Cornell Cooperative Extension

RURAL
Safety and Health

ELECTRICAL SAFETY ON THE FARM

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THIS FACT SHEET COVERS

Electric shock
Basics of electrical systems
Common hazards
Safety precautions
First aid

Over the years, electrically powered farm equipment has become an indispensable element of modern farming. With the widespread use of electricity on the farm, more emphasis needs to be placed on using electricity and electrical equipment safety. Nationally, approximately 30 to 40 people a year are electrocuted on farms. A better understanding of the principles, uses, and hazards associated with electricity could have prevented many of these deaths.

Electric Shock

To understand the hazards associated with electricity, it is important to know the basic principles of electricity and how shocks occur. Electricity's basic principles can be explained with the terms voltage, current (amperage), and resistance. Voltage is the force that initiates the flow of electric charge. The actual flow of electric charge is called current. The rate of flow is measured in amperes. Resistance is based on how much a

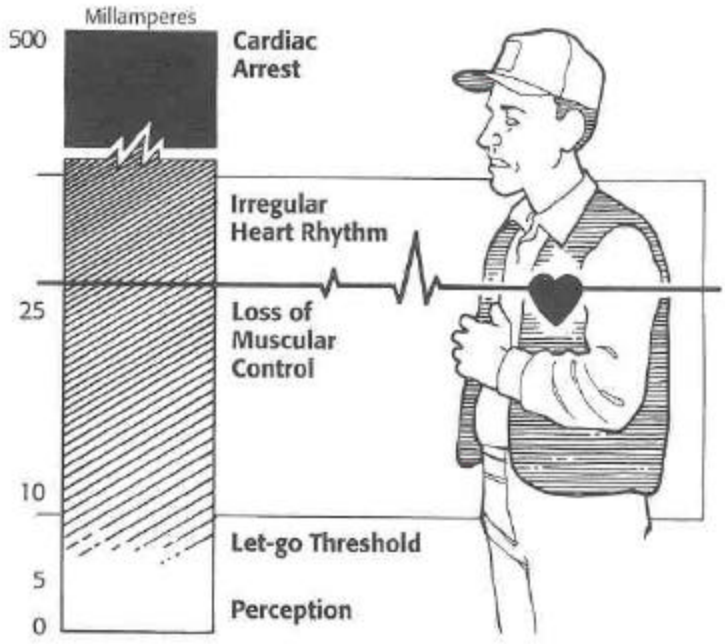


Fig. 1. Increasing levels of current above the "let-go" threshold causes loss of muscular control, irregular heart rhythm, and finally, cardiac arrest.

material impedes the current and *regulates* the rate of flow. Electricity usually takes the path of least resistance. When the human body becomes part of this path, the result is electric shock.

Two wires are needed to complete an electrical circuit--one wire to carry the current to an electric device, the other to return the electricity to the power source and finally to the ground. If the protective insulation on any of the wires or inside a piece of electrical equipment is defective, the current can follow a different path to ground. By coming in contact with a faulty electrical object, a person may act as a conductor to ground and experience a shock.

Several factors determine the effect a shock will have on a human body: the duration of contact, the amperage, the path the current takes through the body, and the electrical resistance of the body. A person standing in water is a better conductor than a person on dry ground. Taken together, these factors can produce some surprising results. For instance, the current from a 7 1/2 watt Christmas tree bulb (60/ 1000 of an ampere) can kill a person if the current passes through the heart. Figure 1 shows the physiological effects of different current levels.

Electrical Distribution System

Electricity is brought to a farm from a power company's supply lines through the main service entrance. Normally, all power to the farm is metered at this point. The main disconnect should be located here so that all power to the farm can be manually turned off at one point.

From the main service entrance, wires lead to each building or area service entrance through buried or overhead wires. These service en- trances should also be equipped with disconnects so that power can be shut off to one site without affecting other areas.

The main distribution system on a farmstead should always be large enough to accommodate present demand and future expansion. Proper installation of the electrical system is essential for safety. Local codes should always be followed because their main purpose is to provide users with safe systems. If no electric code exists for your area, the National Electric Code (NEC) is the minimum standard to follow. Only qualified electricians should install electrical systems.

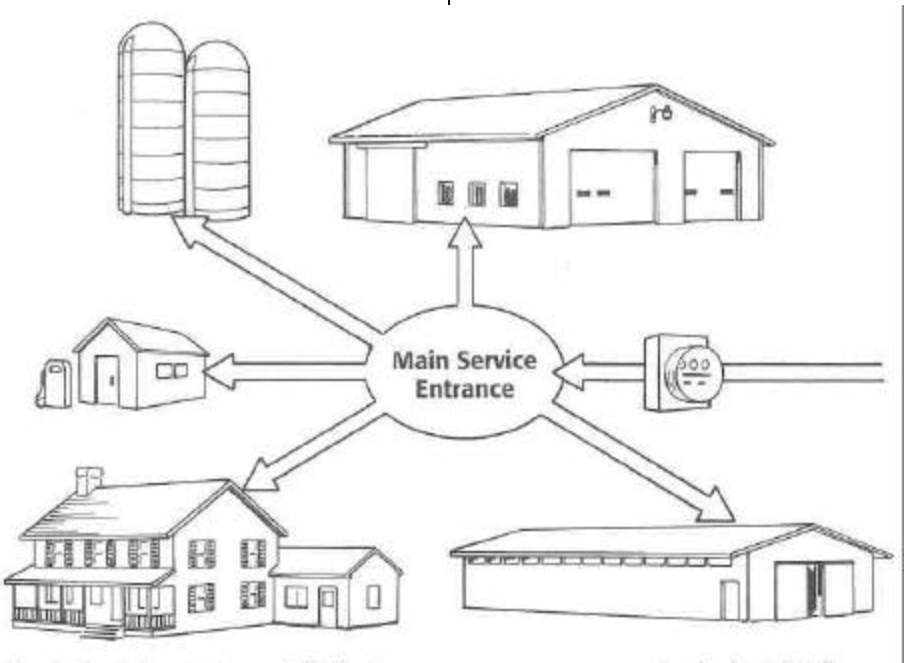


Fig. 2. Central metering and distribution are common components of a farmstead's electrical system.

Protecting Yourself and the Electrical System

Circuit Protection

Electrical systems have built-in features to safeguard equipment and wiring from excessive current. The most common circuit protection is a fuse. When excess current flows to the fuse, a portion of it breaks, cutting power to the circuit. To restore power, the fuse must be replaced. A circuit breaker offers the same protection, but is more convenient. A flip of a switch restores power after a circuit breaker has been tripped by an overload.

When a fuse blows or a circuit breaker is tripped, remember:

- The circuit breaker or the fuse should never be bypassed because this can damage equipment or start a fire if the circuit becomes overheated.
- Never replace a fuse with one that is larger than that specified for the circuit. A fuse that is too large will not protect against an overload, which can cause a fire.
- Do not replace fuses with pennies, nails, bar stock, or other objects. Many electrical fires have been caused by such substitutions.

Grounding

Grounding is a necessary safety feature of every electrical system. It protects against electric shock, fire, and damage to equipment and reduces the hazards associated with lightning. Proper grounding for both the system and electrical equipment is particularly relevant for farmsteads.

System grounding starts at the main service entrance. The neutral of the main service is connected either to an all-metal water pipe or to a metal rod that has been driven into the ground. These act as ground electrodes. If a ground rod is employed, it must be driven deep enough to always be In contact with moist soil (at least 10 feet). To ensure continuity of the ground throughout the system, each branch service entrance should be grounded with its neutral wire connected to the grounded main service neutral.

Equipment grounding ensures that a person who comes in contact with electrical equipment does not get a shock because of a ground fault. A ground fault can occur when wiring connections become loose or protective insulation is broken or defective.

When current leaks and electrifies a metal box or fixture, it follows a conductive path to complete its circuit. An equipment ground serves as a conductor or path of low resistance.

The best way to ground power tools is to use tools with three-wire power cords and three-prong plugs. The third wire is the ground and connects to the system ground when it is plugged into a properly grounded outlet. When using an extension cord, be sure it has a third wire for grounding. To confirm that receptacles have maintained their ground, periodically check them with a circuit tester. Double-insulated power tools are also available, offering protection from ground faults by providing a layer of insulation between the wires and the tool's metal casing. Double-insulated power tools are not as effectively grounded as three-wire tools because the insulation can fail if it gets wet.

Any metal, system, or equipment component that may become electrified when a fault occurs needs to be grounded. This includes, but is not limited to, junction boxes, motor frames, and fuse boxes. The electrical system ground does not ground these metallic enclosures. A qualified electrician should install all ground connections to make sure the system functions properly.

Ground fault circuit interrupters (GFCI) are also used to protect against shocks from ground faults. A GFCI detects current leakage at very low levels (as little as 5 milliamps) and rapidly cuts off the power. Three types of commonly available GFCIs are units built into circuit breakers, units built into receptacles, and portable GFCIs that plug into any receptacle.

Lockouts

The purpose of a lockout is to prevent equipment from being accidentally started and injuring people when it is being serviced or repaired. When servicing electrically powered equipment, a lock should always be placed on its switch. For example, if a silo unloader needs a repair, a lock on the control box will prevent the machine from starting while you are working inside the silo.

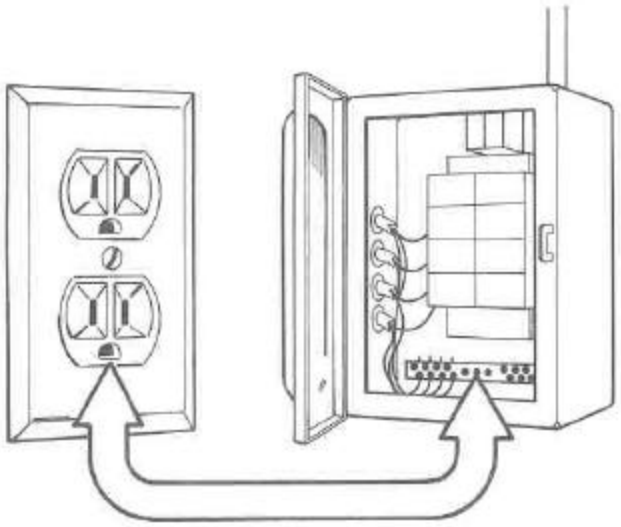


Fig. 3. Equipment grounding protects workers from ground faults by connecting the third wire to the grounded service neutral.

Harsh Farm Environments

Many agricultural facilities have severe environments that require special attention when installing and maintaining electrical systems. Threats to the system come from a number of sources. The vapors from animal waste in confinement housing can corrode electrical components. High humidity in milking facilities can rapidly deteriorate conventional metal electrical boxes. Physical damage to wiring, boxes, and light fixtures can be caused by livestock, equipment, and people. To protect your assets from fire or the cost of rewiring, follow these recommendations when installing your electrical system.

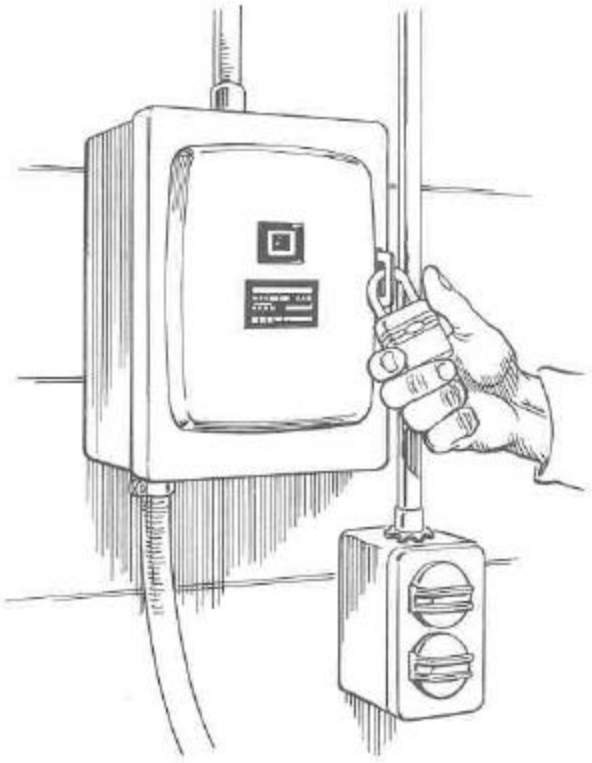
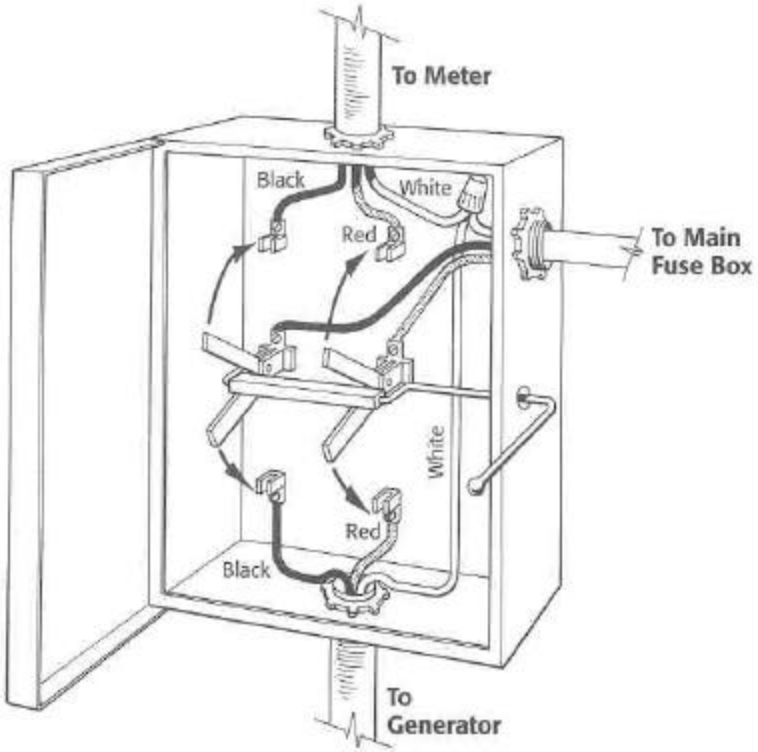


Fig. 4. Lock out the switch. Do not risk having a switch turned on while you are working on the electrical system. Note waterproof outlets.

Fig. 5. When light bulbs are close to a work area, they can be bumped. Glass enclosures help, but a substantial guard further reduces the risk of fire.

Fig. 6. Double-pole, double-throw transfer switch



In corrosive and damp environments

- Use underground feeder (UF) electric cable.
- Make sure all control boxes, light fixtures, switches, and receptacles are made of corrosion-resistant materials.
- Install watertight covers on receptacles and switches and over light bulbs.
- Locate the distribution panel away from severe environments. If a clean, dry area, such as an office, is not available, mount the distribution panel outside.
- Make sure that every electrical system component or piece of equipment located outside is watertight.
- Run conductors through horizontal conduit and seal the conduit ends so moisture cannot enter the distribution panel. When conductors run from a warm, moist environment to a cold location, condensation can form and enter the distribution panel.
- Inside farm buildings, mount wiring outside of walls to allow continuous inspection.

In dusty environments (such as grain or feed handling areas):

- Place protective enclosures over all light bulbs to protect them from dust and lessen the fire hazard.
- Use explosion-proof switches. Fire from an explosion can occur in areas where fine dusts or harmful, highly flammable vapors come in contact with sparks from an electric switch.

In areas where physical damage to the electrical system by livestock, equipment, or people is likely:

- Protect circuit boxes by thought- fully choosing their location. Placing them around a corner or away from animals makes the boxes far less vulnerable to abuse.
- Run conductors in conduit to protect them from physical damage by livestock.

- Use nonmetallic conduit in corrosive environments.
- Place guards over light bulbs located where they may get struck by equipment, and use enclosures to keep moisture and dust out.
- Use only qualified electricians to repair damage to electrical installations.

Standby Power

Many farm owners have standby generators on hand to use during power outages. When a standby generator is installed on single phase systems, it must be connected to the farm's wiring system through a double-pole, double-throw transfer switch (see fig. 6). When the generator is in use, this switch disconnects the farm's electric system from the normal power supply. There are two reasons why this is important. First, it prevents the generator from feeding power to power supply lines where repair persons may be working. Second, the normal power supply cannot feed back to the generator and damage it when power from the electric utility is restored.

The transfer switch must be installed so that the generator is no more than 25 feet from the switch. Installation of the transfer switch should always be reviewed with the local electric supply company.

Overhead Power Lines

Numerous electrocutions on farms have been caused by contact with overhead wires. Transporting equipment requiring high clearance underneath low overhead wires can be especially dangerous. Fatalities have been attributed to portable augers coming in contact with overhead wires. These lives could have been saved if a few minutes had been taken to lower the equipment.

Other activities such as pruning trees or moving irrigation pipe or metal ladders near overhead wires can also be hazardous. Low overhead wires are frequently found in farm- yards and also farm lanes between fields and roads. Anyone working in these situations should be made aware of the dangers overhead wires present.

Hazards are also associated with buried service conductors. A person operating a trencher or excavating equipment may get electrocuted if the machine comes in contact with the underground wires. Keep a detailed map of all buried power lines to avoid such accidents.

First Aid

Electric shock can cause respiratory paralysis, heart fibrillation, and severe burns. If the heart stops beating and breathing has ceased, the victim will suffer brain damage after four to six minutes.

It is very important to respond quickly to an electric shock emergency. The victim must first be separated from the source of the shock. The best method is to cut off the power source. Never touch a person until he or she has been separated from the power source, or you also risk being electrocuted. Send for professional medical help immediately. If the victim is not breathing, artificial respiration must be administered quickly. When there is no pulse, coronary pulmonary resuscitation (CPR) should be started.

If you are alone and are not trained in administering CPR, you should still attempt to revive the victim, because this may be the only chance for survival. Tilt the injured person's head back, pinch the nostrils closed with your fingers, take a deep breath, place your mouth over his or her mouth and blow. Move your head away and allow the person to exhale. Repeat. Position the heel of one hand on the lower half of the adult victim's sternum, place your other hand on top of the first, and press down 1.5 to 2 inches. Fifteen compressions to two breaths should be repeated until professional help arrives.

Summary

Proper installation of a farm's electrical system is essential to electrical safety. This includes grounding the entire system and all electrical equipment. Protect the electrical system and your life by using only the appropriate fuses and circuit breakers. Follow local electric codes or the National Electric Code and hire a qualified electrician when installing or modifying your electrical system.

Finally, maintain your system by promptly repairing any damage or deterioration. Electrical safety is a critical component of a productive and safe farm business.

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