Lesson 1: Electrical Safety

Electricity is all around people every day. It lights their homes and workplaces, keeps them warm and cool, and cooks their food. Electricity is also a major energy source utilized in agriculture. While electricity is a helpful tool, it can be a hazard if not respected. Estimates from the National Electrical Safety Foundation indicate that the electrical systems in homes were involved in 43,000 fires, 330 deaths, and 1,720 injuries in 1993. In 1992, their data shows an estimated 530 electrocution deaths.

Basic Rules of Electrical Safety

Electrical safety is a major consideration in the home and in agricultural operations. In electrical safety, the primary focus is on two main concerns: shock and fire. Anyone who has ever touched an electric fence has felt the effects of an electric shock, which is the passing of an electric current through the body and the body's reaction to it. An electric shock will affect the rhythm of the heart, possibly leading to serious injury or death.

Everyone is familiar with fires, but an electrical fire generally begins unnoticed. Electrical fires have two main causes. Some fires begin because wires overheat. This situation generally occurs when a restriction exists in the flow of electricity through the conductor or if a system is overloaded. The second way electrical fires begin is with an electrical current jumping a gap, creating sparks. Broken wires or improper electrical connections may produce a gap.

How can these hazards be reduced? Anyone working around or using electricity must take note of a number of precautions. During the installation and repair of electrical systems, the main power source should always be disconnected before working with the system. Also, state and local electrical codes should be followed when installing new systems. Manufacturers' instructions for the installation and use of electrical equipment are another important source of information about the proper procedures to use. Short cuts during installation can lead to hazards later.

As with most hazardous situations, misuse due to the human factor tends to be the single greatest cause of electrical mishaps. Electricity, although beneficial, can cause large amounts of

The use of extension cords is another factor that can create electrical hazards. Extension cords are not a permanent fix for a lack of wall outlets. Cords should only be used for a short period when the cords on electrical equipment do not reach an outlet. Extension cords should not be placed under items, such as rugs or other things that put weight directly onto the cord. Placing them in high traffic areas can also lead to insulation damage and a restriction of electrical flow and should be avoided. A long extension cord should always be uncoiled before plugging it in. A coiled conductor creates greater resistance to electrical flow, which can lead to voltage loss, blown circuits, and fire hazards. If an extension cord becomes warm or smells of burning rubber, its use should be discontinued immediately.

Fuses and breakers, which are safety devices designed to shut off electrical flow, can be a source of electrical hazards. Activation of a fuse or breaker device is an indication that a problem exists with the electrical system. The problem may be an electrical overload, with too many items running on a system, or something more serious within the electrical circuit. Checking out the system and correcting the problem is important before replacing the fuse or resetting the breaker. A higher capacity fuse or circuit breaker should never be used for a repair. Electrical systems are designed to carry a certain load, and an attempt to increase this load will burn out the system.

A situation that can be extremely hazardous, and one in which agricultural electricians often find themselves, is performing an installation near wet areas. Water is an excellent conductor of electricity, and if electricians are working on a system or using a tool in a damp environment, they can become a conductor for the electrical flow as it seeks a ground. While working with electrical systems or appliances in areas that are wet or damp, making sure that the power is disconnected is important. Cabinets, shelves, and stands should be utilized to keep tools and appliances dry. GFCI outlets, special outlets designed to interrupt electrical flow in hazardous situations, in noncorrosive plastic device boxes should be installed in wet or damp areas.

property damage and lead to loss of life, so following suggestions for safe installation and use of electrical systems is vital. When working with electricity, remember that safety devices put in place by manufacturers have a purpose and do not damage or disable them. Do not use any electrical product that is damaged in any way. Do not remove a plug from an outlet by pulling on a cord, and never carry a power tool by its cord.

Joining two wires that are composed of different metals can pose a hazard. They can create a fire hazard. A special type of connector should be used to prevent problems.

Sources of Electrical Defects in Equipment

Defects that occur in electrical equipment have six common sources. They are problems with the ground wire, open conduits, damage to the insulation, damage to equipment, lack of maintenance, and misuse.

Ground wire defects occur when the ground, or neutral, wire is missing, broken, improperly connected, or not connected at all. These problems can lead to shorts in the system and a possible shock hazard to anyone using equipment connected to the line.
Conduits are metal or plastic tubes that enclose electrical wires. Open conduits are defects that lead to wire damage. When a conduit is left open, damage may occur from water entering the conduit. Open conduits also allow for wear and deterioration of the insulation. This type of defect can create a short circuit.

Insulation damage occurs when the insulation becomes worn, wet, or oily. Damaged insulation can lead to short circuits, shocks, and fire hazards.

Another source of defects is damage to equipment that occurs during manufacturing or installation and use. Defects normally occur in switches, receptacles, and extension and appliance cords. This type of defect can lead to shock and fire hazards.

Poor equipment condition may be caused by a lack of maintenance. Dirty, improperly adjusted electrical equipment can overheat, throw sparks, and short out. Poor maintenance can also create a fire hazard.

The most common source of defects is misuse through carelessness. Carelessness may result in the misuse of equipment, improper wiring practices, limited knowledge of electrical systems, and working around electricity in wet environments without proper precautions.

Electrical Injuries

Electrical injuries can occur anywhere a source of electricity is present. Coming in contact with an electrical source can send a current of electricity through the body. The amount of current will depend on the degree and quality of the insulation on the electrical source and the electrical resistance of the skin. Skin resistance is at its lowest when the skin is damp or if the location is wet. In this situation, a current of .006 amps can electrocute a healthy individual in less than one second.

What should be done if someone gets shocked? For someone receiving an electric shock of 120 to 240 volts, the first step is to disconnect the source of the electric current, if possible. If it cannot be disconnected, a long pole or other item of nonconductive material, such as wood or fiberglass, is needed. The person holding the pole should insulate himself or herself by making sure to avoid any liquids or wet areas and then use the pole to move the person or the conductor, depending on which is easier and safer to move.

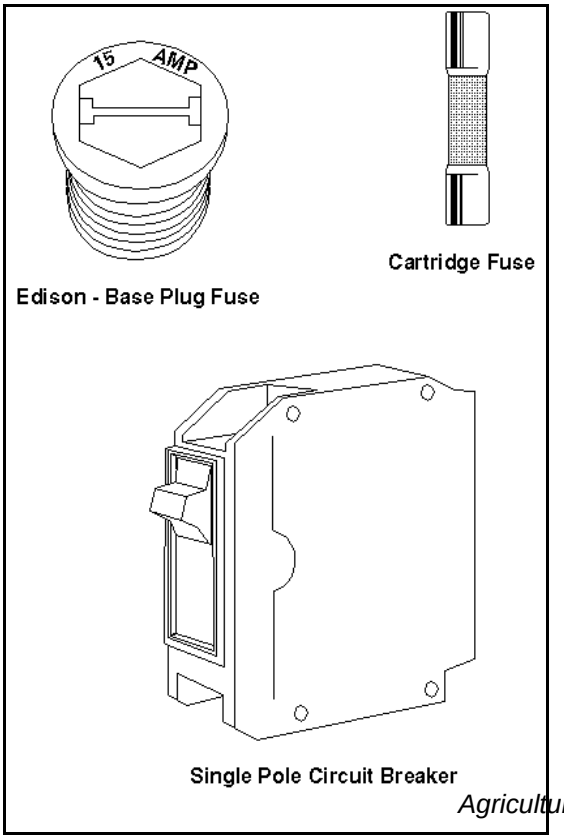
If the power source is over 240 volts, as is the case with overhead wires, anyone in the area should assume that the downed wire is live and can kill. Everyone should be kept at least 200 feet away because the static electricity in the air can arc to individuals wearing any type of metal. Rather than trying to help the victim themselves, they should contact emergency personnel immediately and call the power company to give them the exact location of the incident.

In either case, rescuers should never attempt to grab a person in direct contact with a live wire. The electrical current will “freeze” muscles, thus compounding the situation and putting the rescuer at risk of electrocution and death.

First aid should be given once the victim is removed from the electrical source. Rescuers should check to see if she or he is conscious and then check for signs of breathing and a pulse. If they are trained in the use of CPR, they should perform CPR on the victim until emergency personnel can arrive. Victims of electrical shock often suffer burns. If burns are present, they should be covered with a dry, sterile dressing. Rescuers should not attempt to cool electrical burns since efforts to soothe them may only make the situation worse and can lead to further damage. Finally, the victim should never be moved unless an immediate threat to his or her safety exists. Due to the nature of an electrical injury, the victim may experience damage to the spine that would be worsened by being moved.

Types of Circuit Protection

An overcurrent device limits the amperage in any wire to the maximum permitted. Fuses and circuit breakers are overcurrent devices. Both of these devices are rated by the number of amps that will travel through the overcurrent device without triggering it. The size of the wire used in the system will determine the amperage rating of the overcurrent device used. Different types of overcurrent devices are shown in Figure 1.1.



A fuse is a short piece of metal that has been experimentally tested to melt at a predetermined flow of amps. This piece of metal is housed in a nonconductive material for the purposes of protection and removal. The most common type of fuse is the plug type, which screws into the electrical service panel, the box located where power enters the building. If a fuse blows, it should be replaced with one of equal amperage, never with one of higher amperage.

The circuit breaker is a semi-permanent device positioned in the service panel during wire circuit installation. This device does not require replacement when a break occurs in the circuit. The circuit breaker resembles a toggle switch with a handle. It has four switch positions: on, tripped, off, and reset. Inside the circuit breaker is a mechanism that "trips" the breaker and disconnects the load in an overload situation. Because of the ease of resetting a circuit breaker, this overcurrent device is the type most commonly used.

Fuses and circuit breakers normally provide sufficient protection for electrical equipment. However, they do not always entirely protect people from being shocked. Therefore, ground fault circuit interrupters (GFCI) should be used in certain situations. They interrupt the flow of electricity in order to prevent electrical shock if a fault exists in the circuit that will not affect a fuse or circuit breaker. GFCIs will be discussed in more detail in Lesson 4 of this unit.

Summary

Electrical safety concerns everyone. Being aware of electrical hazards will enable an individual to safely work with electricity. He or she must understand the safety devices needed and know what to do in an electrical emergency.

Credits

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