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

The primary intent of electrical wiring is to provide a convenient source of power for lighting and mechanical needs. These needs are met through the use of lighting systems, outlets, and switches. In planning the wiring of an agricultural structure, safety standards from the NEC and local rules and regulations must be followed.

Rules for Lighting Outlets in Agricultural Structures

Light fixtures must be appropriate for the environmental conditions that will be present in agricultural structures. Because of the nature of these structures, most will have wet or dusty environments. Therefore, specific measures must be taken when planning lighting outlets for these structures.

In wet areas, the NEC requires the use of a nonmetallic light fixture. These fixtures are to be made of nonconductive materials, such as porcelain, plastic, or rubber.

In areas where dust is a problem, such as a feed elevator or hay barn, dust-tight light fixtures are required. These fixtures prevent combustible materials from coming into contact with electrical connections that produce sparks.

Types of Lighting and Their Uses

Another important consideration in agricultural structures is the type of lighting to be used in a particular structure. To choose the best alternative, being familiar with the different types of light sources and the uses of each is necessary.

When discussing light sources such as light bulbs and fluorescent tubes, the term “lamp” is used. A lamp is a mechanism that produces light when an electrical current passes through it. Larger lamps will be more efficient and provide more light per watt of power used. For instance, three 60-watt lamps will provide 10 percent more light than five 40-watt lamps. The difference in wattage is an important consideration when planning the number of fixtures and the wire size to be used in a structure.

Numerous types of lighting are available. Incandescent lamps are the most familiar type. These lamps produce light when electricity moves through a wire filament that then glows at a white heat. The electricity heats the filament to more than 4,500 degrees Fahrenheit. The high temperature makes the filament give off light. This type of lamp is inefficient because much of the electricity used is changed to heat instead of light.

Another group of lamps are known as gaseous discharge lamps. These lamps pass an electric current through a gas enclosed under pressure in a tube or bulb. This process, referred to as electric discharge, produces light when the current moves through the gas particles. Two types of gaseous discharge lamps are available: low pressure gaseous discharge lamps, such as fluorescent lamps and low pressure sodium lamps, and high pressure gaseous discharge lamps, such as mercury vapor lamps, metal halide lamps, and high pressure sodium lamps.

Fluorescent lamps are made up of a glass tube that contains mercury vapor and argon gas under low pressure. Electricity flowing through the mercury vapor produces ultraviolet energy. This energy turns to visible light after striking the fluorescent coating on the inside of the tube; the coating is made up of phosphors, which are solid, nonmetallic chemical elements. Fluorescent lamps are used indoors. Because of advances in light quality, they can be used effectively for supplementary lighting in greenhouses. Fluorescent lamps are also made in a compact form for use in light sockets usually used for incandescent lamps.

Low pressure sodium lamps consist of two glass tubes, one inside the other. The inner tube contains solid sodium and a mixture of argon and neon gas. The outer tube provides a protective barrier for the lamp. When electricity moves through the inner tube, the gases react with the electricity to produce heat and an orange-colored light. As the sodium heats up, it vaporizes, and the lamp gives off a yellow light. These lamps are commonly used for street lights in towns.

Mercury vapor lamps also have a two-bulb configuration. The inner bulb is made of quartz and is called the arc tube. The arc tube contains mercury vapor at a high pressure, which allows it to produce visible light without the presence of phosphors. The light produced is greenish blue in color. These lamps have a longer life than other lamps of similar wattage. However, it may take 5 to 7 minutes for vapor pressure to build up and reach full brightness. Mercury vapor lamps are primarily used outdoors around farms and homes to light the outside of buildings.

Metal halide lamps contain compounds of metal and halogen with the same basic two-bulb design. These lamps produce more naturally colored light than do mercury vapor lamps. Metal halide lamps also have a long life and high light output. They are an excellent outdoor light source and have some indoor applications as well, such as supplementary lighting for greenhouses.

High pressure sodium lamps are similar to mercury vapor lamps. The difference is that the arc tube in the two-bulb configuration is made of aluminum oxide. The tube contains a solid mixture of sodium and mercury. These lamps produce an orange-white light and have a long life and very high light output. They are also used outside around homes and farms.

Rules for Convenience Outlets in Agricultural Structures

Convenience outlets are the points in the wiring system where electric power is used, such as electrical receptacles. They allow electrical appliances to be plugged in as necessary. A sufficient number of convenience outlets must therefore be included when planning agricultural structures.

Some basic guidelines are followed in determining the location of convenience outlets. First, outlets are installed where animals will not readily bump into them. Generally, they should be at least 5 feet above ground level anywhere livestock may be present. Also, they must be easily accessible. The outlets should be mounted between the studding or flush with the wall.

For agricultural structures, the correct type of convenience outlet must be used. They must be 20-amp duplex receptacles with a safety ground. A GFCI receptacle is preferable, especially in damp areas. Also, due to the environmental conditions in most agriculture structures, nonmetallic outlet boxes are necessary.

The number of convenience outlets installed within a structure depends on the amount of use the outlet will receive and the building type. For livestock buildings, 12 to 15 feet between outlets is recommended. In other structures, 8 to 10 feet of space is acceptable. A good rule of thumb when planning for convenience outlets is to install enough outlets so that extension cords will not have to be used on a regular basis.

Rules for Switches in Agricultural Structures

Switches are an important component in the electrification of agricultural structures. Switches control everything from lighting to motorized equipment. A major use of switches in agricultural structures is as safety disconnect devices. These switches shut off power to rows of receptacles on a single circuit or to motors when not in use.

The location of switches should be based on convenience and ease of access. Switches should be installed at elbow height in protected spots. If possible, the switch should be on the latch side of doors and on the traffic side of arches. When multiple doors provide access to a single room or bay, multiple switches are needed if the doors are farther than 10 feet apart.

Electrical Protection for Agricultural Structures

Because of the damp and corrosive environments typically found in agricultural structures, electrical protection is a priority in these buildings. Overcurrent devices and proper grounding procedures are a must. Branch circuits must contain adequate amperage-rated fuses or circuit breakers, which is calculated based on the anticipated use of the circuit. Proper grounding is also an important consideration. All noncurrent carrying devices, or ground wires connected to motor housings or

to equipment, should be grounded. The system ground wire to the ground rod must be the same size as the wires carrying electrical current. For example, if the hot and neutral wires are AWG 12, then the ground wires must also be AWG 12.

The building must have enough circuits to carry out business efficiently. General purpose circuits that must be considered in planning are permanent lighting circuits, convenience outlets, any special lighting circuits like automatic on/off outdoor lights, and portable heater units. Also, the service entrance panel should have open circuit spaces for anticipated electrical expansion.

Some limitations apply to the use of branch circuits. Branch circuits should not operate at more than 2 percent voltage drop or use wire smaller than AWG 12. The electrical load is not to exceed 80 percent of the branch circuit rating, which is the rating of the branch fuse or circuit breaker. Fixed appliances must not be over 50 percent of the load if lighting is also included on the circuit.

Summary

When planning the electrical wiring of an agricultural structure, identifying the requirements for lighting, outlets, and switches

General Recommendations for Branch Circuits

Branch circuits are the primary electrical connections for all uses within the agriculture structure. Therefore, it is very important to carefully plan the uses and load of these circuits. for that building is crucial. Using materials designed for the typical uses and environmental conditions of these structures is also important. As in any structure, electrical protection and good circuit design are necessary. Careful planning is required to design a system that will meet current and future demands.

Credits

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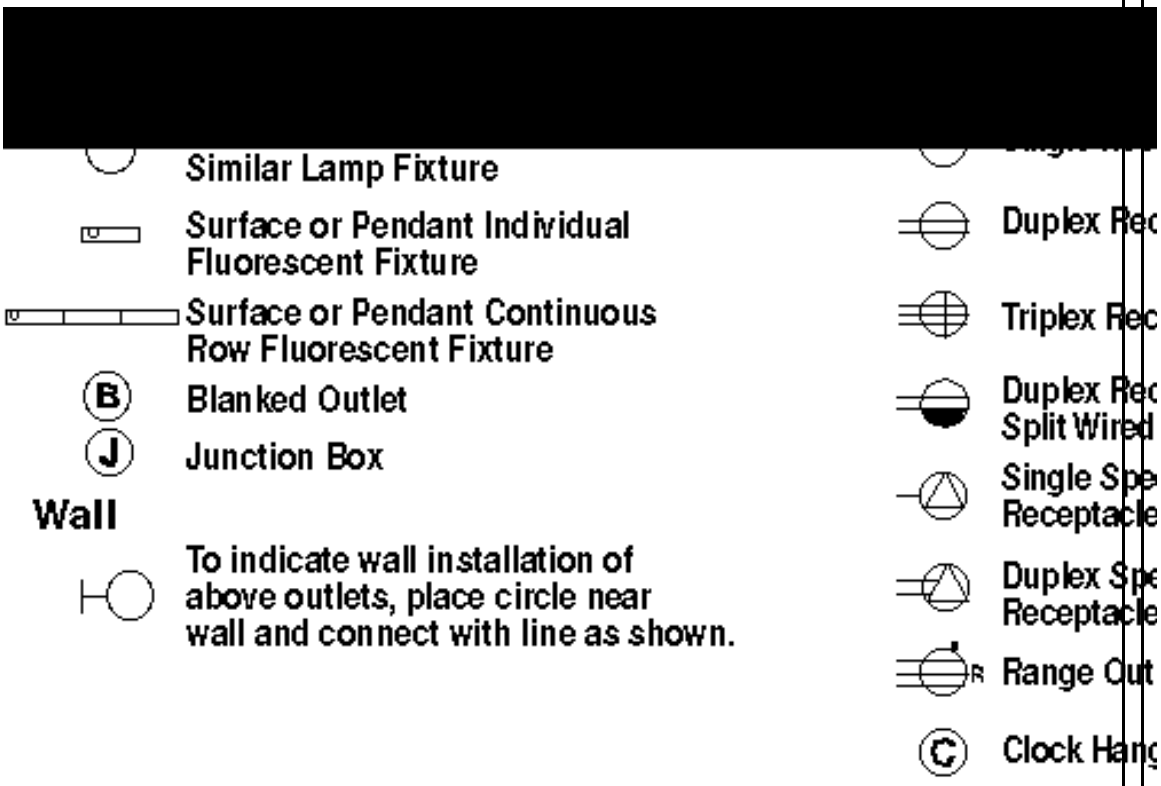
Similar Lamp Fixture
Surface or Pendant Individual Fluorescent Fixture
Surface or Pendant Continuous Row Fluorescent Fixture
B
Blanked Outlet
J
Junction Box
Wall
To indicate wall installation of above outlets, place circle near wall and connect with line as shown.
Duplex Rec
Triplex Rec
Duplex Rec Split Wired
Single Spe Receptacle
Duplex Spe Receptacle
R
Range Out
C
Clock Hang