UNIT 5 LECTURE NOTES

Sources of Electrical Hazards

The major causes of electrical shock are:

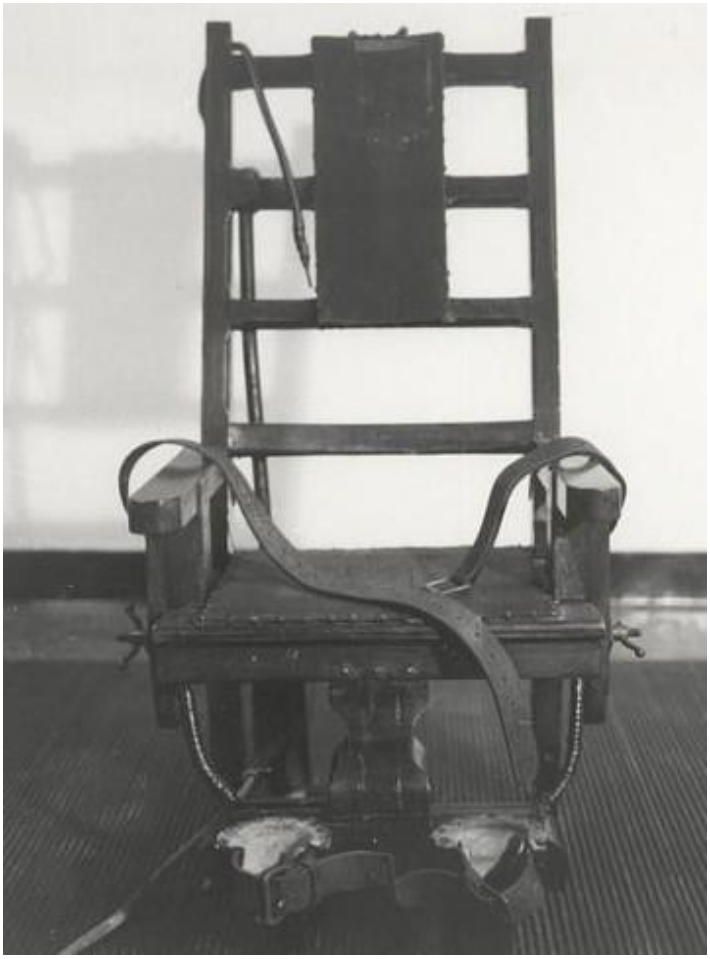
- Contact with a bare wire carrying current
- Electrical equipment that has not been properly grounded
- Working with electrical equipment on damp floors or other sources of water
- Static electricity discharge
- Using metal ladders to work on electrical equipment
- Working on electrical equipment without ensuring that the power has been shut off
- Lightning strikes

Types of Electrical Hazards

- Electrostatic hazards
- Arcs and sparks hazards
- Combustible and explosive materials
- Lightning hazards
- Improper wiring
- Insulation failure
- Equipment failure
- Hazardous locations for electrical equipment

Sources of Electrostatic Hazards

- Briskly rubbing a nonconductive material over a stationary surface
- Moving large sheets of plastic which may discharge sparks
- The explosion of organic and metallic dusts, which have occurred from static build-up in farm grain silos and mine shafts
- Conveyor belts
- Vehicle tires rolling across a road surface
- Friction between a flowing liquid and a solid surface



Electric Shocks can be Fatal

Detection of Electrical Hazards

Several items of test equipment can be used to verify electrical equipment safety:

- A circuit tester
- A receptacle wiring tester
- Infrared thermal imaging

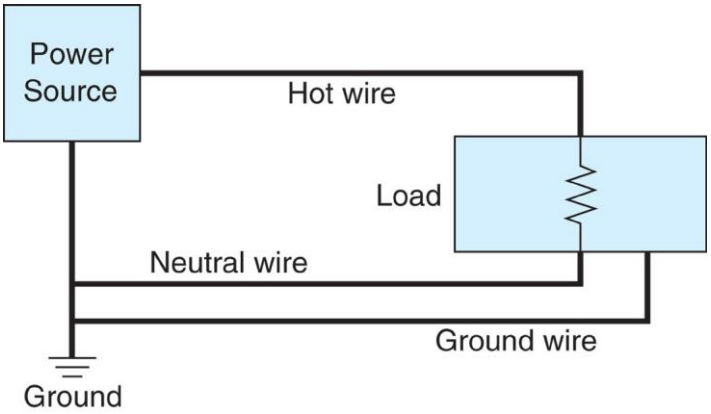
Grounding

Grounding of electrical equipment is the primary method of reducing electrical hazards. This is achieved when one conductor of the circuit is connected to the earth.

The purposes of grounding are:

- To safeguard people from electrical shocks
- To reduce the probability of a fire
- To protect equipment from damage

Typical Three-wire Circuit



Equipment RequiringGrounding or Double Insulation

- Portable electric tools such as drills and saws
- Communication receivers and transmitters
- Electrical equipment in damp locations

- Television antenna towers
- Electrical equipment inside flammable liquid storage areas
- Electric equipment operated with over 150 volts

Class	Group	Division I	Division II
I. Flammable vapors and gases	A. Acetylene B. Hydrogen C. Ether D. Hydrocarbon fuels and solvents	Normally explosive; flammable paint spray areas	Not normally in explosive concentration; adjacent to paint spray area
II. Combustible dusts	E. Metal dusts F. Carbon dusts G. Flour, starch, grain, plastic, or chemical dusts	Conductive or ignitable dusts may be present; grain mills or processors	Not normally in ignitable concentration; grain storage areas
III. Ignitable fibers	Textiles; woodworking	Handled or used in manufacturing; cotton gins	Stored or handled in storage, not in manufacturing; excelsior storage

Hazardous Electrical Equipment Location Categories

Bonding Defined

Bonding is the process used to connect two pieces of equipment by a conductor in order to reduce potential voltage differences between the equipment, reducing the possibility of sparking.

Primary Causes of Electrocution on the Job

The primary cause of electrocution on the job is accidental contact with internal wiring, buried electrical cable, or overhead power lines by any of the following:

- Cranes
- Booms
- Hoists
- Riggings
- Scaffolds
- Ladders
- Trucks
- Vehicles

Current Effects on the Human Body (60-cycle AC current)

Dose in Current in Milliamps	Effect on Human Body
Less than 1	No sensation, no perceptible effect.
1	Shock perceptible, reflex action to jump away. No direct danger from shock but sudden motion may cause accident.
More than 3	Painful shock.
6	Let-go current for women.*
9	Let-go current for men.*
10–15	Local muscle contractions. Freezing to the conductor for 2.5% of the population.
30–50	Local muscle contractions. Freezing to the conductor for 50% of the population.
50–100	Prolonged contact may cause collapse and unconsciousness. Death may occur after three minutes of contact due to paralysis of the respiratory muscles.
100–200	Contact of more than a quarter of a second may cause ventricular fibrillation of the heart and death. AC currents continuing for more than one heart cycle may cause fibrillation.
Over 200	Clamps and stops the heart as long as the current flows. Heart beating and circulation may resume when current ceases. High current can produce respiratory paralysis, which can be reversed with immediate resuscitation. Severe burns to the skin and internal organs. May result in irreparable body damage.

*Difference between men and women is based on the relative body mass of the "average"-sized man and woman (60-cycle AC current).

Handling Equipment Exposed to Water

The following factors often cause electrical hazards when equipment is exposed to water:

- Floods
- Firefighting
- Tropical storms
- Hurricanes
- Other natural calamities

Methods of Reducing Electrical Hazards

Methods of reducing electrical hazards include the following:

- Electrical system grounding
- Bonding
- Humidification
- Iconizers
- Fuses
- Double insulation
- Interlocks

OSHA Standards Relating to Design of Electrical Systems

- 1910.302 Electrical utilization systems
- 1910.303 General requirements
- 1910.304 Wiring design and protection
- 1910.305 Wiring methods, components, and equipment for general use
- 1910.306 Specific-purpose equipment and installations
- 1910.307 Hazardous (classified) locations
- 1910.308 Special systems

OSHA StandardsRelating to Work Practices

- 1910.331 Scope
- 1910.332 Training
- 1910.333 Selection and use of work practices
- 1910.334 Use of equipment
- 1910.335 Safeguards for personal protection

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Electrical equipment in flammable liquid storage areas
Electrical equipment operated with over 150 volts

Equipment Requiring Grounding or Double Insulation

Strategies for Establishing an Effective Electrical Safety Program

Ensure compliance with existing OSHA regulations.

Provide all workers with adequate training in the identification and control of hazards associated with electrical energy in the workplace.

Provide additional specialized training for those working with or around exposed components of electric circuits.

Develop and implement procedures to control hazardous electrical energy that include lockout and tagout procedures, and ensure compliance with these procedures.

Provide testing or detection equipment.

Conduct safety meetings.

Conduct scheduled and unscheduled inspections.

Train workers to conduct job site inspections.

Ensure that proper personal protective equipment is available and worn.

Conduct job hazard analyses.

Identify potential hazards and establish appropriate safety interventions.

Rules for Extension Cords

Never use an extension cord for long periods of time (more than a few weeks) even if it appears to be in good condition.

Never cover extension cords by rugs or carpet in an attempt to prevent tripping; this can hide shorts or bare spots in the cord that can set the rug on fire.

Never just unplug an extension cord that feels hot in order to let it cool down; get rid of it. (Extension cords that get hot have reached the end of their period of safe usage.)

Avoid using extruded-type cords that have only one layer of insulation.

Avoiding Arc Flash Injuries

The best and most obvious way to prevent arc flash injuries is to deenergize the electrical equipment in question and lock or tag it out before beginning maintenance or service work on it.

When this is not possible:

Perform a flash hazard analysis in accordance with NFPA 70E, Article 130.3 or use Table 130.7©(9){a} {Hazard/Risk Category Classifications} to identify the hazard/risk category.

Establish a flash protection boundary around the equipment in question in accordance with NFPA 70E.

Select the PPE that will be worn by the worker(s) who will perform the tasks in question on the energized equipment from Table 130.7.

Personal Protective Equipment When Performing Tasks on Energized Equipment

Cotton Underwear

Fire-resistant pants and shirt

Fire-resistant coverall

Lightning Hazard Control

- Place lightning rods so that the upper end is higher than nearby structures.
- Avoid standing in high places or near tall objects. Be aware that trees in an open field may be the tallest object nearby.
- Do not work with flammable liquids or gases during electrical storms.
- Ensure proper grounding of all electrical equipment.
- If inside an automobile, remain inside the automobile.
- If in a small boat, lie down in the bottom of the boat.
- If in a metal building, stay in the building and do not touch the walls of the building.
- Wear rubber clothing if outdoors.
- Do not work touching or near conducting materials, especially those in contact with the earth such as fences.
- Avoid using the telephone during an electrical storm.
- Do not use electrical equipment during the storm.
- Avoid standing near open doors or windows where lightning may enter the building directly.

Summary of Safety Precautions for Electrical Hazards

- Ensure that power has been disconnected from the system before working with it. Test the system for deenergization. Capacitors can store current after power has been shut off.
- Allow only fully authorized and trained people to work on electrical systems.
- Do not wear conductive material such as metal jewelry when working with electricity.
- Screw bulbs securely into their sockets. Ensure that bulbs are matched to the circuit by the correct voltage rating.
- Periodically inspect insulation.
- If working on a hot circuit, use the buddy system and wear protective clothing.
- Do not use a fuse with a greater capacity than was prescribed for the circuit.
- Verify circuit voltages before performing work.
- Do not use water to put out an electrical fire.
- Check the entire length of electrical cord before using it.
- Use only explosion-proof devices and nonsparking switches in flammable liquid storage areas.
- Enclose uninsulated conductors in protective areas.
- Discharge capacitors before working on the equipment.
- Use fuses and circuit breakers for protection against excessive current.
- Provide lightning protection on all structures.
- Train people working with electrical equipment on a routine basis in first aid and cardiopulmonary resuscitation (CPR).