

# **Electrical Safety Awareness Training**

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# Training Outline

- o Purpose
- o Basic Concepts of Electricity
- o Hazard Recognition
- o Effects of Electricity on the Human Body
- o Electrical Hazard Protection
- o Work Practices
- o How to Respond/Report a Problem
- o Supervisor Responsibilities
- o Employee Responsibilities
- o Video



# Purpose

- o Raise your awareness to potential electrical hazards.
- o Instruct you on how to recognize electrical hazards.
- o Provide ways to eliminate, remove, and prevent electrical hazards in the workplace.
- o Emphasizing the extreme importance of observing all electrical safety requirements and practices.
- o Instructing you on what to do in the event an electrical accident.

# Purpose

- o Course is not designed to teach you to work on electrical equipment.
- o You will not be qualified to work on electrical equipment .
- o If you see problems with electrical equipment, notify your supervisor.



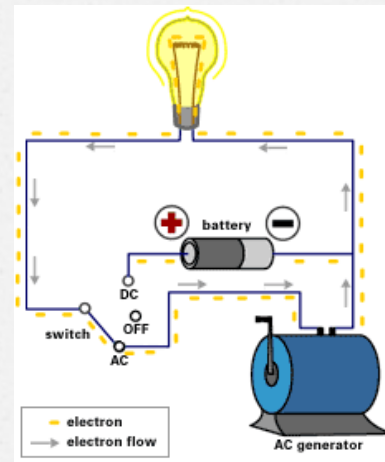
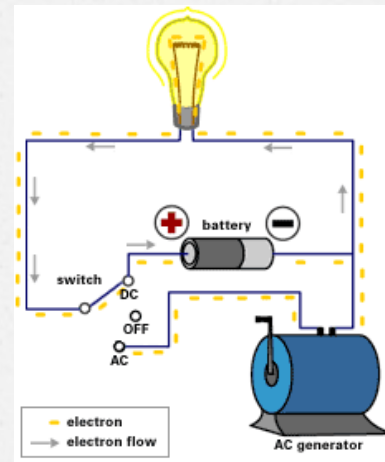
# Basic Concepts of Electricity

- Ohm's Law defines the flow of electrons (current) through a conductor.
  - $\text{Current (amps)} = \text{Voltage (volts)} / \text{Resistance (ohms)}$
- A conductor is a material that allows electrons to flow through it.
- An insulator resist the flow of electrons.
- Resistance is a materials ability to decrease electrical flow.



# Basic Concepts of Electricity

- Requires a source of power: usually a generating station.
- Travels in a closed circuit.
- When you become part of the circuit, the injury may be fatal.





# Hazard Recognition

- o Cords & Equipment
  - o Power tools and extension cords must be inspected each time they are used.
  - o They must be taken out of service immediately upon discovery of worn or broken insulation.



# Hazard Recognition

- o Cords & Equipment
  - o Visually inspect electrical equipment before each use for damage and/or external defects such as loose, missing or deformed parts, pinched or crushed outer jackets or insulation. This type of external damage may indicate internal damage to the equipment.
  - o Electrical cords that are worn or damaged must be replaced without delay.
  - o Before cleaning electrical equipment, turn it off and unplug it.



# Hazard Recognition

- o Electrical Panels
  - o Electric panels must be kept clear of any obstructions at all times.
  - o Storage is not allowed in electrical vault or service panel rooms. Find another place for storage of materials, products, etc.



# Hazard Recognition

- o Trip Hazards
  - o Don't cause tripping hazards or create pinch points for cords.
  - o If you must run a cord temporarily across the floor, protect your co-workers by covering the cord appropriately.





# Hazard Recognition

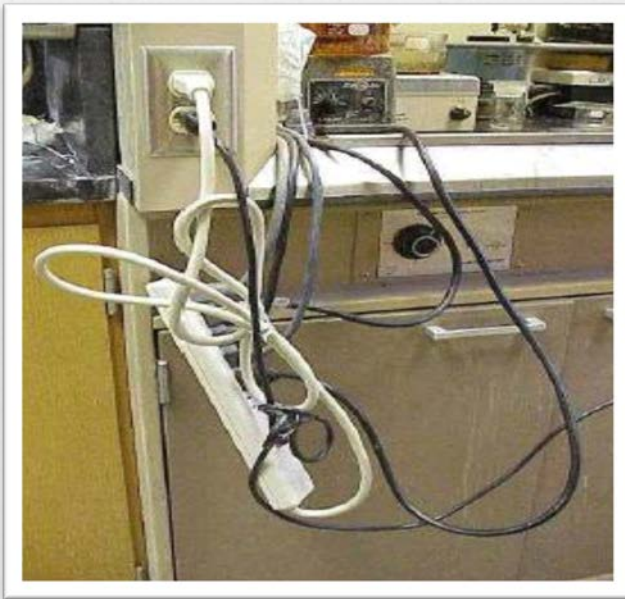
- o Exposed Wiring
  - o Assume all exposed wiring is energized until proven otherwise.
  - o Stop, protect the area, and contact supervision if you encounter this situation.





# Hazard Recognition

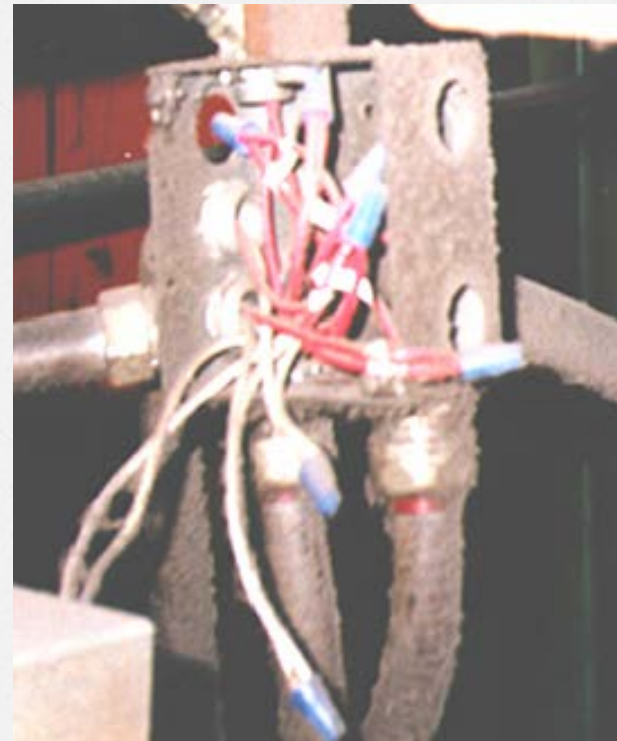
- o Power Strips
- o Never daisy chain multi-outlet strips (plugging into each other)





# Hazard Recognition

- o Junction boxes, pull boxes, and fittings must have approved covers in place.
- o Unused openings in cabinets, boxes, and fittings must be closed (no missing knockouts).
- o Report these situations to your supervisor.



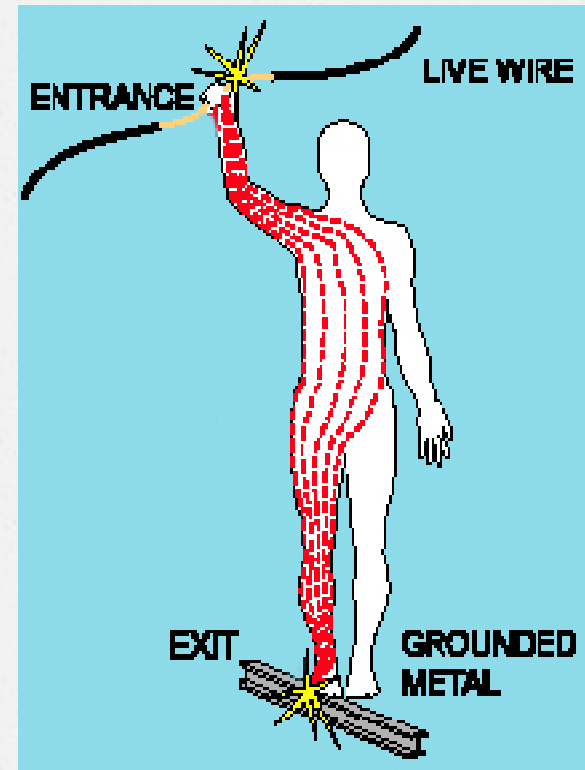
# Effects of Electricity on the Human Body

- o The four major types of electrical injuries are:
  - o Direct
    - o Electrical Shock
    - o Electrocution
    - o Burns
  - o Indirect
    - o Falls



# Effects of Electricity on the Human Body: 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.



# Effects of Electricity on the Human Body: Electrical Shock

- o Range of currents lasting 1 second will illicit the following reactions:
  - o 1 milliamp
    - o A faint tingle.
  - o 5 milliamps
    - o Slight shock felt. Most people can let go.
  - o 6-30 milliamps
    - o Painful shock. Muscular control is lost. This is the range were “freezing current” starts. It may not be possible to let go.



# Effects of Electricity on the Human Body: Electrical Shock

- 50-150 milliamps
  - Extremely painful shock, respiratory arrest, (breathing stops) and severe muscle contractions. Death is possible.
- 1,000-4,300 milliamps (1-4.3 amps)
  - Arrhythmic heart pumping action, muscles contract, and nerve damage occurs. Death is likely.
- 10,000+ milliamps (10 amps)
  - Cardiac arrest and severe burns occur. Death is probable.

# Effects of Electricity on the Human Body: Electrical Shock

- The longer the exposure, the increased danger of shock to the victim.
- Low voltage can be extremely dangerous because the degree of injury depends not only on the current, but on the length of time in contact with the circuit.
- Example:
  - A current of 100mA applied for 3 seconds is as dangerous as 900mA applied for 0.03 seconds.



# Effects of Electricity on the Human Body: Electrical Shock

- o High voltages lead to additional injuries such as:
  - o Violent muscular contractions
    - o Muscle contractions may cause bone fractures from either contractions themselves or from falls.
  - o Internal bleeding, destruction of tissues, nerves and muscles.

# Effects of Electricity on the Human Body: Electrocution

- o Electrocution results when a human is exposed to a lethal amount of electrical energy.
  - o Currents as low as 50mA at 120V have caused death.
- o Low Voltage Does Not Mean Low Hazard.



# Effects of Electricity on the Human Body: Electrical Burns

- o The most common shock related, nonfatal injury is a burn.
- o Burns caused by electricity may be of three types:
  - o Electrical burns
  - o Arc burns
  - o Thermal contact burns
- o Electrical burns need to be given immediate medical attention.

# Effects of Electricity on the Human Body: Electrical Burns

- o Electrical burns occur when a person touches electrical wiring or equipment that is used or maintained improperly.
- o Typically such burns occur on the hands.
- o Clothing may catch on fire and a thermal burn may result for the heat of the fire.





# Effects of Electricity on the Human Body: Arc-blast

- o An arc-blast is a luminous electrical discharge that occurs when high voltages exist across a gap between conductors and current travels through the air.
- o Temperatures as high as 35,000° F have been reached in arc-blasts.



# Effects of Electricity on the Human Body: Arc-blast

- The three primary hazards associated with an arc-blast are:
  - Arching gives off thermal radiation (heat) and intense light which causes burns.
  - A high voltage arc can produce a considerable pressure wave blast.
    - Example: A person 2 ft. away from a 25,000-amp arc feels a force of about 480lbs on the front of the body.
  - May cause copper and aluminum components to melt.
    - The molten metal can be blasted great distances by the pressure wave.



# Effects of Electricity on the Human Body: Falls

- o Electric shock can also cause indirect injuries.
- o Workers in elevated locations who experience a shock may fall, resulting in serious injury or death.



# Electrical Hazard Protections

- o Insulation
- o Grounding
- o Guarding
- o Electrical protective devices
- o Personal Protective Equipment
- o Safe work practices



# Electrical Hazard Protections

## o Insulation

- o Plastic or rubber coverings that does not conduct electricity.
- o Insulation prevents live wires from coming in contact with people thus protecting them form electrical shock.

# Electrical Hazard Protections

- o Grounding
  - o Grounding is another method of protecting you from electric shock.



**Ground Electrical Devices.**



# Electrical Hazard Protections

- Grounding

- The "ground" refers to a conductive body, usually the earth, and means a conductive connection, whether intentional or accidental, by which an electric circuit or equipment is connected to earth or the ground plane.
- By "grounding" a tool or electrical system, a low-resistance path to the earth is intentionally created.

# Electrical Hazard Protections

## o Guarding

- o A type of isolation that uses various structures to close off live electrical parts.
- o These structures include:
  - o Boxes
  - o Screens
  - o Covers
  - o Partitions

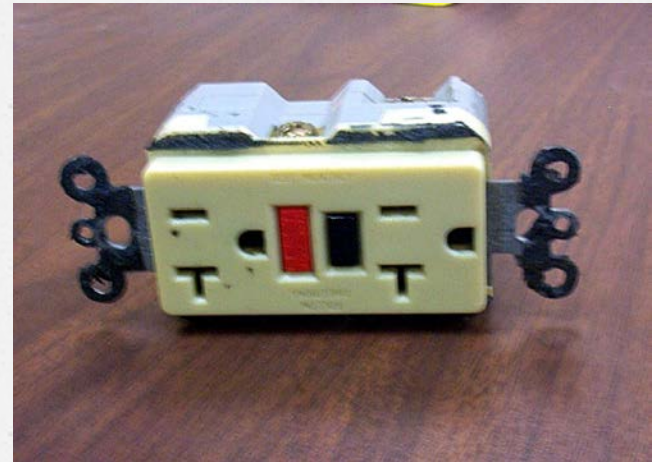




# Electrical Hazard Protections

## o Ground Fault Circuit Interrupters (GFCI)

- o Detects the difference in current between two circuits wires.
- o This difference in current could happen when electrical equipment isn't working correctly.
- o GFCI are set at about 5mA and are designed to protect workers and not equipment.



# Electrical Hazard Protections

## o Fuses and Circuit Breakers

- o Fuses and circuit breakers are intended primarily for the protection of conductors and equipment.
- o They prevent over-heating of wires and components that might otherwise create hazards for operators.
- o They also open the circuit under certain hazardous ground-fault conditions.



# Electrical Hazard Protections

- Personal Protective Equipment
- *Foot protection*
  - Footwear will be marked “EH” if it’s approved for electrical work.
  - EH = Electrical Hazard
  - Footwear must be kept dry, even if it is marked “EH”



# Electrical Hazard Protections

- Personal Protective Equipment

- *Head protection*

- Hard hat (insulated - nonconductive)
- Class B & E.
- Always wear your hat with the bill forward.
- Do not store anything in the top of your hat while wearing it.





# Electrical Hazard Protections

- Personal Protective Equipment
- *Hand protection*
  - Rubber insulating gloves.
  - Classified by the level of voltage and protection they provide.
  - Leather protective gloves should always be worn over rubber insulating gloves to provide the mechanical protection needed against cuts, abrasions, and punctures.



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Janesville, WI

# Electrical Hazard Protections

## o Personal Protective Equipment

- o Use, store and maintain your electrical PPE in a safe, reliable condition.
- o Wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts.
- o Wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion.



# Electrical Hazard Protections

- o Personal Protective Equipment
  - o Electrical PPE with any of the following defects may not be used:
    - o If holes, tears, punctures, or cuts are present.
    - o Texture changes: Swelling, softening, hardening, or becoming sticky or inelastic.
    - o An embedded foreign object.
    - o Any other defect that damages the insulating properties.

# Work Practices

- o Employees and others working with electric equipment need to use safe work practices.
  - o Plan your work by yourself and with others.
    - o Allows you to coordinate your work and take advantage of what others know about identifying and controlling hazards.
    - o Remove watches, rings and other conductive jewelry.
  - o Lock out and Tag out circuits and equipment.
    - o Shut off the circuit.
    - o Lock and tag out the circuit at the distribution panel.
    - o Test the circuit to make sure it's de-energized.



# Work Practices

- o Do not work with wet hands or in wet conditions.
- o Avoid overhead power lines.
  - o You should be at least 10 feet away from high-voltage transmission lines.
- o Use proper wiring and connectors
  - o Avoid overloading circuits.
  - o Test GFCI's monthly.
  - o Make sure switches and insulation are in good condition.
  - o Never use a three prong plug with the third prong broken off.

# Work Practices

- Use and maintain tools properly.
  - Inspect tools before using them.
  - Damaged tools must be removed from service.
  - Keep tool and cords away from heat, oil and sharp objects.
- Using appropriate personal protective equipment
  - Wear safety glasses to avoid eye injury.
  - Wear proper foot protection.
  - Wear a hard hat.
  - Follow the manufacturer's directions for cleaning/maintaining PPE.



# How to Respond/Report a Problem

- o Do not panic; remain calm
- o In the event of a personal injury:
  - o Call 911 immediately
  - o If a person is being shocked, turn off the source of electricity
  - o Do not touch someone being shocked
  - o Remove the person away from the electrical source using a non-conductive material
  - o Call Security at X4111 and EH&S at X4150
  - o Notify your supervisor

# How to Respond/Report a Problem

- o In the event of an electrical fire:
  - o Activate the fire alarm system
  - o If you know how to use an extinguisher, use a CO<sub>2</sub> or dry chemical (Type ABC) fire extinguisher
  - o Do not use a Type A, water extinguisher
  - o Alert everyone in the area to evacuate
  - o Notify Security at X4111 and EH&S at X4150
  - o If you are not sure about using a fire extinguisher, leave the area and close any doors behind you
  - o Wait for the Fire Dept. personnel to arrive



# Supervisor Responsibilities

- o Review project carefully with your workers, unless they are routine assignments
- o Emphasize safety practices
- o Train workers on area-specific policies and procedures
- o Check your employees' work practices to ensure compliance
- o Check the final product to ensure that no deficiencies exist
- o Provide the appropriate disciplinary measures for poor electrical safety practices.

# Employee Responsibilities

- o Review each project carefully with your supervisor
- o Become thoroughly familiar with your assignments
- o Only perform work in which you are trained
- o If at all in doubt, ask questions
- o Have your supervisor review your completed project
- o Follow your supervisor's instructions



# Employee Responsibilities (Continued)

- o Follow safe work practices
- o Make sure lines are de-energized before your work on them
- o Wear any required PPE
- o Alert your co-workers to any unsafe work practices
- o Report all problems to your supervisor
- o Know what to do in the event of an emergency

# Summary

- o Electricity will try to reach ground even if it means going through a person
- o Even the “small” voltage from your home can cause serious injury
- o Always inspect power tools and cords before each use and do not use them if damaged
- o Do not attempt to repair electrical equipment unless you are trained and qualified
- o Always use lockout/tagout procedures to de-energize electrical systems



# Summary

- o Use electrical tools and equipment that are protected by a GFI  
Review your assignments with your supervisors
- o Utilize correct PPE
- o Report all problems to your supervisors
- o If at all in doubt, ask questions

# References

- o OSHA 1910.333
- o NFPA 70E: Standard for Electrical Safety in the Workplace
- o NIOSH: Electrical Safety

