Basic Training

on

Electrical Safety

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Compiled By: SAFETY COMMITTEE, IPR

Introduction

- As per the statistics published by the NCRB (MoHA) – GOI,

  Death due to electrocution in the year 1999: **5671**

  Death due to electrocution in the year 2008: **8067**

  Death due to electrocution in the year 2010: **9059**

  Death due to electrocution in the year 2011: **8945**

- As per OSHA, an average of one worker is electrocuted on the job every day.

Introduction

Electricity is invisible. It cannot be seen, heard, tasted, or smelled.

Like a snake hiding in the grass, electricity will strike if you don't follow safe work practices as well as using and maintaining safe equipment."

5 Electrical Myths -Need to Know

1. Electricity takes the path of least resistance.
2. Electricity wants to go to ground.
3. If an electrical appliance/tool falls into water, it will short out.
4. It takes high voltage to kill. (DC > 32 V; AC > 110 V) ; (Body current ~ 15 mA detrimental effects begin); (current flow period)
5. Double-insulated power tools can be used in wet and damp locations.

HAZARDS OF ELECTRICITY

Types of electrical hazards

- Electrocution (death due to electrical shock)
- Electrical shock 
- Burns
- Falls

Types of electrical hazards

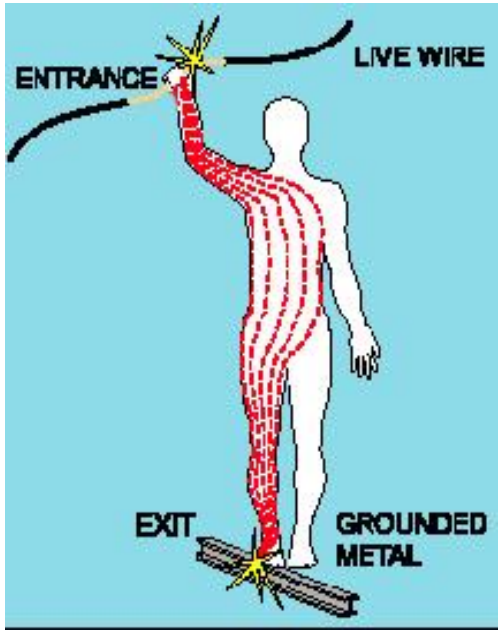
Other hazard associated with electricity

- Fire
- Explosions
- Equipment damage

Electrical Shock

- **Received when current passes through the body**
- Severity of the shock depends on:

  - Path of current through the body,
  - Amount of current flowing through the body,
  - Length of time the body is in the circuit,



Electrical Shock

LOW VOLTAGE DOES NOT MEAN LOW HAZARD but depends on Resistance of the body and surrounding condition. E.g. **Low voltage shock while taking bath is very serious and mostly fatal.**

How is an electrical shock received?

- Ohm's Law : Current = Voltage/Resistance
- If you come into contact with an energized (live) wire, and you are also in contact with the earth wire/ground, current will pass through your body and YOU WILL RECEIVE A SHOCK,
- Current flow is inversely proportional to Resistance. High resistance shoes increase ground resistance so less current will flow through the body and low risk of serious shock.

Electrical Burns

Mainly Three Types of Electrical Burns,

1. Radiation burn
2. Flash-over burn
3. Direct contact burn

- Radiation burn: When exposed body is quite away from arcing, flash-over. Less serious than flash-over burn and direct contact burn.

Electrical Burns

- Flash-over burn : Normally with HV system. When air get ionized between two HV terminal it results. It results surface burn over area exposed to flash.

- Direct contact burn : High current passes through body, it result puncture burn at the point where current enters in the body and leaves.
- It is very serious and deep routed burn.

Secondary hazards of electricity

FALLS: Workers in elevated locations who experience a shock can fall, resulting in serious injury or death.

Secondary hazards of electricity

FIRE OR EXPLOSION: For the fire or explosion ignition source is very important, this requirement is fulfilled by spark/arc generated from overloading or short-circuit of electric supply or from the poorly maintained electrical appliances.

The severity of fire depends on the nature and quantity of flammable material available.

(toxicity of smoke from insulating materials!!!)

MAIN CAUSES OF ACCIDENTS

1) Inadequate / Improper Wiring
2) Excessive & Continuous Overloading (in higher amb. Temp.)
3) Improper Grounding/ Earthing

1. Inadequate Wiring

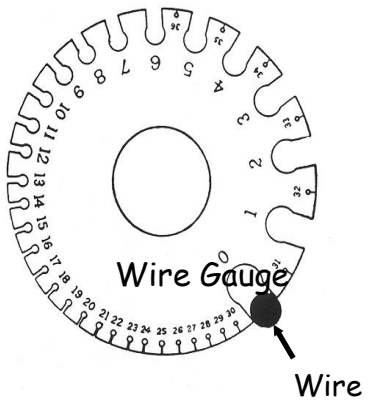
For electrical started fire, 90% incidents due to inadequate wiring or overload.

i. **Improper selection of cord:**

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

1. Inadequate Wiring

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



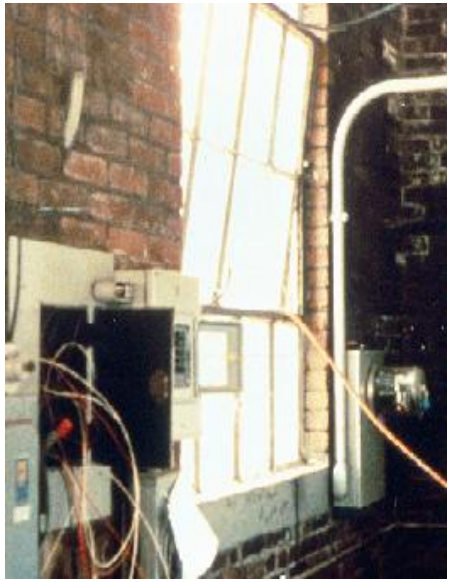
- The tool will draw current higher than the cord can handle, causing overheating and a possible fire without tripping the circuit breaker,
- The circuit breaker could be the right size for the circuit but not for the smaller-wire extension cord,

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

1. Inadequate Wiring

ii. Use of Flexible cords

- **More vulnerable than fixed wiring**
- Flexible cords can be damaged by:
  - Aging,
  - Door or window edges,
  - Staples or fastenings,
  - Abrasion from adjacent materials,
  - Activities in the area,

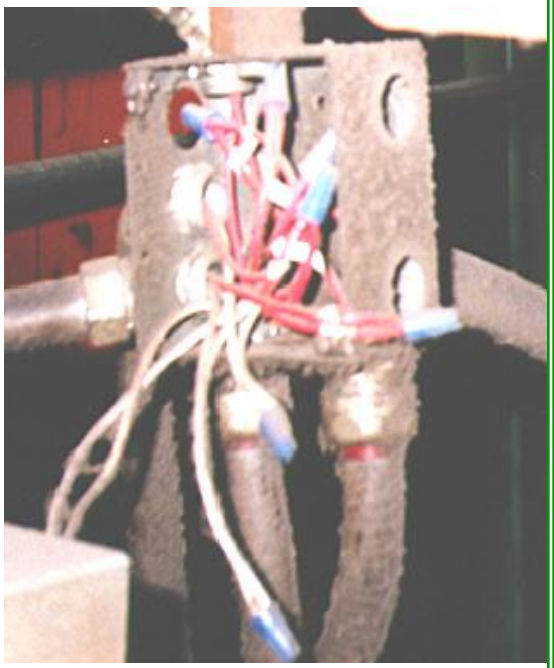


Improper use of flexible cords can cause shock, burn or fire

1. Inadequate Wiring

iii. Lack of maintenance/inspection

- Use of improper Junction boxes, pull boxes and fittings. Lack of maintenance of the same leads to shock or fire.
- Improper maintenance/ inspection of protective gadgets render them inoperative and does not give protection.
- Unused openings in cabinets, boxes and fittings must be closed (no missing knockouts)



1. Inadequate Wiring

1. Inadequate Wiring

2. Overloading

- More than 70% incidents of electrical fire are due to overloading and short circuit.
- Main cause of residential/ commercial building fire.

2. Overloading

- If too many devices are plugged into a circuit, the current will heat the wires to a very high temperature, which may cause a fire.
- If the wire insulation melts, arcing may occur and cause a fire in the area where the overload exists, even inside a wall.

3. Improper Grounding/Earthling

- Some of the most frequently violated OSHA & IS standards.
- **Main cause of Electrical Shock / Electrocution**
- Grounding / Earthing: Metal parts of an electrical wiring system that we touch (switch plates, ceiling light fixtures, conduit, etc.) should be at zero (nearly) volts relative to ground,

3. Improper Grounding/Earthling

- Housings of motors, appliances or tools that are plugged into improperly grounded circuits may become energized,

- If you come into contact with an improperly grounded electrical device, YOU WILL BE SHOCKED.

3. Improper Grounding/Earthling

- The grounding and earthing conductor should be rated as per load and earth pit resistance should be lowest possible (< 3 ohm) – and is dependent on fault current and fault clearing time (by switchgear)

- The path to ground from circuits, equipment, and enclosures must be permanent and continuous (without any switches)

3. Improper Grounding/Earthling

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- Violation shown here is an extension cord with a missing grounding prong.

3. Improper Grounding/Earthling

- To protect you from shock, burns, and electrocution, tools must,
  - Have a three-wire cord with ground and be plugged into a grounded receptacle, or
  - Be double insulated, or
  - Be powered by a low-voltage isolation transformer,

PREVENTION OF ACCIDENTS

1. Engineering controls

Installation of Electrical Protective Devices:

- These devices shut off electricity flow in the event of an overload or ground-fault in the circuit,
- Include fuses, circuit breakers and Earth Leakage Circuit Breaker (ELCB) etc.,

1. Engineering controls

a) Fuses and circuit breakers give protection against over-current/short ciruit only.

When there is too much current:

- Fuses melt - it should be weakest link in circuit
- Circuit breakers (MCB) trip open,

- Prefer MCB instead of fuse because if fuse is not wired as per the load it does not give protection,

1. Engineering controls

(b) Earth Fault Circuit Breaker (ELCB) or GFCI

- This device **protects you from dangerous shock**
- The ELCB detects leakage current known as ground fault, which is vital for electric shock.

1. Engineering controls

- If a ground fault is detected, the ELCB can shut off electricity flow in as little as 1/40 of a second, protecting you from a dangerous shock,
- However, once it is installed, periodically testing is very important to ensure its functioning.

2. Procedural control

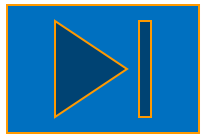
1. Control 'Access to Live parts'

- Guard live parts of electric equipment operating at 50 volts or more against accidental contact by:
  - Approved cabinets/enclosures, or
  - Location or permanent partitions making them accessible only to qualified persons, or
- Mark entrances to guarded locations with conspicuous warning signs.

2. Procedural control

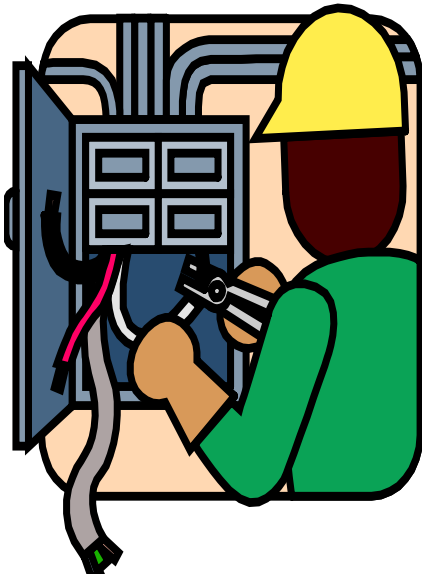
2. Energy Isolation

Before attempting any electrical operated equipment isolate (physically separate, wherever possible) the electrical energy from elsewhere and apply tags/locks.



2. Procedural control

- Any person exposed to an un-insulated live/energized electrical conductor must be Qualified.



- Being Qualified doesn't mean being an electrician but means the person knows: (caution about less knowledge)
  - What the hazards of the task are,
  - How to identify the hazards, and
  - The safe work practice to avoid the hazard.

2. Procedural control

- Untrained and un-alert person is unsafe in safe condition and safe and alert worker is safer in unsafe condition - so Training is a must to all person.

FIRST AID FOR SHOCK

3. First Aid For Electrical Shock

ORDER OF ACTION TO BE FOLLOWED :

1. Switch Off Current

2. Secure Release from Contact

Safeguard yourself when removing casualty from contact.

Stand on non-conducting material (rubber mat, DRY wood). Use rubber gloves, DRY clothing, a length of DRY rope or a length of DRY wood to pull or push the casualty away from the contact.

3. First Aid For Electrical Shock

3. Start Artificial Resuscitation

If the casualty is not breathing, artificial resuscitation is of extreme urgency. A few seconds' delay can mean success or failure. Continue until the casualty is breathing satisfactorily or until a doctor tells you to stop.

4. Call Doctor or Ambulance immediately.

ELECTRICITY IS A GOOD SLAVE BUT A BAD MASTER

SO... BE THE 'MASTER',
DON'T LET IT TAKE
AWAY YOUR LIFE.

MANAGE ELECTRICITY
SAFELY

Thanks