

UNIT V - ELECTRICITY

Lesson 5: Lights, Outlets, Switches, and Circuit Protection

Competency/Objective: Locate lights, outlets, and switches, and identify circuit protection needs.

Study Questions

1. What are the rules for lighting outlets located in an agriculture structure?
2. What are the types of lighting and their uses?
3. What are the rules for convenience outlets located in an agriculture structure?
4. What are the rules for switches located in an agriculture structure?
5. What electrical protection is needed in an agricultural structure?
6. What are the general recommendations for branch circuits?

References

1. *Agricultural Structures (Student Reference)*. University of Missouri-Columbia: Instructional Materials Laboratory, 1999, Unit V.
2. Activity Sheet
 - a) AS 5.1: Evaluating Lights, Outlets, Switches, and Circuit Protection

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Lesson 5: Lights, Outlets, Switches, and Circuit Protection

TEACHING PROCEDURES

A. *Review*

In Lesson 4, proper grounding practices and GFCI use was discussed. Another important aspect of the installation of electrical wiring in an agricultural structure is planning the number and type of lights, outlets, and switches.

B. *Motivation*

Ask students if they know what a dust explosion is. What leads to dust explosions in agriculture structures? Discuss ways to avoid these problems, focusing particularly on items such as lights, switches, and outlets.

C. *Assignment*

D. *Supervised Study*

E. *Discussion*

1. When planning the wiring of an agricultural structure, it is important to follow safety standards from the NEC and local regulatory agencies. Discuss the general guidelines for lighting outlets.

What are the rules for lighting outlets located in an agriculture structure?

- a) Wet areas - nonmetallic light fixture made of nonconductive materials, such as porcelain, plastic, or rubber
 - b) Areas where dust is a problem - dust-tight light fixtures that prevent combustible materials from coming into contact with electrical connections
2. Another important consideration is the type of lighting to be used in the structure. In order to choose the most appropriate type, it is necessary to be familiar with the different types of lighting. Ask students to list the types of lighting they have seen. Discuss the different types and their uses.

What are the types of lighting and their uses?

- a) Incandescent lamp - produces light when electricity moves through a wire filament that then glows at a white heat
- b) Gaseous discharge lamps - pass an electric current through a gas enclosed under pressure in a tube or bulb, producing light when the current moves through the gas particles

- 1) Low pressure gaseous discharge lamps
 - (a) Fluorescent lamps
 - (1) Made up of a glass tube that contains mercury vapor and argon gas
 - (2) Ultraviolet energy produced by electricity flowing through the mercury vapor; turns to visible light after striking the fluorescent coating of phosphors on the inside of the tube
 - (3) Used indoors
 - (4) Used effectively for supplementary lighting in greenhouses
 - (b) Low pressure sodium lamps
 - (1) Consist of two glass tubes, one inside the other
 - (2) Inner tube - contains solid sodium and a mixture of argon and neon gas
 - (3) Outer tube - protective barrier for the lamp
 - (4) Gives off a yellow light
 - (5) Commonly used for street lights
- 2) High pressure gaseous discharge lamps
 - (a) Mercury vapor lamps
 - (1) Two-bulb configuration
 - (2) Inner bulb - quartz arc tube containing mercury vapor at a high pressure, which allows it to produce visible light without phosphors
 - (3) Produces greenish-blue light
 - (4) Longer life than other lamps of similar wattage
 - (5) May take 5 to 7 minutes for vapor pressure to build up and reach full brightness
 - (6) Primarily used outdoors around farms and homes
 - (b) Metal halide lamps
 - (1) Contain compounds of metal and halogen with the same basic two-bulb design
 - (2) Produce more naturally colored light
 - (3) Long life and high light output
 - (4) Excellent outdoor light source
 - (5) Some indoor applications as well, such as supplementary lighting for greenhouses
 - (c) High pressure sodium lamps
 - (1) Similar to mercury vapor lamps
 - (2) Arc tube made of aluminum oxide containing a solid mixture of sodium and mercury
 - (3) Produce an orange-white light
 - (4) Long life and very high light output
 - (5) Used outside around homes and farms
3. A sufficient number of convenience outlets must be included in an agricultural structure. Have students observe the number of convenience outlets in the

classroom and the spacing between them. Discuss the guidelines for their installation.

What are the rules for convenience outlets located in an agriculture structure?

- a) Location
 - 1) Installed where animals will not readily bump into them; should be at least 5 feet above ground level anywhere livestock may be present
 - 2) Must be easily accessible
 - 3) Mounted between the studding or flush with the wall
 - b) Type
 - 1) 20-amp duplex receptacles with a safety ground
 - 2) GFCI receptacle preferable, especially in damp areas
 - 3) Nonmetallic outlet boxes
 - c) Number
 - 1) Depends on the amount of use the outlet will receive and the building type
 - (a) Livestock buildings - 12 to 15 feet between outlets
 - (b) Other structures - 8 to 10 feet
 - 2) Rule of thumb - to install enough outlets so that extension cords will not have to be used on a regular basis
4. Switches control everything from lighting to motorized equipment. Discuss the use of switches in agricultural structures.

What are the rules for switches located in an agriculture structure?

- a) Location based on convenience and ease of access
 - b) Installed at elbow height in protected spots
 - c) On the latch side of doors and on the traffic side of arches
 - d) Need multiple switches when multiple doors provide access to a single room or bay, if the doors are farther than 10 feet apart
5. Because of the damp and corrosive environments found in agricultural structures, electrical protection is a priority in these buildings. Describe the types of electrical protection needed.

What electrical protection is needed in an agricultural structure?

- a) Branch circuits - need adequate amperage-rated fuses or circuit breakers, which is calculated based on the anticipated use of the circuit
 - b) Grounding
 - 1) Needed for all noncurrent carrying devices
 - 2) System ground wire - same size as the wires carrying electrical current
6. Branch circuits are the primary electrical connections within agricultural structures. Therefore, it is very important to carefully plan these circuits. Discuss the

recommendations for branch circuits. Have students complete AS 5.1. Point out that older structures may not meet the current standards described in this lesson, although they may not be unsafe.

What are the general recommendations for branch circuits?

- a) Must have enough circuits to carry out business efficiently
 - 1) General purpose circuits must be considered in planning.
 - (a) Permanent lighting circuits
 - (b) Convenience outlets
 - (c) Special lighting circuits like automatic on/off outdoor lights
 - (d) Portable heater units
 - 2) The service entrance panel should have open circuit spaces for anticipated electrical expansion.
- b) Limitations
 - 1) Branch circuits should not operate at more than 2 percent voltage drop or use wire smaller than AWG 12.
 - 2) The electrical load is not to exceed 80 percent of the branch circuit rating.
 - 3) Fixed appliances must not be over 50 percent of the load if lighting is also included on the circuit.

F. *Other Activities*

Have students identify the branch circuits and the outlets they control in the agriculture building by examining the labeling on the service entrance panel.

G. *Summary*

When planning the electrical system of an agriculture structure, identifying the lighting, outlet, and switch requirements for that building is crucial. The materials installed should be designed for the typical uses and environmental conditions of the structure. Careful planning is required to design a system that will meet current and future demands.

H. *Answers to Activity Sheets*

I. *Answers to Evaluation*

- 1. d
- 2. e
- 3. a
- 4. b
- 5. c
- 6. f
- 7. To prevent combustible materials from coming into contact with electrical connections
- 8. 12 to 15 feet in livestock buildings, 8 to 10 feet in others

9. The same size as the wires carrying electrical current
10. Answers may include any two of the following: permanent lighting circuits, convenience outlets, special lighting circuits, and portable heater units.

EVALUATION

Match the lamp types on the right with the descriptions on the left.

- | | | |
|------------|---|-------------------------|
| 1. ____ | Contains compounds of metal and halogen | a. Incandescent |
| 2. ____ | Produces an orange-white light | b. Fluorescent |
| 3. ____ | Uses a filament that produces light under high heat | c. Mercury vapor |
| 4. ____ | Converts ultraviolet light into visible light | d. Metal halide |
| 5. ____ | Produces greenish-blue light | e. High pressure sodium |
| 6. ____ | Contains sodium, argon, and neon | f. Low pressure sodium |

Complete the following short answer questions.

7. Why should dust-tight light fixtures be used in areas where dust is a problem?

8. How far apart should convenience outlets be placed in livestock buildings? In other structures?

9. What size wire should be used to ground the system in agricultural structures?

10. What are three general purpose circuits to be considered when planning branch circuits?
 - a.

b.

c.

Lesson 5: Lights, Outlets, Switches, and Circuit Protection Name _____

Evaluating Lights, Outlets, Switches, and Circuit Protection

Objective: Observe the existing lights, outlet, switches, and circuit protection in an agricultural structure and determine if they meet the recommendations presented in class.

Observe the electrical system of an agricultural structure, such as a barn, machine shed, etc., looking at the lighting, outlets, and switches. Answer the following questions to determine if the electrical system meets NEC recommendations.

Type of Structure: _____

1. Are the lighting fixtures appropriate for the type of structure?
2. Is there adequate lighting for this structure, based on light type?
3. How many convenience outlets are present?
4. Are the convenience outlets in the recommended positions?
5. Are switches provided in convenient locations? Are multiple switch systems set up?
6. How many outlets, both light and convenience, are found on each branch circuit? (Hint: Look at the labels found on the inside cover of the SEP panel.)

7. Using the information from Lesson 2 of this unit, calculate the branch circuit loads (lights, outlets, other equipment, and motors). Is the circuit protection for these branch circuits adequate?

