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ELECTRICAL SAFETY

NORAINI

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ELECTRICAL SAFETY

PREFACE

Electrical safety refers to any safety precautions taken against electricity. Electricity is obviously one of the most basic needs in modern life, but electrical hazards are very dangerous.

Some of the serious injuries you can receive from electricity include electrical shocks, electrical burns, and electrocution, which could be fatal. Electrical safety precautions can protect against electrical shocks and burns, and authorities responsible for workplace safety ensure that workers are following the correct safety procedures while dealing with electricity.

ACKNOWLEDGEMENTS

Thanks to my family and colleague

COURSE LEARNING OUTCOMES (CLO)

CLO 1

- Apply the concept and principle of electrical safety and regulation in performing electrical wiring according to MS IEC 60364. .(C3, PLO1)

CLO 2

Construct single phase domestic wiring according to MS IEC 60364.(P4, PLO5)

CLO 3

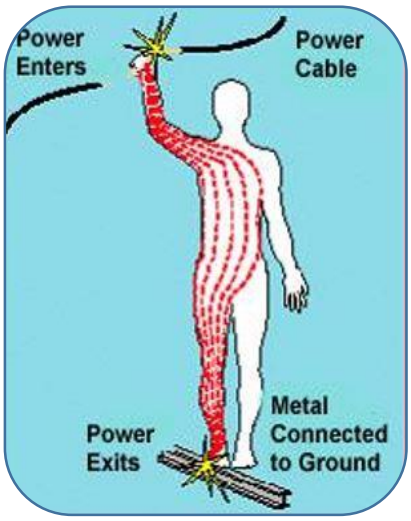
Demonstrate an understanding and commit to professional ethics and responsibilities of engineering norms during performing single phase domestic wiring task. (A3, PLO8)

TABLE OF CONTENT

Electrical Hazards

What is electricity

- Electricity is a natural energy force.
- Electricity is also a man made energy force.
- It is essential to modern life and taken for granted everyday.



- Electricity flows through conductors.
- Conductors include metals, water, the Earth and the human body.
- Electricity must have a complete circuit or path to flow.

How electricity works

- When electrical tools are working properly a complete circuit is maintained between the tool and the energy source.

- However, if the tool is damaged the person may come in contact with the electricity and can become a path for the current.
- The person will be shocked!

Hazard means:

Any potential or actual threat to the wellbeing of people, machinery or environment

Electrical hazard safety means:

Taking precautions to identify and control electrical hazards

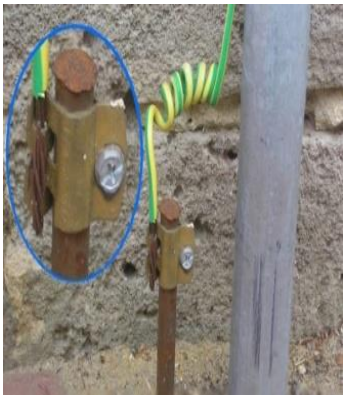
Common causes of electrocution

1. making contact with overhead wires
2. Undertaking maintenance on live equipment
3. Working with damaged electrical equipment, such as extension leads, plugs and sockets
4. Using equipment affected by rain or water ingress

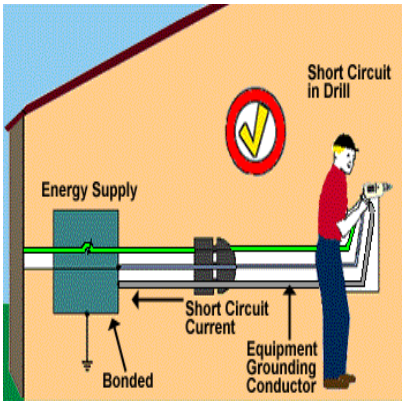
List of a common electrical hazards:

1. Improper grounding
2. Exposed electrical parts
3. Inadequate wiring
4. Overhead power lines
5. Damaged insulation
6. Overloaded circuits
7. Wet conditions
8. Damaged tools and equipment

1. Improper grounding



- Grounding is the process used to eliminate unwanted voltage.
- A ground is a physical electrical connection to the earth.



- Electrical equipment must be properly grounded.
- Grounding reduces the risk of being shocked or electrocuted.

- The ground pin safely returns leakage current to ground.
- Never remove the ground pin

- Removing the ground pin removes an important safety feature.
- You can get shocked!

2. Exposed electrical parts

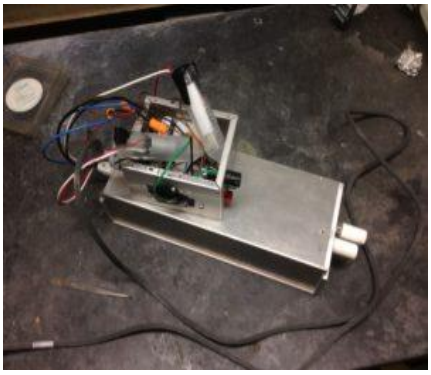
A part is considered exposed if it is not properly guarded, isolated, or insulated. Some common exposures to look for include:

- Exposed wires or terminals are hazardous.

- Unguarded parts

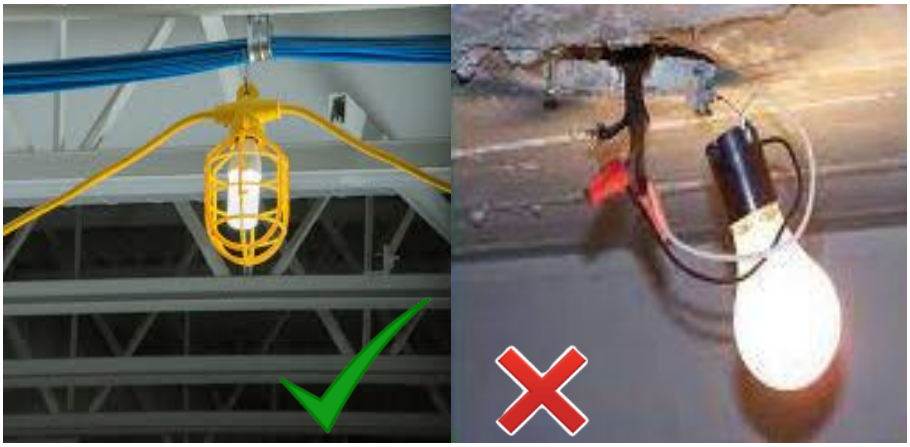
- Broken receptacles

- Open equipment



- Open Panels

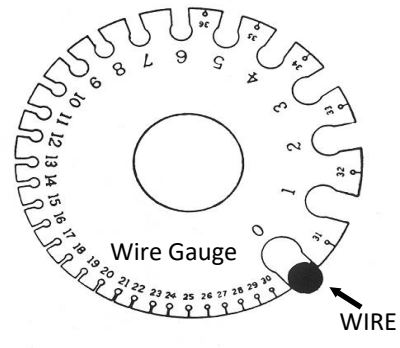
- On construction sites, temporary lighting must be properly guarded and protected to avoid contact with broken bulbs and avoid potential shocks.



3. Inadequate wiring

A hazard exists when a conductor is too small to safely carry the current .

Example: using a portable tool with an extension cord that has a wire too small for the tool.

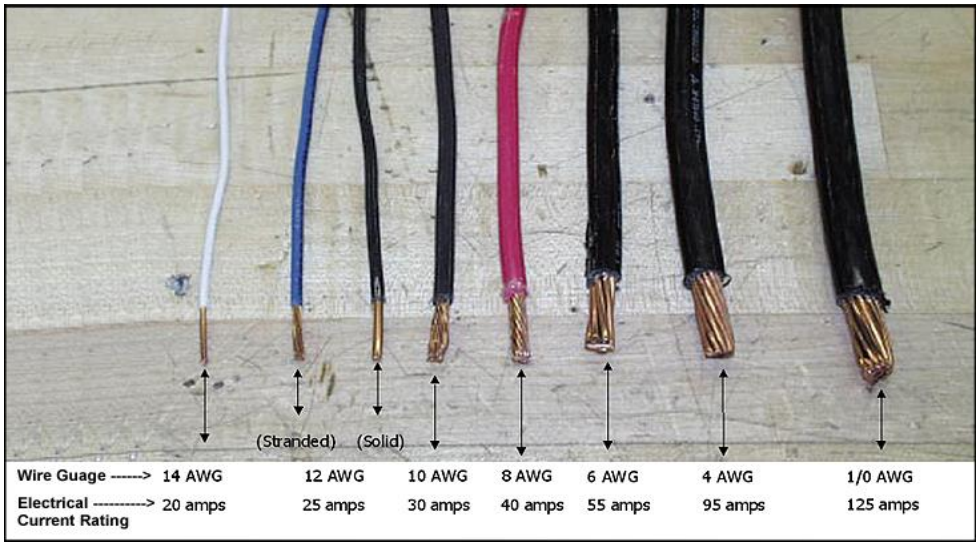


Wire gauge measures wires ranging in size from number 36 to 0 American wire gauge (AWG)

- The tool will draw more current than the cord can handle, causing overheating and a possible fire without tripping the circuit breaker.

- The circuit breaker could be the right size for the circuit but not for the smaller-wire extension cord.

- Different types of wires with their electrical current rating



4. Overhead power lines

Any work near electric overhead power lines must be carefully planned and carried out to avoid danger from accidental contact or close proximity to the lines.

Work involving long or high plant or equipment eg excavators, MEWPs, scaffold poles, tipper vehicles and cranes, presents a particularly high risk.

Remember:

- Contact with a power line is not necessary for danger. Close approach to live conductors may allow a 'flashover‘.
- Contact can be lethal with voltages as low as 230V
- Do not mistake overhead power lines on wooden poles for telephone wires.
- electric current can flow through wood or plastic (if damp or dirty) and cause fatal shocks.

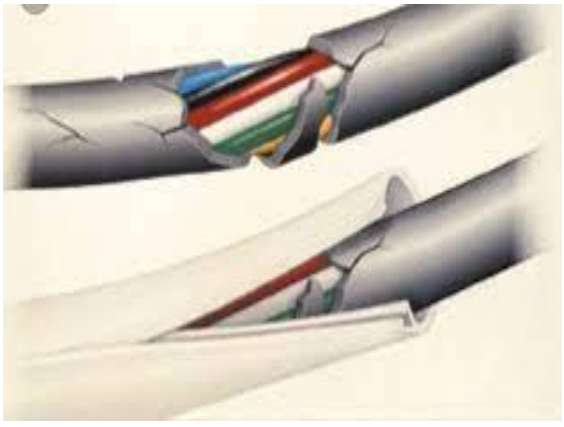
5. Damaged insulation

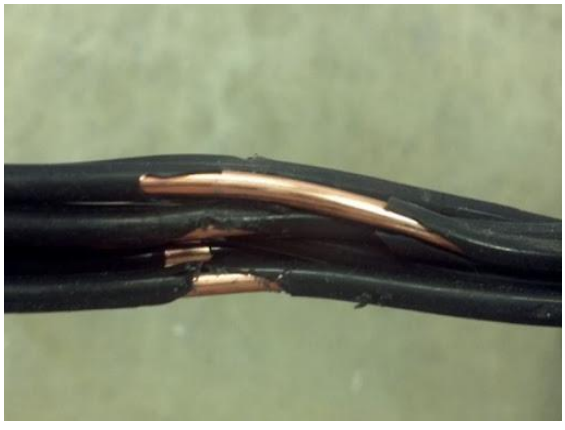
Insulation is the plastic covering that surrounds wires in a circuit. If the cable's insulation is destroyed, metal wires within the cable are revealed.

A person could be electrocuted if they touch the exposed wires, which could result in death.

Insulation damage to wire and cable can occur for a variety of reasons

1. Mechanical damage - The cable was accidently injured by the excavator due to heavy items.
2. Improper construction - The cable head and the weak link in the middle are broken due to poor construction methods and low-quality materials, resulting in insulation damage.
3. The insulation has become wet - Moisture intrudes into the interior of the cable due to a faulty cable head construction procedure, or the cable's inner protective coating is destroyed, allowing moisture in.
4. Overvoltage - The insulation layer is broken down by atmospheric or internal overvoltage, particularly if the system's internal overvoltage causes many wires to break at the same time.
5. Insulation aging - The insulating layer becomes brittle or fractured over time due to poor heat dissipation or overload, and the electrical and mechanical properties of the insulating material deteriorate.





6. Overloaded circuits

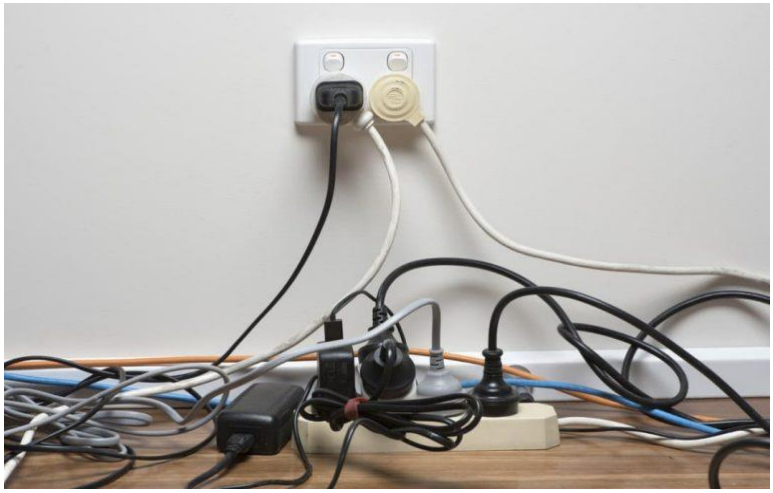
Electrical circuits include a wiring and a breaker (or fuse in old wiring systems).

Anything plugged into an outlet, like appliances, whose power consumption increases the overall load on the circuit.

Circuits can only cope with a limited amount of electricity. Overload happens when you draw more electricity than a circuit can safely handle – by having too many things running on one circuit.

Causes an Overloaded Circuit

- Plug in too many appliances on the same circuit
- Piggybacking extra appliances on wall outlets or extension cords



The Warning Signs of an Overloaded Electrical Circuit

- Lights that flicker or dim, especially when you switch on appliances or more lights.
- Buzzing noises from outlets or switches.
- Outlet or switch covers that become warm to the touch.
- Smell of burning from outlets or switches.
- Scorched plugs or outlets.
- Lack of power in appliances.
- Sluggish electronics.
- Tingling sensation or mild shock when you touch outlets, switches, or appliances.

To avoid a circuit overload

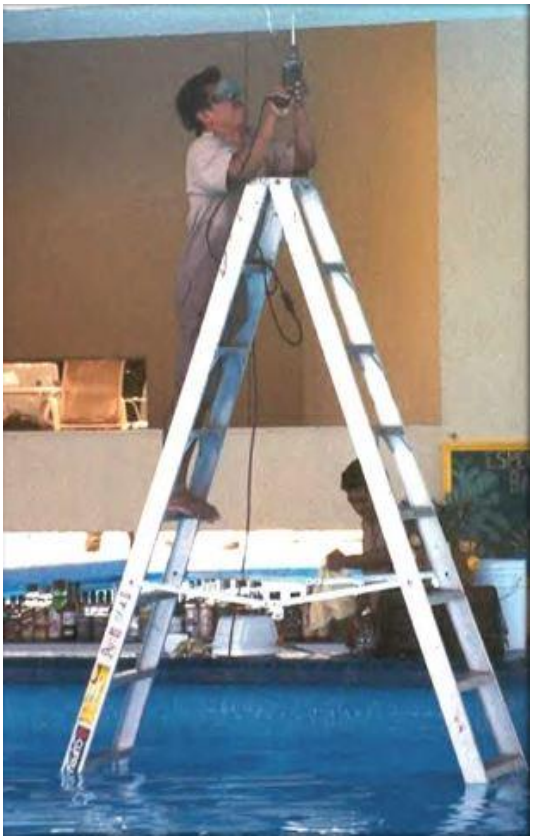
- Be aware of the amperage of your breakers or fuses.
- Electrical Code safety regulations say you can load a circuit up to 80 percent of its amperage rating. For instance, a 20-amp breaker will trip if it draws 16 amps of power. Keeping below the 80 percent figure will avoid overloads when you plug-in appliances like a vacuum cleaner.

7. Wet conditions

Working in wet conditions is hazardous because you **may become an easy path for electrical current**.

There are many circumstances that create wet conditions:

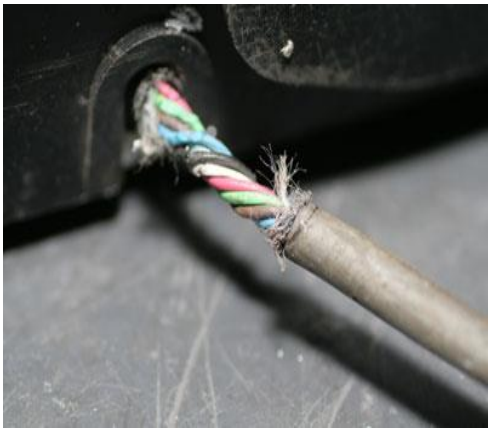
- Standing in water
- Wet clothing
- High humidity
- Perspiration



8. Damaged tools and equipment

Damaged equipment can result in serious electrical hazards.

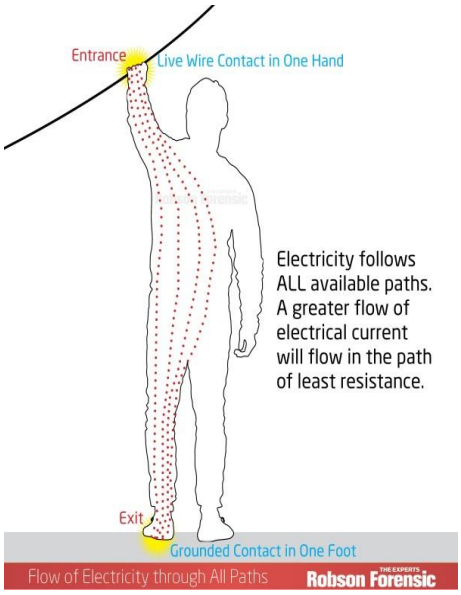
- Any damaged electrical covers on electrical panels, junction boxes and other equipment where live electrical parts and wiring may be exposed.
- Electrical cords which are easily damage, exposing live wires.



Dangers Of Electrical Shocks

An electric shock or electrocution is when electricity runs through your body, and it can always be dangerous.

- Like water and metal, the human body is a conductor of electricity. Therefore, it's important to avoid situations where you might come into contact with electricity.
- An electric shock can cause a tickle, muscular spasms, serious burns and even cardiac arrest or death.

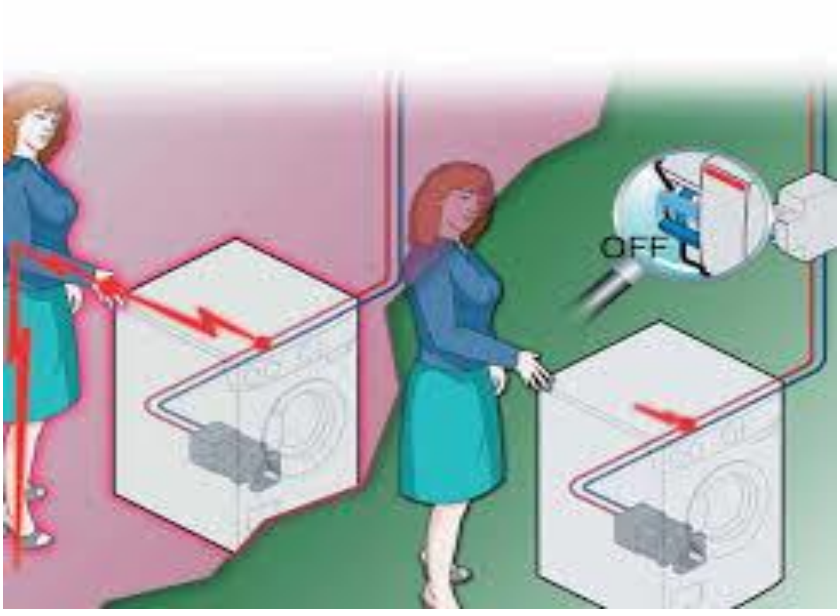


Direct contact of electrical shock

Direct contact occurs when someone touches an exposed live part, such as a bare wire. Such contact should not be possible, unless a cable's insulation is damaged, or a plug top or socket-outlet is missing or broken.

Indirect contact of electrical shock

Indirect contact occurs when someone touches a part which is not normally live. It becomes live due to a fault in the electrical installation or appliance. For example, failure of the electrical insulation between a live part and the metal casing of an appliance would cause the casing to become live.



WORKING ENVIRONMENT SAFETY

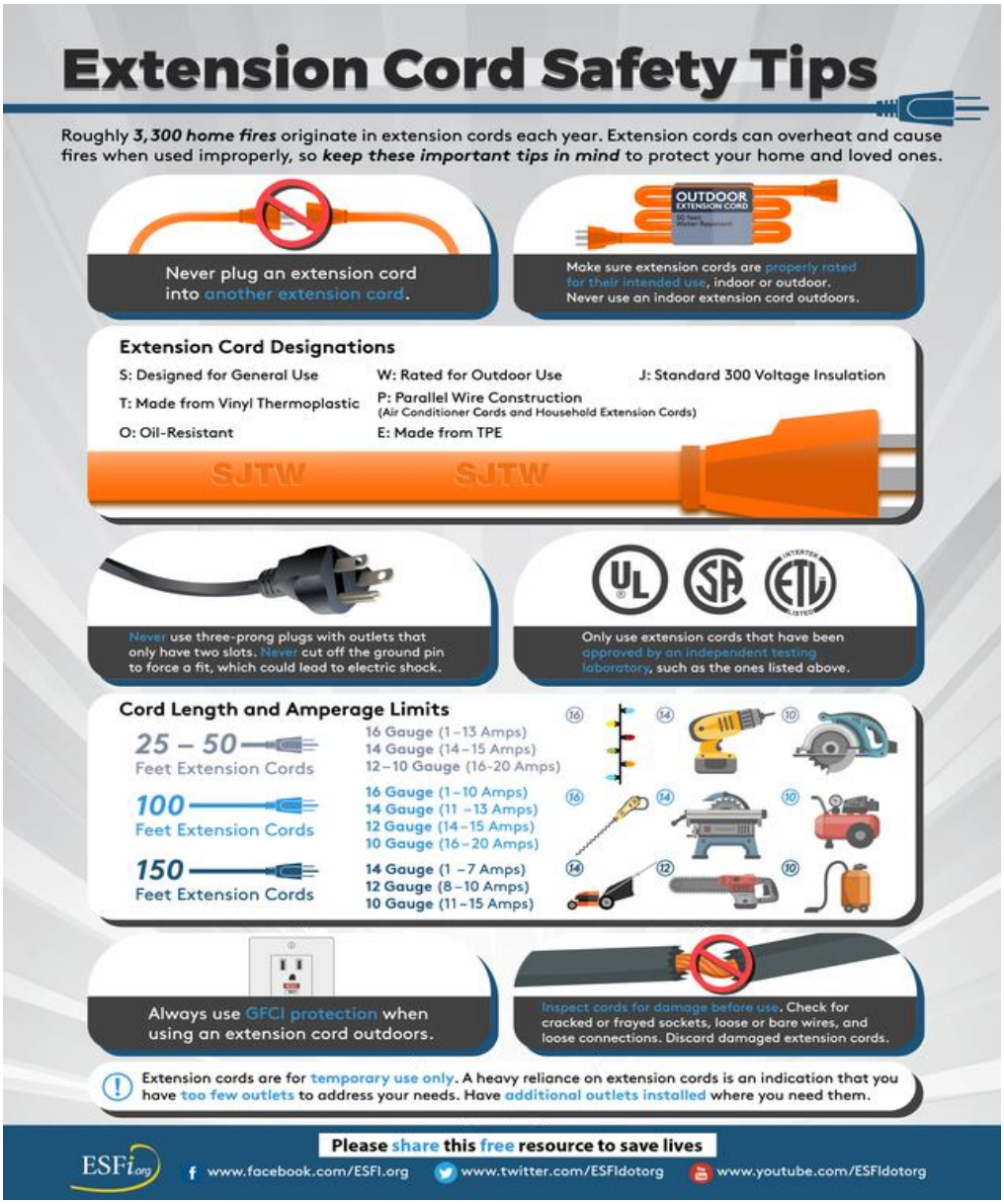
In a good work environment, the workspaces and working and production methods have been designed and implemented in such a way that workers can work and move about safely.

Workers are familiar with the hazards and risks related to the raw materials used in the work and the substances produced in the work processes, and they have been trained how to control them. The machines and tools used in the work suit their purpose.

Create safe working environment

Electrical safety tips for the workplace to avoid electrical hazard

- Keep your work area clean and orderly. This reduces the chance of accidents and prevents the accumulation of combustibles as well as flammable materials in the workplace



- Extension cords shall only be used for temporary power supply with portable equipment.

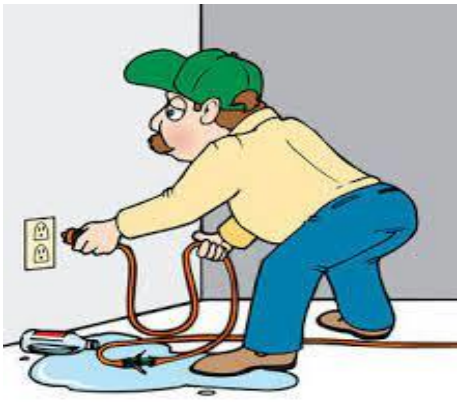
- Power strips must be plugged directly into a building outlet.

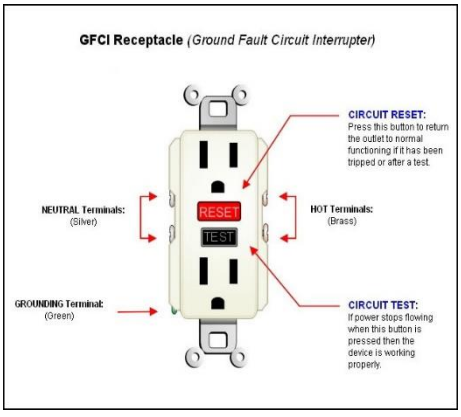
- Inspect all electric tools and equipment before use for damaged or frayed power cords. Remove frayed or defective extension and power cords from the workplace.

- Use insulated hand tools and double insulated power tools. Portable ladders used for electrical tasks shall have non-conductive side rails.

- Remove all metal jewelry, rings, and watches before working on electrical equipment.

- Never work around a source of electricity when you, your surroundings, or your tools are wet.

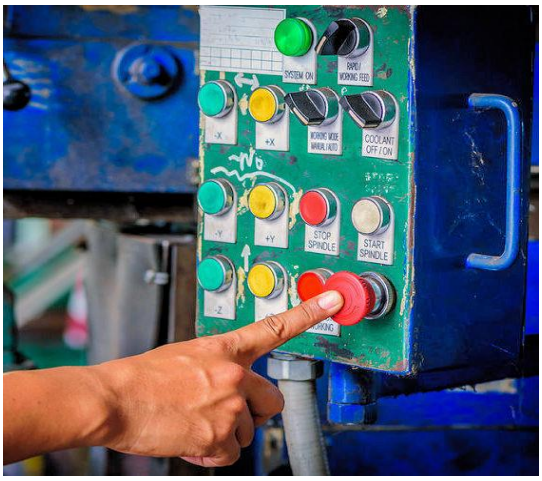




- Use Ground Fault Interrupters (GFI's) when working outside, near wet areas or when using extension cords.

- All live parts operating at 50 volts or greater shall be guarded against accidental contact

- De-energize all electrical equipment before beginning service or repairs. Verify that equipment is de-energized before work begins.



Waste management

- E-waste is waste from electric and electronic equipment such as end-of-life computers, phones and home appliances. E-waste is generally classified as hazardous because it contains toxic components (e.g. PCB and various metals). [1]

The ways to recycle e-waste

According to Columbia Climate School, there are formal and informal ways of recycling e-Waste

- Formal e-Waste recycling

  Formal e-Waste recycling typically requires electronics disassembling, separating, and categorising the contents according to the material before cleaning them.

Next, the e-Waste items are mechanically shredded so further sorting can be done using advanced separation tech. Companies that do this kind of thing need to adhere to health and safety rules and use pollution-control technologies that reduce the health and environmental hazards of handling e-Waste.

Meanwhile, based on a study by the watchdog group Basel Action Network, they found that 40% of the e-Waste supposedly recycled in the United States (US) was exported. What's worse is that most of it ended up in developing countries, usually in Asia and including Malaysia, where informal recycling is typically unlicensed and unregulated.

- **Informal e-Waste recycling**

  At these informal recycling sites, men, women, and even children would work to recover valuable materials by burning devices to melt away non-valuable materials using mercury and acids, and dismantling devices by hand to reclaim other materials of value. Normally, they don't wear any sort of protective equipment and lack any awareness that they are handling dangerous materials

e-Waste recycling companies in Malaysia

The DoE list also features a list of licensed e-Waste recycling companies by the state in Peninsular Malaysia

Working Practices Safety

Safe work practices are generally written methods outlining how to perform a task with minimum risk to people, equipment, materials, environment, and processes. Safe job procedures are a series of specific steps that guide a worker through a task from start to finish in a chronological order

Safety precautions when working with electricity

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.

- 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.

- Never use equipment with frayed cords, damaged insulation or broken plugs.

- 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.

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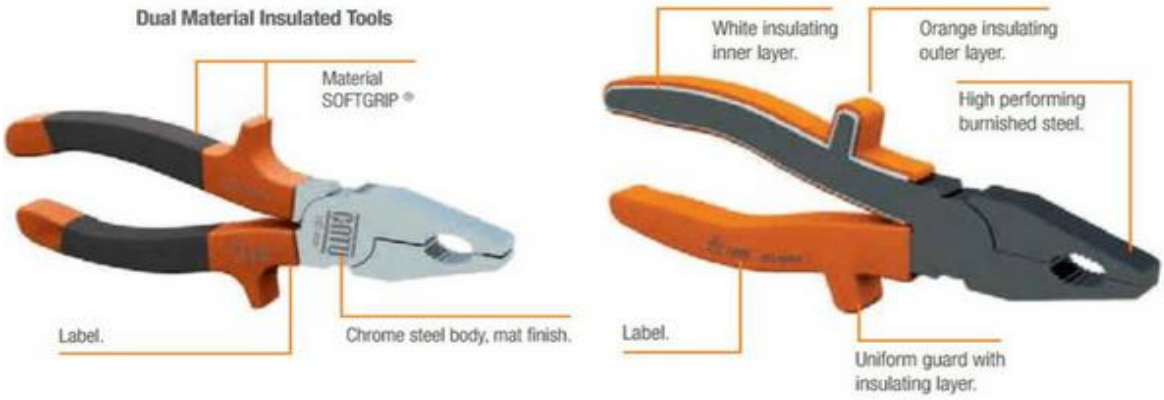
- Always use insulated tools while working.



- 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.

- Always use appropriate insulated rubber gloves and goggles while working on any branch circuit or any other electrical circuit.

- 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.

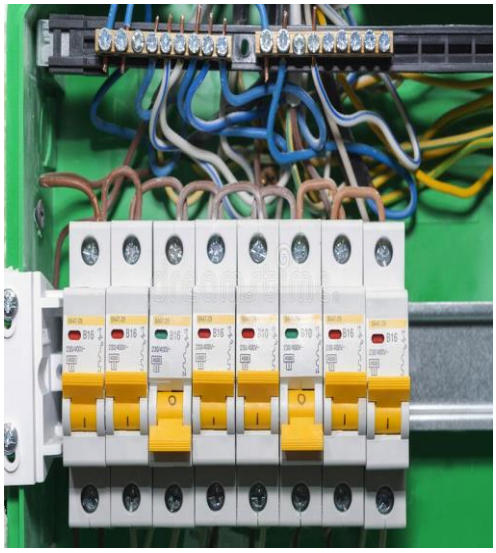
- Never use an aluminum or steel ladder if you are working on any receptacle at height in your home. An electrical surge will ground you and the whole electric current will pass through your body. Use a bamboo, wooden or a fiberglass ladder instead.

- Know the wire code of your country

	Single Phase	Three Phase
Phase Conductor (Line)	Red or Yellow or Blue	Line 1 Red Line 2 Yellow Line 3 Blue
Neutral Conductor	Black	
Protective Conductor (Earth)	Green-and-Yellow	

- 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.

- Always use a circuit breaker or fuse with the appropriate current rating. Circuit breakers and fuses are protection devices that automatically disconnect the live wire when a condition of short circuit or over current occurs. The selection of the appropriate fuse or circuit breaker is essential. Normally for protection against short circuits a fuse rated of 150% of the normal circuit current is selected. In the case of a circuit with 10 amperes of current, a 15 ampere fuse will protect against direct short circuits whereas a 9.5 amperes fuse will blow out.



- Working outside with underground cabling can be dangerous. The damp soil around the cable is a good conductor of electricity and ground faults are quite common in the case of underground cabling. Using a spade to dig at the cable can damage the wiring easily so it is better to dig at the cable by hand while wearing insulated gloves.

- Always put a cap on the hot/live wire while working on an electric board or service panel as you could end up short circuiting the bare ends of the live wire with the neutral. The cap insulates the copper ends of the cable thus preventing any kind of shock even if touched mistakenly.

- Take care while removing a capacitor from a circuit. A capacitor stores energy and if it's not properly discharged when removed it can easily cause an electric shock. An easy way to discharge low voltage capacitor is that after removal from the circuit is to put the tip of two insulated screw drivers on the capacitor terminals. This will discharge it. For high voltage ones a 12 Volts light bulb can be used. Connecting the bulb with the capacitor will light up the bulb using up the last of the stored energy.

- Always take care while soldering your circuit boards. Wear goggles and keep yourself away from the fumes. Keep the solder iron in its stand when not in use; it can get extremely hot and can easily cause burns.

Tool and equipment care and maintenance

Tools and equipment require proper care and maintenance, not only for longevity but also to remain useful and safe for the task at hand

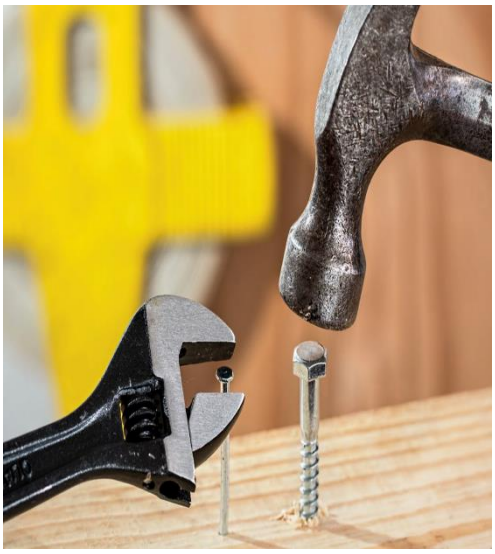
1. Proper storage
2. Using tools and equipment for their right task
3. Cleaning after use
4. Inspect tools regularly
5. Read and follow manuals

Proper storage

Proper storage entails shielding tools from harsh weather conditions, damage and theft. It is particularly crucial for metallic tools to be kept away from moisture to avoid rusting. Having a cabinet where these tools and equipment are stored will be vital to ensuring a secure storage area. Also, greasing, lubricating or oiling metallic tools and equipment is essential to prevent rust from forming while keeping the tools in the best condition for future tasks.

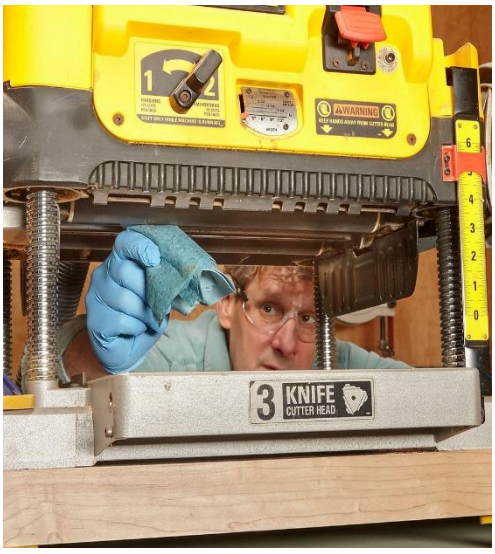
Using tools and equipment for their right task

Using a tool for the right task it is intended helps to keep it in its best shape. This reduces unnecessary damage and protects the user. It is also important to check whether the tools are in the right condition before using them.



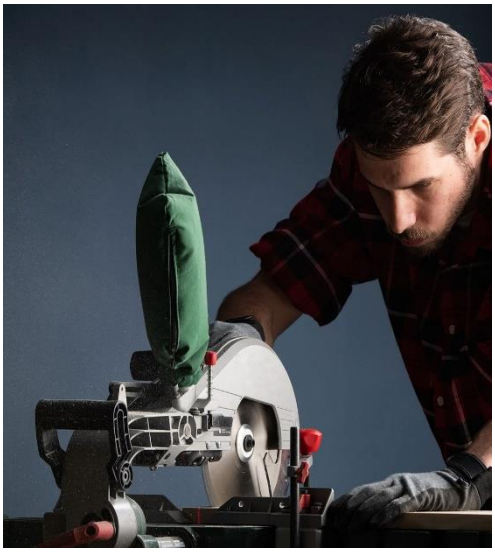
Cleaning after use

Storing dirty tools without cleaning them can cause them to deteriorate. Routine cleaning reduces the chances of rust and can reduce the rate of wear and tear.



Inspect tools regularly

Regular inspection of tools is beneficial since it provides an opportunity to see if tools may need repair or replacing. Inspections can help to prevent a situation where a last minute trip to the store to purchase a new tool or spare parts delays a project.



Read and follow manuals

The manuals that come with equipment, especially power tools, have important and useful guidelines. They instruct and advise on the best way to keep equipment in optimal condition.

REFERENCE

[1]	R. A. R. A. Y. M. S. M. Fatihah Suja, "e-Waste Management Scenarios in Malaysia," *Journal of Waste Management,* 2014.


TERIMA KASIH

Terbitan

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