Building Electrical installation

Level II

Learning Guide-41

Unit of Competence: Conduct In-Service Safety Testing of Electrical Cord Connected Equipment and Cord Assemblies

Module Title: Conducting In-Service Safety Testing of Electrical Cord Connected Equipment and Cord Assemblies

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LO1**:** Prepare to test cord connected apparatus and cord assemblies

This learning guide is developed to provide you the necessary information regarding the

Instruction Sheet	Learning Guide #41

following **content coverage** and topics:

- Identifying, obtaining and understanding of OHS procedures for a given work area
- Following OHS risk control measures in preparation of the work
- Minimizing disruption to the work place
- Obtaining connected apparatus and cord assemblies to test
- Checking Portable apparatus testing device for correct operation and safety

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**:

- ✓ Identify, obtain and understanding of OHS procedures for a given work area
- ✓ Follow OHS risk control measures in preparation of the work
- ✓ Minimize disruption to the work place
- ✓ Connect apparatus and cord assemblies to test
- ✓ Check Portable apparatus testing device for correct operation and safety

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, sheet 4 and Sheet 5”. **In page 3, 10, 14, 23 and 29** respectively.
4. Accomplish the “Self-check 1, Self-check 2, Self-check 3, Self-check 4 and Self-check 5” **in page 9, 13, 22, 28 and 33 respectively**.

Information sheet-1	**Identifying, obtaining and understanding of OHS procedures for a given work area**

1.1 Definition of OHS

Occupational safety and health (**OSH**), also commonly referred to as occupational health and safety (OHS), occupational health, or workplace health and safety (WHS), is a multidisciplinary field concerned with the safety, health, and welfare of people at work. These terms also refer to the goals of this field, so their use in the sense of this article was originally an abbreviation of occupational safety and health program /department etc.

Occupational Health and Safety

The Saskatchewan Occupational Health and Safety (OHS) Act and Regulations set health and safety standards for all places of employment and set rules and requirements for controlling hazards in specific industries, processes and conditions.

Under the OHS Act and Regulations, employers are responsible for ensuring, where reasonably practicable:

- A safe work environment;
- Systems and equipment that are maintained;
- Established work processes and procedures;
- Workers are qualified and trained; and
- That appropriate tools and personal protective equipment are used in the performance of electrical work.

1.2 OHS procedures for connected apparatus and cord assemblies

Flexible extension cords are widely used at marinas, construction sites, yacht clubs, homes, businesses, and more. Because these cords are often exposed, flexible, and unsecured, they are highly susceptible to damage and misuse that can result in significant hazards. Following safety guidelines can enable effective and safe use of flexible extension cords in most common applications.

Gowrie's Guidelines for Safe Usage of Extension and Flexible Cords:

- **Look for the united laboratory (UL) Mark** on all extension cords that you purchase. It means that representative samples of the cord have been tested for all foreseeable safety hazards.
- **Never keep an extension cord plugged in when it is not in use**, since the cord will still conduct electricity until it is unplugged from the outlet. All extension cords should be unplugged at the end of shifts or when work has been completed, whichever comes first.
- **Examine extension cords before each use.** Cracked, frayed, or otherwise damaged cords should be replaced immediately. Touching even a single exposed strand of wire can result in an electric shock or burn.
- **Store all cords indoors when not in use**; outdoor conditions can deteriorate a cord over time.
- **When working outdoors, use only weather-resistant, heavy gauge extension cords** marked "for outdoor use." These cords have added safeguards designed to withstand the outdoor environment.
- **Keep all outdoor extension cords and light strands clear of snow and standing water** and well-protected from the elements.
- **Most new, indoor extension cords with more than one outlet have covers for the unused openings.** Make sure to use them.
- **To avoid overheating extension cords, make sure that they do not run under furniture or carpeting, or behind baseboards.** Do not run extension cords through doorways, windows, or holes in walls.
- **Polarized plugs (one blade wider than the other) are a safety feature** designed to prevent electric shock by properly aligning circuit conductors. If a plug does not fit, have a qualified electrician install a new outlet.
- **Never file or cut the plug blades or grounding pin of an extension cord** or appliance to plug it into an old outlet.
- **If the ground plug has "fallen" out of an extension cord,** discontinue use of the cord immediately.

- **Do not attempt to repair cords yourself**. This work needs to be completed by a qualified electrician.
- **Never plug an extension cord into an electrical source with wet hands,** or if either end of the plug is wet. Do not come in contact with or use any electrical items while standing in water.
- **Remember that extension cords are meant to provide a temporary solution** and should not be used as a long-term or permanent electrical circuit.

Figure 1.1 Examples of cord and plug appliances

Figure 1.2 Examples of Hard Wired Appliances

1.3 purpose

The goals of occupational safety and health programs include to foster a safe and healthy work environment.

OHS may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment.

1.4 Identify OHS hazards and suitable safety

1.4.1 OHS hazards

- Improper use of easily overloaded, unapproved extension cords can present a serious fire safety hazard in the workplace and home. In fact, misuse of extension cords led to a significant fires in offices and residential areas in 2012.
- The most common cause of fires from extension cords is due to improper use and/or overloading, especially when cords have multiple outlets.
- Most extension cords are only rated for a maximum of 10 amps or 1200 watts. Overloading can occur when multiple devices are plugged into one cord or when cords are “daisy chained” (plugging multiple extension cords together).
- The use of unapproved extension cords is a violation of both OSHA and National Fire Protection Association codes.
- Approved extension cords are only allowable in the workplace as temporary wiring, and for no more than 90 days.

1.4.2 Suitable Safety

Safety for Extension Cords

Extension cords provide a convenient method of bringing AC power to a device that is not located near a power source. They are also used as temporary power sources. As such, extension cords are heavily used. They are also often involved in electrical code and safety violations.

- Inspect the cord before each use. Replace the cord if worn or damaged. Remove from service and tag “Danger, Do Not Operate.”
- Keep extension cords away from heat, oil/chemicals, and sharp edges and ensure they do not become a tripping hazard.
- Make sure extension cord is for the correct amperage and has the proper plug.
- Verify condition of the cord and plugs and check rated use: indoor or outdoor.
- Don’t overload electrical outlets. Figure1.4
- Never disconnect power by pulling on the cord – use the PLUG

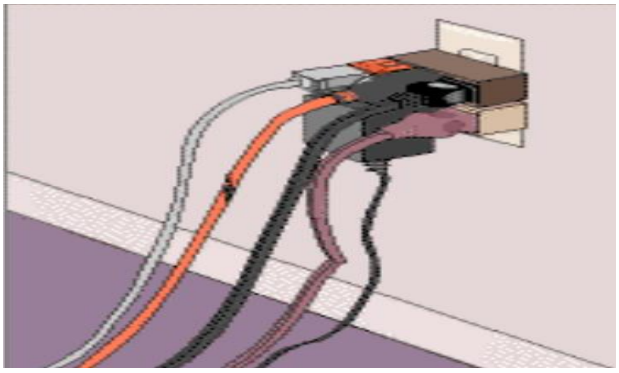


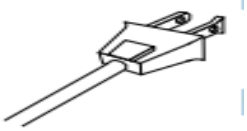
Figure 1.3 Three Prong Plug Missing Ground Figure 1.4 – Overloaded Outlet

Safety for Flexible Cords

- Be sure the cord you have selected meets the intended use.
- Never use a cord outdoors that is not marked for outdoors.
- Inspect cord thoroughly before each use. Do not use if damaged.
- Do not remove, bend or modify any metal prongs or pins of plug.

- Look for the number of watts on appliances to be plugged into cord.
- Refer to UL Label on cord for specific wattage.
- Do not connect a three-prong plug into a two-hole cord.

- Do not plug more than the specified number of watts into a cord.
- Make sure appliance is off before connecting cord to outlet.
- A polarized plug has one blade wider than the other.
- Fully insert plug into outlet



- Do not use excessive force to make connections.
- Do not run cords through doorways, holes in ceilings, walls or floors.
- Do not use an extension cord when wet.

  - Keep extension cords away from water.
  - Keep children and pets away from extension cords.
  - Avoid overheating. Uncoil cord and do not cover it with any other material.

  - Do not plug one extension cord into another.
  - Do not drive, drag or place objects over extension cord.
  - Always grasp plug when removing it from cord or outlet.
  - Do not unplug by pulling on cord.

  - Always store extension cords indoors.
  - Do not walk on cord.

- Always unplug cord when not in use.

Self-Check -1	Written Test

Directions:

I. ***Answer all the questions listed below***.

1. Which of the following is not OHS hazards?
   a) Improper use b) overload c) proper use d) unapproved extension cords
2. Never keep an extension cord plugged in when it is not in use
   a) True b) False
3. One of the following is not correct about safety for Flexible Cords
   a) meets the intended use c) Inspect cord before each use
   b) Never use a cord outdoors that is not marked d) modify any metal prongs
4. The most common cause of fires from extension cords is:
   a) due to improper use b) overloading c) cords have multiple outlets d) all

II. Write short answers for the following question.

1. Write down at least 4 Safety tips for Flexible Cords. (4 pts)
2. What is the purposes of occupational safety and health programs? (2 pts)

Note: **Satisfactory rating - 5 and above out of 10 points Unsatisfactory - below 5 out of 10 points**

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

Score = _____

Rating: _____

Information sheet 2	OHS risk control measures are following in preparation for the work

2.1 Definition of terms

OHS Risk: is defined as a description of the likelihood and consequence of a hazard causing injury or illness.

Control measures: Control the risks once hazards have been identified and the risks assessed, appropriate control measures must be put in place.

The ways of controlling risks are ranked from the highest level of protection and reliability to the lowest. This ranking is known as the *hierarchy of risk control.* You must work through this hierarchy to choose the control that most effectively eliminates or minimizes the risk in the circumstances, so far as is reasonably practicable. This may involve a single control measure or a combination of two or more different controls.

2.2 OHS risk

Risks to health and safety associated with electrical equipment and electrical installations must be managed in accordance with the WHS Risk Management Procedures, including:

I. when planning processes using electrical equipment and electrical installations
II. When processes using electrical equipment and electrical installations are changed.
III. Safe work procedures, as determined by the risk assessment must be adhered to.
IV. Workers and others in the workplace must be informed of any potential electromagnetic hazards in the workplace which may affect a medical condition.

2.3 OHS risk control measures

Risk assessment

The department manager should form a team to undertake the risk assessment.

- The team should consist of a competent person to lead the risk assessment process, workers who are involved in the activity to be assessed, a HSR (where one exists), the manager or supervisor and other stakeholders or experts where relevant.

- The risk assessment should be undertaken in accordance with the WHS Hazard Management and Plant procedures.
- For work on energized electrical equipment, a risk assessment must be completed and documented by a competent person and controls put in place before work commences.

Risk control

- Controls should be implemented to eliminate, so far as is reasonably practicable, identified risks to health and safety.
- If it is not reasonably practicable to eliminate risks, risk controls will be selected in descending order from the hierarchy of control, and in accordance with the WHS Hazard Management Procedure.
- The risk assessment must clearly indicate what control measures are to be used.
- Examples of risk control include, but are not limited to:

Elimination	The most effective control measure is to remove the hazard or hazardous work practice. By designing-in or designing-out certain features, hazards may be eliminated.	• Remove electrical equipment • Design in or out certain features
Substitution	Replacing a hazardous process or material with one that is less hazardous will reduce the hazard, and hence the risk. For example, it may be reasonably practicable to use extra low voltage electrical equipment such as a battery-operated tool rather than a tool that is plugged into mains electricity.	• Replace electric tools with battery operated or pneumatic tools in wet environments • Use non-conductive scaffolding or ladders instead of metal
Isolation	Preventing workers from coming into contact with the source of an electrical hazard will reduce the relevant risks.	• Isolate, lock out and tag out the source of electrical energy during operations or maintenance functions • Erect a physical barrier around the work area • Restrict access to electrical switchboards and electrical equipment rooms

Engineering	Use engineering control measures to minimise the risk, for example installing residual current devices to reduce the risk of receiving a fatal electric shock.	• Use residual current devices (RCDs)
Administrative	Administrative controls involve the use of safe work practices to control the risk, for example establishing exclusion zones, use of permits and warning signs. Administrative controls and PPE do nothing to change the hazard itself. They rely on people behaving as expected and require a high level of supervision. Exclusive reliance on administrative controls and PPE must only occur where other measures are not reasonably practicable or as an interim control while the preferred control measure is being implemented.	• Tag and test electrical equipment • Identify electrical services before work commences e.g. dial before you dig, cable locator use for walls • Ban the use of electrical equipment in the rain • Use tiger tails • Apply minimum safe approach distances when working near overhead power lines • Use permits and warning signs
Personal protective equipment	PPE includes protective eyewear, insulated gloves, hard hats, aprons and breathing protection. Most forms of PPE are not relevant to minimising electrical risks in workplaces, except in relation to energized electrical work.	• This includes, for example, choosing insulating gloves, mats and tools, hard hat, aprons and breathing protection

Conduct risk assessment to identify any hazards that may be present in the work area as well as the Device Under

2.4 Rules to follow

Implement the controls identified by the risk assessments before work commences.

Any hazards that are unable to be immediately controlled within the risk assessment process should be transferred to the Hazard/ Risk/ Corrective Action Register for further action and management. Work should not commence until all selected controls are in place.

- Each person involved in the job should sign their acknowledgement of the risk assessment prior to work commencing.

Self-Check -2	Written Test

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

1. It is defined as a description of the likelihood and consequence of a hazard causing injury or illness.
   a) Control measure b) risk c) injury d) OHS
2. One of the following is not the mechanisms of risk control
   a) Elimination b) substitution d) administration d) risk
3. Which is the purpose of risk control mechanism implemented for identified risks?
   a) To eliminate b) to minimize c) to health and safety d) all
4. One of the following is not included in personal protective equipment
   a) Insulated Gloves b) safety shoes c) hand tools d) protective eyewear

Note: **Satisfactory rating - 2 out of 4 points Unsatisfactory - below 2 out of 4 points**

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

Score = _____

Rating: _____

Information sheet 3	wanting advice from appropriate person to minimize disruption/disorder to the work place

3.1 Introduction

- An important feature about safety at work is the need for employers to consult with employees about the work they do.
- You may find that your workplace has a workplace health and safety committee or OHS representatives. The purpose of the committee and representatives is to allow health and safety issues to be meaningfully discussed and acted upon.
- The process of consultation should allow people in the workplace to have a real say in matters that may affect their health and safety.
- Employers should ensure there are established mechanisms for employees to be consulted about any hazards that may be present in the workplace and how these can best be controlled.
- Similarly, employees need to have a say in the type of equipment or substances brought into the workplace.
- The process of consultation also provides you with the opportunity to meet your OHS obligations and contribute to the safety of the workplace.
- Make the most of your chance to have your say, by making your suggestions helpful and worthwhile.

a) Workers will be consulted in the ongoing review, development and implementation of the Electrical Testing and Tag Procedure, using the forum of the Health and Safety Committee through the Health and Safety Representatives as its first recourse in such consultation.

3.2 advice from appropriate person to minimize disruption/disorder

The structure and wiring of an electric plug appear to be simple. However, the electrical hazards associated with the unsafe use of electric plugs should not be overlooked.

Occupational accidents, such as electric shocks, burns, fires and explosion, that result from improper selection, wiring, handling, usage, repairing and maintenance of electric plugs are not uncommon.

They can result in damage of equipment, lots of properties and production time, and the more important casualties.

Caution: for the sake of electrical safety, electric plugs should be wired and repaired by competent persons.

1. Use acceptable plugs only. Those plugs should bear the relevant markings as follows:

Type of plug	Round pins (small)	Square pins	Round pins (large)
Current Rating (Ampere, A)	5	13	15
Markings	BS546 5 Amp ~250V	BS1363 13 Amp ~250V	BS546 15 Amp ~250V

N.B.: For details, please refer to publications of the Electrical & Mechanical Services Department.

Table 3.1 plugs bearing the relevant markings

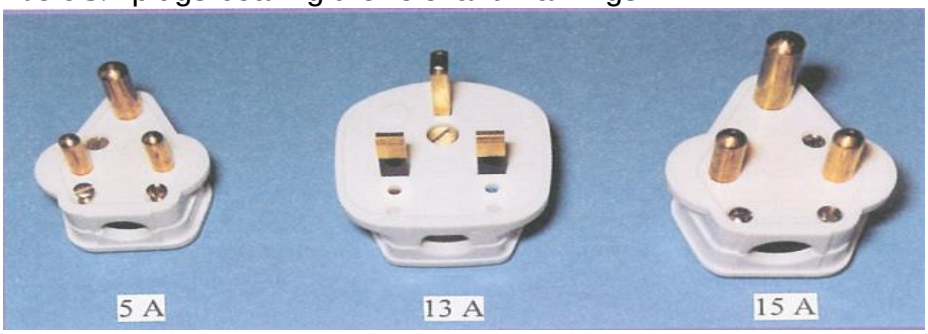


Figure 3.1 Plugs marking

2. Choose waterproof type plugs for outdoor use or a wet working environment, or a workplace where there is water dripping or splashing.

- **Proper wiring of electric plugs**

1. When wiring the cord of electrical equipment to a plug, it should first remove suitable length of outer insulation sheath of the cord and insulation cover of the inner cable cores. Do not screw the inner cable cores onto the plug terminals direct without removing the insulation cover of the cores.

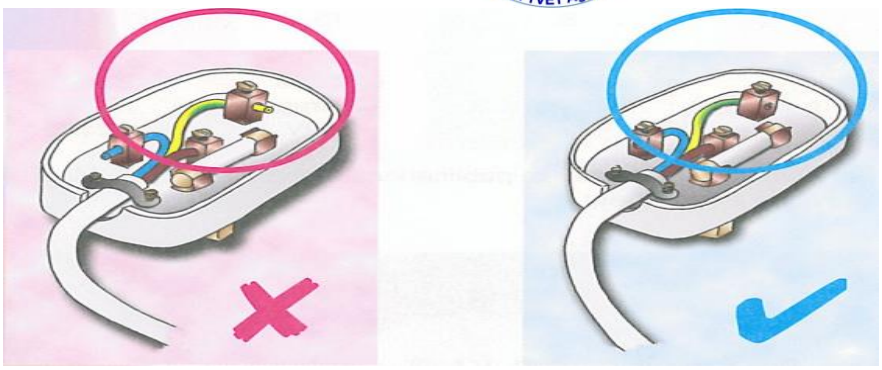


Figure 3.2 wiring the cord of electrical equipment to a plug

2. The insulation cover of the cord/cores should be removed with care to avoid cutting the strands of copper wires, or other damages.

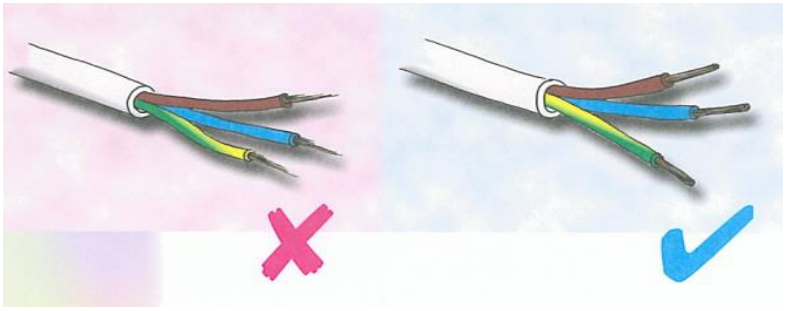


Figure 3.3 insulation cover of the cord/cores

3. Fasten the cord to the plug firmly using the cord grip on the plug. Fix on the outer insulation sheath of the cord instead of the inner cores.

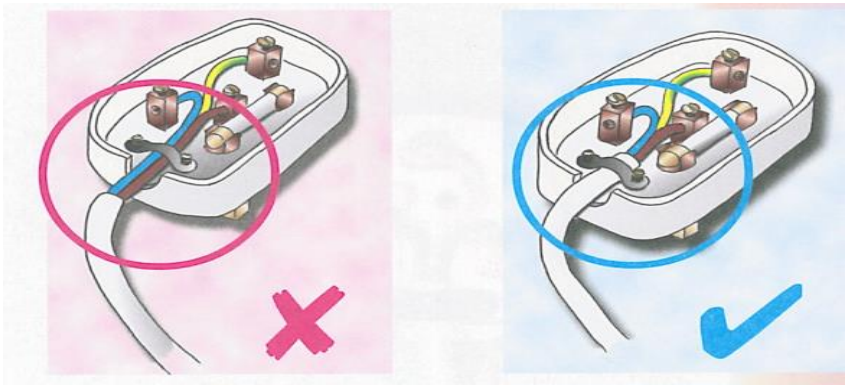


Figure 3.4 fastening the cord to the plug

4. Secure the cores firmly to the respective plug/ terminals in accordance with the following schedule:

Pins of the plug / cores of the cord	Markings on the plug	Colour of the cores	
		New type	Old type
Line	L	Brown	Red
Neutral	N	Blue	Black
Earth	E (⏚)	Yellow / Green	Green

Table 3.2 colors of the cores on the plug

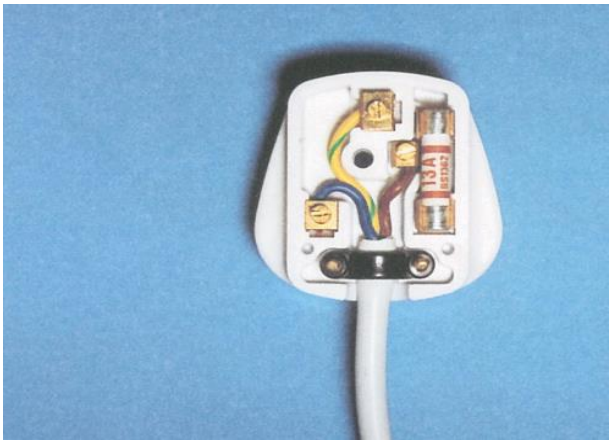


Figure 3.5 securing the cores to the respective plug/ terminals

Warnings: do not reverse the line (L) and the neutral (N) cores. Do not leave the earth core unconnected.

Note: sometimes the electrical equipment would still operate even if the line and the neutral cores are reversed, or the earth core is not connected. However, such conditions are dangerous and are liable to cause electric shock. Therefore, do not commit the above mistakes.

- **Proper use of electric plugs**

1. Never insert electric cable cores direct into a socket outlet or an adapter to get power. Use a plug or other suitable devices for proper connection to the power source.

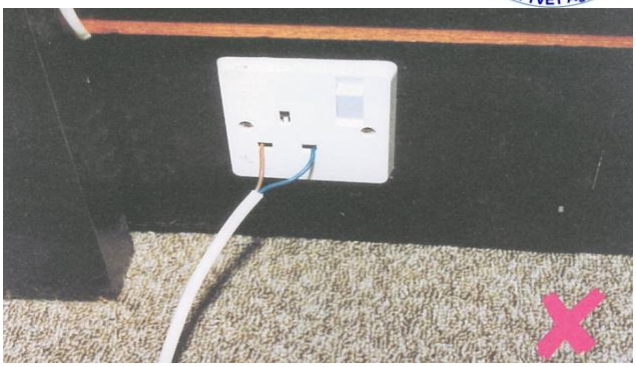


Figure 3.6 plug or other suitable devices

2. A plug should match with the socket outlet or the adapter to be connected to. Do not tamper the plug or the socket to make the matching, or insert the plug to the socket by force if they are of the different types.

3. Do not overload the plugs. The plug connecting an electrical equipment should match with the power/current rating of the equipment. The maximum allowable power of electrical equipment connected for the different types of plug should be as follows:-

Type of plug	Round pins (small)	Square pins	Round pins (large)
Current Rating (Ampere, A)	5	13	15
Maximum power of equipment connected (Watt, W)	1,000	2,600	3,000

Table 3.3 plug connecting rating

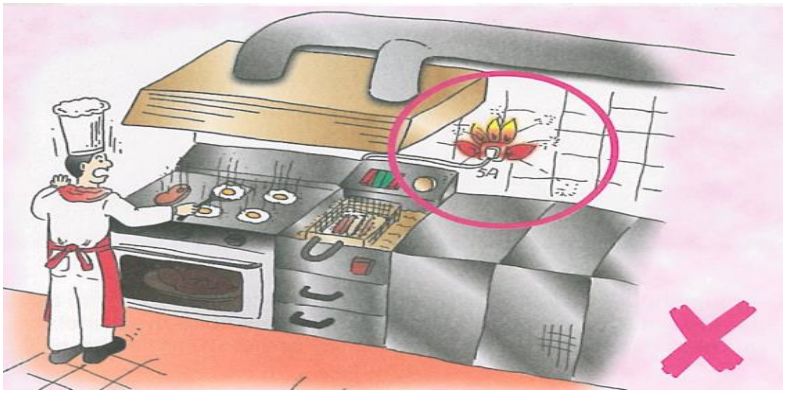


Figure 3.7 overloaded plugs

4. Plugs should be kept away from naked or heat sources.

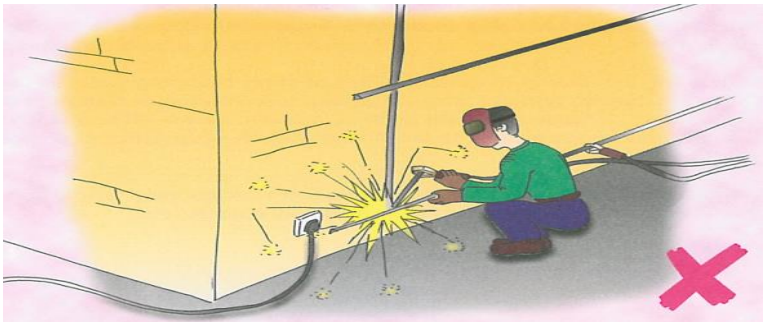


Figure 3.8 plugs near to heat

5. Avoid dripping and splashing of water or other liquids on the electric plug and the adapter.

Figure 3.9 dripping and splashing of water to electric plugs

- **Points to note when handling electric plugs**

1. Check the plug before using an electrical equipment. Do not use an electric equipment having a broken plug. Replace the plug as soon as possible**.**

2. Notice the symptoms of overloading/heating of a plug such as feeling warm/hot, having burning smell, charring, discoloring or distortion of the plug casing. In case there are such symptoms, switch off and stop using electrical equipment immediately and seek the assistance of competent persons.

3. Handle plugs with care to avoid breaking them accidentally. Avoid crashing them with hard objects, rolling over by heavy objects, etc.

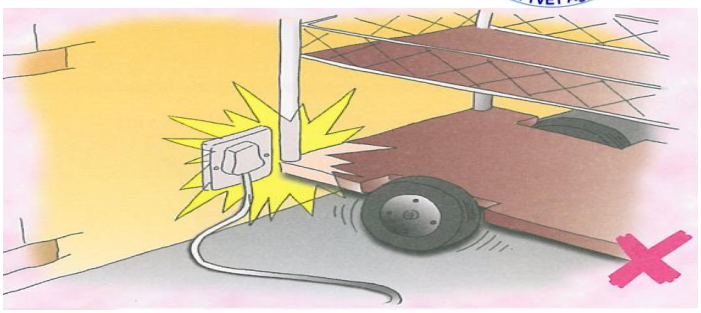


Figure 3.10 improper handling of plugs

4. If the plug is broken accidentally while using an electrical equipment, immediately switch off the equipment and the power source. Seek the assistance of competent persons.

Warning: never try to remove a broken plug from a live socket or a live adapter.

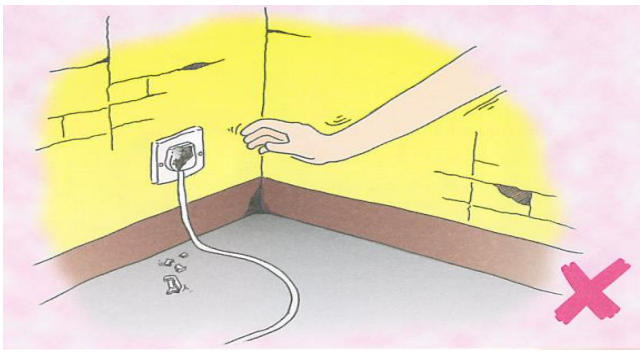


Figure 3.11 removing a broken plug

5. Unplug by pulling the plug instead of the cord.

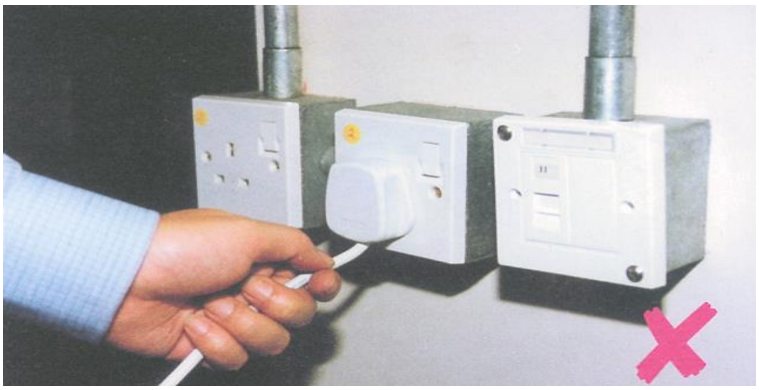


Figure 3.12 plugging by pulling the plug

6. Beware not to touch the metallic plug pins with your fingers while plugging or unplugging a plug.

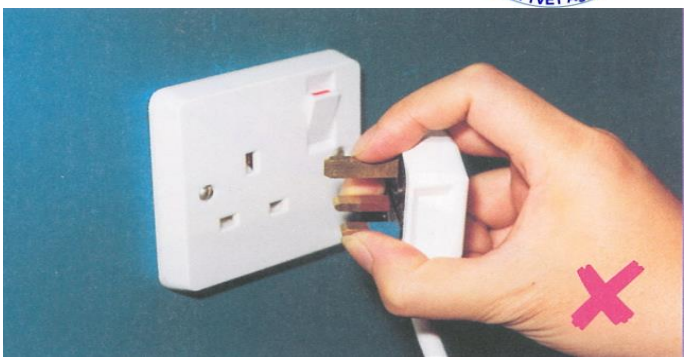


Figure 3.13 touching the metallic plug pins with your fingers

7. Keep your hands dry while plugging or unplugging a plug.

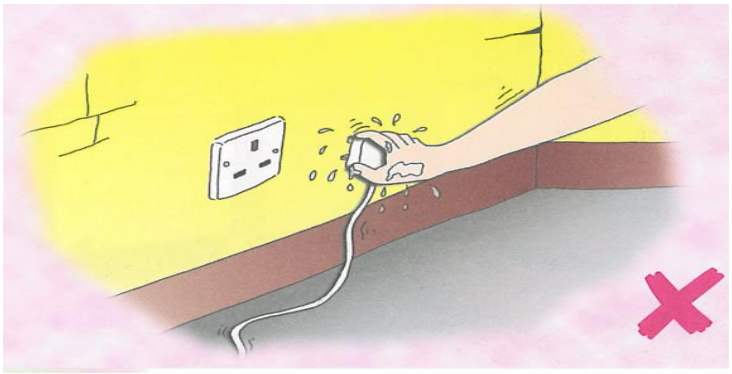


Figure 3.14 drying hands while plugging or unplugging

Self-Check -3	Written Test

Directions: ***Say true if the statement is correct and false for incorrect statements.***

1. An important feature about safety at work is the need for employers to consult with employees about the work they do.
2. Reversing the line (L) and the neutral (N) cores have not risks.
3. Removing a broken plug from a live socket or a live adapter by hand have not risks.
4. Checking the plug before using an electrical equipment is not necessary.
5. For the sake of electrical safety, electric plugs should be wired and repaired by competent persons.
6. Matching the plug connecting an electrical equipment with the power/current rating of the equipment is not necessary.

Note: **Satisfactory rating - 3 out of 6 points Unsatisfactory - below 3 out of 6 points**

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

Score = _____

Rating: _____

Information sheet 4	obtaining cord connected apparatus and cord assemblies to test

4.1 Definition of terms

Cord is a flexible cable with a limited number of conductors of small cross-sectional area.

Portable apparatus means electrical apparatus capable of being carried manually while it is being used but does not include a cap lamp.

It covers such items as hand-held portable or transportable welders, portable power tools, appliances and flexible extension cords.

Cord connected apparatus: is portable or frequently moved that is connected by a flexible cord to a power supply. Examples of this are kitchen appliances, overhead projectors, lights/lamps, heaters, computers etc.

Cord assemblies: A **power cord**, **line cord**, or **mains cable** is an electrical cable that temporarily connects an appliance to the mains electricity supply via a wall socket or extension cord.

The terms are generally used for cables using a power plug to connect to a single-phase alternating current power source at the local line voltage (generally 100 to 240 volts, depending on the location).

Testing: - The use of standardized tests to check equipment, plant operation, process control, performance and effectiveness according to a procedure.

4.2 Obtaining cord connected apparatus to test

Cord and plug connected appliances have a cord with a molded plug that is either factory or field installed on the appliance. The appliance is then ready to be plugged in to a receptacle in the location it is permanently installed.

The appliance need only to be tested to the power inlet. Some appliances have a switch for selection of voltage.

Testing on electrical equipment and appliances supplied within the electrical installation, e.g. meters, fans, etc. shall be carried out in accordance with the relevant sections of other Building Services Branch Testing and Commissioning Procedures for other building services installations and manufacturer's recommended testing procedures.

4.3 Obtaining cord assemblies to test

- A **cord set** includes connectors molded to the cord at each end. Cord sets are detachable from both the power supply and the electrical equipment, and consist of a flexible cord with electrical connectors at either end, one male, or one female.
- One end of the cord set is attached to a molded electrical plug; the other is typically a molded electrical receptacle to prevent the possibility of having an exposed live prong or pin which would cause electric shock.
- The female connector attaches to the piece of equipment or appliance while the male plug connects to the electrical receptacle or outlet.

Figure 4.1 Power cord, with plug at end, plugged into an outlet with ground post

A power cord, line cord, or mains cable is an electrical cable that temporarily connects an appliance to the mains electricity supply via a wall socket or extension cord.

The terms are generally used for cables using a power plug to connect to a single-phase alternating current power source at the local line voltage.

Figure 4.2 grounding conductor distinguishable from other conductors.

- A conductor of a flexible cord or cable that is used as a grounded conductor or an equipment grounding conductor shall be distinguishable from other conductors.
- **Extension cords (extension leads)** are used for temporary connections when a socket is not within convenient reach of an appliance's power lead.
- A power strip with multiple sockets may also have a switch, surge voltage protection, or over-current protection.

Figure 4.3 power cable assemblies

4.4 Identify OHS hazards and suitable safety

4.4.1 Risks while Testing Cords

- Electric shock
- Electrocution
- Falling over on same level causing bruises, sprains, strains, fractures
- Muscular stress
- Musculoskeletal Disorder

4.4.2 Safety Tips

- Extension cords should be a minimum 16 gauge (AWG);

- Extension cords are for temporary use only.
- Use polarized extension cords with polarized equipment, instruments and appliances. Polarized plugs have one blade slightly wider than the other and can only be inserted one way into the outlet. Polarization and grounding ensure that certain parts of appliances that could have a higher risk of electric shock when they become live are instead connected to the neutral, or grounded, side of the circuit. Such electrical products should only be used with polarized or grounding type extension cords;
- Routinely inspect power and extension cords. The plug should be molded to the cord or have a clamping mechanism that fits snugly around the cord without pinching. The cord should not be frayed or have exposed wiring. Electrical tape is not an acceptable repair for a damaged cord, replace the entire cord;
- Power cords must have grounding plugs or be double insulated. Never remove the third (round or U-shaped) ground prong from electrical cords. The ground prong is a safety feature designed to reduce the risk of shock and electrocution;
- Do not connect multiple cords or power strips together;
- Carefully place power and extension cords so they don't come in contact with water or chemicals. Contact with water is a shock hazard. Corrosives and solvents can degrade the cord insulation;
- Do not allow cords to dangle from counters or hoods in such a manner that equipment could be unplugged, fall, or cords could be tripped over or snagged;
- Do not have cords that are strained;
- Do not allow cords to run under movable equipment or chairs;
- Properly secure cords for temporary installations when they cross travel ways;
- Do not use staples or nails to attach extension cords to a baseboard or to another surface. This could damage the cord and present a shock or fire hazard;

- Do not allow cords to contact hot surfaces to prevent melting insulation;
- Do not lift a piece of electrical equipment by the cord or pull the cord to disconnect it from the outlet in order to prevent damage;
- Never use an extension cord while it is coiled or looped, it could overheat;
- Never cover any part of an extension cord with newspapers, clothing, rugs, or any object's while the cord is in use;
- Insert plugs fully so that no part of the prongs are exposed when the extension cord is in use;
- Check the plug and the body of the extension cord while the cord is in use. Noticeable warming of these plastic parts is expected when cords are being used at their maximum rating. However, if the cord feels hot or if there is a softening of the plastic, this is a warning that the plug wires or connections are failing and that the extension cord should be discarded and replaced; and
- Check for hot or discolored outlet wall plate that may indicate dangerous heat buildup at the connections.

Self-Check -4	Written Test

Directions: ***Say true if the statement is correct and false for incorrect statements.***

1. Cord is a flexible cable with a limited number of conductors of small cross-sectional area.
2. Allowing cords to run under movable equipment or chairs have no danger.
3. Testing is checking equipment, plant operation, process control, performance and effectiveness.
4. Extension cords are used for temporary only.
5. Electric shock and Electrocution are the only risks occurred while Testing Cords.
6. Connecting multiple cords or power strips together doesn't have any damage.
7. Using coiled or looped extension cord cannot bring overheating.
8. Inserting exposed plugs prongs fully when using the extension cord has risks.

Note: **Satisfactory rating - 4 and above out of 8 points** **Unsatisfactory - below 4 out of 8 points**

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

Score = _____

Rating: _____

Information sheet 5	**checking Portable apparatus testing device for correct operation and safety**

5.1 Definition of terms

Portable appliance means an appliance which is or can easily be moved from one place to another when in normal use and while connected to the supply.

It is a device or an apparatus that is connected to the electrical power supply through a general purpose outlet in the form of a plug-in type.

Portable Electrical Appliance is, literally, any electrical equipment capable of being carried and, in general, connected to the mains supply by a flexible lead and a plug. The definition includes appliances with their own power sources, e.g. “intrinsically safe” equipment used in potentially explosive environments and equipment designed to operate at 220 volts. The definition does not include equipment which is “hard” wired, e.g. heavy equipment supplied by a fixed, armored power cable, which is tested using other regimes.

Portable Appliance Testing is the visual examination and electrical testing of portable electrical equipment used in industrial, commercial or public access areas and locations (including rented property) to ensure they are safe to use, and cannot present an electrical hazard to the operator or anyone in their vicinity.

Portable appliance testing (PAT) is the term used to describe the examination of electrical appliances and equipment to ensure they are safe to use. Most electrical safety defects can be found by visual examination but some types of defect can only be found by testing. However, it is essential to understand that visual examination is an essential part of the process because some types of electrical safety defect can't be detected by testing alone.

5.2 Checking Portable apparatus testing device

Many faults with work equipment can be found during a simple visual inspection and working on it. So the following care tips should be implemented.

- Switch off and unplug the equipment before you start any checks.
- Check that the plug is correctly wired (but only if you are competent to do so).

- Ensure the fuse is correctly rated by checking the equipment rating plate or instruction book.
- Check that the plug is not damaged and that the cable is properly secured with no internal wires visible.
- Check the electrical cable is not damaged and has not been repaired with insulating tape or an unsuitable connector. Damaged cable should be replaced with a new cable by a competent person.
- Check that the outer cover of the equipment is not damaged in a way that will give rise to electrical or mechanical hazards.
- Check for burn marks or staining that suggests the equipment is overheating.
- Position any trailing wires so that they are not a trip hazard and are less likely to get damaged.

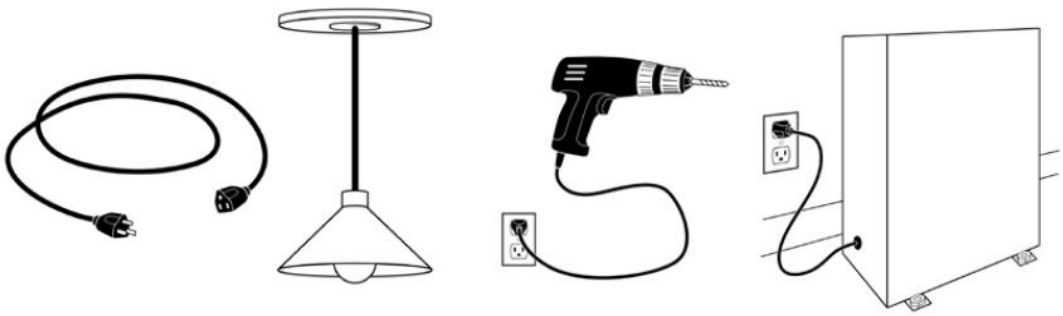


Figure 5.1. Checking Portable apparatus testing device

5.3 Operation of Portable apparatus testing device

The person doing testing work needs to competent to do it. In many low-risk environments, a sensible (competent) member of staff can undertake visual inspections if they have enough knowledge and training. However, when undertaking combined inspection and testing, a greater level of knowledge and experience is needed, and the person will need:

- the right equipment to do the tests
- the ability to use this test equipment properly
- the ability to properly understand the test results

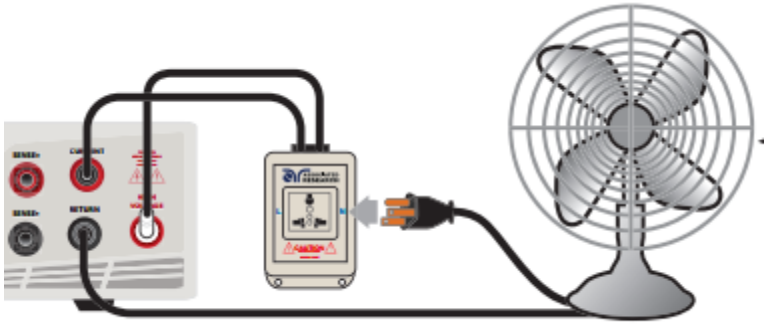


Figure 5.2 operation of Portable apparatus testing device

5.4 Portable apparatus testing device safety

You should make sure that electrical equipment used for work is safe. Here are a list of actions that should be taken to ensure this is so:

1. Perform a risk assessment to identify the hazards, the risks arising from those hazards, and the control measures you should use.
2. Check that the electrical equipment is suitable for the work and way in which it is going to be used.
3. Check that the electrical equipment is in good condition. The HSE booklet maintaining portable and transportable electrical equipment will help you do this.
4. Check that the equipment is suitable for the electrical supply with which it is going to be used, and the electrical supply is safe.

5. It is often beneficial to use a Residual current device (RCD) between the electrical supply and the equipment.
6. Make sure that the user of the equipment is trained to use it safely and can keep others safe.

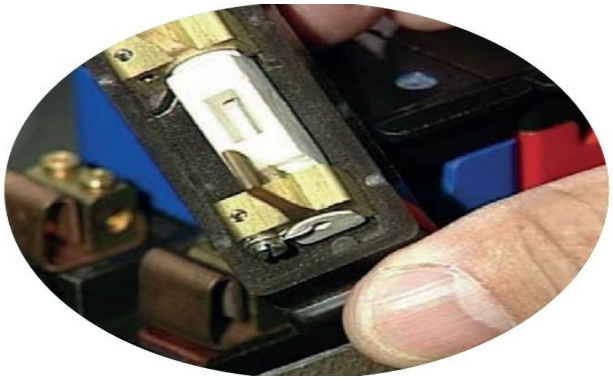


Figure 5.3 checking a fuse carrier (base missing)

- **Who has responsibilities to ensure that equipment continues to be safe?**

Various people have responsibilities for electrical equipment, these being:

- ✓ Property owners, equipment owners, company owners, directors, and line managers. The duty holder is normally drawn from these.
- ✓ The person undertaking the formal visual examination and electrical testing.
- ✓ Maintenance managers.
- ✓ Operators of the equipment – to monitor the equipment they use and ensure it has no obvious faults or damage.

The regular planned formal inspection and testing of portable electrical equipment may include:

- Formal visual inspection for signs of damage and deterioration
- Electrical tests using a calibrated PAT device. As a minimum these electrical tests take the form of an earth continuity and leakage test (where an earth is present), and an insulation test.

The type of inspection and testing should be determined by risk assessment and be related to the type of equipment, environment it is to be used in and the activities it is used for.

Self-Check -5	Written Test

Directions: Answer all the questions listed below.

1. It is a device or an apparatus that is connected to the electrical power supply through a general purpose outlet in the form of a plug-in type.
   a) Portable apparatus b) Portable Appliance Testing c) hand tools d) all
2. It is the term used to describe the examination of electrical appliances and equipment to ensure they are safe to use.
   a) Device b) apparatus c) Portable appliance testing (PAT) d) none
3. Who has responsibilities to ensure that equipment continues to be safe?
   a) Property owners b) equipment owners c) directors d) all
4. What makes that electrical equipment is safe?

   a) Perform a risk assessment to identify the hazards

   b) Check that the electrical equipment is suitable for the work

   c) Check that the electrical equipment is in good condition

   d) All

II. answer the following question

1. List at least 4 means of safety cares that should be implemented while checking portable apparatus testing device. (4 pts)

2. Write at list 3 Portable apparatus testing device safety. (3 pts)

Note: **Satisfactory rating – 5.5 and above out of 11 points Unsatisfactory - below 5.5 out of 11 points**

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

Score = _____

Rating: _____

List of Reference Materials

- Guides for safety at work, **safe use of electric plugs**. May 2009
- *Content from: Gowrie Group, OSHA**, Electrical Safety Foundation***
- **Extension Cord Safety,** Fact Sheet
- Mine Safety Operations December 2006, **Technical Reference Electrical Engineering Safety EES004**, NSW DPI Technical Reference Practices for Portable Electrical Apparatus, *Coal Mine Health and Safety Act 2002 Coal Mine Health and Safety Regulation 2006*

Building Electrical installation

Level II

Learning Guide-42

Unit of Competence: Conduct In-Service Safety Testing of Electrical Cord Connected Equipment and Cord Assemblies

Module Title: Conducting In-Service Safety Testing of Electrical Cord Connected Equipment and Cord Assemblies

LG CODE: EIS BEI2 M011 LO42-LG-42

TTLM CODE: EIS BEI2 M011 TTLM 1019V1

LO2: Test cord connected apparatus and cord assemblies

This learning guide is developed to provide you the necessary information regarding the

Instruction Sheet	Learning Guide #42

following **content coverage** and topics:

- Following OHS risk control work measures and procedures
- Following measures to cord connected apparatus and cord assemblies to tested not connected to the electrical supply
- Applying knowledge of electrical safety requirements and parameters to safety testing
- Carrying out Visual checks of the cord connected apparatus and cord assemblies
- Obtaining approval with established procedures from appropriate personnel
- Following PAT routines to test cord connected apparatus and cord assemblies
- Identifying unsafe cord connected apparatus and cord assemblies from test results
- Undertaking testing with minimum waste of energy and damage to apparatus

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**:

- ✓ Follow OHS risk control work measures and procedures
- ✓ Follow measures to cord connected apparatus and cord assemblies to tested not connected to the electrical supply
- ✓ Apply knowledge of electrical safety requirements and parameters to safety testing
- ✓ Carry out Visual checks of the cord connected apparatus and cord assemblies
- ✓ Obtain approval with established procedures from appropriate personnel
- ✓ Follow PAT routines to test cord connected apparatus and cord assemblies
- ✓ Identify unsafe cord connected apparatus and cord assemblies from test results
- ✓ Undertake testing with minimum waste of energy and damage to apparatus

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, Sheet 4, Sheet 5, Sheet 6, Sheet 7 and Sheet 8” **in page 38, 43, 47, 50, 59, 64, 68 and 73** respectively.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self-check 4, Self-check 5, Self-check 6, Self-check 7, and Self-check 8” **in page 42, 46, 49, 58, 63, 67, 72 and 82** respectively
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation and Operation Sheet 2” **in page 83 and 84.**
6. Do the “LAP test” **in page 85.**

Information sheet-1	Following OHS risk control measures and procedures

1.1. Overview

What Must Be Done to Be Safe?

- Use the three-stage safety model: recognize, evaluate, and control hazards.
- To be safe, you must think about your job and plan for hazards.
- To avoid injury or death, you must understand and recognize hazards.
- You need to evaluate the situation you are in and assess your risks.
- You need to control hazards by creating a safe work environment, by using safe work practices, and by reporting hazards to a supervisor or teacher.
- If you do not recognize, evaluate, and control hazards, you may be injured or killed by the electricity itself, electrical fires, or falls. If you use the safety model to recognize, evaluate, and control hazards, you are much safer.

Figure 1.1 Report hazards to supervisor or teacher.

recognize hazards

The first part of the safety model is recognizing the hazards around you only.

It is best to discuss and plan hazard recognition tasks with your co-workers. Sometimes we take risks ourselves, but when we are responsible for others, we are more careful. Sometimes others see hazards that we overlook. Of course, it is possible to be talked out of our concerns by someone who is reckless or dangerous. Don't take a chance.

Careful planning of safety procedures reduces the risk of injury. Decisions to lock out and tag out circuits and equipment need to be made during this part of the safety model. Plans for action must be made now.

Figure 1.2 Always lock out and tag out circuits.

Evaluate hazards

When evaluating hazards, it is best to identify all possible hazards first, then evaluate the risk of injury from each hazard.

Do not assume the risk is low until you evaluate the hazard. It is dangerous to overlook hazards. Job sites are especially dangerous because they are always changing. Many people are working at different tasks. Job sites are frequently exposed to bad weather.

A reasonable place to work on a bright, sunny day might be very hazardous in the rain. The risks in your work environment need to be evaluated all the time. Then, whatever hazards are present need to be controlled.

Control hazards

Once electrical hazards have been recognized and evaluated, they must be controlled. You control electrical hazards in two main ways:

1) Create a safe work environment and
2) Use safe work practices. Controlling electrical hazards (as well as other hazards) reduces the risk of injury or death.

One way to implement this safety model is to conduct a job hazard analysis (JHA). This involves development of a chart: 1) Column 1, breaking down the job into its separate task or steps; 2) Column 2, evaluating the hazard(s) of each task, and 3) Column 3, developing a control for each hazard. See the example below.

Task analysis	Hazard analysis	Hazard abatement
Removing the cover	Electric shock from exposed live wires	De-energize by opening circuit breaker or removing fuse
Removing old GFCI	Possible other live wires in opening	Test wires with appropriate voltmeter to ensure all wires are de-energized
Installing new GFCI	Possible connecting wires incorrectly	Check wiring diagrams to ensure proper connections
Replace cover and re-energize	Possible defective GFCI	Test GFCI

Table 1.1 job hazard analysis (JHA)

Figure 1.3 safety model to *recognize*, *evaluate*, and *control* workplace hazards

1.2 Following OHS

Most people should be aware of the health and safety hazards associated with electricity. To avoid injury, or worse, it is essential to adopt the following precautions:

a. Faulty Equipment: Report faults immediately
   - Do not use, or continue to use, faulty equipment
   - Do not carry out repairs etc. or even fit plugs, unless you are authorized to do so

b. Portable and transportable electrical equipment:
   - Personal issued equipment should be visually inspected at least once a week by the user
   - Equipment used out of doors should be 220 volt or be supplied via a residual current device (RCD)
   - Avoid using long extension leads wherever possible.

1.3 Risk control work measures and procedures

A systematic risk management approach must be applied to eliminate or control the risk of electrical hazards. A range of control measures can be implemented including:

- routine visual checks;
- regular inspection;
- maintenance;
- repair;
- replacement;
- use of residual current devices (RCDs);
- where warranted, testing of identified electrical equipment

Self-Check -1	Written Test

Directions:

I. **Answer all the questions listed below.**

1. A range of control measures can be implemented including:

   b) routine visual checks b) regular inspection c) maintenance d) all

2. What Must Be Done to Be Safe?

   a) Use the three-stage safety model c) you must think about your job

   b) Plan for hazards d) all

3. One of the following precautions is not the essential to avoid injury

   a) Don't use faulty equipment c) Report faults immediately

   b) use faulty equipment d) carry out repairs

II. Give short answer for the given question.

1. Write at list three mechanisms of risk control work measures and procedures.(2 pts)

Note: **Satisfactory rating – 2.5 and above out of 5 points Unsatisfactory - below 2.5 out of 5 points**

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

Score = _____

Rating: _____

Information sheet-2	Following measures to cord connected apparatus and cord assemblies to test not connected to the electrical supply

2.1 Overview

Testing must be carried out to confirm the relevant circuits have been de-energized and the status of any other relevant conductors in the work area.

The person must not connect an electrical installation on which electrical work has been performed to a source of electricity unless:

a. the person who performed the electrical work was authorized under the Act to perform it; and
b. The electrical installation, to the extent it is affected by the electrical work, has been tested to ensure it is electrically safe and complies with the requirements of the wiring rules and any other standard applying under this regulation to the electrical installation.

2.2 Measures to cord connected apparatus to test not connected to electrical supply

1. Take out of Service. Shut down the apparatus. Open switches. De-energize. Disconnect from other equipment and circuits, including neutral and protective (workmen's temporary) ground connections.
2. Make Sure, What is included in the Test. Inspect the installation very carefully to determine just what equipment is connected and will be included in the test, especially if it is difficult or expensive to disconnect associated apparatus and circuits.
   Pay particular attention to conductors that lead away from the installation.
   It is always possible, of course, that the insulation resistance of the complete installation (without disconnecting everything) will be satisfactorily high, especially for a spot check.
3. Discharge of Capacitance It is very important that capacitance be discharged, both before and after an insulation resistance test.
4. Current Leakage at Switches When apparatus is shut down for the insulation resistance test, make sure that the readings are not affected by leakage over or

through switches or fuse blocks, etc. Such leakage may mask the true insulation resistance of the apparatus under test.

Figure2.1 test a circuit to de-energize before working on it

2.3 Measures to cord assemblies to test not connected to electrical supply

- **Defective insulation hazards**

- Insulation that is defective or inadequate is an electrical hazard. Usually, a plastic or rubber covering insulates wires. Insulation prevents conductors from coming in contact with each other. Insulation also prevents conductors from coming in contact with people.

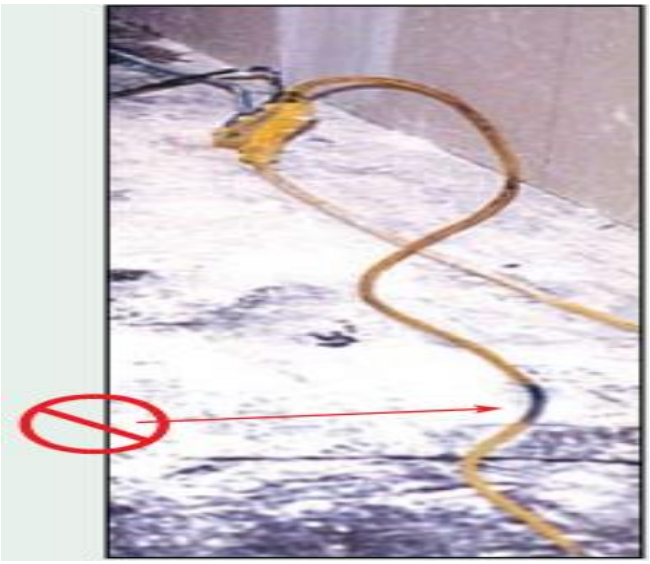


Figure 2.2 damaged extension cord

- Extension cords may have damaged insulation. Sometimes the insulation inside an electrical tool or appliance is damaged. When insulation is damaged, exposed metal parts may become energized if a live wire inside touches them.

- Electric hand tools that are old, damaged, or misused may have damaged insulation inside. If you touch damaged power tools or other equipment, you will receive a shock.

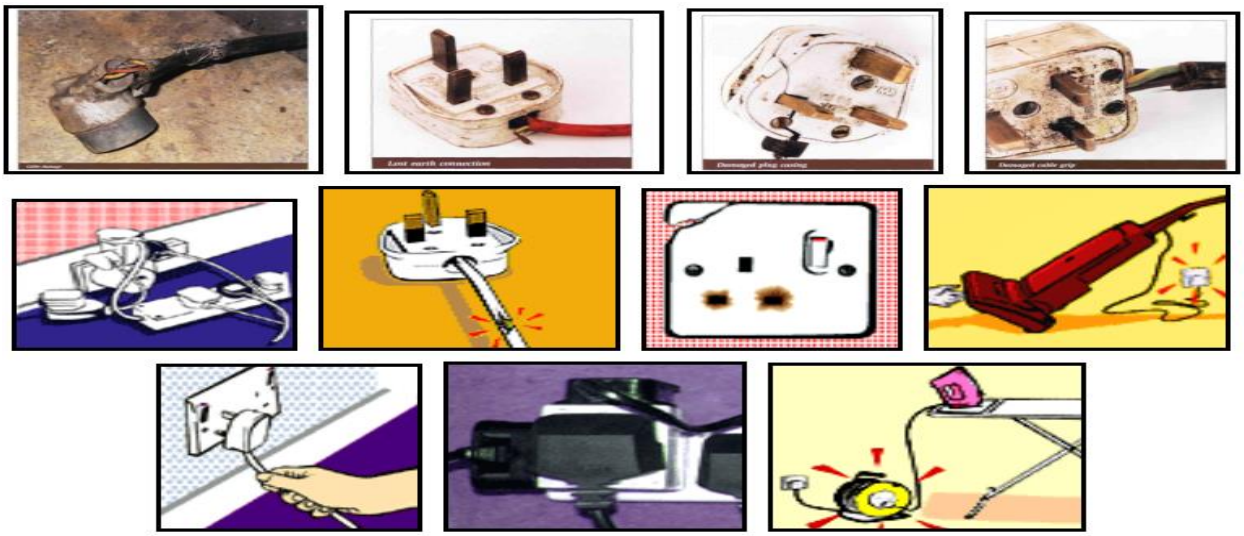


Figure 2.3 cord assemblies

2.4 Suitable safety for Extension Cords

- Extension cords must be 3-wire grounded type, must be designated for hard service or extra hard service, and must be listed by the Underwriters Laboratories.
- Do not exceed the rated load.
- Use cords only in continuous lengths without splice.
- Do not use worn or frayed extension cords.
- To protect cable assemblies, flexible cords, and cables from damage, support them in place with approved staples, cable ties, straps, or similar type fittings installed to prevent damage.

2.5 Rules to follow

- Disconnect any equipment from the General Power Outlet (GPO) to be used for testing.
- General Power Outlet protected by RCD's should be marked RCD Protected and where applicable include the circuit number.
- Disconnect any equipment from the PRCD being tested.
- Ensure all cords and extension leads are uncoiled before testing.

Self-Check -2	Written Test

Directions:

I. Answer all the questions listed below.

1. One of the following is not parts of procedures to test cord connected apparatus to not connected to electrical supply

   a) Take out of Service b) Shut down the apparatus c) "ON" switches d) open switches

2. One of the following is not suitable safety tips for Extension Cords.

   a) Do not exceed the rated load c) use cords in continuous lengths with splice

   b) Do not use worn cords d) frayed extension cords

3. Insulation of the cords or extension cords is important except one of the following:

   a) To have electrical hazard c) to have inadequate electrical hazard

   b) prevents conductors from coming in contact d) all

II. Say true if the statement is correct and false if the statement is incorrect.

1. Testing is carried out to confirm the relevant circuits have been de-energized and the status of any other relevant conductors in the work area.
2. The person who perform the electrical work is not expected to be authorized under the act to perform it.

Note: **Satisfactory rating – 2.5 and above out of 5 points Unsatisfactory - below 2.5 out of 5 points**

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

Score = _____

Rating: _____

Information sheet-3	Applying knowledge of electrical safety requirements and parameters to safety testing

3.1 Introduction

Portable Electrical Appliances must be inspected and tested regularly by Competent Persons to ensure that they can continue to be used safely. The planned inspection and testing will include:

- User check
- Visual Inspection for signs of damage or deterioration
- Electrical Tests, i.e.
    - an Earth Continuity test and
    - relevant Insulation tests

Apart from the user check, the test results will be recorded to allow for future comparison, for written identification of defects to be remedied and to provide information for an assessment of risk.

3.2 Electrical safety requirements

Appliance testing, by its very nature, can be hazardous and various common sense precautions should be observed -

- Ensure that the person responsible for testing is competent and fully trained in the general principles of Safety Testing and the correct use of any required test instruments.
- Ensure, where possible, that a 'test area' is clearly defined and offers limited access to all persons not involved in the testing.
- Ensure that the appliance to be tested is on an insulated (non-conducting) work surface - never use metal, or metal edged, worktops - a robust wooden bench with a securely fitted rubber covering is best.

  For those 'on site' situations where dedicated test areas are unavailable, an old plastic tea tray or rubber car mat can come in very useful for creating the insulated

work surface. Do not use ‘anti-static’ matting as this is highly conductive - which rather defeats the object.

- Arrange appliances and test equipment so that controls are easily accessible without having to reach over or lean across the item during testing - never come into contact with an appliance under test.
- Securely fix down motorized appliances and ensure that moving parts are adequately guarded.
- Check that the intended test is suitable for the appliance - if in doubt contact the Manufacturer or Importer of the appliance.
- Always carry out a thorough Visual Inspection, and complete any necessary repairs, before applying any electrical test.
- If any Safety Test failure occurs ensure that the appliance is fully re-tested after undergoing appropriate repairs.

3.3 Parameters to safety testing

a) The safe work procedure ‘TEST FOR ‘DEAD’ BEFORE YOU TOUCH’ must be applied at all times. Even if the electrical supply is believed to have been isolated, it must be assumed that all conductors and electrical components are energized until they have been proven de-energized.

b) Testing for ‘dead’ must be undertaken as appropriate for the duration of the electrical work. Testing is undertaken prior to touching, taking into account all relevant factors including the nature of the conductor, nature of the isolation, nature of work, if there has been a change or the area has been left idle (unattended) for a period.

c) If voltage testers are used they should be tested for correct operation immediately before use and again after use to confirm that the instrument is still working. This check should be considered to be part of the ‘TEST FOR ‘DEAD’ BEFORE YOU TOUCH’ safe work procedure.

d) If there are any exposed conductors in the immediate work area they should be separated by design or segregated and protected with insulated barricades, insulated shrouding or insulated material to prevent against inadvertent or direct contact.

Self-Check -3	Written Test

Directions: ***Answer all the questions by saying true if the statement is correct and false if the stamen is false.***

1. Always carry out a thorough Visual Inspection, and complete any necessary repairs, before applying any electrical test.
2. Testing is undertaken prior to touching and taking into account all relevant factors.
3. The person can come into contact with an appliance with live supply doesn't have any risks.
4. Regular inspecting and testing of Portable Electrical Appliances can be made by incompetent Person.

Note: **Satisfactory rating – 2 and above out of 4 points** **Unsatisfactory - below 2 out of 4 points**

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

Score = _____

Rating: _____

Information sheet-4	Carrying out Visual checks of the cord connected apparatus and cord assemblies

4.1 Definition of terms

Inspection - Conformity evaluation by observation and judgement of the work environment, work practices, equipment use, work posture or reported hazard.

Appliance/apparatus an item of current-using equipment other than a luminaire or an independent motor

Cord is a flexible cable with a limited number of conductors of small cross-sectional area.

Cord assemblies/ extension set: Means an assembly of a plug intended for connection to a mains socket-outlet, a sheathed flexible cord and a cord extension socket (e.g. extension cord).

Cord set means an assembly of a plug intended for connection to a mains socket-outlet, a sheathed flexible cord and an appliance connector.

4.2 Carrying out Visual checks of the cord connected apparatus

Everything portable or transportable, whether fitted with a plug for connection to a socket-outlet or connected directly to a fused spur, requires visual inspection and testing. Such items include:

- **Multiway adapters and GFCI Adapters**

Multiway adapters are used to increase the number of connection points at any location within a property. The use of these adapters should be avoided wherever possible, and a suitable judgement made during the visual examination as to how appropriate their use is in any specific application.

- Adapters are those Multi-Outlet units less than 6’ long**.**
- Extension Cords with Multi-Outlet cord caps are also a good choice for field use

Figure 4.1 Multiway adapters and GFCI Adapters

- **Extension Cords and ground-fault circuit interrupter GFCI-protected**

- An extension cord is used where an item of equipment needs to be supplied but a convenient socket/outlet is not nearby. Preferably, the use of extension cords should also be avoided whenever possible.
- They can present physical hazards such as tripping that could be avoided if an installation has sockets in the appropriate place.
- A GFCI extension cord is one that includes GFCI protection either at the plug or near the sockets, for powering equipment used outdoors.

Figure 4.2 Extension Cords

Figure 4.3 ground-fault circuit interrupter

- **Hand-held Equipment**

These appliances require the operator to hold them in their hand(s) during normal operation (i.e. steam irons, hair dryers, soldering irons and drills).

- **Portable Appliances**

These appliances are ones that can be easily moved while they are energized and have a mass of less than 40 lbs. Equipment included in this category are items such as coffee makers and electric space heaters.

➢ **Information Technology (IT) Equipment**

This category covers IT business equipment that is found in most commercial offices (i.e. mains-powered computers, telephones, printers, photocopiers, fax machines, laminators, shredders etc.).

➢ **Portable Equipment**

This category covers equipment that is:

- Not fixed to the location and weighs less than 40 lbs., (i.e. a small television).
- Furnished with wheels or casters which is intended to be moved on an occasional basis. (I.e. commercial kitchen or laundry equipment).

➢ **How to carry out simple visual checks on electrical equipment?**

- Electricity can kill. Do not take unnecessary chances.
- If you are unsure whether any electrical equipment is unsafe or if there are signs that could indicate the equipment is faulty or damaged, DO NOT USE IT and REPORT IT

4.3 Carrying out Visual checks of the cord assemblies

The following points are carrying out visual checks of the cord assemblies:

○ **Casing**

- Check for signs of undue wear, cracks or dents, missing components such as guards, covers or hand grips etc.
- Ensure that all screws and catches are present and secure.
- Check for evidence of excessive dust and dirt build up in and around any ventilation slots, especially carbon-brush dust which is highly conductive and could create a 'live' path around insulation barriers.
- Also ensure that all movable guards operate smoothly.

○ **Supply Lead**

- Check for any signs of damage or fraying along the entire length, this should also include any extension lead that may be regularly used with the appliance.
- Ensure that any cable entry or connector is sound and secure.

○ **Plugs And Fuses**

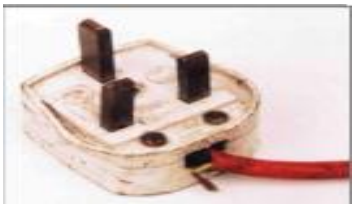
- Thoroughly check plug tops for damage and ensure that all wires are correctly connected.
- Ensure that cable grips and strain relief bushes are properly secure.
- Check that the correctly rated fuses are fitted - even a 5A fuse fitted in place of a recommended 3A fuse may give rise to a potentially dangerous fault condition.
    - **Switches And Function Selectors**
- Ensure that all switches, including rotary selector devices, operate smoothly and in the expected manner.
- Set supply switches to the ON position in preparation for the Safety Test. Multi-function appliances, such as a two heat/two speed heater, will require testing in each operating mode.

NOTE: Any fault or irregularity highlighted by the visual inspection must be corrected before electrical testing is carried out.

- Here are some examples on carrying out visual checks of cord assemblies and cord connected apparatus

Points to check	Example photograph	Description of photograph
Damage to the cable sheath (apart from light scuffing)		Outer insulation of the cable is broken. Inner cables or wires are visible.
Damage to the plug casing and lack of insulation on bottom two pins		The plug casing is broken. Also, the bottom two metal pins are fully exposed and have no insulation (black sheathing which covers one half of each

bottom pin, closest to the plastic casing of the plug).

Damage to the casing of the electrical equipment		A portable fan with a broken base. Internal connections and wires are exposed
Signs of unsafe connection		Electrical cable connectors have been used to join two separate pieces of cable in order to extend the overall length of cable
Lost earth connection		The earth wire has become detached from inside the plug casing
Damage to cable grip		Outer insulation cable is not gripped inside the plug casing. Internal cables are exposed.
Overloaded socket		An overloaded extension lead which is being used to supply electricity to multi-way plugs and other adaptors.

Overloading and multiple wiring of socket		The wall mains socket is overloaded. Multiple items of electrical equipment have been wired into one plug; this is highly dangerous.
Overloading and wiring of second item of equipment onto pins outside protective casing		Wires are exposed. Two items of equipment are being run off a single plug; this is highly dangerous
Evidence of overheating		Scorch or burn marks on socket casing due to either a poor connection in the socket or in the equipment which is plugged into the socket
Unsuitable conditions - inside		Electrical weighing machine used on kitchen sink. Potential contact between water and electricity
Unsuitable conditions - outside		Electrical extension leads used outside in wet conditions.

Unsuitable conditions – poor housekeeping		Electrical cable is likely to be cut by the circular saw.
Overloaded sockets		Multiple appliances connected to inappropriate adaptors, plugs or extension leads
Unsuitable conditions – poor housekeeping		Cables are lying across the floor in front of a doorway. Likely trip hazard

Table 4.1 Carrying out Visual checks cord assemblies and cord connected apparatus

4.4 What Inspection and Testing Needs to be done?

The dangers of contact with live electrical parts need no explanation to an electrician. However, the environments in which the majority of portable appliances are used are not necessarily where operators would be aware of the dangers or the implications of damage to equipment. The point of routine visual inspection and electrical testing is to identify potential hazards and actual dangers before they turn into an accident.

The hazards that must be identified include:

- Personal exposure to live conductors — electrocution.
- High current faults causing excessive heat — fire.
- Intermittent connection — arcing causing heat and potential ignition.

These hazards can be identified by performing in-service:

- Regular electrical tests.
- Visual examination.
- Combined visual examination and electrical tests.

Various people have responsibility for electrical equipment, including:

- Property owners, equipment owners, company owners, directors, and line managers etc.
- The person undertaking the formal visual examination and electrical testing.
- Maintenance managers.
- Operators of the equipment.

Self-Check -4	Written Test

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

1. hazards can be identified by performing by:
   a) Regular electrical tests b) Combined visual examination and electrical tests
   b) Visual examination. d) all
2. Who have the responsibility for electrical equipment?
   a) Property owners b) equipment owners c) company owners, d) all

III. Match from column A to column B the following.

Column A	Column B
1. Personal exposure to live conductor's	a. Unsuitable conditions
2. High current faults causing excessive heat	b. electrocution.
3. Intermittent connection	c. arcing causing heat and potential ignition.
4. 	d. fire.
5. 	e. Evidence of overheating

Note: **Satisfactory rating - 4 and above out of 8 points** **Unsatisfactory - below 4 out of 8 points**

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

Score = _____

Rating: _____

Information sheet-5	Obtaining approval with established procedures from appropriate personnel

5.1 Introduction

Only authorized and qualified electrical workers should install, repair or perform maintenance on commercial electrical equipment. Only authorized and qualified electrical workers are permitted to install, repair or perform maintenance on laboratory and building electrical systems;

- All staff and students should receive health and safety training appropriate to the work and activities they are engaged in;
- Follow the instructions provided by your supervisor or instructor;
- Treat all electrical devices as if they are live or energized;
- Review procedures and safety rules prior to beginning work. Ensure that you understand the procedures, electrical hazards and what measures are in place to protect you. Follow all safety rules including those for the use of required personal protective equipment;
- Review emergency procedures;
- Know the location of electrical panels and shut-off switches so that they can be quickly disconnected in the event of an emergency;
- Know the locations of safety devices such as first aid kits, fire extinguishers, emergency eye washes and showers, automated external defibrillators, etc.;
- Ensure equipment, tools and personal protective equipment is in good operating condition. Never use equipment, tools or personal protective equipment that are in disrepair or not properly maintained;
- Keep flammable materials away from electrical equipment;
- Limit the use of extension cords. Use only for temporary activities. In all other cases, request installation of a new electrical outlet;
- Practice good housekeeping. Poor housekeeping is a major factor in many accidents. A cluttered area is likely to be both unsafe and inefficient;

- Access to electrical panels should not be blocked or covered by materials. There should be a one meter clearance between electrical panels and any object;
- Do not engage in horseplay; and
- Immediately report unsafe acts or conditions to your supervisor or instructor.
- When designing circuits and systems include circuit protection devices as needed;
- Do not wear loose clothing or ties near equipment. Remove metal jewelry (watches, rings, etc.) before working on electrical circuits;
- Turn off power and unplug power and extension cords from the wall before assembling or working on an electronic circuit or apparatus, except when absolutely necessary;
- Ensure electrical components (switches, resistors, capacitors, inductors, transistors, etc.) are appropriate for the circuit or apparatus;
- Place exposed electrical conductors (especially those with greater than 50 volts) in protective chassis boxes or behind Plexiglas shields;
- Complete all wiring and check it carefully before applying power to the circuit power.
- Use the shortest wires possible and ensure that all connections are secure. Students should have circuits inspected by instructors prior to applying power;
- When a circuit or apparatus is to be reconfigured or rewired, turn the power supply off. It is also a good practice to disconnect power and extensions cords from the power supply.
- Ensure to test the circuit using an appropriate multimeter to confirm that the circuit or apparatus is fully de-energized;
- Safely discharge capacitors and inductors in equipment before working on the circuits. Large capacitors found in many laser flash lamps and other systems are capable of storing lethal amounts of electrical energy and pose a serious danger even if the power source has been disconnected;
- Avoid contact with energized electrical circuits. Never touch live circuit components with bare hands;
- Make sure equipment chassis or cabinets are grounded. Never cut off or defeat the ground connection on a plug;

- When performing measurements on a live/active circuit, be sure to shift meter probes and connectors using only one hand. It is best to keep the other hand off other surfaces and behind your back;
- Do not work on electrical equipment in a wet area or when touching an object that may provide a hazardous earth ground path;
- Never overload circuits;
- Never leave unprotected systems unattended;
- Never place containers of liquid on electrical systems;
- Ensure to turn off the power supply first before disassembling the circuit;
- Use only tools and equipment with non-conducting handles when working on electrical devices;
- Never use metallic pencils or rulers, or wear rings or metal watchbands when working with electrical equipment;
- When it is necessary to handle equipment that is plugged in, be sure hands are dry and, when possible, wear nonconductive gloves and shoes with insulated soles;
- If water or a chemical is spilled onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment;
- Equipment producing a "tingle" should be disconnected and reported promptly for repair. “Shorts” (ground faults) are extremely hazardous especially where in contact with metal framework of an exhaust hood or damp floor;
- Do not rely on grounding to mask a defective circuit nor attempt to correct a fault by insertion of another fuse or breaker, particularly one of larger capacity; and
- Never touch another person’s equipment or electrical control devices unless instructed to do so.

5.2 Obtaining approval with established procedures

1. Understand the job & isolation requirements
    - voltage levels
    - Authority to Work
    - any other relevant permits
    - Complete testing/fault finding

2. Identify and control the work environment hazards
    - Area free of tripping hazards?
    - Damp situations?
    - Access and egress?
    - clear area of unnecessary equipment and materials
    - safeguards to prevent hazards from moving equipment
    - Barriers to prevent inadvertent contact with other live circuits/equipment
3. accurately identified the equipment to be worked on
    - refer to relevant electrical drawings
    - check for correct labelling
4. Identify all relevant electrical and other energy sources, including multiple feeds to equipment, induced voltage or capacitive charge then isolate & lockout with equipment lock/s
    - refer to relevant electrical drawings
    - refer to relevant procedures, work instructions & switching schedules
    - Consider live connections from induced voltage or capacitive charge from testing procedures or other unexpected sources.
    - Check for voltage on disconnected/ separated neutral conductors
5. Verify that all sources of energy are isolated or blocked
    - Prove the test instrument (before and after testing for isolation)
    - Test that the all power has been isolated from the circuit to be worked on Any other verification procedure in the Isolation permit
6. Apply personal lock/s
    - Procedure depends on whether individual or group isolation.
    - The circuit to be worked on should be tested at the work site before starting work.

Self-Check -5	Written Test

Directions:

I. ***Answer all the questions by saying true if the statement is correct and false if the stamen is false***.

1. Working on electrical equipment in a wet area or touching an object that may provide a hazardous earth ground doesn't have hazard.
2. Using conducting handles of tools and equipment when working on electrical devices is a safe working environment.
3. It is important to shut off power at the main switch or circuit breaker and unplug the equipment; if water or a chemical is spilled onto equipment.

II. Answer the following question

1. Write the steps to get approval with established procedures. (5 pts)

Note: **Satisfactory rating - 4 and above out of 8 points Unsatisfactory - below 4 out of 8 points**

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

Score = _____

Rating: _____

Information sheet-6	Following PAT routines to test cord connected apparatus and cord assemblies

6.1 Definition of terms

Electrical Appliance: A device or apparatus that is connected to the electrical power supply through a general purpose outlet in the form of a plug-in type.

Portable apparatus means electrical apparatus capable of being carried manually while it is being used but does not include a cap lamp. It covers such items as hand-held portable or transportable welders, portable power tools, appliances and flexible extension cords.

A Portable Appliance Tester (PAT) is an electronic instrument that automatically tests equipment plugged into it. The results it indicates require no technical interpretation.

Portable Equipment: Equipment that is carried or moved while the electricity supply is connected, that is either designed to be portable (i.e. laptop computers, power tools, vacuum cleaners, industrial polishers, etc.) or can be made portable (i.e. overhead projectors, power boards, extension leads, urns, heaters, some portable research equipment etc.). Kitchen appliances such as toasters, kettles, jugs, frypans, urns etc. are also defined as portable equipment.

The input to portable electric heating and cooking appliance for use on nominal 230.0v branch circuits protected by overcurrent devices rated or set at not more than 16.0A shall not exceed 1500.0W at 230.0v.

6.2 PAT routines/procedures to test cord connected apparatus

The best means by which to control risks in the use and maintenance of electrical appliances is to establish a system of regular Portable Appliance Testing (PAT). The Portable Appliance Testing (PAT) test includes the following items, are to be tested preferably in the sequence indicated below:

- Preliminary visual inspection
- Using a PAT device:

- Earth continuity tests (for Class 1 equipment)
- Insulation testing (which may sometimes be substituted by earth leakage measurement)
- Functional checks.

Visual inspection can be carried out by all users of portable appliance, ideally each time the appliance is used.

However electrical testing with a PAT device must only be performed by a person who is competent in the safe use of the test equipment and who knows how to interpret the test results obtained. This person must be capable of inspecting the equipment and, where necessary, dismantling it to check the cable connections.

Figure 6.1 PAT testing of cord connected apparatus

6.3 PAT routines to test cord assemblies

➢ Extension Cord and IEC Power Cord Tests

- To check extension cords and line cords for safe operation.
- In addition to these standard tests, some instruments will perform a flash test (hi pot or dielectric strength test) to test breakdown voltage levels. This test is normally done on new equipment, articles that have had a major overhaul, or equipment in the rental industry.

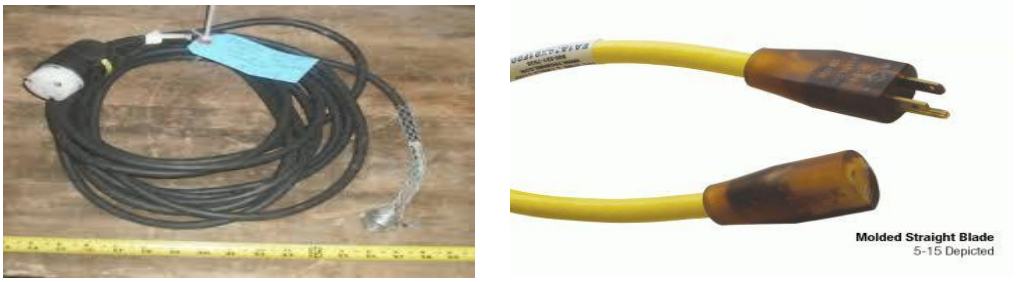


Figure 6.2 power cord assemblies

Figure 6.3 PAT testing of power cord assemblies

6.4 Frequency of testing.

The frequency of PAT maintenance depends upon the type of equipment and the environment it is used in. The Electricity at Work Regulations 1989 require all portable appliances to be maintained and inspected on a schedule that is determined by the risk presented by each unit. This should take account of the

- Type of equipment
- power rating, and class of electrical equipment,
- age of equipment,
- manufacturers recommendations,
- individuals using the equipment,
- frequency of use,
- Working environment it is to be used in.

A combined inspection and test should also be carried out whenever there is reason to suppose the equipment is defective and this cannot be confirmed by visual inspection, and after any repair or modification work.

Self-Check -6	Written Test

Directions:

Answer all the questions listed below.

1. Schedule of all portable appliances to be maintained and inspected is determined by the risk presented. And this should take account of the:
   a) Type of equipment c) power rating, and class of electrical equipment
   b) age of equipment d) all
2. one of the following is not importance of PAT routines to test cord assemblies
   a) To check extension cords c) line cords for safe operation
   b) To check current carrying capacity d) all
3. The best means to control risks in use and maintenance of electrical appliances is to establish a system of regular Portable Appliance Testing (PAT).
   a) True b) False
4. One of the following is not categorized under portable apparatus?
   a) cap lamp b) welders c) portable power tools d) appliances

Note: **Satisfactory rating - 2 and above out of 4 points Unsatisfactory - below 2 out of 4 points**

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

Score = _____

Rating: _____

Information sheet-7	Identifying unsafe cord connected apparatus and cord assemblies from test results

7.1 concepts

A portable or movable appliance is any electrical equipment that is capable of being moved whilst either connected or disconnected from an electrical supply. In general it will have a lead (cable) and a plug, but includes fixed equipment that is connected via fused connection.

Extension cords provide a convenient method of bringing AC power to a device that is not located near a power source. They are also used as temporary power sources. As such, extension cords are heavily used. They are also often involved in electrical code and safety violations.

A power strip is a variation of an extension cord, where the cord terminates in a row or grouping of receptacles. Power strips are commonly used in offices to provide multiple receptacles to office equipment. In general, safety principles pertaining to extension cords also apply to power strips.

Electrical accidents are caused by a combination of unsafe factors including:

- Equipment and/or
- Installation
- Environment, and
- Work practices.

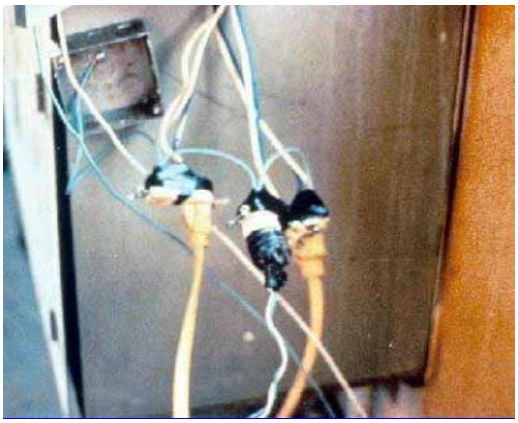


Figure 7.1 exposed and unsafe electric cord assemblies

7.2 unsafe cord connected apparatus from test results

Cord-connected electrical equipment shall not be used where the tool and/or cord cannot be secured to prevent its falling or reaching closer than the “Safe Limits of Approach” for authorized workers unless a safe work area has been created through the use of approved barriers.

Figure7.2 damaged extension cords & tools

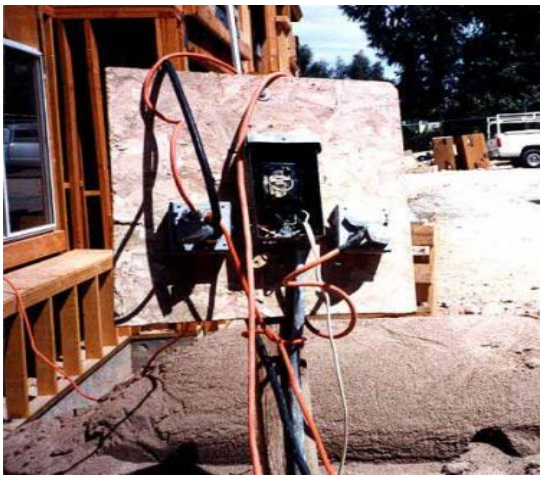


Figure 7.3 damaged extension cords & tools

7.3 unsafe cord assemblies from test results

- Electrical articles found to be unsafe will be disconnected from the supply (unplugged), withdrawn from service and tagged in accordance with procedure Safety Tag and Lockout. The choice of remedial action, disposal or other corrective action (repair) for the out of service equipment will be determined by the departmental Manager or Team leader/Supervisor.
- Where possible, the unsafe electrical article will have the method for energizing the electrical article disabled in such a way to prevent inadvertent use. Only a qualified person may repair faulty electrical equipment.
- Any equipment which is the cause of an electric shock or is damaged in an incident is to be tagged out with a **‘DO NOT OPERATE’** tag and is to remain out of service and not repaired until such time all investigations are completed. The item is to be tested and tagged prior to use.
- Where an incident involves electrocution or an electric shock, the incident site must not be disturbed the Team Leader Human Resources & Audit Officer must be

contacted immediately and an Incident Early Notification Report Form must be completed.

Figure 7.4 Damaged Cords

Figure 7.5 exposed electricity

Figure 7.6 broken plugs

7.4 Safe Conditions for Work

No work shall be done on electrical apparatus, mobile or fixed equipment, mechanical equipment or systems that may have electrical, dynamic or potential energy, unless safe conditions for work are provided by one or more of the following methods:

1) The apparatus is isolated and de-energized in accordance with the Utility Work Protection Code.
2) Worker protection is provided by an approved isolation procedure as defined in the Utility Work Protection Code.

3) The apparatus is physically removed from the immediate vicinity of any source of electrical, dynamic or potential energy, has no ready means of connection, and has had all stored energy discharged.
4) Worker protection is provided by an approved practice, the work is performed by an authorized

Figure 7.7 Metal electrical boxes grounded to prevent shocks

Self-Check -7	Written Test

Directions:

I. Answer all the questions listed below.

1. Electrical articles found to be unsafe will be disconnected from the supply (unplugged).
   a) True b) False
2. One of the following is not the causes of Electrical accidents
   a) Equipment b) well insulated tools c) Installation d) Environment
3. Which one of the following is not correct about Extension cords?
   a) Provide a convenient method of bringing AC power to a device
   b) Used as a permanent power sources
   c) used as temporary power sources d) none

II. Give short answers

1. Write at list (3) methods of safe working conditions. (3 pts)

Note: **Satisfactory rating - 3 and above out of 6 points Unsatisfactory - below 3 out of 6 points**

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

Score = _____

Rating: _____

Information sheet-8	Undertaking testing with minimum waste of energy and damage to apparatus

8.1 Introduction

Common measurements of electrical wiring installations are usually carried out with the following instruments:

- Continuity testers
- Multimeters

Figure 8.1: Example of a multimeter

➢ Use of Measuring Instruments

The measuring equipment for the power supply and building wiring installation modules is used for two main purposes:

- Measurement and testing of electrical appliances
- Initial and subsequent measurements on the installation as a whole

  All these measurements/tests may only be carried out by experienced and qualified technicians.

Main Earthing Conductor/Equipotential Bonding Conductor: Connect the short lead to the earth electrode and measure the earth resistance of the main earthing conductor. Connect the short lead to the equipotential bonding conductor and measure the earth resistance of the bonding conductor. In both cases the resistance shall not exceed 0.5 ohms for either the main earthing conductor or the equipotential bonding conductor.

8.2 Testing with minimum waste of energy

- Following a visual inspection of the electrical installation, testing is required to be carried out to verify that the electrical installation complies with the requirements of the 'Wiring Rules', and that the installation is safe for its intended use.

- Currently there are four mandatory tests with the provision of two additional tests.
- On construction sites the use of RCDs on final sub-circuits is mandatory. As such, the provision for RCD testing is then mandatory as they are required to be installed and so must be tested to verify that they are performing as required.
- The other additional test, earth fault loop impedance, verifies that the protective device will function where there is fault to earth. This test is performed on an energized installation which tests not only the impedance of the installation but also the impedance of the network asset.

The following tests are to be carried out on the electrical installation:

Mandatory tests prior to supply being connected:

- Continuity of the earthing system;
- Insulation resistance;
- Polarity; and
- Correct circuit connections

Tests after supply has been connected:

- Operation of residual current devices (RCDs); and
- Verification of impedance required for automatic disconnection of supply (earth fault-loop impedance)

If the electrical installation fails a test, that test and any preceding tests that may have been influenced by the fault indicated shall be repeated after the fault has been rectified.

8.2.1 Continuity of the earthing system

- Verification to prove the continuity of the earthing system (earth resistance of the main earthing conductor, protective earthing conductors and bonding conductors) are necessary to ensure that the earthing system has been installed in a manner that will cause circuit protective devices to operate if there is a fault between live parts, other than the neutral, and the mass of earth.
- An effective earthing system will ensure that exposed conductive parts of electrical equipment do not reach dangerous voltages when such faults occur.

- **Verification is to be conducted by testing the installation**

The resistance of protective earthing conductors shall be:

a. Low enough to permit the passage of current necessary to operate the overcurrent protective device; and
b. Consistent with the length, cross-sectional area and type of conductor material, e.g. for a 100m length of 2.5mm2 copper conductor, a resistance of 0.8 could be expected.

The resistance of the main earthing conductor or any equipotential bonding conductor shall be not more than 0.5 ohm.

Continuity of the Earthing System (Supply Is Not Connected)

- **Test Procedure**

1. Ensure that the electricity supply is not connected;
2. Connect an insulated copper conductor of suitable length (long lead) to one terminal of the ohmmeter;
3. Connect a standard length test lead to the other terminal of the ohmmeter (short lead);
4. Connect the two leads together, and ‘ zero the multimeter or, if this is not possible, record the resistance of the test leads;
5. Disconnect the water pipe equipotential bonding conductor and the water heater earthing conductor (if applicable). Care must be taken that there are no parallel earth paths when conducting this test, i.e. the earthing system must not be connected to either the water or gas pipes; and

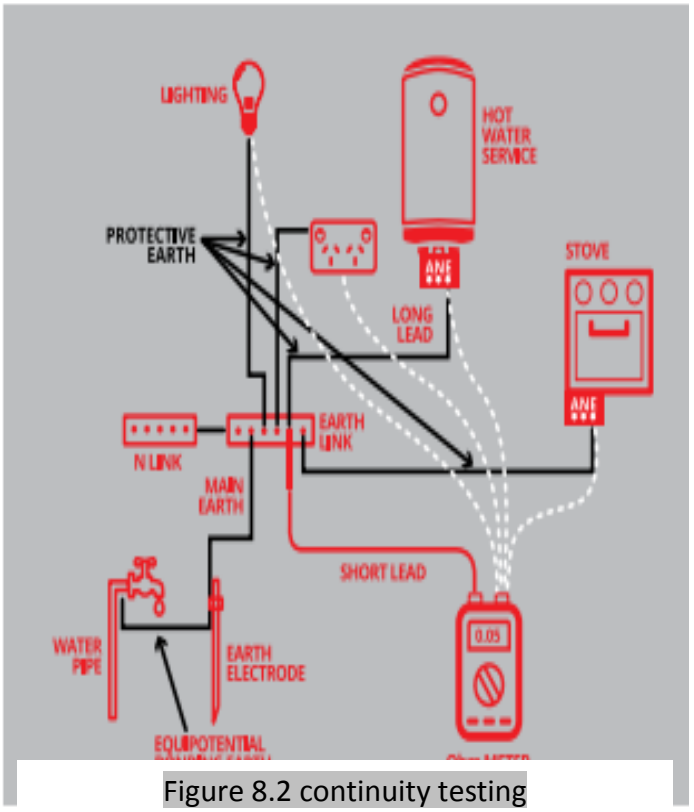


Figure 8.2 continuity testing

6. Disconnect the MEN link from the main neutral link and connect it to the long lead (i.e. long lead now connected to the earth bar)

- **Earth Continuity Test**

Using the long lead and zeroed multimeter, measure, for each circuit, the earth conductor resistance from the circuit extremity to the switchboard.

This test is applicable to all circuits, including socket-outlet circuits, lighting circuits and fixed equipment (e.g. water heater supply) circuits.

7. Re-connect the MEN link to the main neutral link.
8. Re-connect the water pipe equipotential bonding conductor.

8.2.2 Insulation Resistance

An insulation resistance test is required to ensure that the insulation resistance between all live conductors (active and neutral) and earth or, as the case may be all live parts and earth is adequate to ensure the integrity of the insulation. This is to prevent:

a) Electric shock from inadvertent contact;
b) Fire hazards from short-circuits; and
c) Equipment damage.

- The integrity of the insulation is stressed by applying a direct current at 500V. Where surge protective devices (SPDs) or other equipment are likely to influence the verification test or be damaged, such equipment shall be disconnected before carrying out the insulation resistance test.
- Where it is not reasonably practicable to disconnect such equipment (e.g. in case of fixed socket-outlets incorporating an (SPD), the test voltage for the particular circuit may be reduced to 250V d.c.
- The insulation resistance must be not less than 1MΩ.

Note: It is envisaged that on construction sites that there would be no valid reason why it is not reasonably practicable to disconnect surge protection and/or RCD protection from the installation so that the test voltage would be 500V with an insulation resistance not less than 1MΩ.

The insulation resistance tester used shall be able to maintain its terminal voltage when measuring a resistance of 1MΩ on the 500V range or 10MΩ on the 1000V range.

Note: Care may be required with the application of the insulation resistance test to electronic equipment and surge protective devices to prevent damage to the devices.

The insulation resistance between live and earthed parts of an electrical installation or parts is to be not less than 1MΩ. The value of 1MΩ may be obtained with appliances disconnected.

The value of 1MΩ may be reduced to 0.01MΩ for sheathed heating elements of appliances.

- **Insulation Resistance Test**

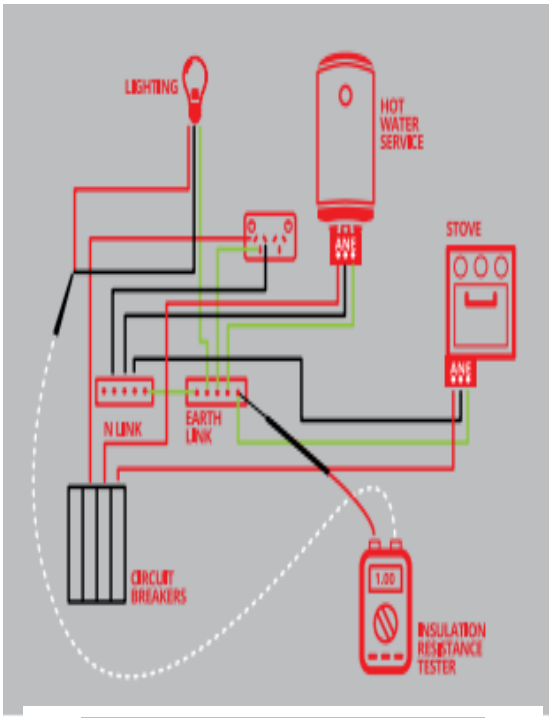


Figure 8.3 insulation resistance

Testing Sequence

1) Ensure that supply is not connected.
2) Connect meter test lead to earth link.
3) Disconnect the active and corresponding neutral from the circuit breaker and neutral link.
4) Connect the neutral and active conductors together.
5) Where necessary disconnect the appliance.
6) Test the A/N with mega-ohmmeter.
7) Reading to be not less than 1 mega-ohm (sheathed heating elements can be not less than 0.01 mega-ohm).

Note: if the circuit contain electronic dimmers ensure that you follow the manufacturer's specifications for testing of the installation.

Insulation Resistance Test Considerations

- The Insulation Resistance (IR) test is used to provide a quantifiable value for the resistance of a product's insulation. The tester applies a DC voltage across the insulation of a product and measures the corresponding leakage current in order to calculate a resistance value.
- Although most IR testers have a variable output voltage, the test is usually specified at 500 or 1000 volts.
- The IR test is sometimes required by safety agencies to be performed subsequent to the Hi pot test in order to make sure that the DUT's insulation was not damaged as a result of the high voltage applied to it.

Remember, the higher the resistance, the better the insulation. If no IR value is specified by and agency specification, the insulation resistance for an IR test at 1000 V or less should be at least 1 MΩ.

Figure 8.4 insulation resistance testing of motor

Before testing, turn on all power switches on the appliance so that all internal circuits are tested. Ensure the appliance is disconnected from all other circuits.

Figure 8.5 Insulation resistance testing of test leads and adapter box

8.2.3 Polarity

Polarity testing is to prevent:

a. The transposition of active and neutral conductors of the consumer's mains or sub-mains, with an MEN connection at an outbuilding, resulting in the electrical installation earthing system becoming energized;
b. Combinations of incorrect active, neutral and earthing conductor connections resulting in the exposed conductive parts of the electrical installation becoming energized; and
c. The connection of switches or protective devices in neutral conductors, resulting in parts of appliances, such as heating elements and lamp holders, remaining energized when the switches are in the 'OFF' position.

Testing will ensure that all active, neutral and protective earthing conductors in the electrical installation are correctly connected to the corresponding terminals of electrical equipment.

8.2.4 Correct circuit connections

Tests for correct circuit connections are necessary to ensure the following:

a. Protective earthing conductors do not normally carry current; and
b. No short circuit exists, because short-circuit current flowing between live conductors and through part of the earthing system can cause considerable fire damage or personal injury, particularly in high current locations.

Testing will ensure that the active, neutral and protective earthing conductors of each circuit are correctly connected.

Note: Testing must ensure that no ring circuits exist. See the following procedures.

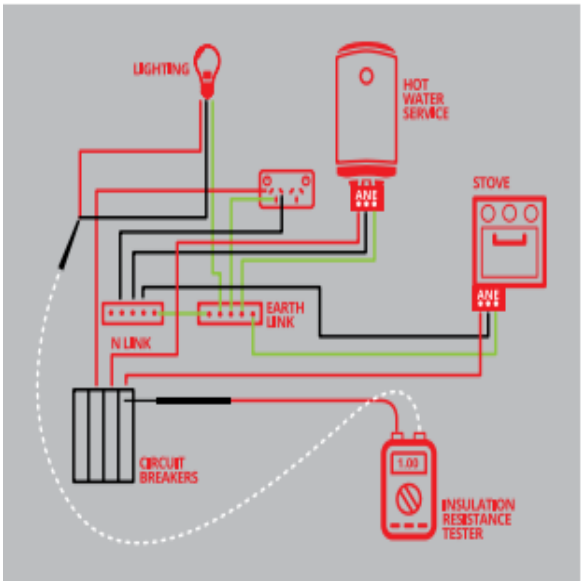


Figure 8.6 Correct circuit connections

Ring Circuits

Test procedure

1. Ensure that supply is not connected.
2. Disconnect and join the active and corresponding neutral conductors.
3. Using a mega-ohmmeter with test voltage set on 500V, connect one lead to the active/neutral junction, and the other lead to each circuit active and neutral in turn and test. No interconnections should be found.

8.3 Testing with minimum damage to apparatus

- Always start by starting the range switch at a value higher than that which you reasonably expect to measure. If not, you could damage the instrument.
- Make sure your multi-tester is set in the right mode. Trying to measure voltage with the mode set on “AMPS” could destroy the meter and possibly cause harm to the operator. Also, some meters are destroyed by trying to measure voltage if meter is set to measure resistance.
- If you have a choice of finding a fault in a circuit with dangerous voltages on it by either testing voltages or measuring resistance, turn off the power and use the latter. Keep test leads in good condition—No cracked insulation, keep probes sharp, connectors tight.
- Do not place the instrument in a place where it may be pulled off and onto the floor or onto other circuitry.
- If using an ammeter that requires that it be inserted in series with the measured circuit, turn off the power, make your connections, and turn on the power and measure. Repeat procedure when disconnecting the meter.
- Clamp-on type ammeters do not require the circuit to be opened for insertion of the meter; safer and faster to use. When using a HI-POT tester, keep the area clear of those who are not part of the testing.

- Always start tests with output control at zero, and the switch in the “OFF” condition. Make sure all equipment grounds are tight, and that the device is connected and used according to manufacturer’s instructions. This device can fry you.
- Make sure that the power cannot be turned on to the circuits you are testing unless or until you want it turned on. Stand on a rubber mat; concrete is a good electrical conductor.

Figure 8.7 Testing of apparatus

8.4 Who can do the testing?

Inspection and testing can be carried out by any competent person. The Competent Person is “A person possessing sufficient technical knowledge or experience to be capable of ensuring that injury is prevented”.

“Technical knowledge or experience may include: adequate knowledge of electricity, adequate experience of electrical work; adequate understanding of the system to be worked on and practical experience of that Class of system; understanding the hazards that may arise during the work and the precautions that need to be taken; or the ability to recognize at all times whether it is safe for work to continue.”

The person doing the testing must have an understanding of the types of electrical, mechanical and thermal damage of electrical equipment which may be encountered in any environment.

Self-Check -8	Written Test

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

1. It is important to perform testing with minimum damage to apparatus by:
   a) Adjusting the range switch at higher value than expected value
   b) Make multi-tester in the right mode
   c) Keep test leads in good condition
   d) All
2. Inspection and testing can be carried out by:
   a) Supervisor b) any competent person c) any person d) employer
3. An insulation resistance test is required to ensure that the insulation resistance between all live conductors (active and neutral) and earth, and to prevent:
   a) Electric shock from inadvertent contact
   b) Fire hazards from short-circuits
   c) Equipment damage
   d) All
4. One of the following is not correct about necessity of tests for correct circuit connections:
   a) To ensure protective earthing conductors do not carry current
   b) To ensure the existence of open circuit
   c) To ensure no short circuit existence
   d) To prevent personal safety

Note: **Satisfactory rating – 2 and above out of 4 points Unsatisfactory - below 2 out of 4 points**

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

Score = _____

Rating: _____

Operation Sheet 1	Undertaking testing with minimum waste of energy and damage to apparatus

Title: - Insulation resistance testing

Step 1. Ensure that the electricity supply is not connected

Step 2. Connect an insulated copper conductor of suitable length to one terminal of the ohmmeter;

Step 3. Connect a standard length test lead to the other terminal of the ohmmeter

Step 4. Connect the two leads together, and ‘zero the multimeter or, if this is not possible, record the resistance of the test leads;

Step 5. Disconnect the water pipe equipotential bonding conductor and the water heater earthing conductor (if applicable). Care must be taken that there are no parallel earth paths when conducting this test, i.e. the earthing system must not be connected to either the water or gas pipes; and

Step 6. Disconnect the MEN link from the main neutral link and connect it to the long lead (i.e. long lead now connected to the earth bar)

Step 7. Re-connect the MEN link to the main neutral link.

Step 8. Re-connect the water pipe equipotential bonding conductor.

.

Operation Sheet 2	Undertaking testing with minimum waste of energy and damage to apparatus

Title:- making Correct circuit connections

Step1. Ensure that supply is not connected.

Step2. Disconnect and join the active and corresponding neutral conductors.

Step3. Using a mega-ohmmeter with test voltage set on 500V, connect one lead to the active/neutral junction, and the other lead to each circuit active and neutral in turn and test.

No interconnections should be found.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

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

Task 1. Perform correct circuit connections testing

Task 2. Demonstrate Polarity testing

Task 2. Demonstrate Insulation resistance testing

References

- *www.megger.com,* ***PAT testing guide*** *- 4th Edition*
- University of Essex, **How to carry out simple visual checks**, Issue 1: June 2013
- Training Systems for Electrical Wiring Installation, **Techniques for Electrical Wiring in Buildings**, Presented in Project-oriented Fashion to Emulate Authentic Practice Lucas-Nülle
- **Electrical Utility Safety Rules**, published by the Infrastructure Health & Safety Association
- http://www.deltami.gov/wp-content/uploads/2012/09/Electrical-Safety.pdf/
- Arrium mining and materials, **Electrical Safety Manual Document**: Version: 4.0 Authorised By: One Steel Whyalla ESN Date Reviewed: 13/12/2016
- **The Complete Guide to Electrical Insulation Testing**, a stitch time (https://www.instrumart.com/assets/Megger-Guide-to-Insulation-Testing.pdf).
- http://www.hipot.com/docs/guide-to-electrical-safety-testing.pdf

Building Electrical installation

Level II

Learning Guide-43

Unit of Competence: Conduct In-Service Safety Testing of Electrical Cord Connected Equipment and Cord Assemblies

Module Title: Conducting In-Service Safety Testing of Electrical Cord Connected Equipment and Cord Assemblies

LG CODE: EIS BEI2 M010 LO43-LG-43
TTLM CODE: EIS BEI2 M010 TTLM 0919V1

LO3: Tag tested cord connected apparatus and cord assemblies and document testing activities

Instruction Sheet	Learning Guide #43

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

- Following OHS, risk control measures and procedures
- Cleaning work site and making safe with established procedures
- Tagging cord connected apparatus and cord assemblies
- Making arrangements for unsafe cord connected apparatus and cord assemblies
- Documenting safety testing activities with requirements

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**:

- ✓ Follow OHS, risk control measures and procedures
- ✓ Clean work site and making safe with established procedures
- ✓ Tag cord connected apparatus and cord assemblies
- ✓ Make arrangements for unsafe cord connected apparatus and cord assemblies
- ✓ Document safety testing activities with requirements

Learning Instructions:

7. Read the specific objectives of this Learning Guide.
8. Follow the instructions described below 3 to 5.
9. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, sheet 4 and Sheet 5” **in page 89, 93, 98, 104 and 109** respectively
10. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self-check 4 and Self-check 5” **in page 92, 97, 103, 108 and 111 respectively**.
11. If you earned a satisfactory evaluation from the “Self-check” proceed to next information sheet.

Information sheet-1	Following OHS, risk control measures and procedures

3.1. Definition of terms

Risk assessment: A documented process for determining suitable controls to reduce the risk of hazards, and to assess the level of risk of a hazard.

Risk: The combination of the likelihood and consequences of a negative outcome resulting from a hazard.

Controls: Steps taken to reduce the likelihood or consequence of a negative outcome occurring for a hazard.

3.2. Following OHS

A safe work environment is created by controlling contact with electrical voltages and the currents they can cause.

Electrical currents need to be controlled so they do not pass through the body. In addition to preventing shocks, a safe work environment reduces the chance of fires, burns, and falls.

You need to guard against contact with electrical voltages and control electrical currents in order to create a safe work environment.

Make your environment safer by doing the following:

- Treat all conductors—even “de-energized” ones—as if they are energized until they are locked out and tagged.
- Verify circuits are de-energized before starting work.
- Lock out and tag out circuits and machines.
- Prevent overloaded wiring by using the right size and type of wire.
- Prevent exposure to live electrical parts by isolating them.
- Prevent exposure to live wires and parts by using insulation.
- Prevent shocking currents from electrical systems and tools by grounding them.
- Prevent shocking currents by using GFCIs.
- Prevent too much current in circuits by using overcurrent protection devices.

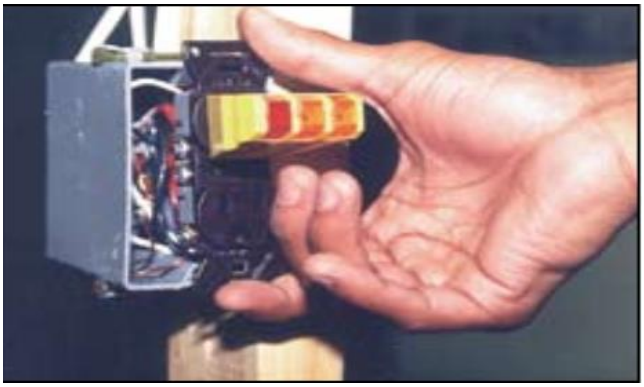


Figure 3.1 Always test a circuit to make sure it is de-energized before working on it.

Figure 3.2 **Lock-out/tag-out saves lives.**

3.3. Risk control measures and procedures

a) The objective of this procedure is to manage the risk associated with the maintenance of electrical installations and equipment through the inspection, testing and tagging of electrical equipment in accordance with:
    - Work, Health and Safety (WHS) Regulation 2011
    - Code of Practice – Managing Electrical Risks in the Workplace
    - Australian Standard - AS/NZS 3760 in Service Safety Inspection and Testing of Electrical Equipment

b) Electricity can cause injury, damage to property and death. Electricity should always be treated with care and respect. Electrical equipment should be properly installed, operated and maintained to prevent the possibility of electric shock or damage. Faulty electrical equipment can cause electrocutions, fires or explosions caused by the heat generated from overloading or by inadequate ventilation of electrical equipment.

c) Electrical risks must be eliminated as far as reasonably practicable and if elimination is not practicable, the risks must be minimized to a low level as is reasonable practicable.

1.3.1 Risk Assessment and Control

How Do You Create a Safe Work Environment?

- The electrical equipment to be tested and the frequency of testing shall be determined by a risk assessment which relates directly to the environment in which the equipment is operated and the operational use of the equipment.
- To control the risk associated with using electrical equipment in a hostile environment the following control measures where reasonably practicable should be implemented.
- The hierarchy of risk control is to be applied as follows:

Elimination: change the work practices so that electrical equipment is no longer required to be used.

Where elimination is not reasonably practicable the following control measures must be implemented.

Substitution: replace corded electrical equipment with cordless equipment to minimize the risk of electrocution during operation.

Engineering Control – install Residual Current Devices (RCDs) to reduce the risk of electric shock.

Administration - develop Safe Work Method Statement (SWMS) and provide instruction and training in safe work methods and use of equipment.

Self-Check -1	Written Test

Directions:

I. ***Answer all the questions listed below.*** (4 pts)

1. It is the combination of the likelihood and consequences of a negative outcome resulting from a hazard.
   a) Risk b) control c) injury d) all
2. One of the following is not categorized under Risk Assessment and Control mechanism
   a) Elimination b) hazard c) administration d) substitution
3. Steps taken to reduce the likelihood or consequence of a negative outcome occurring for a hazard.
   a) Injury b) risk c) control d) none
4. A documented process for determining suitable controls to reduce the risk of hazards, and to assess the level of risk of a hazard.
   a) risk b) Risk assessment c) control d) all

II. ***Give short and precise answers for the following***

1. List at least 3 mechanisms to make your environment safer.(4 pts)

Note: **Satisfactory rating - 4 and above out of 8 points Unsatisfactory - below 4 out of 8 points**

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

Score = _____

Rating: _____

Information sheet-2	Cleaning work site and making safe with established procedures

2.1 overview

On completion of Electrical work, the following shall occur.

- all tools and equipment shall be removed from the work area
- All cables not connected shall be terminated with appropriate connectors. No bare conductors are to be left exposed.
- All covers and doors shall be placed securely in position, with switchboard external doors locked or bolted and keys returned to facilities management
- Electrical workers shall remove any personal isolation locks or personal danger tags from the positive isolation point and reconnect the equipment to the electrical supply. If voltage checks are required to be performed, the appropriate PPE and clothing requirements must be worn
- electrical equipment placed back into service must be checked to ensure it is functioning correctly
- Any electrical equipment not able to be put back into service must be isolated from the supply at the circuit breaker or through the removal of the cable from the supply. Isolated equipment shall be isolated in accordance with the Isolation Lockout and Tagging Procedure (PRO-1060) which includes being locked and tagged with a completed out of service tag attached including the electrical supervisor's contact details.
- Electrical equipment that has been de-energized must be re-energized through a controlled process in accordance with the Isolation Lockout and Tagging Procedure (PRO-1060), the relevant isolation plan, Electrical isolation and test certificate (FRM-1071) and must not be inadvertently reenergized.
- When re-energizing equipment, the electrical worker must inform other workers, facilities Management and other persons impacted or in control of

equipment about to the reenergizing. This is to occur in a manner that is in accordance with the requirements of the Isolation Lockout and Tagging Procedure (PRO-1060)

Figure 2.1 safety tips

2.2 Cleaning work site

Good housekeeping benefits everyone in your manufacturing establishment by creating safe and clean surroundings.

Keeping floors clean and clear reduces the chance that employees will trip or fall. Uncluttered work areas leave more room to work with and less irritation from trying to find misplaced items.

- **Start by Cleaning Up:**
  Begin with a thorough housecleaning.
  Remove all trash, accumulations of scrap, and unused materials.
- **Make Housekeeping an Ongoing Effort:**
  Employees should understand that housekeeping is a priority and that each person is accountable for making sure their area remains clean and well-kept.

- **Properly Dispose of Trash:**

  Provide and instruct employees to use proper containers for trash and waste. Liquids and chemicals must be stored in approved containers.

  Empty out trash and waste containers often enough to prevent overflow onto the floor.

2.3 Making safe work site

It's vitally important to take safety precautions when working with electricity. Safety must not be compromised and some ground rules need to be followed first. The basic guidelines regarding the safe handling of electricity documented below will help you while working with electricity.

1. Avoid water at all times when working with electricity. Never touch or try repairing any electrical equipment or circuits with wet hands. It increases the conductivity of the electric current.
2. Never use equipment with frayed cords, damaged insulation or broken plugs.
3. If you are working on any receptacle at your home then always turn off the mains. It is also a good idea to put up a sign on the service panel so that nobody turns the main switch ON by accident.
4. Always use insulated tools while working.
5. Electrical hazards include exposed energized parts and unguarded electrical equipment which may become energized unexpectedly. Such equipment always carries warning signs like "Shock Risk". Always be observant of such signs and follow the safety rules established by the electrical code followed by the country you're in.
6. Always use appropriate insulated rubber gloves and goggles while working on any branch circuit or any other electrical circuit.
7. Never try repairing energized equipment. Always check that it is de-energized first by using a tester. When an electric tester touches a live or hot wire, the bulb inside the tester lights up showing that an electrical current is flowing through the respective wire. Check all the wires, the outer metallic covering of the service panel

and any other hanging wires with an electrical tester before proceeding with your work.

8. Never use an aluminum or steel ladder if you are working on any receptacle at height in your home. An electrical surge will ground you and the whole electric current will pass through your body. Use a bamboo, wooden or a fiberglass ladder instead.
9. Know the wire code of your country.
10. Always check all your GFCI's once a month. A GFCI (Ground Fault Circuit Interrupter) is a RCD (Residual Current Device). They have become very common in modern homes, especially damp areas like the bathroom and kitchen, as they help avoid electrical shock hazards. It is designed to disconnect quickly enough to avoid any injury caused by over current or short circuit faults.

Figure 2.2 safety sign

Figure 2.2 Outlets must be grounded

Self-Check -2	Written Test

Directions:

Answer all the questions listed below.

1. List at least 3 activities to do on completion of Electrical work.(5 pts)
2. Write at least 4 basic guidelines regarding the safe handling of electricity while working with electricity. (5 pts)

Note: **Satisfactory rating - 5 and above out of 10 points Unsatisfactory - below 5 out of 10 points**

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

Score = _____

Rating: _____

Information sheet-3	Tagging cord connected apparatus and cord assemblies

3.1 Definition of terms

Tagging is fitting of a durable, non-reusable, non-metallic tag or other indicator to electrical equipment that has been tested and found to be compliant.

It must include the name of the person or the company who performed the test, the test or inspection date and may also include a re-test date. Where a tag does not include this information (for example electronically recorded on a data base) records must be available for inspection within one working day for site audit as required.

3.2 Tagging cord connected apparatus

What is testing and tagging?

- Electrical testing and tagging is subjecting an electrical appliance to regular inspection and testing to detect obvious damage, wear and other conditions that might render it unsafe.

- Faulty electrical appliances have caused electrical fires, electrical shocks and accidental electrocutions (there have been multiple deaths every year).

- Testing and Tagging is therefore necessary for the safety of persons using the equipment and to ensure that employers and employees meet work and safety regulations

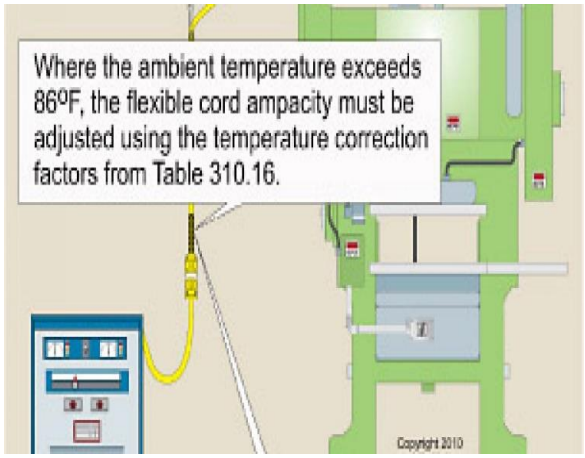


Figure 3. 1 tagging of cord connected apparatus

3.2.1 Compliant Electrical Appliances

Electrical appliances which are compliant with the inspection and testing procedure are to be fitted with an appropriate tag. The tag must include the asset identification number, the identity of the person carrying out the testing, the date tested and the date due for retest.

Figure 3. 2 tag of Compliant Electrical Appliances

3.2.2 Non-Compliant Electrical Appliances

Electrical appliances which are non-compliant with the inspection and testing procedure are to be identified as not safe to use and removed from service. Removal from service includes:

- Fitting the item with a failed appliance test tag

- Fitting the item with an out of service tag
- Taping the plug with hazard tape

The item is to be withdrawn from service (if possible), the area supervisor is to be informed and responsible to isolate the item to ensure that it cannot be used.

Figure 3. 3 tag of non-compliant Electrical Appliances

3.3 Tagging cord assemblies

- The test and tag program will apply to all electrical items where there is a reasonable chance of a person touching the equipment and completing an earth circuit. Testing and Tagging will be conducted at intervals to comply with relevant Acts, Regulations, Code of Practices and Standards.
- All electrical equipment used in an location in which the normal use of electrical equipment exposes the equipment to operating conditions that are likely to result in damage to the equipment or a decrease in its estimated life span, including conditions

that include exposure to moisture, heat, vibration, mechanical damage, corrosive chemicals or dust shall be subject to inspection, testing and tagging.

- Testing of electrical equipment under this procedure will take place in accordance with the requirements of AS/NZS 3760:2010 in Service Safety Inspection and Testing of Electrical Equipment. Both 220VAC single phase and 380VAC poly phase equipment are required to be tested and tagged.
- Inspection and testing of electrical equipment shall be carried out by a competent person who has the relevant knowledge, skills and testing instruments to carry out the inspection and testing program. The person carrying out testing in accordance with AS/NZS 3760:2010 - in Service Safety Inspection and Testing of Electrical Equipment must be:
    - a licensed electrician and/or licensed electrical inspector
    - a person who has successfully completed a structured training course and been deemed competent in the use of a pass-fail portable appliance tester and the visual inspection of electrical equipment
- A regular program of inspection, test and tagging comprises of:
    - a visual check to ensure there are no obvious problems
    - electrical testing to ensure the safety of the item
    - tagging of the equipment to indicate to users that the item has been identified as safe in accordance with *AS/NZS 3760:2010* and details of when the item is due to be retested
    - establishment of a detailed electrical equipment asset register and/or testing and tagging log book
- Compliant electrical equipment shall have attached a non-metallic tag which shall be durable, non-reusable, color coded for the month and contain a number identification and test and tag details. Further details can be found in the Australian Standard *AS/NZS 3760:2010.*

What Equipment needs to be testing and tagging?

- **Portable, hand-held and stationary appliances, designed for connection to power supply using a power cord**
- Power cord extensions and outlet devices
- Power cords connected to fixed equipment in hostile environments i.e. an area where equipment may be subject to physical abuse, exposure to moisture, heat, vibration, corrosive chemicals or dust
- Portable isolation transformers

Figure 3.4 Tagging cord assemblies

3.4 Test and Tag Process

The testing and tagging process should consist of the following steps

1. An external inspection of the equipment and the connecting facilities checking for obvious damage or defects
2. Protective earth continuity test for Class I equipment (basic insulated, protectively earthed equipment), power boards and power cords
3. Insulation testing, which may be achieved by measuring insulation resistance or leakage current
4. Confirmation of the correct polarity of live connections

Self-Check -3	Written Test

Directions:

I. Answer all the questions listed below.

1. It is fitting of a durable, non-reusable, non-metallic tag or other indicator to electrical equipment that has been tested and found to be compliant.
   a) Testing b) tagging c) inspection d) all
2. What type of Equipment needs to be testing and tagging?
   a) Power cord extensions c) outlet devices
   b) Power cords connected to fixed equipment d) all
3. A regular program of inspection, test and tagging comprises of:
   a) visual check to ensure there are no obvious problems
   b) electrical testing to ensure the safety of the item
   c) tagging of the equipment to indicate to users that the item has been identified
   d) all
4. Which of the following is the importance of electrical testing and tagging? is subjecting an electrical appliance to regular inspection and testing
   a) to detect obvious damage c) wear
   b) Other conditions that might render it unsafe. d) all

II. Answer the following question?

1. Write down steps the testing and tagging process.(4 pts)

Note: **Satisfactory rating - 4 and above out of 8 points Unsatisfactory - below 4 out of 8 points**

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

Information sheet-4	Making arrangements for unsafe cord connected apparatus and cord assemblies

Score = _____
Rating: _____

4.1 Introduction

Any electrical equipment found to be unsafe in the workplace must be immediately disconnected (isolated) from the power supply and tagged out and not placed back into service until the equipment is repaired, tested and found to be safe or the equipment is replaced.

- **Electrical articles found to be unsafe**

a) Electrical articles found to be unsafe will be disconnected from the supply (unplugged), withdrawn from service and tagged in accordance with WHS procedure 5.6.1 Safety Tag and Lockout. The choice of remedial action, disposal or other corrective action (repair) for the out of service equipment will be determined by the departmental Manager or Team leader/Supervisor.

b) Where possible, the unsafe electrical article will have the method for energizing the electrical article disabled in such a way to prevent inadvertent use. Only a qualified person may repair faulty electrical equipment.

c) Any equipment which is the cause of an electric shock or is damaged in an incident is to be tagged out with a **'DO NOT OPERATE'** tag and is to remain out of service and not repaired until such time all investigations are completed. The WHS Support & Audit Officer will advise when the item may be repaired and/or returned to service. The item is to be tested and tagged prior to use.

d) Where an incident involves electrocution or an electric shock, the incident site must not be disturbed the Team Leader Human Resources or WHS Support & Audit Officer must be contacted immediately and an Incident Early Notification Report Form WHSF0051 must be completed.

4.2 Making arrangements for unsafe cord connected apparatus

If you use cord- and plug-connected equipment or extension cords in your manufacturing establishment, you must follow these safety requirements:

- Handle equipment in a way that does not cause damage. Extension cords must not be attached with staples or in any manner that causes damage to the outer jacket or insulation.

- Visually inspect extension cords and cord- and plug-connected equipment at the beginning of each shift for external defects such as loose parts, deformed and missing pins, or damage to the outer jacket or insulation, and for evidence of possible internal damage such as a pinched or crushed outer jacket.
- Remove defective or damaged items from service, and do not allow employees to use them.
- Use attachment plugs or receptacles that provide proper continuity of the equipment grounding conductor.
- Be sure that portable electric equipment and extension cords used in highly conductive work locations are approved for those locations. Examples of highly conductive work locations are areas where employees are likely to contact water or conductive liquids.
- Employees must not have wet hands when plugging and unplugging flexible cords when energized equipment is involved

Figure 4.1 arranged cord connected apparatus

4.3 Making arrangements for unsafe cord assemblies

- Inspect all extension cords daily for damage and missing grounding prongs.
- Use a Ground Fault Circuit Interrupter to protect against any electrical fault.
- Keep extension cords away from foot traffic to prevent tripping and cord damage. The insulation in cords and electrical tools can become damaged. If a live wire touches exposed metal parts inside a tool, it can become energized.

- DO NOT use extension cords/flexible wiring

- where frequent inspection would be difficult
- where damage would be likely
- for long-term electrical supply as a substitute
- For the fixed wiring of a structure.

- In addition, NEVER USE
  - a metal outlet box, Romex, or nonmetallic cable as an extension cord
  - staples or nails to hold cords in place
  - Multiple cords connected together (use one long cord instead).

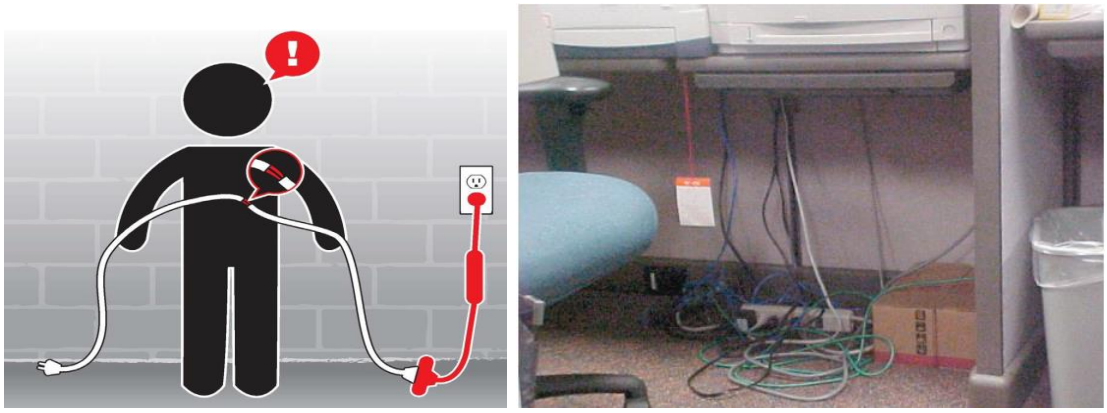


Figure 4.2 arrangements of unsafe cord assemblies

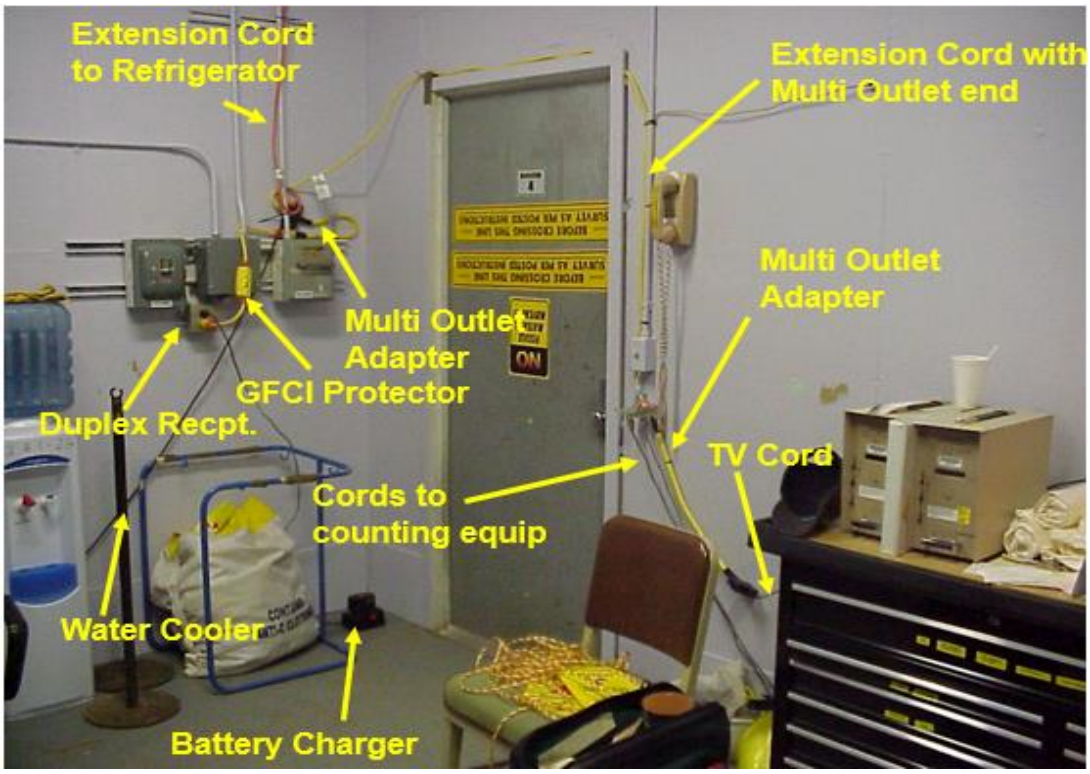


Figure 4.3 unsafe cord connected apparatus cord assemblies and cord assemblies

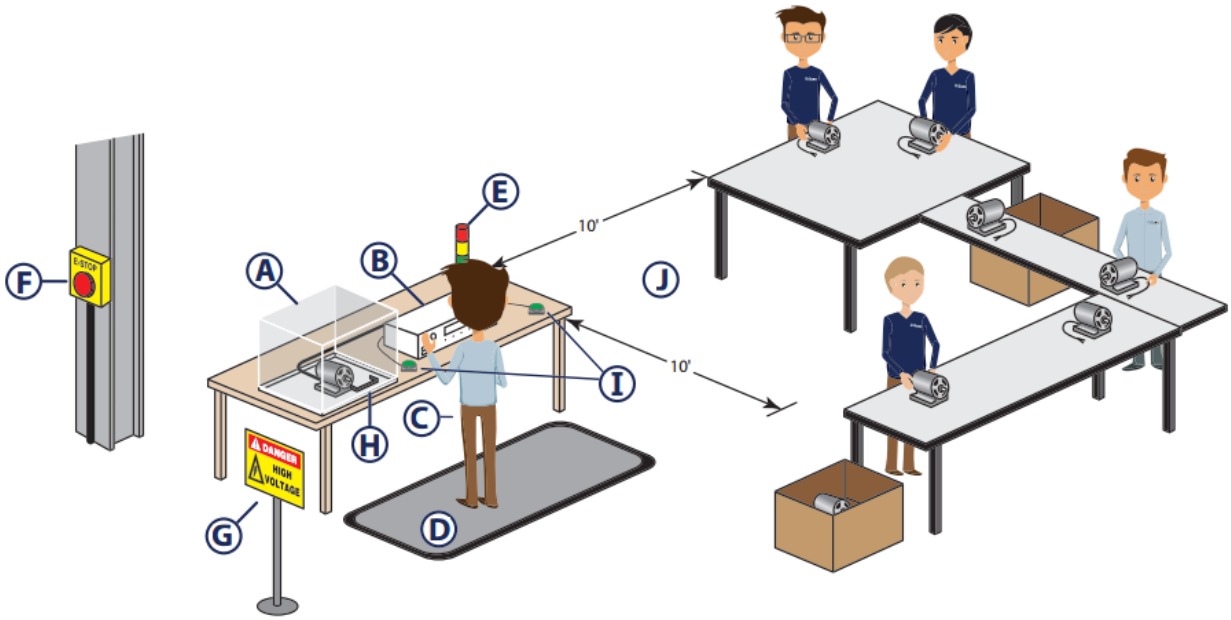


Figure4.4 arranged cord connected apparatus and cord assemblies

Self-Check -4	Written Test

Directions:

I. <u>Answer all the questions listed below.</u>

1. What will you do if electrical equipment found unsafe in the workplace?
   a) immediately disconnected b) tag out c) test d) all
2. One of the following is not the defects for unsafe cord assemblies and cord connected apparatus
   a) loose parts b) missing pins c) damage to the outer jacket d) well insulated
3. Any equipment causes an electric shock or is damaged in an incident is to be:
   a) tagged out with a **'DO NOT OPERATE'** tag c) remain out of service
   b) Remove defective or damaged items d) use defective items for service
4. DO NOT use extension cords/flexible wiring where
   a) frequent inspection would be difficult c) damage would be likely
   b) for long-term electrical supply as a substitute d) all

II**. Answer the following question.**

1. Write the mechanisms to make arrangements for unsafe cord assemblies.(3 pts)
2. Write the mechanisms to make arrangements for unsafe cord connected apparatus.(3 pts)

Note: **Satisfactory rating – 5 and above out of 10 points Unsatisfactory - below 5 out of 10 points**

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

Score = _____

Rating: _____

Information sheet-5	Documenting safety testing activities with requirements

5.1 Principles of safety testing

- Keep the unqualified and unauthorized personnel away from the testing area. If this is not possible, the unqualified person must be supervised by a qualified operator while they are in the test area.
- Arrange the testing area out of the way of routine activity. Designate the area clearly.
- Never touch the DUT or the connections between the DUT and the instrument during a test.
- In the case of an emergency, or if problems arise, turn off the high voltage first.
- Properly discharge any DC-tested product before touching or handling connections.

5.2 Documentation

A good documentation process goes hand in hand with a good inspection program. Grounding inspections should be well documented.

The HSE's Memorandum of Guidance on these regulations advises that records are kept throughout the equipments working life.

The following records should be established and maintained:

- A register of all equipment.
- A record of formal and combined visual examinations and electrical tests.
- A register of all faulty equipment.
- A repair register.

  Examples of suitable forms and registers are available in Megger software.

  As the company carrying out the testing you should maintain the following paper or electronic records:
- Copy of the formal visual examination and combined visual examination and electrical test results.
- Register of all equipment repaired**.**

The test results will be recorded to allow for future comparison, for written identification of defects to be remedied and to provide information for an assessment of risk

5.3 SAFETY TEST RECORDS

The recording of test results, to provide a traceable history of equipment worthiness, can also prove beneficial as a management tool for monitoring the effectiveness of the overall maintenance system, for reviewing test frequencies, and for asset tracking purposes etc.

A dated test label indicating PASS or FAIL and its identification (e.g. departmental inventory number) must be affixed to the appliance (and to the plug, if the lead is detachable).

The inspection and test results must be kept in written form; on record cards, sheets or in a book. Computers may aid record keeping.

5.4 Documenting safety testing

a) The Manager will ensure that electrical inspection and testing records are maintained and stored.
b) A record of any testing carried out must be kept until the electrical equipment is next tested, or permanently removed from the workplace, or disposed of.
c) Records will include inspections and tests made and maintenance carried out on electrical equipment and electrical installations.
d) In particular, the following information is to be recorded:
    - the name of the person who made the inspection or carried out the test or maintenance
    - description and serial number of the item
    - the date on which, or dates over which, the inspection was made or the test or maintenance was carried out
    - the result or outcome of the inspection, test or maintenance
    - the date by which the next inspection and test must be carried

Self-Check -5	Written Test

Directions:

I. Answer all the questions listed below.

1. Which of the following information is not to be recorded in testing?
   a) the name of the person who made the inspection or carried out the test
   b) description and serial number of the item
   c) the result or outcome of the inspection, test or maintenance
   d) none
2. What is the importance of safety test records?
   a) to provide traceable history of equipment c) for asset tracking purposes
   b) beneficial as a management tool for monitoring d) for reviewing test frequencies e) all

II. ***Answer the following question***

1. What is the necessity of documentation? (3 pts)
2. Write down at list 3 principles of safety testing. (3 pts)

Note: **Satisfactory rating - 4 and above out of 8 points Unsatisfactory - below 4 out of 8 points**

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

Score = _____

Rating: _____

References

- Kempsey Shire Council, **Electrical Safety Test And Tag**, Procedure 5.6.16
- HRD-WHS-GUI-145.17, **Electrical Safety Guidelines,** Page 23 of 23
- Work Health and Safety, **Electrical Safety Test and Tag**, 4 March 2015
- **https://testtagoutlet.com.au/tag-regulations**
- Government Of India Central Public Works Department**, General Specifications For Electrical Works Part-I,** Internal 2013
- EBCS 10.

These Learning Guides are prepared by:-

No	Name of trainer	Qualification	Region	E-mail
1	Rehma Muluneh	Electrical and computer Engineering(control) (BSc)	Addis Abeba	rehmamuluneh@gmail.com
2	Salahadin Hussien	Electrical control and automation (BSc)	Addis Abeba	salahadinethio@gmail.com
3	Elias Getachew	Electrical control and automation (MSc)	Addis Abeba	get.elias19@gmail.com
4	Mesfin Bekele	Electrical control and automation (BSc)	Addis Abeba	mesfin8430@gmail.com
5	Rahel Ouma	Electrical Electronics (MSc)	Somalia	rahelouma@yahoo.com
6	Getinet Melkie	Electrical Electronics (MSc)	Somalia	melkiegetinet@gmail.com
7	Zenebe Shiferawu	Construction Technology (BSc)	Dire dewa	zeadeshiferaw@gmail.com
8	Tewodros Yossef	Electrical Engineering (BSc)	Benshangul	tedyo05@yahoo.com
9	Zelalem Taye	Educational Leadership (MA)	Amhara	tayezelalem22@gmail.com
10	Addisu Wedajo	Vocational management (MA)	Amhara	addalvy2010@gmail.com