Lesson 7: Running Electrical Wiring

The electrical service pole is the central hub for power distribution on an agricultural operation. The installations made at the yard pole, the main service entrance, and the meter should be made by an electrical contractor or the power company. However, understanding the configuration at the pole is important in completing further wiring installations or making repairs to the system.

The Configuration at the Pole

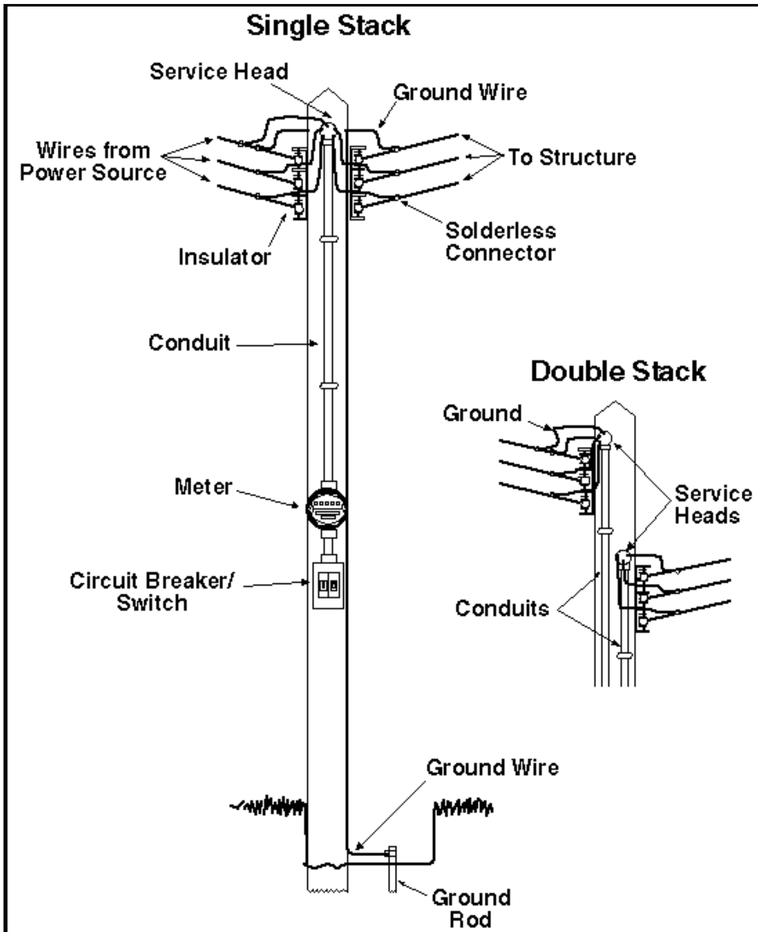
Three wires bring electricity in from the power company to an agricultural operation. These wires include two hot wires and one neutral wire. The wires are connected to the meter base at the yard pole, and power is distributed to the different structures from the pole. The grouping of the wires at the pole is called the stack.

Connections at the pole are relatively simple. All of the wires carrying power in to or out from the pole are connected directly to the pole with insulators. These insulators should be heavy enough to withstand weather conditions and are typically made of ceramic. Two racks of

The stack may have either a single stack or a double stack, as shown in Figure 7.1. In single stacking, the 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 attached to the pole.

In double stacking, the supply wires coming in from the power company use a separate conduit from the wires that lead out to the individual structures. This configuration is used for both overhead and underground wiring installations. Double stacking is utilized when a large number of structures are being served by one meter.

A separate ground wire that is connected to the neutral wires runs along the outside of the conduit to a ground rod. This form of electrical grounding is best for handling lightning. The ground wire should be AWG 6 in size.



insulators with three insulators per rack are required, one rack for incoming wires and the other for outgoing wires. The insulators should be anchored with heavy lag screws and at least one through bolt inserted through the pole for added strength. Insulators are not needed for underground wiring because the wires are fed through a buried conduit.

Feeder wires are used to carry power to the meter base. They are attached to the supply wires with solderless connectors. Once the splice is made, these connectors should be taped to provide insulation. The feeder wires then enter the conduit through the service head, which is a special fitting that is angled to keep water from entering the conduit. The wires run down the conduit and then attach directly to meter base.

Short feeder wires are attached from the meter base to the main power disconnect switches at the pole. A disconnect switch should be available for all individual electrical service systems to which power is supplied. For individual electrical systems, two structures may be operated off of one.

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. The supply wires are either attached to the pole with insulators or buried underground.

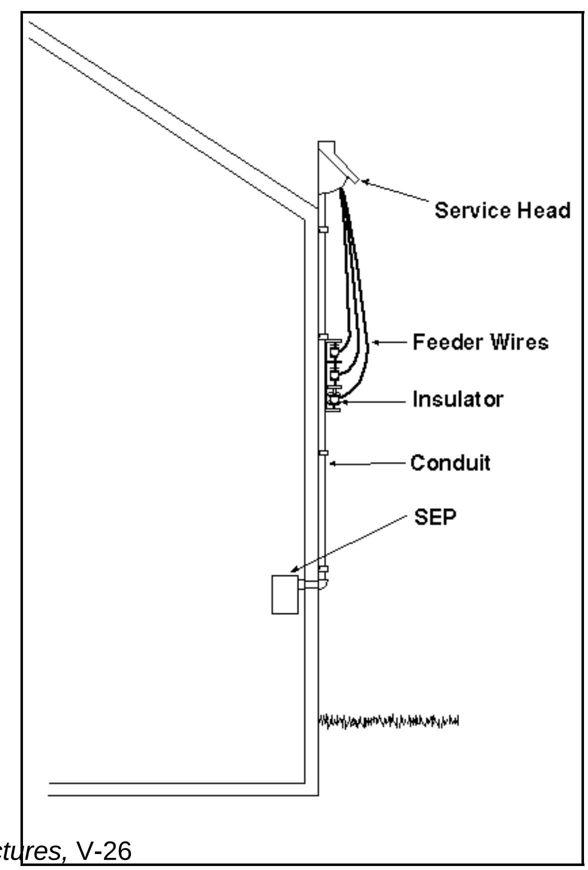
Installing the Service Entrance

Once the configuration at the pole is in place and the amperages determined for the individual structures, the service entrance needs to be installed. NEC regulations determine the size and type of wire used at the service entrance. According to the NEC, AWG 8 wire is allowed if up to two two-wire circuits are being installed, and AWG 6 is allowed if up to five two-wire circuits are being installed. For bigger systems, amperage calculations and wire size tables are needed to determine the proper wire size.

The type of power service required in the structure will determine if the service entrance will have a two-wire or three-wire type service. 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. A three-wire system has both 110 and 220 volts available for use within the structure. It can provide electricity for equipment requiring 220 volts, such as a welder.

The location of the service entrance is an important consideration. The location of the SEP should be determined prior to running wires from the power pole. NEC guidelines indicate that the SEP should be as close as practical to the point where wires enter the building. If possible, the service box should be near equipment that requires higher 220-volt electrical loads to reduce expensive wire runs and voltage drop. The SEP should be installed in a location that is easily accessible.

The wire connections at the building are similar to those at the yard pole. Insulators are connected to the structure for overhead runs of wire. The feeder wires connect to main wires and then run into the service head, through the conduit, and into the service entrance panel (SEP). Figure 7.2 illustrates the service entrance.



Using Branch Circuits

When planning an electrical system, it is important to consider how many branch circuits will be necessary within a structure. The type of structure and its use will be determine the number of circuits needed. Small sheds with lighting need only two branch circuits. The second circuit allows for backup lights if one circuit blows. Larger structures, such as shops and barns, typically need 110/220-volt service because they often have equipment that requires 220 volts. Each 220-volt outlet requires a separate circuit, which is made by combining two 110-volt circuits at the service entrance panel. The number of circuits will vary depending on the number of electrical systems and the number and type of appliances used.

When determining the number of circuits needed, careful calculations of the wattage used by all electrical components are necessary. A good rule of thumb is to add additional circuits and break up the system to avoid overload problems. Planning for expansion is also important when installing the SEP and calculating the need for branch circuits.

Wiring a Barn

Most agricultural structures have special characteristics that must be considered when planning electrical wiring. One of the biggest considerations for barns is their environmental conditions. Barns naturally have damp and corrosive environments and tend to lack proper ventilation. NCM or UF cable is required along with nonmetallic junction boxes that resist moisture.

Another factor to consider is mechanical damage, or damage caused by crushing, pinching, or crimping conductors when livestock, tools or equipment inadvertently come in contact with wires. Running wires along the sides of beams and joists to where fixtures are located provides protection. Wires are also run in protective conduits to prevent mechanical damage.

When planning for electricity in the barn, providing lighting, switches, and receptacles is important. Plenty of lighting should be included throughout the barn. Switches should be easily accessible and mounted at elbow height. Receptacles should be dust tight, watertight, and corrosion resistant. Installing GFCI outlets is a good idea.

Livestock considerations are also a factor in planning electrical wiring. Lights, outlets, and switches should be out of the reach of livestock. This practice will prevent damage to equipment, fire hazards, and shock hazards to animals.

Wiring a Hay Barn

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

Selecting Switches and Receptacles

Choosing proper switches and receptacles is an important consideration when planning the wiring of any agricultural structure. The NEC requires that switches, circuit breakers, motor controllers, fuses, push buttons, relays and similar devices be protected from environmental and physical damage. These components should have weatherproof, corrosion resistant enclosures designed to minimize the entrance of dust, water, and corrosive elements. Switches and receptacles designed for outdoor use may be useful because these components tend to be durable and provide protection from environmental conditions.

Summary

Wiring for agricultural operations is in some ways very different than other wiring situations. For example, the use of a centrally located yard pole that acts as a power hub for all the surrounding structures is unique to agriculture. Only trained professionals should connect the electrical service at the pole and meter base and at the main service entrance.

Wiring for branch circuits and electrical fixtures is less specialized, however. Carefully planning the wiring for a structure is important. In particular, due to the nature of agriculture structures, wiring and fixtures such as lights, switches, and receptacles should have adequate protection from their environment.

Credits

Holzman, H.N. *Modern Residential Wiring.* South Holland, Ill.: Goodheart-Willcox Company, Inc., 1986.

Richter, H.P., and W. C. Schwann. *Wiring Simplified*. 38th ed. Somerset, Wis.: Park Publishing, Inc., 1996.