

# Indian Association of Amusement Parks & Industries (IAAPI)

## Electrical Safety 26/09/2019



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# Thanks to Thomas Edison and All Inventors!

**“My desire is to do everything within my power to free people from drudgery and create the largest measure of happiness and prosperity.”**

**- Thomas Alva Edison**



**Electrical Safety is not a rocket science. It is compliance of NEC & IS standards and Indian Electricity Regulations.**

**– Electricity is a good servant....  
..... But a worst monster.**

**It is safer to be familiar with:**

- ▶ **the fundamental concepts of electricity.**
- ▶ **the effects of electricity on the human body.**
- ▶ **electrical protective devices**

**Electrical Safety**  
**26/09/2019**

# **Electrical Safety**

## **26/09/2019**

- **Electricity is the backbone of nation's progress. As a result the relation between GDP & highest electrical consumption has been established.**
- **We live in electrified society.**



# ELECTRICAL SAFETY

***Acronym of Electricity stands for:***

- E- Earthing for protection
- L- Load- Normal & Overload
- E- Electrocution hazard
- C- Current- flow of electrons
- T- Transmission
- R- Resuscitation- to save life
- I- Insulation for protection
- C- Conductor
- I- It is Invisible
- T- Trips on fault for protection
- I[Y]- Induction effect

# FUNDAMENTALS OF ELECTRICAL HAZARDS

- ▶ To flow, electricity must have a complete & closed path.
- ▶ Electricity flows through good *conductors*:
  - water, metal, the human body
- ▶ Insulators are non-conductors
- ▶ The human body is also a conductor.
- ▶ Electric current does not occur without sufficient voltage available to motivate electrons to flow (current).

# FUNDAMENTALS OF ELECTRICAL HAZARDS

## Have You Ever Received a Shock ?



### Electrical Hazards:

- Electrical Shock,
  - Burns
  - Fatality,
  - Arc Flash/Blast and
  - fire.
- Electrical injury is a physiological reaction caused by electric current passing through the body. Electric shock occurs upon contact of a body part with any source of electricity that causes a sufficient magnitude of current to pass through the victim's flesh, viscera or hair. Physical contact with energized wiring or devices is the most common cause of an electric shock.



# FUNDAMENTALS OF ELECTRICAL HAZARDS

The severity and effects of an electrical shock depend on a number of factors,:

- the pathway through the body,
- the amount of current,
- the length of time of the exposure, and
- whether the skin is wet or dry.





ELECTRICAL CURRENT	Probable Effect on Human Body
1 mA	Perception level. Slight tingling sensation. Still dangerous under certain conditions.
5 mA	Slight shock felt; not painful, but disturbing. Average individual can let go of object. However, strong, involuntary reactions to shocks in this range may lead to injuries.
6-16 mA	Painful shock, begin to lose muscle control. Commonly referred to as the freezing current or let-go range.
17-99 mA	Extreme pain, respiratory arrest, severe muscular contractions. Individual cannot let go of electrified object. Death is possible.
100-2000 mA	Ventricular fibrillation (uneven, uncoordinated pumping of heart). Muscular contractions and nerve damage begin to occur. Death is likely.
2000+ mA	Cardiac arrest, internal organ damage, and severe burns. Death is probable.

Source: OSHA

# ELECTRICAL PROTECTION

## ▶ **Circuit Breakers are**

- Provided to protect EQUIPMENT not people.
- Do not reset breakers with a line voltage higher than 120V and only reset if you know why it tripped.

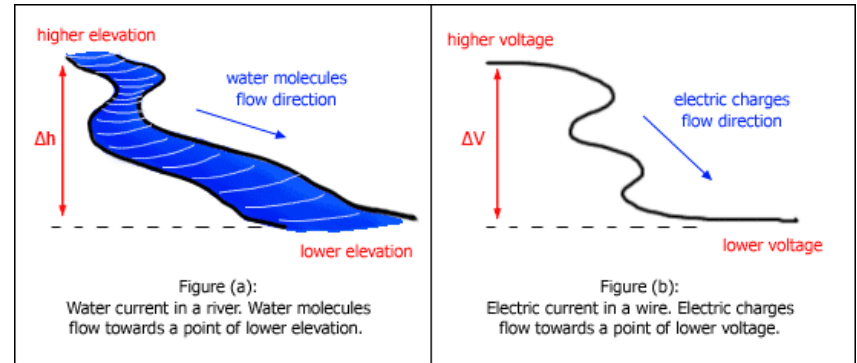
- **ELCBs are:**

- Provided to protect people
- Range 30 mA, 100 mA
- Monthly test



# FUNDAMENTALS OF ELECTRICITY

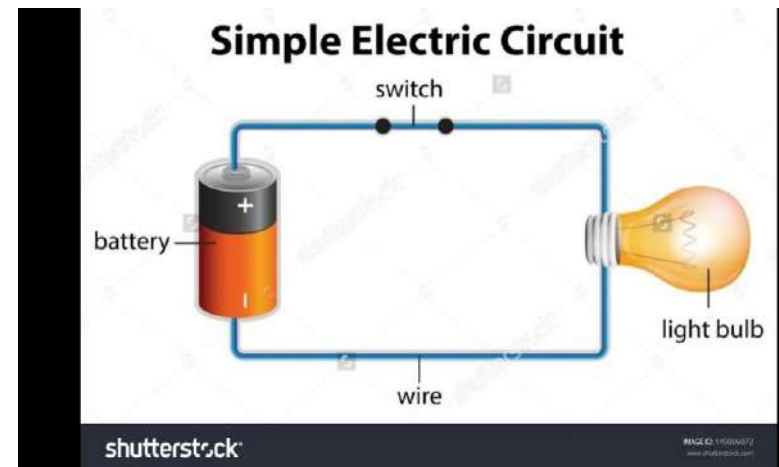
- ▶ **Voltage**
  - electrical pressure (water pressure)
- ▶ **Amperage**
  - electrical flow unit (gallons/min)
- ▶ **Impedance or Resistance**
  - restriction to electrical flow (e.g. pipe friction)



**Electric current** is very **similar** to a flowing **river**. ... With **electricity**, **current** is a measure of the amount of charge transferred over a period of time. **Current** is a flow of electrons, or individual negative charges. When charge flows, it carries energy that can be used to do work.

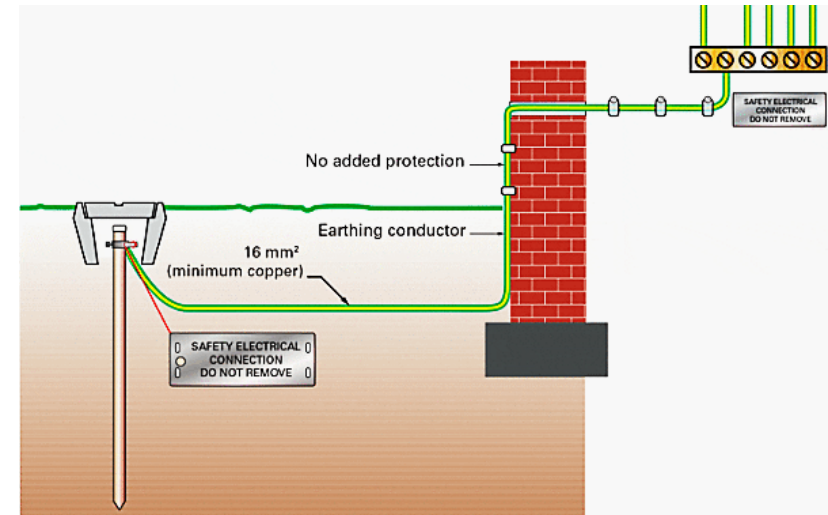
# FUNDAMENTALS OF ELECTRICITY

- ▶ **Circuit**
  - path of flow of electricity
- ▶ **Circuit Element**
  - objects which are part of a circuit through which current flows– wiring, switch, load,
- ▶ **Fault/ Abnormal condition**
  - current flow through an unintended path.



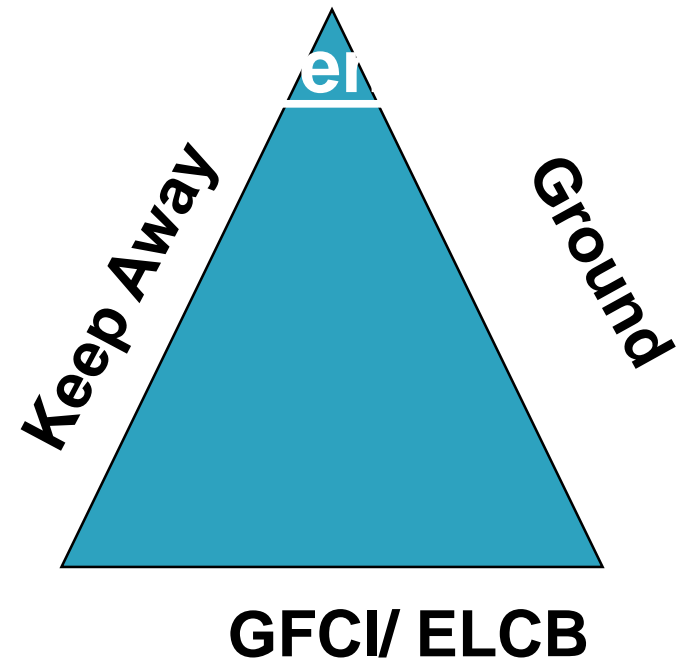
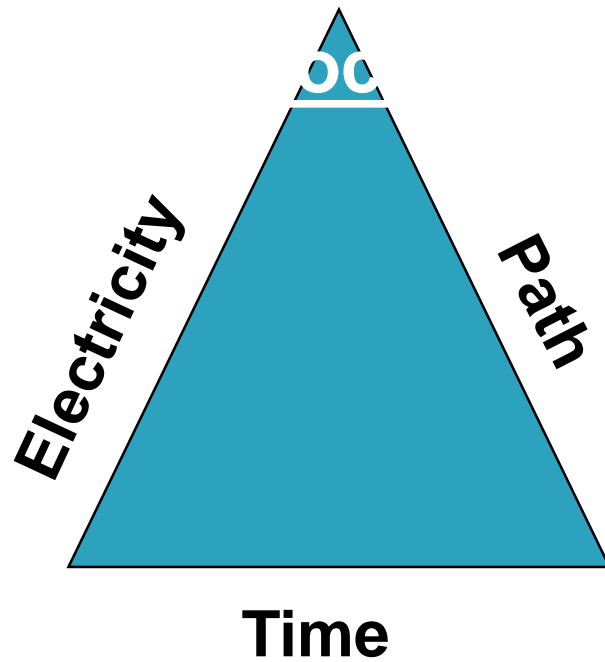
# FUNDAMENTALS OF ELECTRICAL HAZARDS

- ▶ What is Earthing?
  - Protection from electric shock
    - normally a secondary protection measure
- ▶ An earth is a conductive connection
  - between electrical circuit or equipment and earth or ground plane
  - creates a low resistance to the earth.





# PREVENTING ACCIDENTAL ELECTRICAL CONTACT



# ELECTRICAL SAFETY

- ▶ Remember:
- ▶ Electricity takes the path of least resistance.
- ▶ Electricity always wants to go to ground.
- ▶ If an electric tool falls into a sink or tub of water, the item will short out.





# ELECTRICAL PROTECTION

## Signs of Electrical Hazards

- Tripped over current protective devices (circuit breakers, fuses and ground fault circuit interrupter);
- Hot to the touch on tools, wires, cords, connections, or junction boxes;
- Dim and flickering lights;
- Sizzles and buzzes or unusual sounds from electrical equipment, apparatus or circuits;
- Burning smell of poor insulation;
- Mild tingle from contact with case or equipment;
- Worn or frayed insulation around wire or connection; and
- Burn marks or discoloration on receptacle plates or plug prongs.



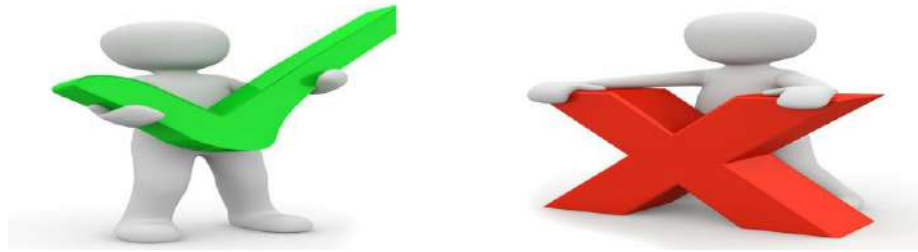
# ELECTRICAL HAZARD CONTROLS

Hazard controls should be considered in order of their efficacy. Listed below is the accepted hierarchy of hazard control: ---- **4 “E”s**

1. **Eliminate** the hazard if possible such as de-energizing the equipment and locking it out prior to performing any work;
2. Implement **Engineering controls** (e.g. over current/ short circuit protective devices, enclosure, or using insulated tools);
3. **Education**- Develop safe work practices (e.g. training and safe work procedures); and
4. **Ensure**- Utilize personal protective equipment (e.g. eye protection, gloves, laboratory coats).



# DO'S AND DON'TS



- ▶ Do plug power equipment into wall receptacles with power switches in the Off position.
- ▶ Do unplug electrical equipment by grasping the plug and pulling. Do not pull or jerk the cord to unplug the equipment.
- ▶ Do not drape power cords over hot pipes, radiators or sharp objects.





# DO'S AND DON'TS



- ▶ Do check the receptacle for missing or damaged parts.
- ▶ Do not plug equipment into defective receptacles.
- ▶ Do check for frayed, cracked, or exposed wiring on equipment cords.
- ▶ Don't insert naked wires into the plugs. It is dangerous.
- ▶ Do use junction boxes [JB] instead of open joints.

# DO'S AND DON'TS

- ▶ Do check for defective cords clamps at locations where the power cord enters the equipment or the attachment plug.
- ▶ Extension cords should not be used in office areas. Generally, extension cords should be limited to use by maintenance personnel.
- ▶ Don't stand on wet surface and work on electricity.
- ▶ Always lay the wires in either through conduits, casing-capping. Use cable trays for support. Frayed wires and power cables pose a significant electrical hazard.



# DO'S AND DON'TS

- ▶ Employees should know the location of electrical circuit breaker panels that control equipment and lighting in their respective areas. Circuits and equipment disconnects must be identified



# DO'S & DON'TS



- ▶ Keep flammable materials away from electrical equipment.
- ▶ Practice good housekeeping. Poor housekeeping is a major factor in many accidents. A cluttered area is likely to be both unsafe and inefficient;
- ▶ Any electrical equipment causing shocks or with high leakage potential must be tagged with a Danger tag or equivalent.
- ▶ Double insulated power tools are doubly safe and can be used in wet and damp locations.

# USE OF PERSONAL PROTECTIVE EQUIPMENT

- ▶ Use rubber hand gloves while working on electricity.
- ▶ Use insulated screw driver blades and pliers.
- ▶ Use non conductive ladder to work at height.
- ▶ Provide rubber mats in front of the electrical panels.
- ▶ Don't wear gold rings, chain, wrist watch, etc.





# ELECTRICAL PANEL SAFETY

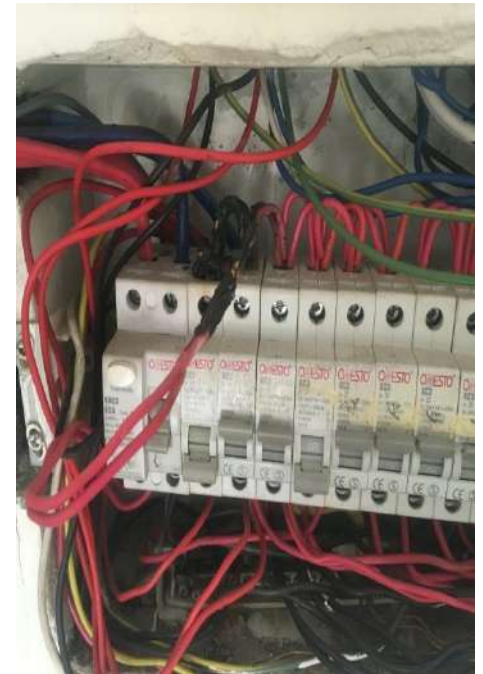


- ▶ All indicating lamps must be in working condition and glow i.e. ON/OFF/Trip, etc.
- ▶ Provide proper labeling on the panel feeders./ Push Button Stations/Equipments
- ▶ Use proper Lock Out Tag Out (LOTO) on isolated circuits.
- ▶ Don't work without obtaining Electrical Isolation Permit .
- ▶ Close all openings on the panels.– cable entries, holes, etc.
- ▶ Provide proper ventilation in switch rooms.
- ▶ Ensure that all meters are in working condition.
- ▶ Shut down work: Make a list of tools to be used and count.
- ▶ Maintain good Housekeeping .
- ▶ Provide rubber mat in front of the panel.

# ELECTRICAL RULES



- Rule no. 1  
Avoid contact with energized electrical circuits.
- Rule no. 2  
Treat all electrical devices as if they are live or energized.
- Rule no. 3  
Disconnect the power source before servicing or repairing electrical equipment. The only way to be sure. Apply LOTO
- Rule no. 4  
Use only tools and equipment with non-conducting handles when working on electrical devices.



# ELECTRICAL RULES



## Rule no. 5

Never use metallic pencils or rulers, or wear rings or metal watchbands when working with electrical equipment . Always be aware.

## Rule no. 6

Remember to use: Safety clothes, rubber gloves and shoes, stand on dry ground. Stand on insulated mat.



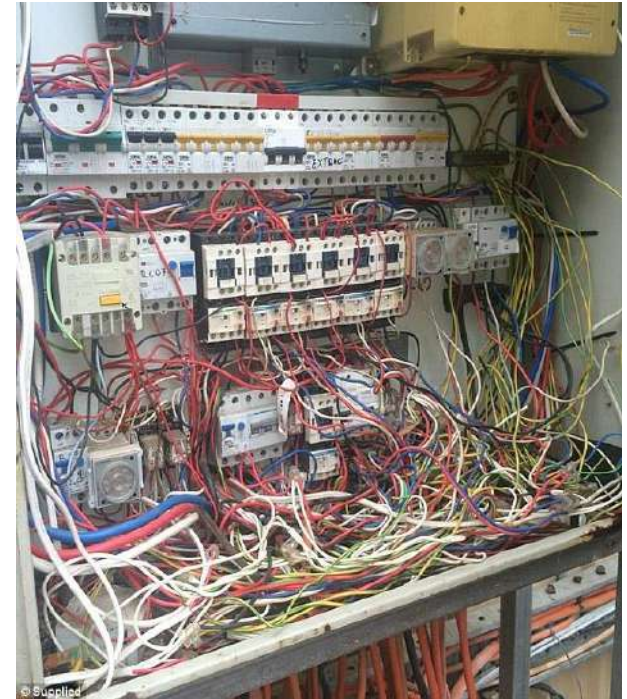
# ELECTRICAL RULES

- Rule no. 7

If it is safe to do so, work with only one hand, keeping the other hand at your side or in your pocket, away from all conductive material. This precaution reduces the likelihood of accidents that result in current passing through the chest cavity.

## Rule no. 8

Minimize the use of electrical equipment in cold rooms or other areas where condensation is likely. If equipment must be used in such areas, mount the equipment on a wall or vertical panel.







# ELECTRICAL RULES

## Rule no. 9

If water or a chemical is spilled onto equipment, shut off power at the main switch or circuit breaker and unplug the equipment.



## Rule no. 10

If an individual comes in contact with a live electrical conductor, do not touch the equipment, cord or person. Disconnect the power source from the circuit breaker or pull out the plug using a leather belt.

- Rule no. 11

Equipment producing a “tingle” should be disconnected and reported promptly for repair.



# ELECTRICAL RULES



- Rule no. 12

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.

- Rule no. 13

Drain capacitors before working near them and keep the short circuit on the terminals during the work to prevent electrical shock.

- Rule no. 14

Never touch another person's equipment or electrical control devices unless instructed to do so. Don't be too smart. Don't try your luck.



# ELECTRICAL RULES



- Rule no. 15  
Enclose all electric contacts and conductors so that no one can accidentally come into contact with them.
- Rule no. 16  
Never handle electrical equipment when hands, feet, or body are wet or perspiring, or when standing on a wet floor.
- Rule no. 17  
When it is necessary to touch electrical equipment (for example, when checking for overheated motors), use the back of the hand. Thus, if accidental shock were to cause muscular contraction, you would not “freeze” to the conductor.

# ELECTRICAL RULES



- Rule no. 18  
Be aware that interlocks on equipment disconnect the high voltage source when a cabinet door is open but power for control circuits may remain on.  
Understand the single line diagram and wiring schemes – know your switchboard.
- Rule no. 19  
De-energize open experimental circuits and equipment to be left unattended.
- Rule no. 20  
*Do not wear loose clothing or ties near equipment.  
Remove metal jewelry (watches, chain, bracelets, rings, etc.) before working on electrical circuits .*

# What is the best way to prevent the hazards of electricity?

- Stop - Before Action
- Think - Risks/Hazards
- Options - LOTO
- Protection - Proper PPE



Avoiding energized circuits is the safest way!

# Electrical Safety

## PIRE ( Not a PYRE)



- ▶ P – Protection– Circuit breaker with relays
- ▶ I – Insulation as insulators
- ▶ R – Resistance, insulation resistance
- ▶ E – Earthing
- ▶ If you don`t follow this principle, you may land on PYRE for funeral,







**Be Safe  
Be Prepared**