

UNIT V - ELECTRICITY

Lesson 1: Electrical Safety

Competency/Objective: Identify the dangers and safety practices associated with electrical work.

Study Questions

1. What are the basic rules of electrical safety?
2. What are the sources of electrical defects in equipment?
3. What should be done if someone gets shocked?
4. What are the types of circuit protection?

References

1. *Agricultural Structures (Student Reference)*. University of Missouri-Columbia: Instructional Materials Laboratory, 1999, Unit V.
2. Activity Sheet
 - a) AS 1.1: Electricity on the Internet

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TEACHING PROCEDURES

B. *Introduction*

Everyone uses electricity in many different ways every day. Electricity is also a major energy source in agriculture. However, it can be dangerous if used improperly. To work with electricity safely, understanding the basic safety practices, and hazards is important. This lesson will provide information that will help you work safely with electricity.

C. *Motivation*

1. Take students on a tour around the shop or school. Point out possible electrical hazards. Make note of warning signs around electrical equipment. Discuss the importance of these warnings.
2. Bring a damaged and/or burned out electrical fixture to class. They can usually be obtained from a local electrician or electrical company. Explain the hazards of faulty wiring and the misuse of electrical equipment.

D. *Assignment*

E. *Supervised Study*

F. *Discussion*

1. Ask students what they believe to be the major hazards associated with electricity. Discuss the various aspects of electrical safety.

What are the basic rules of electrical safety?

- a) Two major safety concerns with electricity
 - 1) Shock is the passing of an electric current through the body and the body's reaction to it; it affects the rhythm of the heart,
 - 2) Electrical fires have two main causes.
 - (a) Wires overheat, generally due either to a restriction in the flow of electricity through the conductor or an overloaded system.
 - (b) An electrical current jumps a gap, creating sparks; the gap may be produced by broken wires or improper electrical connections.
- b) Precautions to minimize these hazards
 - 1) During the installation and repair of electrical systems, always disconnect the main power source before working with the system.

- 2) Follow state and local electrical codes when installing new systems.
 - 3) Manufacturers' instructions for the installation and use of electrical equipment are another important source of information about the proper procedures to use.
- c) Sources of electrical hazards
- 1) The use of extension cords is another factor that can create electrical hazards.
 - (a) Do not place extension cords under items, such as rugs or other things that put weight directly onto the cord.
 - (b) Avoid placing cords in high traffic areas, which can also lead to insulation damage and a restriction of electrical flow.
 - (c) Always uncoil a long extension cord before plugging it in.
 - (d) If an extension cord becomes warm or smells of burning rubber, discontinue its use immediately.
 - 2) Fuses and breakers, safety devices designed to shut off electrical flow, can be a source of electrical hazards.
 - (a) Check out the system and correct the problem before replacing a fuse or resetting a breaker.
 - (b) Never use a higher capacity fuse or circuit breaker for a repair; electrical systems are designed to carry a certain load, and an attempt to increase this load will burn out the system.
 - 3) A situation that can be extremely hazardous is performing an installation near wet areas.
 - (a) While working with electrical systems or appliances in areas that are wet or damp, make sure that the power is disconnected.
 - (b) Utilize cabinets, shelves, and stands to keep tools and appliances dry.
 - (c) Install GFCI outlets in noncorrosive plastic device boxes in wet or damp areas.
 - 4) As with most hazardous situations, misuse due to the human factor tends to be the single greatest cause of electrical mishaps.
 - (a) Remember that safety devices put in place by manufacturers have a purpose; do not damage or disable them.
 - (b) Do not use any electrical product that is damaged in any way.
 - (c) Do not remove a plug from an outlet by pulling on a cord.
 - (d) Never carry a power tool by its cord.
 - 5) Joining two wires that are composed of different metals can pose an electrical hazard; a special type of connector should be used.
2. Ask students if they have ever seen or used electrical equipment that had a defect and what that defect was. Then discuss the common sources of defects.

What are the sources of electrical defects in equipment?

- a) Ground wire

- 1) Occurs when the ground, or neutral, wire is missing, broken, improperly connected, or not connected at all
 - 2) Can lead to shorts in the system and a possible shock hazard to anyone using equipment connected to the line
 - b) Open conduit
 - 1) Conduit - metal or plastic tube that encloses electrical wires
 - 2) Leads to wire damage from water entering the open conduit
 - 3) Allows for wear and deterioration of the insulation
 - 4) Can create a short circuit
 - c) Damage to insulation
 - 1) Occurs when the insulation becomes worn, wet, or oily
 - 2) Can lead to short circuits, shocks, and fire hazards
 - d) Damage to equipment
 - 1) Occurs during manufacturing or installation and use
 - 2) Normally occurs in switches, receptacles, and extension and appliance cords
 - 3) Can lead to shock and fire hazards
 - e) Lack of maintenance
 - 1) Can cause dirty, improperly adjusted electrical equipment to overheat, throw sparks, and short out
 - 2) Can create a fire hazard
 - f) Misuse through carelessness
 - 1) Most common source of defects
 - 2) May result in the misuse of equipment, improper wiring practices, limited knowledge of electrical systems, and working around electricity in wet environments without proper precautions
3. Ask students if they have ever been shocked (by either an electric fence or by electrical equipment). Discuss what it felt like. Then describe what should be done if someone receives a serious shock.

What should be done if someone gets shocked?

- a) For someone receiving an electric shock of 120 to 240 volts
 - 1) Disconnect the source of the electric current, if possible.
 - 2) If it cannot be disconnected, a long pole or other item of nonconductive material, such as wood or fiberglass is needed.
 - 3) Insulate oneself by making sure to avoid any liquids or wet areas.
 - 4) Use the pole to move the person or the conductor, depending on which is easier and safer to move.
- b) For a power source over 240 volts
 - 1) Assume that the downed wire is live and can kill.
 - 2) Keep everyone at least 200 feet away because the static electricity in the air can arc to individuals wearing any type of metal.
 - 3) Contact emergency personnel immediately.
 - 4) Call the power company to give them the exact location of the incident.

- c) In either case
 - 1) Never attempt to grab a person in direct contact with a live wire.
 - 2) The electrical current will “freeze” muscles, thus compounding the situation and putting a rescuer at risk of electrocution and death.
 - d) First aid given once the victim is moved from the electrical source
 - 1) Check to see if the victim is conscious.
 - 2) Check for signs of breathing and a pulse.
 - 3) Perform CPR if trained.
 - 4) If burns are present, cover them with a dry, sterile dressing; do not attempt to cool electrical burns since efforts to soothe them may only make the situation worse and can lead to further damage.
 - 5) Never move the victim unless an immediate threat to his or her safety exists; due to the nature of an electrical injury, the victim may experience damage to the spine that would be worsened by being moved.
4. Ask students what they would do if they walked into a room, turned on some sort of appliance, and the power shut off. What is the likely reason the electricity shut off? Discuss the different circuit protection devices. Hand out AS 1.1.

What are the types of circuit protection?

- a) Overcurrent devices
 - 1) Devices that limit the amperage in any wire to the maximum permitted
 - 2) Consist of fuses and circuit breakers
 - 3) Both rated by the number of amps that will travel through the overcurrent device without triggering it; the size of the wire used in the system will determine the amperage rating of the overcurrent device used
- b) Fuse
 - 1) Short piece of metal that has been experimentally tested to melt at a predetermined flow of amps
 - 2) Housed in a nonconductive material for protection and removal
- c) Circuit breaker
 - 1) Semi-permanent device positioned in the service panel during wire circuit installation
 - 2) Does not require replacement when a break occurs in the circuit
 - 3) Resembles a toggle switch with a handle
 - 4) Has four switch positions
 - (a) On
 - (b) Tripped
 - (c) Off
 - (d) Reset
 - 5) Has a mechanism inside that “trips” the breaker and disconnects the load in an overload situation
 - 6) Most commonly used type of overcurrent device because of the ease of resetting it

- d) Ground fault circuit interrupter (GFCI) - interrupts the flow of electricity in order to prevent electrical shock if a fault exists in the circuit that will not affect a fuse or circuit breaker

G. *Other Activities*

Schedule a guest speaker from a local power company to discuss electrical safety.

H. *Conclusion*

Because electricity affects the lives of every person, electrical safety should be a concern for everyone. For people working with electricity in particular, being aware of the electrical hazards that may affect them will help enable them to work safely. They must be familiar with safety devices and know what to do if someone is injured by electricity.

I. *Answers to Activity Sheet*

J. *Answers to Evaluation*

1. b
2. c
3. d
4. Answers may include any three of the following: problems with the ground wire, open conduits, damage to insulation, damage to equipment, lack of maintenance, and misuse through carelessness.
5. Answers may include any one of the following.
 - Do not place extension cords under items, such as rugs or other things that put weight directly onto the cord.
 - Avoid placing cords in high traffic areas, which can also lead to insulation damage and a restriction of electrical flow.
 - Always uncoil a long extension cord before plugging it in.
 - If an extension cord becomes warm or smells of burning rubber, discontinue its use immediately.
6. Fuse and circuit breaker
7. Disconnect the source of the electric current, if possible. If it cannot be disconnected, a long pole or other item of nonconductive material, such as wood or fiberglass, is needed to move the person or the conductor.

EVALUATION

Circle the letter that corresponds to the best answer.

1. The part of the body affected by electricity when a person is shocked is the:
 - a. Bones.
 - b. Heart.
 - c. Lungs.
 - d. Liver.
2. GFCI outlets should be placed in _____ in wet areas.
 - a. Metal boxes
 - b. Aluminum boxes
 - c. Plastic boxes
 - d. Bare walls
3. A device that limits the amperage in any wire to the maximum permitted is called a:
 - a. Outlet.
 - b. Limiter.
 - c. Undercurrent device.
 - d. Overcurrent device.

Complete the following short answer questions.

4. What are three of the six sources of electrical defects in equipment?
 - a.
 - b.
 - c.
5. What is one thing that can be done to minimize electrical hazards with electrical extension cords?

6. What are the two types of overcurrent devices for circuit protection?
 - a.
 - b.
7. What is the first thing you should do if someone receives a shock of 120 to 240 volts?

Lesson 1: Electrical Safety

Name_____

Electricity on the Internet

Objective: Explore the various sources of information on electricity and electrical safety available on the Internet.

Using the following web sites or others approved by your instructor, investigate one web site and use the information found to answer the questions. Include a print out of the web site's home page. Then use the links from one of these sites or a search engine to find another source of electrical information.

Web Resources

National Electrical Safety Foundation <http://www.nesf.org/>

National Fire Protection Association <http://roproc.nfpa.org/home.html>

Electric Links <http://www.codecheck.com/>

1. What is the name of the site?

2. What is its purpose (educational, marketing, regulatory, etc.)?

3. What is the internet address of this site?

4. What types of information are available on this site?
5. Who sponsors this site?
6. Who would use this site the most and why?
7. What is the most interesting thing about electricity you learned from this site?