Lesson 4: Grounding and GFCI Protection

Electricity can be thought of as a living entity moving along a path through a circuit. However, if that circuit is interrupted, the electrical current still seeks a path to the earth. A ground wire is a safe method of establishing this necessary link by providing a path for the current. However, if a person uses a piece of equipment that is shorted out or improperly grounded, she or he may become the access point for grounding that the electrical current is seeking. Therefore, ground fault circuit interrupters are a crucial safety device, especially in damp areas.

Grounding and Its Importance

Grounding forms the connection between a piece of equipment or electrical appliance and the earth. It provides electricity an alternate path back to its source. The grounding point is typically established at or near the service entrance panel where electricity enters a structure. It may consist of a metal rod made of solid copper or copper-clad metal driven into the ground that is connected directly to the service panel with a ground wire. A grounding system may also consist of a grounding wire attached to an established galvanized metal water pipe.

The grounding system is connected to appliances and electrical equipment through a dedicated ground wire that is isolated from the power conductors in the electrical system. This wire may be connected either to the equipment directly or to the electrical outlet receptacle. The ground wire leads back to the ground connection at the service panel.

Grounding is important in the prevention of electrical shock. It provides a safety measure for channeling an electrical current that is out of the electrical circuit back to the earth at the source. This safety measure helps direct the charge away from humans or livestock who might come into contact with a shorted appliance or equipment.

NEC Requirements for Grounding

According to the NEC, grounding has three main purposes. First, it limits voltages in an electrical system due to lightning, line surges, or unintentional contact with higher voltage lines. Second, grounding helps stabilize voltages within the system. Finally, it provides a path to facilitate the operation of overcurrent devices.

NEC regulations state, “Premises wiring shall not be electrically connected to a supply system unless the latter contains, for any grounded conductor of the interior system, a corresponding conductor that is grounded.” Basically, this statement means that the proper grounding rods must be in place and connected to the electrical system prior to making the electrical connection to the power source.

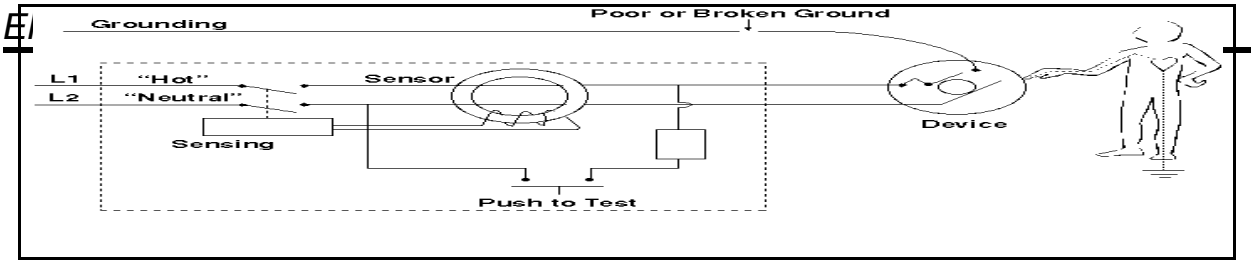
NEC regulations also describe the types of grounding systems allowed. The code states that the ground rod conductor is to be connected at the point where the electrical service enters the service panel. Also, all connections to the ground rod must be made at the service panel and the entrance point to the service panel, not on the individual circuits of the electrical system. The grounding electrode, or ground rod, should be as near as practical to the service entrance.

GFCIs

Putting faith in the grounding wire in a 3-wire electrical system is not always justified. A faulty ground wire could lead to a lethal shock. Therefore, using GFCIs is best in any situation where a potential shock hazard exists.

GFCI stands for ground fault circuit interrupter. A GFCI is a device that interrupts the circuit to any electrical device when a fault current, or a current which has moved out of its normal circuit, exceeds a predetermined level. The level is less than that required to operate the overcurrent protective device of the supply circuit. The primary function of a GFCI is to interrupt the flow of the current to prevent people and animals from being shocked.

A GFCI operates by monitoring the magnitude and time of electrical flow. The GFCI will interrupt abnormal electrical flows of 5/1000 amperes in 25/1000 of a second. These small amounts of amperage will not trip a regular electrical breaker or fuse.



GFCIs work by sensing imbalances in electrical circuits caused by shorts or other faults. When an imbalance occurs between the black "hot" wire and white "neutral" conductors, an uneven electrical load exists in the system, and a ground fault current is present and seeking a return conductor to the source. A person or animal coming in contact with the fault current can provide this path, creating a shock hazard. The GFCI prevents shocks by stopping the electrical flow, as illustrated in Figure 4.1.

NEC Requirements for GFCIs

The NEC establishes where GFCIs should be installed. According to the NEC, GFCI protection is required for all outlet receptacles or any devices permanently wired into the electrical system that are installed in the locations listed.

- Bathrooms
- Garages and grade level portions of unfinished accessory buildings used for storage and work areas
- Outdoors
- Crawl spaces, where the crawl space is at or below ground level
- Unfinished basements and areas not intended as habitable rooms and limited to storage areas, work areas, and the like
- Kitchens, where the receptacles are installed to serve counter top surfaces
- Indoor or outdoor swimming pools
- Hot tubs
- Portable signs
- Any location using temporary power

Installation of GFCIs in Agriculture Structures

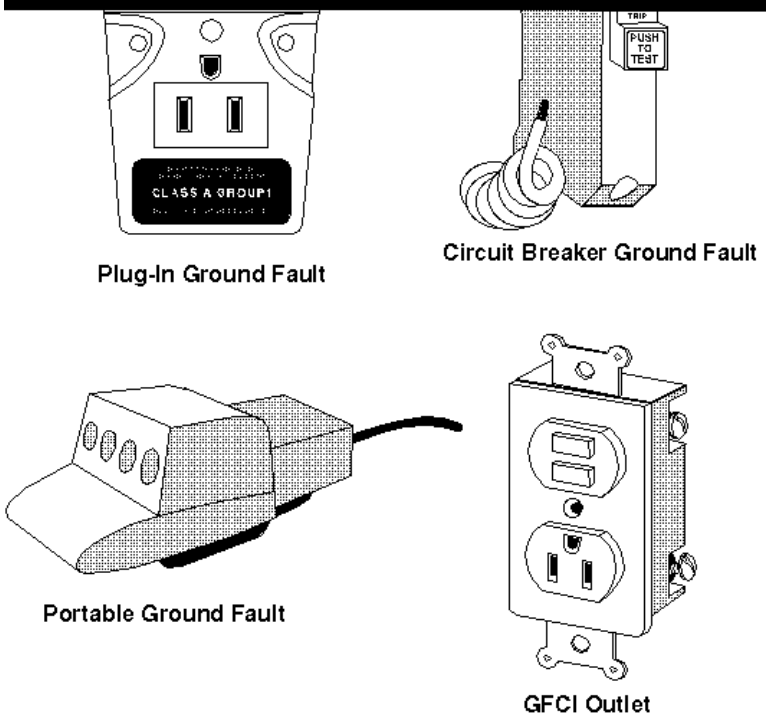
Four types of GFCI units are used in agriculture structures. They are the circuit breaker GFCI, the plug-in GFCI, the portable GFCI, and the outlet-type GFCI, all of which are pictured in Figure 4.2. The selection of one of these types for use in a particular structure depends on the requirements of the structure.

Circuit breaker GFCI - This type of GFCI is a fixed, permanently installed unit. It substitutes for a standard circuit breaker and controls the outlets within an entire circuit.

Plug-in GFCI - This device is designed for use in existing electrical systems that do not have GFCI devices installed. It plugs into a regular receptacle and protects only those appliances plugged into it.

Portable GFCI - The portable GFCI is similar to the plug-in type, except this device has an extension cord and is portable. It plugs into standard outlets. This GFCI is generally used for construction and short term circuit protection needs.

Outlet-type GFCI - As its name suggests, this GFCI is permanently mounted in an outlet box. It protects all the items plugged into it. The outlet-type GFCI is widely used in the construction of new buildings.



Summary

The use of proper grounding and GFCIs in electrical systems is a critical component in construction for the home and farm. They provide a safety feature that protects humans and animals from electrical shock hazards and the electrical system from hazardous overloads. The requirements for this protection are addressed very specifically by the NEC, with regulations governing the application and use of grounding systems and GFCIs.

Credits

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