UNIT V - ELECTRICITY

Lesson 7: Running Electrical Wiring

Competency/Objective: Describe practices for running wire to an agricultural structure and wiring within the building safely.

Study Questions

1. What is the configuration at the pole?
2. How is the service entrance installed?
3. When would branch circuits be used on agricultural structures?
4. What must be considered when wiring a barn?
5. What must be considered when wiring a hay barn?
6. How are switches and receptacles selected?

References

1. *Agricultural Structures (Student Reference).* University of Missouri-Columbia: Instructional Materials Laboratory, 1999, Unit V.
2. Transparency Masters
   a) TM 7.1: Wire Stacking at the Pole
   b) TM 7.2: Installation of the Service Entrance
3. Activity Sheet
   a) AS 7.1: Diagramming the Service Stack

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TEACHING PROCEDURES

B. ***Review***

Planning is an important step in correctly installing an electrical system. As discussed in Lesson 6, prior to installing a single wire, a written diagram should be drawn utilizing the proper wiring symbols to identify electrical components. Wiring can take place when the diagram is complete. Wiring begins with bringing the electrical service in at the yard pole and then installing wiring from the yard pole to the service entrance of a structure. The wire can then be run within the structure to branch circuits and electrical fixtures.

C. ***Motivation***

Show students how service wires enter the agricultural education building at school. Discuss the method of attaching service wires to the SEP.

D. ***Assignment***

E. ***Supervised Study***

F. ***Discussion***

1. The electrical service pole is the central hub for power distribution on agricultural operations. The installations made at the yard pole, main service entrance, and the meter should be done by an electrical contractor or the power company to be sure that they are done properly. However, understanding the configuration at the pole is important. Discuss the configuration, using TM 7.1 to illustrate the various components.

   What is the configuration at the pole?

   a) Three wires bring electricity in from the power company, including two hot wires and one neutral wire.
   b) The grouping of the wires at the pole is called the stack.
      1) Single stack - Wires that travel into the meter from the power company and those wires traveling out to individual structures are both contained within a single conduit.
      2) Double stack
         (a) Supply wires coming in from the power company use a separate conduit from the wires that lead out to the individual structures.

(b) Double stacking is utilized when a large number of structures are being served by one meter.

c) A separate ground wire connected to the neutral wires runs along the outside of the conduit to a ground rod.

d) All of the wires carrying power in to or out from the pole are connected directly to the pole with insulators.
   1) Requires two racks of insulators with three insulators per rack, one rack for incoming wires and the other for outgoing wires
   2) Anchored with heavy lag screws and at least one through bolt inserted through the pole for added strength

e) Feeder wires are used to carry power to the meter base.
   1) Attached to supply wires with solderless connectors
   2) Enter the conduit through the service head
   3) Run down the conduit and then attach directly to meter base

f) Short feeder wires are attached from the meter base to the main power disconnect switches at the pole.

g) The size of the feeder and supply wires traveling from the disconnect switches to the structures will be determined by each structure's demand load.

2. Once the wires are in place at the yard pole, the service entrance needs to be installed. Discuss the installation of the service entrance, using TM 7.2 as an illustration. Hand out AS 7.1.

How is the service entrance installed?

a) Size and type of wire
   1) According to the NEC, AWG 8 wire is allowed if up to two two-wire circuits are being installed.
   2) AWG 6 is allowed if up to five two-wire circuits are being installed.
   3) For bigger systems, amperage calculations and wire size tables are needed to determine the proper wire size.

b) Two-wire or three-wire type service
   1) A two-wire system has 110 volts available for use, which is acceptable for small sheds or buildings that will have only lights or outlet receptacles in use.
   2) A three-wire system has both 110 and 220 volts available for use within the structure to provide electricity for equipment requiring 220 volts.

c) Location of the service entrance
   1) The location of the SEP should be determined prior to running wires from the power pole.
   2) NEC guidelines indicate that the SEP should be as close as practical to the point where wires enter the building.
   3) If possible, the service box should be near equipment that requires higher 220-volt electrical loads.
   4) The SEP should be installed in a location that is easily accessible.

d) Wire connections at the building
    1) Insulators are connected to the structure for overhead runs of wire.
    2) The feeder wires connect to main wires and then run into the service head, through the conduit, and into the service entrance panel (SEP).

3. Ask students what branch circuits are used for. Discuss when they are used in agricultural structures.

When would branch circuits be used on agricultural structures?

a) The type of structure and its use will determine the number of circuits needed.
    1) Small sheds with lighting
        (a) Need only two branch circuits
        (b) Allows for backup lights if one circuit blows
    2) Larger structures, such as shops and barns
        (a) Typically need 110/220-volt service
        (b) 220-volt outlet - requires a separate circuit made by combining two 110-volt circuits at the service entrance panel
        (c) Varying number of circuits depending on the number of electrical systems and the number and type of appliances used
b) When determining the number of circuits needed, careful calculations of the wattage used by all electrical components are necessary.
c) A good rule of thumb is to add additional circuits and break up the system to avoid overload problems.
d) Planning for expansion is also important when installing the SEP and calculating the need for branch circuits.

4. Most agricultural structures have uses that must be taken into account when planning electrical wiring. Ask students what might be considered when wiring a barn.

What must be considered when wiring a barn?

a) Environmental conditions
    1) Barns naturally have damp and corrosive environments and tend to lack proper ventilation.
    2) NCM or UF cable is required along with nonmetallic junction boxes that resist moisture.
b) Mechanical damage
    1) Running wires along the sides of beams and joists to where fixtures are located provides protection.
    2) Wires are also run in protective conduits.
c) Lighting, switches, and receptacles
    1) Plenty of lighting should be included throughout the barn.
    2) Switches should be easily accessible and mounted at elbow height.
    3) Receptacles should be dust tight, watertight, and corrosion resistant.
    4) Installing GFCI outlets is a good idea.

d) Livestock considerations
    1) Lights, outlets, and switches should be out of the reach of livestock.
    2) This practice will prevent damage to equipment, fire hazards, and shock hazards.

5. Discuss the considerations that affect wiring in hay barns.

What must be considered when wiring a hay barn?

a) The dust produced by hay is highly flammable, so precautions must be taken to prevent electrical sparks from coming in contact with the dust.
b) Wires must be enclosed in conduits or within a wall covered with sheathing.
c) Vapor proof fixtures seal out dust from electrical connections.
d) Lighting fixtures should minimize the entrance of dust as well as foreign matter, moisture, and corrosive materials into the exposed wiring areas.
    1) Fixtures exposed to physical damage must be protected by a guard.
    2) Fixtures exposed to water must have watertight protective coverings.

6. Proper switches and receptacles must be used when wiring agricultural structures. Ask students what characteristics these fixtures should have.

How are switches and receptacles selected?

a) The NEC requires that switches, circuit breakers, motor controllers, fuses, push buttons, relays, and similar devices be protected from environmental and physical damage.
b) These components should have weatherproof, corrosion resistant enclosures designed to minimize the entrance of dust, water, and corrosive elements.
c) Switches and receptacles designed for outdoor use may be useful because these components tend to be durable and provide protection from environmental conditions.

G. Other Activities

Invite a certified electrician to discuss the selection and installation of electrical devices in agricultural structures.

H. *Conclusion*

The connections at the yard pole and service entrance panel must be made correctly, so they should be installed only by trained professionals. Other wiring within agricultural structures can be done by nonprofessionals. However, in order to install wiring properly, they must take into account the number of branch circuits needed, the conditions in the structures that will affect wiring, and the measures needed to protect wiring.

I. ***Answers to Activity Sheet***

J. ***Answers to Evaluation***

1. b
2. a
3. c
4. To prevent damage to equipment, fire hazards, and shock hazards
5. Because it is highly flammable
6. Because they are durable and provide protection from environmental conditions
7. As close as practical to the point where wires enter the building

8. Wires in to the meter and out to the structures run through a single conduit in a single stack and through different conduits in a double stack.

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EVALUATION

Circle the letter that corresponds to the best answer.

1. What wire size can be used if up to five two-wire circuits are being installed?

   a. AWG 8
   b. AWG 6
   c. AWG 4
   d. AWG 2

2. How many branch circuits are needed for small sheds with lighting?

   a. 2
   b. 3
   c. 4
   d. 5

3. At the yard pole, feeder wires carry power to the:

   a. Stack.
   b. Ground rod.
   c. Meter base.
   d. Neutral wire.

Complete the following short answer questions.

4. Why should lights, outlets, and switches be out of the reach of livestock in barns?

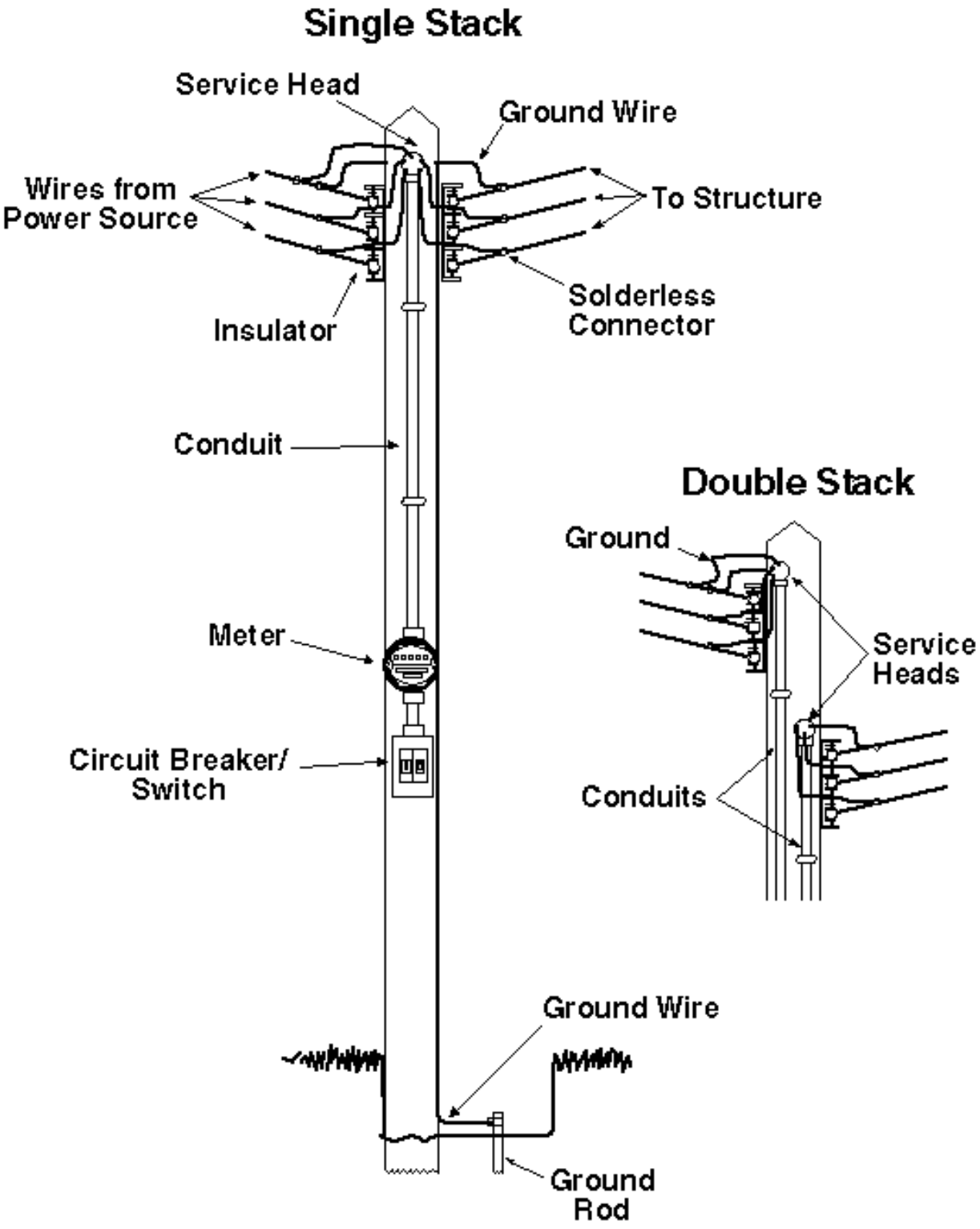
5. Why should hay dust be prevented from coming in contact with electrical sparks in hay barns?

6. Why are switches and receptacles designed for outdoor use useful in agricultural structures?

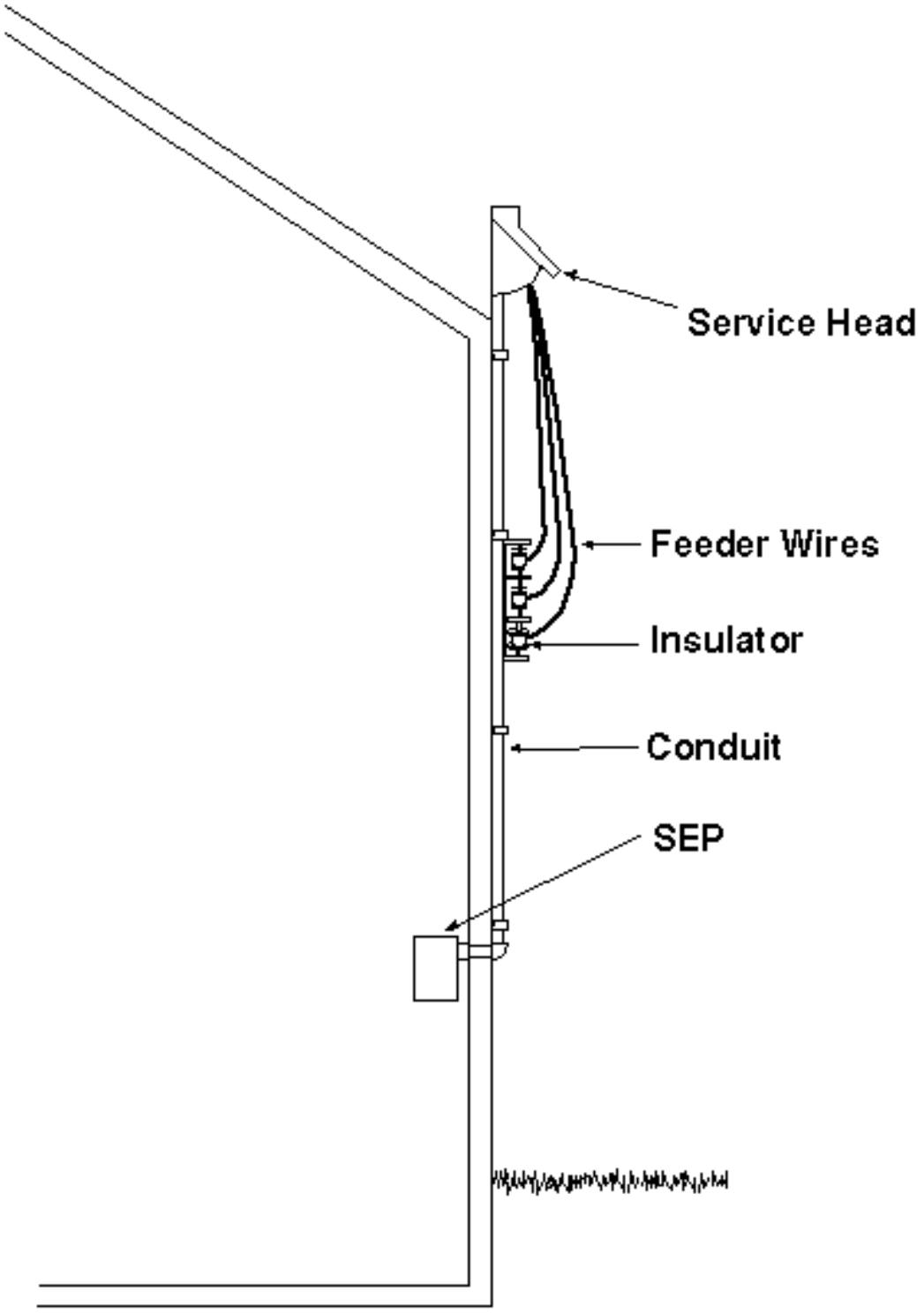
7. Where should the service entrance be installed?

8. What is the difference between a single stack and a double stack?

Wire Stacking at the Pole



Installation of the Service Entrance



Lesson 7: Running Electrical Wiring Name _____

Diagramming the Service Stack

Objective: Identify the stack configuration at the service pole or service entrance.

Identify the stack configuration found at either the electrical service pole or the service entrance at your home. In the space below, diagram the configuration. In the diagram, include the stack configuration, the meter base, the main disconnect switch (if present), and the wires. Color code the wires, using black or red for hot wires, grey for neutral wires, and green for ground wires.