

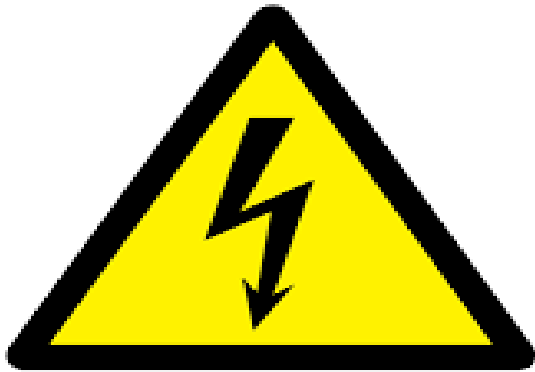
ELECTRICAL SAFETY

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Electrical Danger Signs



**Warning
electricity**



Electricity Danger Signs



Electrical Safety : Against What?

A. Safety against electric shocks

B. Safety against electric fire

A. Safety of equipment

Effects of Electricity on Human Body

A. Effect on Muscles and Veins:

- Tingling sensation
- Muscular Contraction
- Asphyxia (deficiency of oxygen)
- Respiratory Arrest
- Ventricular Fibrillation
 - ✓ Muscle cannot open / close properly
 - ✓ Heart does not pump
 - ✓ Lack of oxygen to brain – **DEATH**

B. Burns:

- Surface burns
- Tissues burn

Effect of Electricity on Human Body

(For AC 50-Hz Power)

Effect on Muscles and Nerves

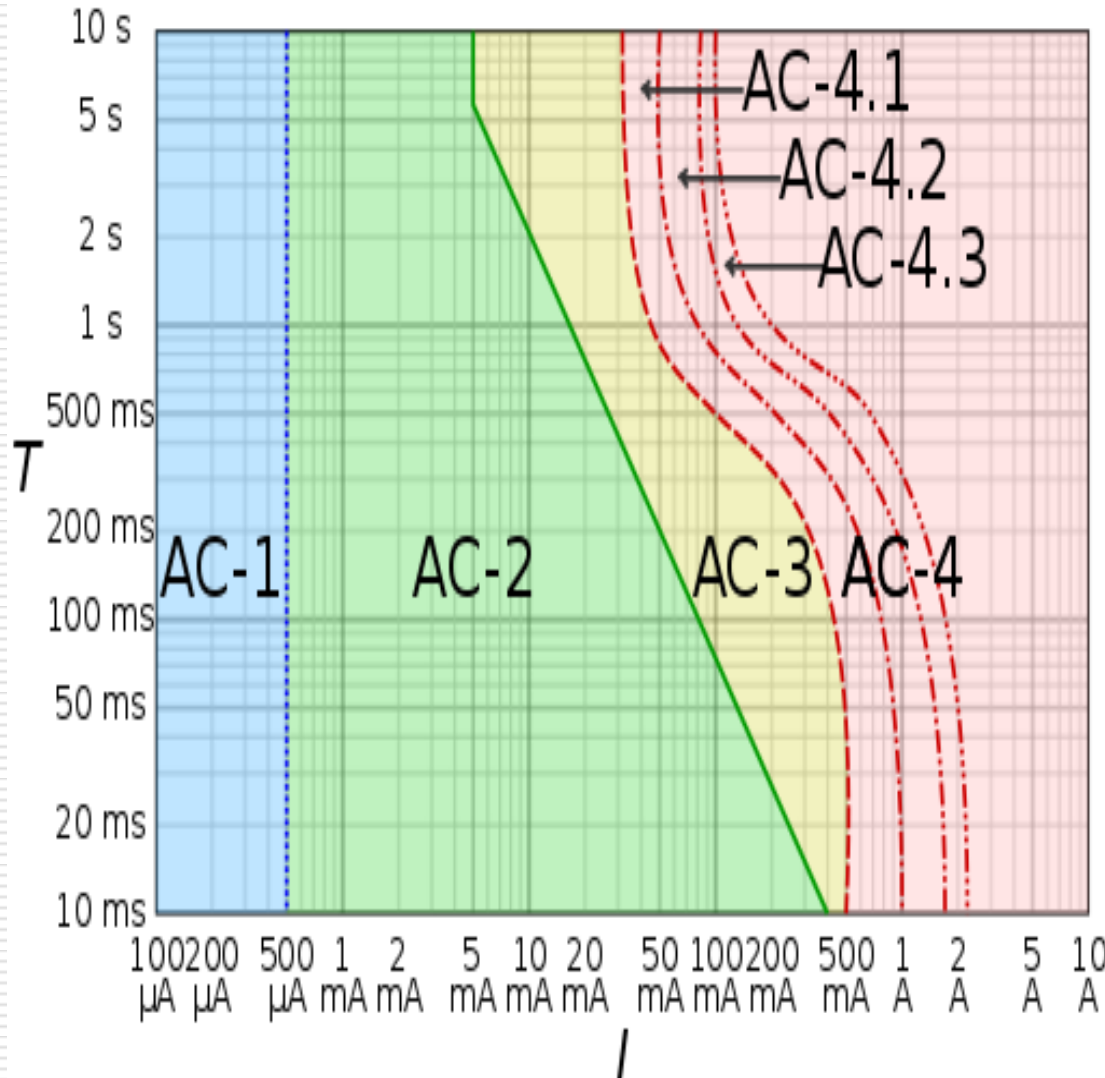
- 0.5 – 3 mA: Tingling sensation without any injury
- 3 - 10 mA: Muscle contraction and pain
- 10 – 40 mA : Victim cannot let go of the shock source because his muscles contract
- 30 – 75 mA : Respiratory paralysis
- 50 - 500 mA: Can trigger cardiac arrest, if current passes through the heart.

Electric Burns to Tissues and Organs

- Above 100 mA: Local burns at the points of contact
- Above 10 A: Severe burns and amputation.

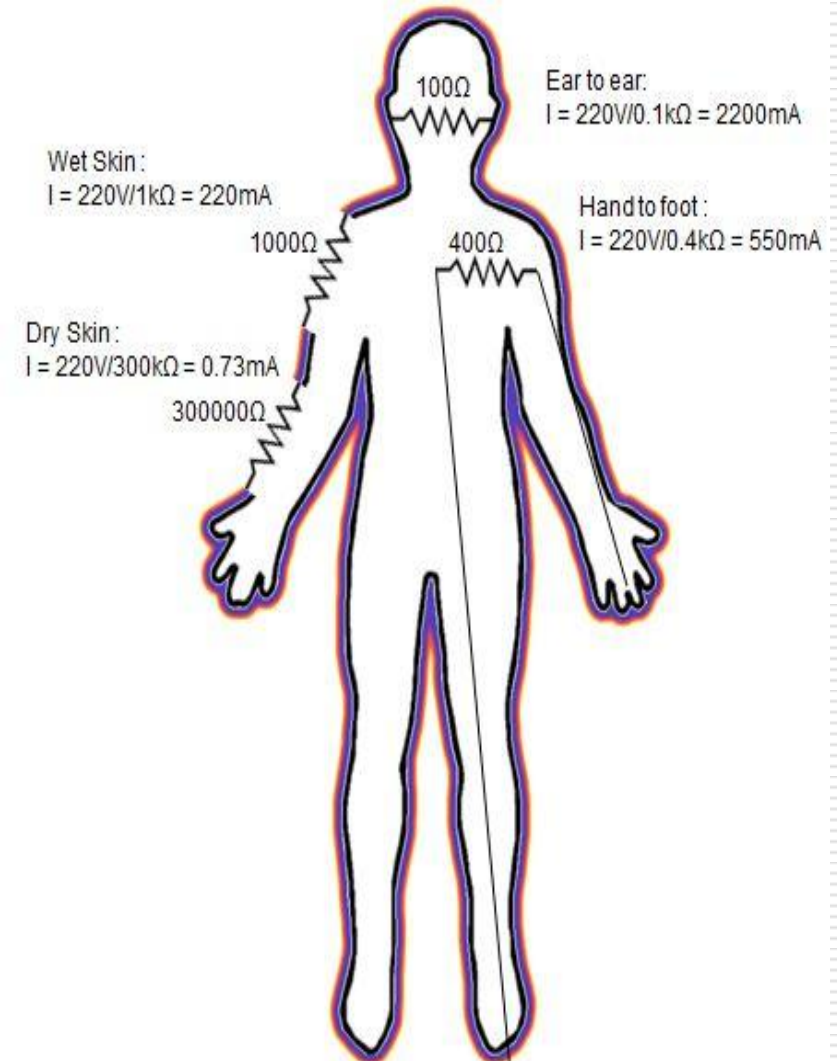
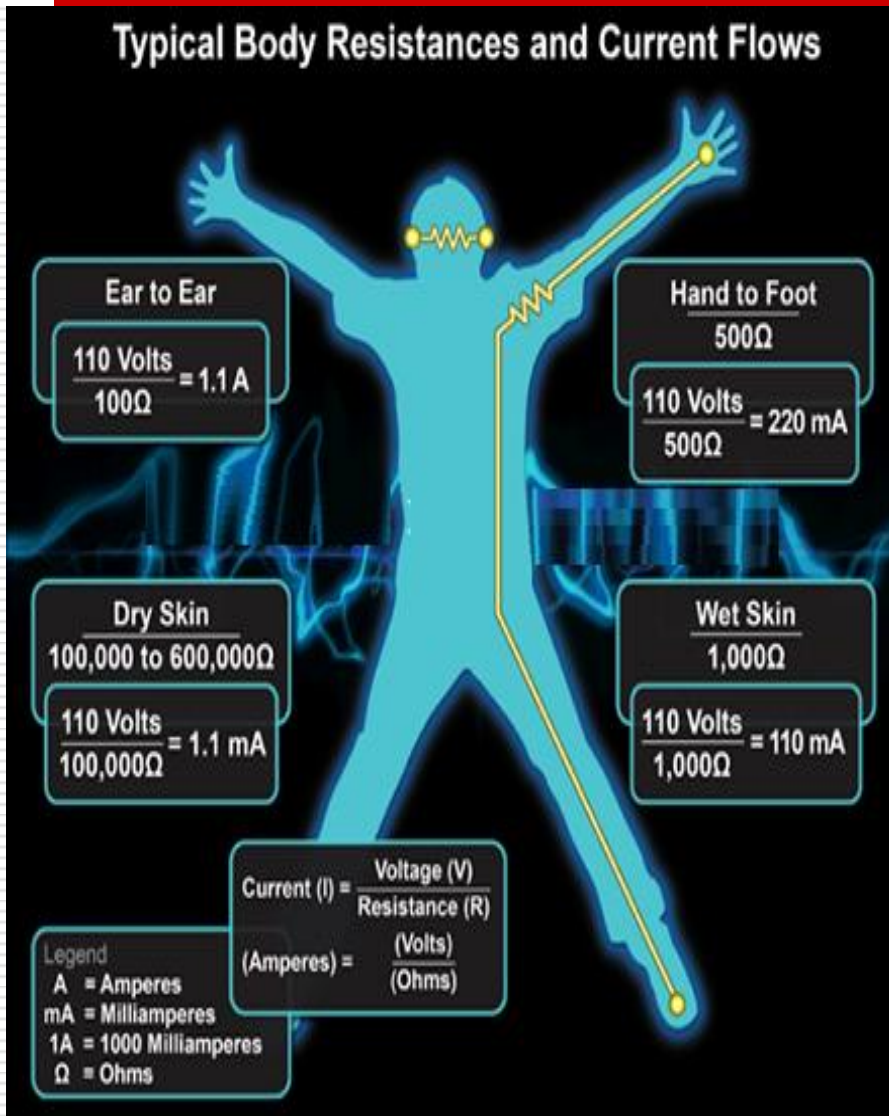
Effect of Electricity on Human Body

AC passing from left hand to feet (IEC:60479-1)



- AC-1: Imperceptible
- AC-2: Perceptible but no muscle reaction
- AC-3: Muscle contraction with reversible effects
- AC-4: Possible irreversible effects (heart fibrillation)
 - AC-4.1: up to 5% probability
 - AC-4.2: 5-50% probability
 - AC-4.3: over 50% probability

Body Resistance and Current Flow



Body Resistance Values Change with Skin Contact Condition

Condition	Resistance (in Ω)	
	Dry	Wet
Finger touch	40 000–1 000 000	4000–15 000
Hand holding wire	15 000–50 000	3000–6000
Finger-thumb grasp ³	10 000–30 000	2000–5000
Hand holding pliers	5000–10 000	1000–3000
Palm touch	3000–8000	1000–2000
Hand around 3.8 cm (1.5 in) pipe (or drill handle)	1000–3000	500–1500
Two hands around 3.8 cm (1.5 in) pipe	500–1500	250–750
Hand immersed	—	200–500
Foot immersed	—	100–300
Human body, internal, excluding skin	200–1000	

Body Resistance Varies with Other Conditions

$$R_{\text{total}} = R_{\text{skin}}(\text{in}) + R_{\text{internal}} + R_{\text{skin}}(\text{out})$$

1. *Internal* resistance of body: 300-1,000 ohms

Bones and fat offer highest resistance

Nerves and muscle have the least resistance

2. Majority of the body's resistance is in the skin

Resistance of *dry skin* is usually between 1,000-100,000 ohms.

Skin resistance is much lower if it is **wet or burnt/blistered**

Therefore, when a person is electrocuted, the body's resistance drops as the skin is burned

3. Resistance goes down as voltage increases

NOTE: AC is more dangerous than DC

Effect of AC versus Effect of DC

- ✓ AC is more dangerous than DC
- ✓ Two reasons:
 1. Peak value of AC current is 2 times its RMS value
Heating effect (I^2R) at the peak is 2 times of average heating
 2. The epidermis (skin's outer layer) offers a very high resistance, so AC finds a parallel path through the epidermis capacitance (dry epidermis acts like dielectric layer between the piece of metal at the top and the underlying tissue, which acts as the other plate)

Electric Fire

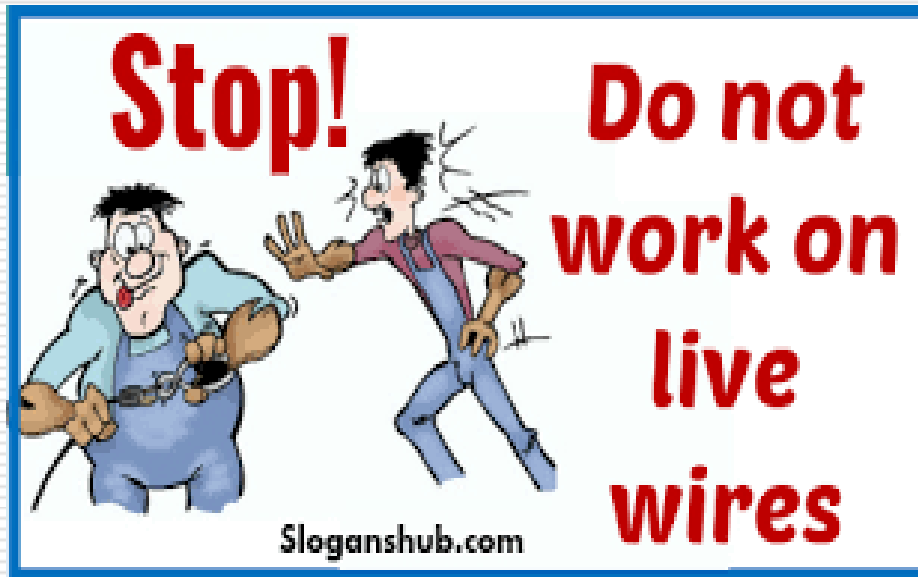
Electric fire can originate from:

1. Overheating due to over-current
2. Sparking due to loose contact
3. Arcing due to short circuit

15 Golden Rules of Electrical Safety

1. Never repair energized appliances
2. Use insulated tools and shoes
3. Never use aluminium or steel ladder
4. Avoid water and wet things near electricity
5. Proper earthing of building and equipment/appliance
6. Put cap or insulating tape on live wire
7. Take care when removing a capacitor from circuit
8. Keep Away from Electric Fence
9. Learn how to Handle Electric Shock Situation
10. Never Use Cracked/ Damaged Cords
11. Pull the Plug, Not the Cord
12. Don't Plug Too Many Appliances
13. No Careless or Casual Attitude
14. Use proper fuse or MCB
15. Install proper RCCB and test it regularly

1 – Never Repair Energized Appliances



1. Never try servicing or repairing an energized appliance or equipment
2. Switch off the power supply first
3. Put up a sign on the service panel so that nobody turns the main switch ON by accident
4. Confirm that it is de-energized by using a tester

2 – Use Insulated Tools & Shoes

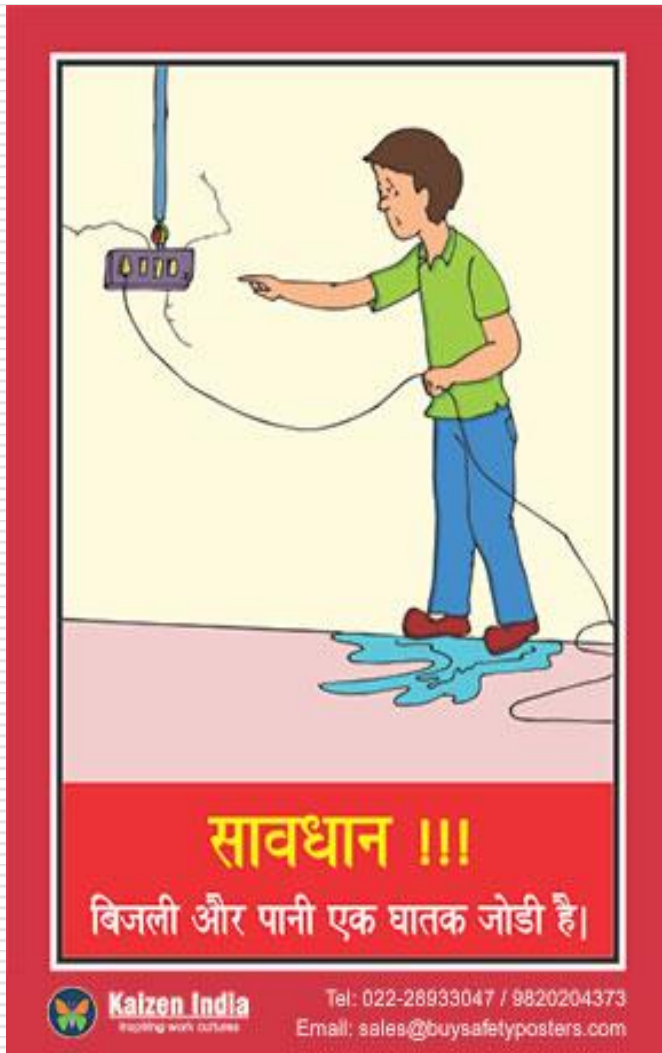


- ✓ While working with electricity:
 - Use insulated tools only
 - Use shoes or chappals with rubber sole only

3 – Never Use Aluminium or Steel Ladder

- ✓ Never use an aluminium or steel ladder for repair work at a height
- ✓ An electrical surge will ground you and the whole electric current will pass through your body
- ✓ Use a bamboo, wooden or fibre-glass ladder

4-Avoid Water and Wet Things near Electricity



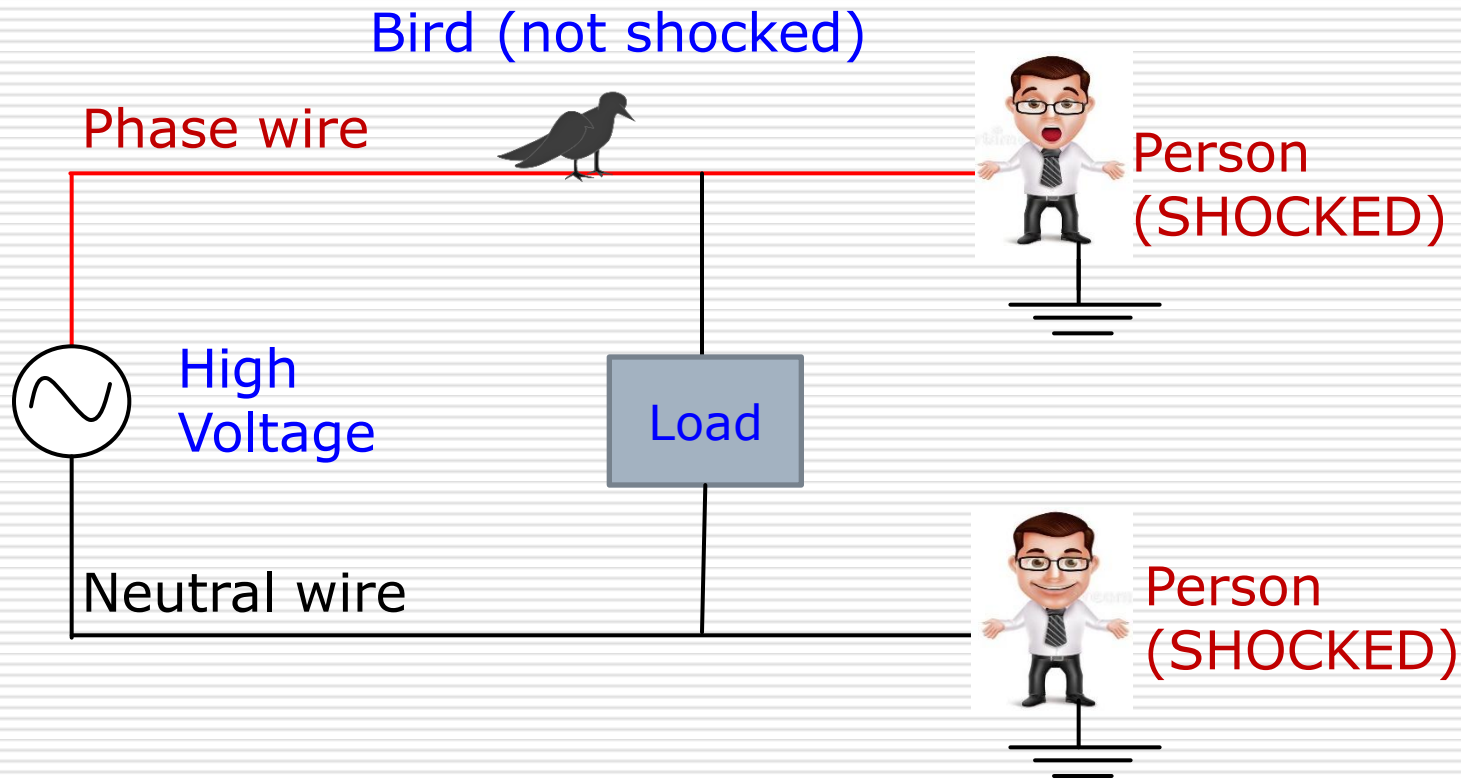
- ✓ Avoid water at all times when working with electricity
- ✓ Never touch or try repairing any electrical equipment or circuits with wet hands
- ✓ Wet surface and water increase conductivity of electric circuit
- ✓ It can give you an electric shock or even kill you
- ✓ Don't use water in case of electric fire

5 – Proper Earthing of Electrical System

Essential for three reasons:

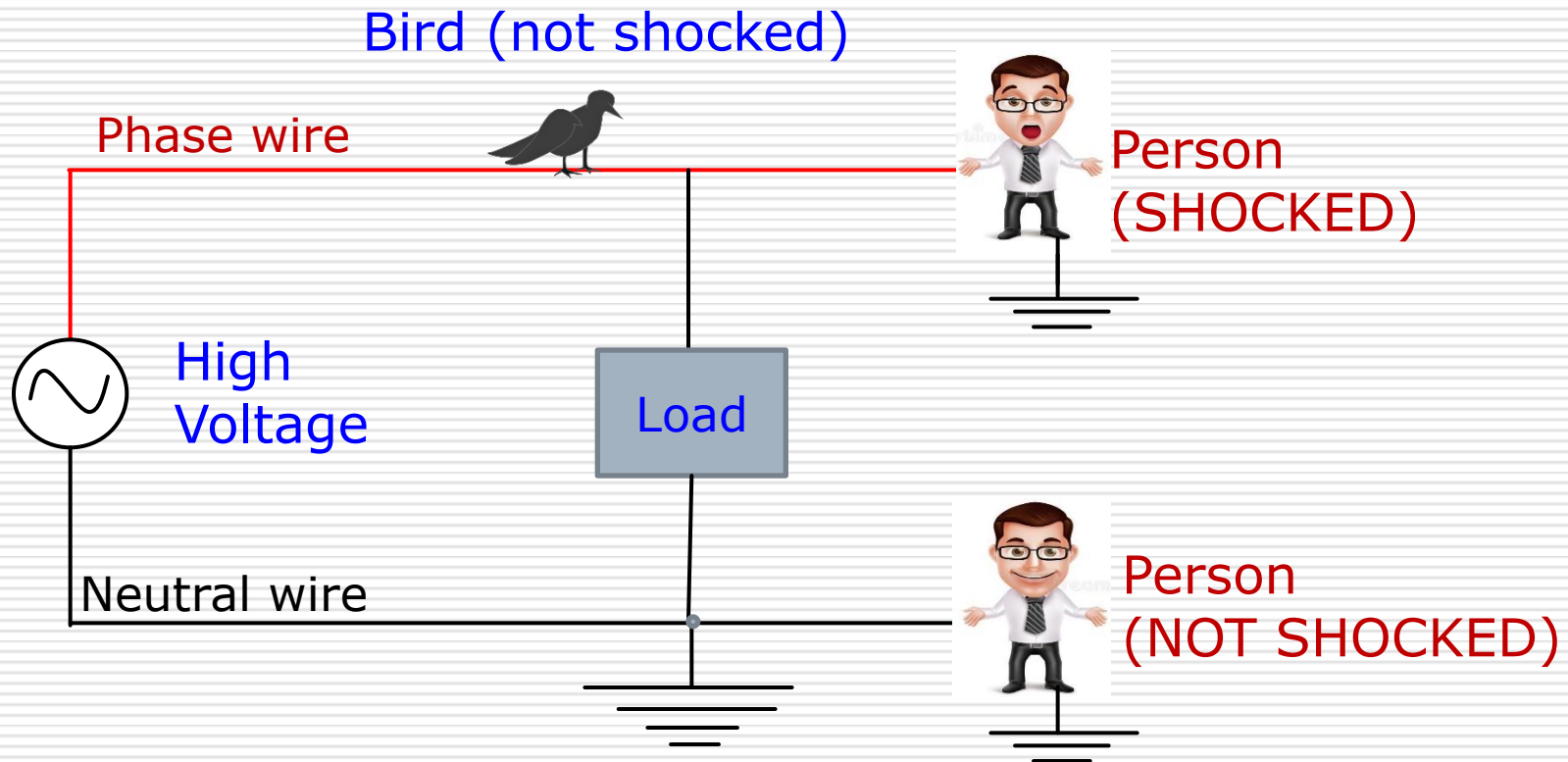
1. For safety of equipments/ appliances
2. For safety of users
3. For operation of protective devices on ground faults

Without System Earthing : Very Unsafe



Without earthing of neutral of the electrical system, a person standing on ground and touching any wire (phase or neutral) will get a shock.

With System Earthing : Less Unsafe



With proper earthing of neutral of the electrical system, a person standing on ground and touching phase wire will get a shock, but will not get a shock if he touches neutral wire.

6 – Put Cap or Insulating Tape on Live Wire

- ✓ Always put a cap or insulating tape on the hot/live wire
- ✓ This will prevent any kind of electric shock if touched by mistake
- ✓ Enclose all electric contacts and conductors so that no one can accidentally come into contact with them.

7 – Take Care when Removing Capacitor

- ✓ Take care while removing capacitor from a circuit
- ✓ Capacitor stores energy
- ✓ If not discharged, can cause electric shock
- ✓ To discharge it after removal from circuit is to put the tip of an insulated screw driver across its terminals

8 - Keep Away from Electric Fence

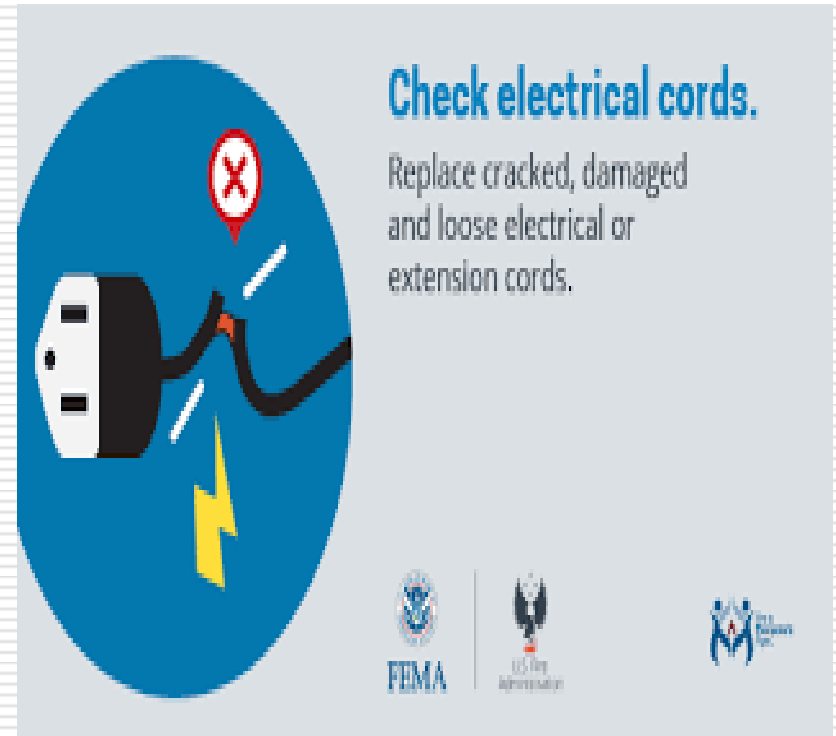
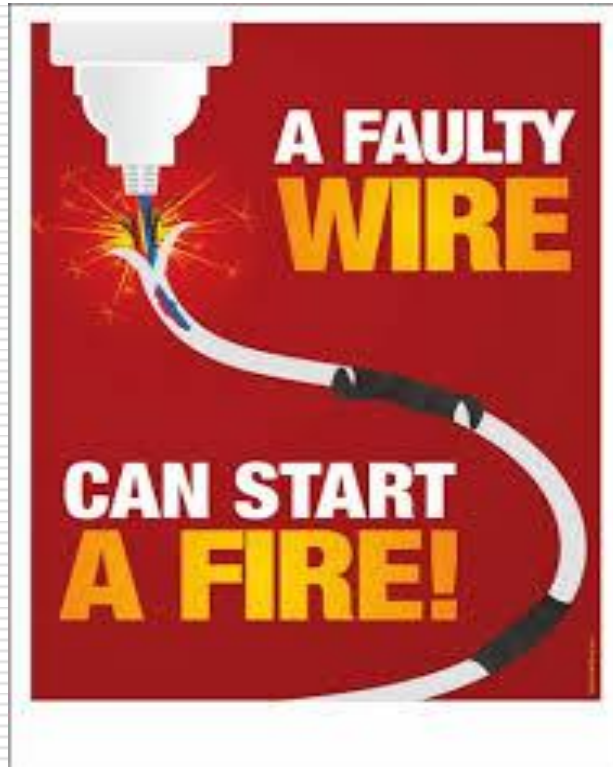


9-Learn to Handle Electric Shock Situation



- I. Switch off supply immediately
- II. Or pull out plug from socket
- III. DO NOT touch victim
- IV. Remove wire from victim using non-conducting implements, like bamboo, cane, leather belt etc.
- V. Check for pulse / breathing, give artificial respiration, if necessary

10 – Never Use Cracked/ Damaged Cords



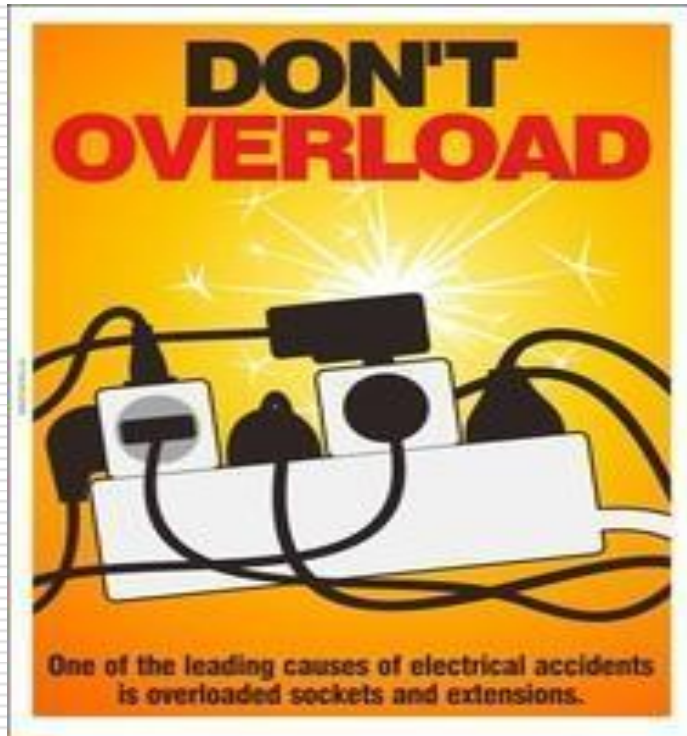
- ✓ Never use cracked or damaged cords
- ✓ They can cause electric shock or fire
- ✓ Replace them at once.

11 – Pull the Plug, Not the Cord



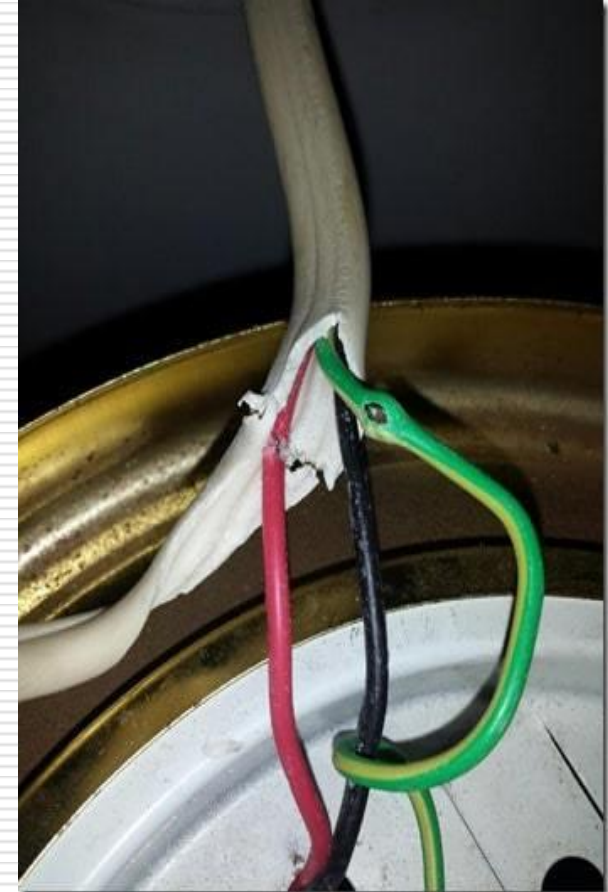
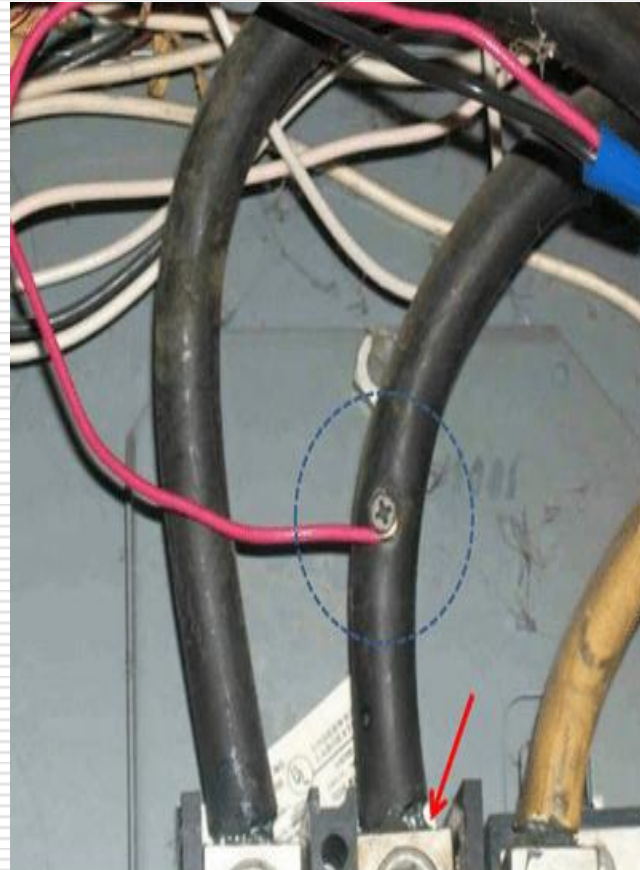
- ✓ To remove an electric appliance from socket, pull the plug not the cord

12 – Don't Plug Too Many Appliances



- ✓ DON'T connect too many appliances into one outlet or extension board
- ✓ It can damage the socket or extension board, or even cause a fire.

13 – No Careless or Casual Attitude



Your careless handling of electricity could kill you or someone else!!

14 – Use Proper Fuse or MCB

- ✓ Must use fuses and MCBs (miniature circuit breakers) for protection of circuits/ appliances/ equipments
- ✓ Use fuse rating of 150% of maximum circuit current
- ✓ Use MCB (miniature circuit breaker) of appropriate current rating and type

15–Install Proper RCCB and Test Regularly

- ✓ Use residual-current circuit breaker (RCCB) or residual-current device (RCD) or earth leakage detector (ELD) for safety
- ✓ Set RCCB to 5 mA
- ✓ Test RCCB regularly

**“Remain Alert,
Stay Safe”**