowns will mean less dangerous contact with machinery is required, as well as having the cost benefits of better productivity and efficiency.

Additional hazards can occur when machinery becomes unreliable and develops faults. Maintenance allows these faults to be diagnosed early to manage any risks. However, maintenance needs to be correctly planned and carried out. Unsafe maintenance has caused many fatalities and serious injuries either during the maintenance or to those using the badly maintained or wrongly maintained/repaired equipment

2.3 Steps **of maintenance of plant and equipment**

1. Standardization of Equipment

The use as far as possible of standard items such as switchgear will help both in buying, stockholding and replacement of components on the most economic and convenient basis

2. Establishment of Records on Breakdown

Initially this may be on a simple log book or card system. This information should give some idea of which plant requires attention and at what intervals. It may also lead to improvements to the plant itself which will reduce the frequency of future failures.

3. Frequency of Maintenance

This requires careful organization to ensure that it fits in with operational requirements. All planned maintenance should therefore have been agreed with the relevant operation manager-prior-to-implementation.

4. Economic of Routine Maintenance

It may not be economic or practical to include some equipment in a scheduled routine although safety inspections will still need to be carried out

5**.** Upgrading to More Efficient Plant

Energy saving can be achieved by changing the type of equipment in use, for example:

1. Replacement of less efficient lamps with more energy efficient lamps.
2. Replacing electro-mechanical control device**s** to electronic systems.
3. Installing new high efficiency motors to replace old motors particularly where extended duty operations prevail.

4. Retrofitting VSDs for flow control of fans or pumps.

The economics of changing inefficient existing systems, which are continuing to provide a satisfactory operational performance, obviously requires careful consideration. Not only the costs of new equipment need to be understood, but also **equipment life** can have a significant impact on the overall financial viability of any proposed changes

6.Emergency Maintenance

The emergency maintenance can hardly be regarded as maintenance in the sense that, in many cases, it consists of an urgent repair to, or replacement of, electrical equipment that has ceased to function effectively

7.Planned Maintenance

In the use of electrical plant and equipment there are obviously **sources of danger** recognized in the Electricity (Wiring) Regulations.

These regulations are mandatory and serve to ensure that all electrical plants and equipment are adequately maintained and tested to prevent any dangerous situation arising that could harm the users of such equipment or the building occupants

2.1.1 **type of Maintenance**

- Time Based Maintenance (TBM)
- Failure Finding Maintenance (FFM)
- Risk Based Maintenance (RBM)
- Condition Based Maintenance (CBM)

- Predictive Maintenance (PDM)

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1 .Electrical maintenance covers(2point)

A .testing B .fixing

C. replacing D. all

2.Maintanance of electrical equipment in building (2point)

A .photo credit B. critical power testing

C. maintenance of LLC D. all

3.Explain the steps of maintenance of Maintaining plant, tools & equipment(2point)

4.What is Important maintenance of plant and equipment?(2point)

5 Why is maintenance of plant and equipment important**?(2point)**

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below5points**

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

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation Sheet 1	Clean up

PURPOSE: To enable trainees develop skill how to clean up the work Project

PROCEDURE:

step1. supply first of all safety requirement

step2. Supply materials and tools cleaning

step3. Supply materials and tools in the in the bill of quantity

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates/guides, workshop, tools and materials you are required to perform the following tasks within 2:30 hours.

Task 1: Using the given template, Report is done to relevant people those necessary variations to the planned programmed of work

Task 2: Using the given template Perform The appropriate action is sought from the relevant people

Task 3: Using a given template, completing OHS procedures and regulations are observed throughout the process of installation

No	Name of trainer	Qualification	Region	
1	RehmaMuluneh	Electrical control Engineering (BSc)	Addis Abeba	rehmam
2	SalahadinHussien	Electrical control and automation (BSc)	Addis Abeba	salahadi
3	Elias Getachew	Electrical control and automation (MSc)	Addis Abeba	get.elias
4	Mesfin Bekele	Electrical control and automation (BSc)	Addis Abeba	mesfin8
5	RahelOuma	Electronics & communication (MSc)	Somalia	rahelour
6	GetinetMelkie	Electrical Electronics (MSc)	Somalia	melkieg
7	ZenebeShiferawu	Construction Technology (BSc)	Dire dewa	zeadesh
8	TewodrosYossef	Electrical Engineering (BSc)	Benshangul	tedyo05
9	ZelalemTaye	Educational Leadership (MA)	Amhara	tayezela
10	AddisuWedajo	Vocational management (MA)	Amhara	addalvy

These learning Guides are prepared by:-