

ELECTRICAL SAFETY ON THE FARM





INTRODUCTION

Agriculture is a vital industry fueling everyday life—one that requires large, complex machinery. There are a number of potential electrical hazards in agriculture; however, with thoughtful and thorough preparation, you can significantly reduce the risk of electrical incidents that can occur in farming.

CALL A PROFESSIONAL ELECTRICIAN

Resourceful farmers can fix plenty of problems around a farm on their own. However, only a trained and certified electrician or electric utility workers should handle electrical issues. When in doubt about how to resolve a problem, always consult a certified electrician or your utility first.

In the long run, it is less expensive and safer to consult a certified electrician or your utility before undertaking anything involving electricity.



THE SCIENCE OF ELECTRICITY

When a person comes into contact with electricity, the electricity (electrons) will flow through their body, causing a shock. An electric shock can be extremely dangerous and damaging to skin and internal organs.

The human body can conduct electricity because 60 to 65 percent of it is water, which is an excellent conductor. The same is true of farm animals. Therefore, it's extremely important to protect people and animals from electrical hazards.



IF SOMEONE HAS BEEN ELECTROCUTED

The Centers for Disease Control recommends the following steps if you believe someone has been or is being electrocuted.

- Look first. Don't touch. The person may still be in contact with the electrical source. Touching them may pass the current through you.
- Call or have someone else call 911 or emergency medical help.
- Turn off the source of electricity if you can. If that's not possible, move the source away from you and the affected person using a dry, nonconducting object made of cardboard, plastic, or wood.
- Once the person is free of the source of electricity, check their breathing and pulse. If either has stopped or seems dangerously slow or shallow, begin cardiopulmonary resuscitation (CPR) immediately.
- If the person is faint or pale or shows other signs of shock, lay them down with their head slightly lower than their trunk and their legs elevated.
- Don't touch burns, break blisters, or remove burned clothing. Electrical shock may cause burns inside the body, so be sure the person is taken to a doctor.
- Get checked out by a doctor yourself. Some injuries from electric shock might not be immediately visible.

POWER LINES

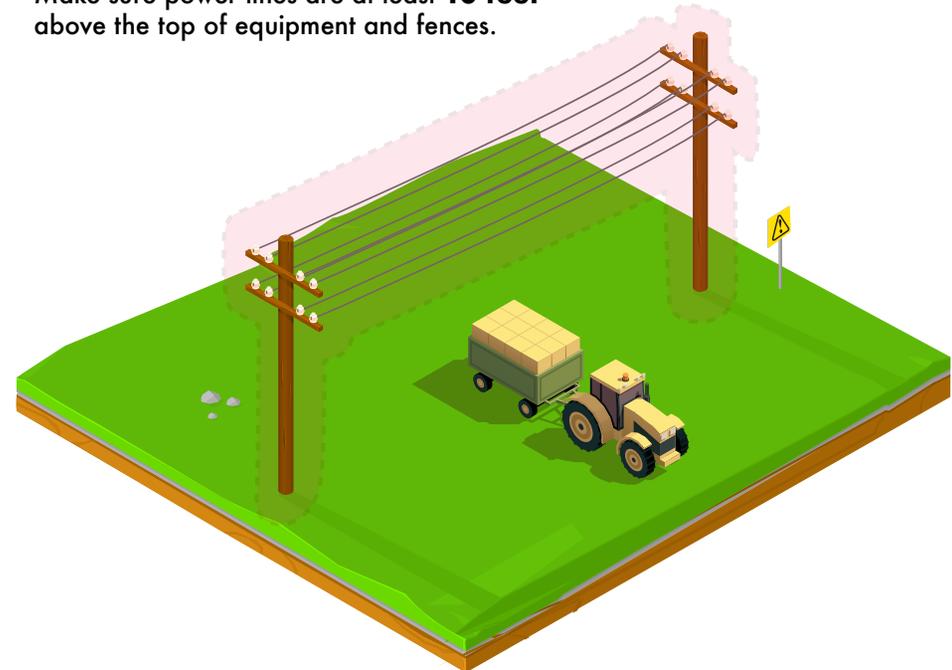
Overhead power lines are one of the biggest electrical hazards on farms. They should always be treated as though they're energized, and great caution should be exerted to keep people, equipment, and other objects away from them. Thoughtful safety procedures communicated to everyone working on the farm are key to ensuring safety around power lines.

- Assume all power lines are live, and take the same safety precautions around a line whether it looks like it's carrying electricity or not.
- Map out where all the power lines on your farm are and make sure all workers know about them. Have your utility measure how high your power lines are, and notify the utility if any of the lines are sagging.
- When moving equipment, plan routes to avoid power lines, and use a spotter to let you know where your equipment is in relation to power lines.
- Don't alter a power line's height or position: Power lines can droop over time and may become an obstruction. Always have them professionally repaired—never attempt to do it yourself.
- Just because your equipment can get under a power line, that doesn't mean it's safe. Electricity can arc from a power line to the equipment. Make sure power lines are at least 10 feet above the top of equipment and fences.
- When moving large equipment, such as a grain auger, always put it in a lowered position. Many accidents occur when equipment is moved on a truck or other transport. Make sure your height calculation includes both the equipment and anything it's on.
- When you buy new equipment, check its height. If it's taller than is safe to move on your farm, call your utility.
- Carry ladders or other metal equipment horizontally.

- Ensure that irrigation equipment stays far away from power lines and doesn't spray water on power lines, which could energize the system and create a shock hazard. Avoid moving irrigation equipment on windy days, because wind could blow the equipment into power lines, and store unused pipes far away from power lines.
- Do not park farm equipment under power lines. Do not get out of equipment to check on it beneath a power line. Park a safe distance away before exiting any equipment.
- The National Electrical Safety Code has strict guidance regarding the proximity of grain bins to power lines based on the height of the bins. Always check before building a new grain bin or remodeling a current one. It's a lot more expensive to move it than to call your utility ahead of time.

STAY OUT OF THE DANGER ZONE

Just because your equipment can get under a power line, that doesn't mean it's safe. Electricity can arc from a power line to the equipment. Make sure power lines are at least **10 feet** above the top of equipment and fences.



DOWNED POWER LINES

Downed power lines are extremely dangerous, and you should always assume they're energized. If you see a downed power line or a power line that's sagging in an unusual way, call your utility company immediately.

- Stay at least 40 feet away from downed power lines. A downed power line will energize the ground below it.
- Don't try to move a downed wire. All coatings and coverings degrade over time, which means you can be electrocuted if you grab the wire to move it.
- Don't go near anything touching a downed wire. Downed wires can energize things they come in contact with, including trees, fences, vehicles, and equipment. Objects that are wet from rain may be more conductive than they would be otherwise.
- Don't go close to water that's near a downed wire. Puddles, streams, and other bodies of water can become energized. Be careful after storms around streams and other sources of water in case a wire has fallen in them.
- De-energized lines can become reenergized: even though a line may not be carrying electricity at the moment, that doesn't mean it won't become reenergized. Show the same caution around any downed power line, energized or not.



WHAT TO DO IF YOUR VEHICLE OR EQUIPMENT COMES IN CONTACT WITH A POWER LINE

- You are safest while still in your vehicle because the electricity travels through the metal to the ground. The metal outside the vehicle and the ground around you could be electrified.
- If you can safely drive away without causing further damage, drive at least 40 feet away and call 911. Ensure that no other people or equipment go near the power line.
- If you can't drive away safely, don't get out unless you have to because of a fire or other emergency. Stay put and call 911. Tell others to stay at least 40 feet away until help arrives.

IF YOU MUST LEAVE YOUR VEHICLE

If you must leave the equipment because of fire or another life-threatening situation, it's important to understand step potential. As electricity disperses from the vehicle, it creates bands of different voltages. If your body comes in contact with two different bands, the electricity could travel through your body to make up the difference in voltages, causing electrocution.

WHAT SHOULD YOU DO?

- Warn others not to approach the vehicle.
- Open the door without touching any metal.
- Do not touch the vehicle and the ground at the same time.
- Jump out of the vehicle with your feet together. This way, there won't be a voltage difference between your feet that could create a circuit and allow electricity to flow through your body.
- Shuffle or hop slowly away from the car, keeping your feet together until you're 40 feet away.
- Utility workers wear specially made rubber boots. Even if your boots have rubber soles, it's unlikely they'll protect you from electricity.

WIRING

It's crucial to pay attention to wiring around your farm. Wiring correctly can drastically decrease the risk of fire and electrical hazards, stray electrical currents, and more. Always consult an electrician for specific wiring recommendations for your farm and leave installations and repairs to the professionals. Regularly check installations, and be prepared to replace damaged parts.

CONNECTING TO THE GRID

Most farms connect to the electric grid at a main service entrance. This is where your meter will be, and from there, buried or overhead wires will connect the other buildings. It's important to ensure that the main distribution system is properly installed and large enough to accommodate both present and future electrical uses on the farm.

The main service entrance should also be the point of the main power disconnect, which you can use to shut off power to the farm in an emergency. In addition, area disconnects should be installed at other buildings so you can shut off parts of the farm as needed.

CIRCUITS

The electrical system on a farm is the series of connected wires, breakers, circuits, and connections. Electricity travels through the farm from the breaker box along circuits. Turning on a light or plugging in a device completes the circuit, and electricity can flow through. Typically, electricity flows through on a black or red wire and returns on a white wire. A bare or green wire will serve as a ground wire, which is a safety check on the system. If the circuit overloads, the circuit wires heat up, tripping the circuit breaker and shutting off the flow of electricity.

Circuit breakers and fuses are rated by size, with smaller breakers (120 volts) powering lighting and small appliances. Large breakers (240 volts) are typically designated for large appliances or central air conditioning. It's important to accurately label your fuses and breakers because that will make it easier to find the right breaker when you're working on equipment.

More importantly, labeled circuit breakers are valuable to firefighters responding to an electrical fire.

There are warning signs that your circuit is overloaded. If you see flickering lights or feel a warm plug, it's likely you're overloading a circuit. If you want or need to install an appliance that doesn't have enough capacity on the circuit, you may need to call an electrician to install a new circuit. A good example of this would be adding a wall air-conditioning unit to an area that didn't have one before. Before adding new appliances, calculate whether your circuits can handle them. Multiply the number of amps that the circuit is rated for by the voltage (120 volts for most of the house, 240 volts for circuits going to large appliances like refrigerators). This will tell you how many watts your circuit can handle.

Never try and circumvent an overloaded circuit by putting a penny in the circuit or replacing a breaker with a higher-amp one. Circuits and breakers are designed to work together. Mixing and matching them could cause a fire.

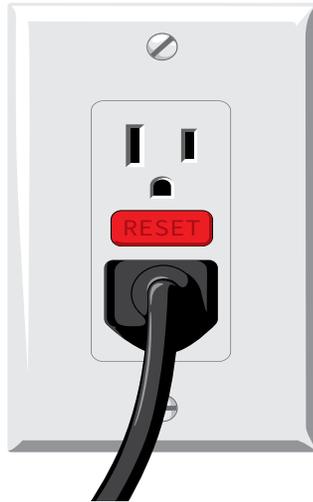
GROUND FAULT CIRCUIT INTERRUPTION

You might have seen outlets in kitchens or bathrooms with two little buttons in the middle. Those are ground fault circuit interruption (GFCI) outlets. Electrical shock is always a risk in wet locations. GFCI outlets sense the difference between the amount of electricity entering a circuit and the amount leaving it. If they aren't equal, the GFCI shuts off electricity. For example, if you come in contact with water while using an appliance, the electrical current can flow through your body and into the ground. This creates a disparity in the amount of electricity flowing back to the circuit, which triggers the GFCI to immediately shut the electricity off.

Ground fault circuit interrupters also can be installed as GFCI breakers, which are commonly used to protect everything on the circuit and can replace conventional breakers and portable GFCIs. Plug a GFCI breaker into any outlet and plug any device directly into the GFCI.

TEST YOUR GFCI OUTLETS

It's important to test your GFCI outlets regularly to make sure they're working properly. An easy way to do this is with a night-light. Plug in the night-light and press the test button. The light should go out. When you press the reset button, the night-light should come back on. If your GFCI is not working properly, it's important to have it inspected by an electrician.



REPLACE OLD WIRING

Ask an electrician to look at the wiring in older farm buildings. Older wires might be made out of materials no longer considered safe and unable to handle the electric loads of modern appliances. Therefore, older wires pose both an electrical and fire hazard.

PROTECTING WIRES

Safeguard your wires from sources of damage, corrosion, or deterioration. Planning where your wires will go and how to best protect them will increase the useful life of your wires and reduce the amount you'll have to spend on electricians to repair them.

- Wires should be kept away from animals that might chew on them and from power lines, where they could become dangerously entangled.
- Wires should be buried whenever possible but can also be encased in metal or plastic.
- Consider converting your two-conductor circuits to three-wire, grounding-type circuits, or try using double-insulated tools. Double-insulated tools are not always an effective method of protection, though they can reduce the risk of electrical shock if you have two-conductor circuits.

SHOCK-RESISTANT TOOLS

Insulators, such as glass, rubber, and plastic, can help lessen the dangers of electricity. Double-insulated power tools are designed with special air space around the tool, reducing the chance of a shock to the user.

KEEP IN MIND:

- Double-insulated tools should be marked "UL Listed" or have the "PTI safety seal."
- Consider replacing your current equipment with new double-insulated tools (though this is not a foolproof method of protection against a shock and is best used in conjunction with other methods).

BURYING WIRES

Wires can cause a slew of hazards and disasters, so one of the best preventative safety measures you can take is to bury them underground. You should be aware of a few things, however, before you start digging:

- Always call a professional. Every electrical wire should be treated as a hot wire, and only professional electricians should work on a hot circuit.
- Before digging, check with your electric company or call 811 to determine if any underground utility lines are in the area.
- Electrical conduits, or tubes that wires are secured in, can help keep wires in good condition and protect people who might get close to them.
- Nonmetallic conduits should be used in corrosive environments.
- Consult the National Electrical Code and local building codes before digging to ensure your wiring and conduits are compliant.

GENERATORS AND BACKFEED

Safely installed generators can be an important backup to maintain operations during outages. It's important to find the generator that suits your farm's needs.

Consider the following to help you find the right standby generator:

- Frequency and duration of outages
- Critical infrastructure: what can't be without power for any length of time?
- Energy requirements

Be sure to buy a model that will supply enough power for your intended emergency use.



PREVENTING BACKFEED

When installing a generator system, hire a licensed electrician to install a transfer switch. Transfer switches fall into two main classifications:

- Portable generators use a manual transfer switch (MTS), meaning you have to manually turn your generator on and connect it to the transfer switch if the power goes out. You also must fill portable generators with gasoline every few hours.
- Standby generators use an automatic transfer switch (ATS), meaning the generator comes on automatically if the power goes out. Standby generators run on propane or natural gas and are connected to existing gas lines.

Using transfer switches prevents backfeed—electricity flowing back to the power lines from your generator. Backfeed is

extremely dangerous because it energizes outside power lines in contact with fences, trees, etc. A utility worker or neighbor might suffer a deadly electric shock if they come into contact with something that's energized.

When using a portable generator, make sure you turn off the main breaker to ensure that electricity doesn't backfeed power to downed power lines. Always connect a generator through a transfer switch. Never try to backfeed through an outlet. Doing so can backfeed the power lines, and you could be found liable if someone is hurt or killed.

CARBON MONOXIDE

To avoid the risk of carbon monoxide poisoning, portable generators should always be run outdoors, at least 25 feet away from buildings. It's important to install carbon monoxide detectors in buildings. This odorless gas is deadly and can also be produced by defective heaters, stoves, and other appliances.



SAFETY PLANNING

While the best form of emergency preparation is prevention, accidents happen, and it's equally important to know what to do when they do. With the proper knowledge and planning, you can minimize the damage an emergency situation can do by handling it calmly and effectively.

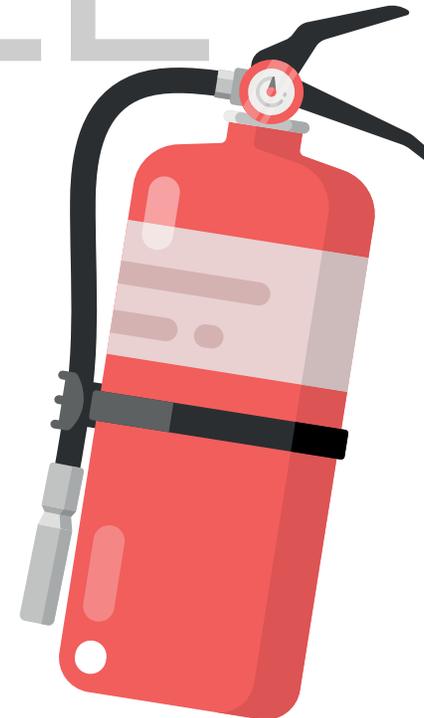
PREVENTING EMERGENCIES

- **Avoid overwork:** the greatest risk of injury comes with fatigue and exhaustion, when little mistakes can cause big trouble. Make sure you're well rested before dealing with hazardous equipment around the farm.
- **Educate your workforce:** ensure that everyone on the farm understands how electricity works on the farm and is trained in best practices to avoid creating an incident.
- **Be prepared:** make sure that all workers have been adequately trained in rescue and emergency procedures such as CPR and that the proper working age restrictions are being followed.
- **Conduct periodic safety checks:** you can handle potential issues before they become huge disasters by checking your equipment frequently.
- **Map out movements:** plan the movement of large equipment to reduce risk and increase efficiency.

FIRE EXTINGUISHERS

Its important that you have the correct type and size of fire extinguishers easily accessible at all buildings and large equipment on the farm:

- Mount fire extinguishers near exit doors so they'll be at hand if a fire is blocking an exit.
- On equipment and vehicles, mount fire extinguishers on the outside near a door.
- Inspect fire extinguishers monthly.
- Train all workers on the farm on how to properly use a fire extinguisher.
- Fire extinguishers come with different ratings based on the type of fire they're intended to extinguish. The most common type on a farm will be rated a, b, c, which is intended for ordinary combustion, flammable-liquid, and electrical fires.



EXTENSION CORDS

Where you need to power your equipment and the location of your installed outlets are not always the same. Extension cords, used safely and correctly, are an important tool for accomplishing your job.

- Extension cords are not permanent fixes. If you need power in a location for a long time, explore having an outlet installed.
- Don't plug extension cords in to one another. The rating on a power cord is for the length of the cord. Plugging two identical power cords together will reduce their capacity, possibly leading to overheating or a drop in voltage.
- Make sure all extension cords have GFCI protection from being connected to either a GFCI outlet or a GFCI circuit breaker.
- Inspect extension cords. Don't use an extension cord that is frayed or otherwise damaged.
- Replace, don't repair, extension cords. If you see electrical tape or duct tape on an extension cord, it should be replaced.
- Do not alter an extension cord to fit a three-prong plug in a two-prong outlet.
- Do not run extension cords under carpet or other coverings. If extension cords are covered, heat cannot escape, creating a fire risk.
- Do not run extension cords through open doors. In addition to being an electrical hazard, poorly placed extension cords are a trip hazard.

TIPS FOR BUYING EXTENSION CORDS

- When purchasing extension cords, ensure they're rated for the intended use and are the correct length. For example, you should never use an indoor extension cord outdoors. Outdoor cords are reinforced with a stronger coating.
- Check the gauge of the wire based on the intended usage. Gauges are based on the American Wire Gauge system. Check the instruction manual of appliances and power tools to determine the correct gauge needed to safely operate it.
- Buy only extension cords that have been verified by a reputable independent testing company, such as Underwriters Laboratories (UL).

SAFETY CHECKLIST

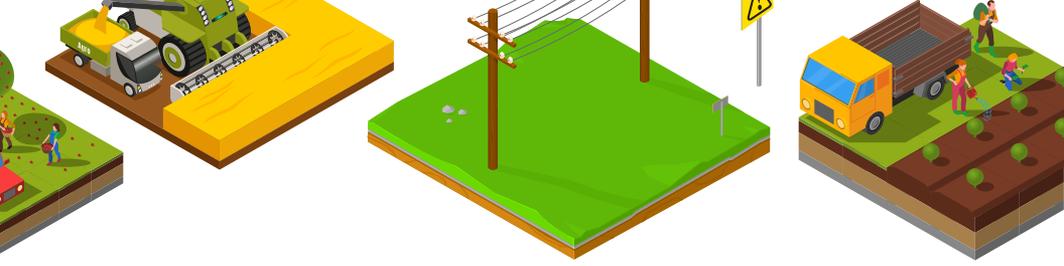
With a few minutes of your time, you can identify areas for improvement that will make everyone on the farm safer:

PLANNING

- Create a map showing where power lines are on your farm. Plan out where large equipment can safely travel on the farm. Note hazards so movements can be planned with safety in mind.
- Ask your utility to measure the height of overhead power lines so you can ensure that equipment can travel without issues.
- Identify your energy needs. Does your current electric infrastructure meet them now? Will it in the future?
- Create daily and monthly checklists. Certain things need to be checked daily (for example, that equipment is parked in a safe location). Other things should be checked monthly (for example, that GFCI outlets, alarms, and fire extinguishers are working properly).
- Ensure that workers on the farm are trained in CPR, fire extinguisher use, and what to do in an emergency.

VISUAL INSPECTION

- Check to see if any power lines are sagging or frayed. If so, call your utility.
- Check extension cords for signs of wear. Replace any that require it.
- Are fire extinguishers placed near exits and on large equipment?
- Check that all outlets have GFCI protection, either as part of the outlet or as an adapter.
- Test GFCI outlets, fire alarms, and CO detectors.
- Ensure that equipment is stored far enough away from power lines.



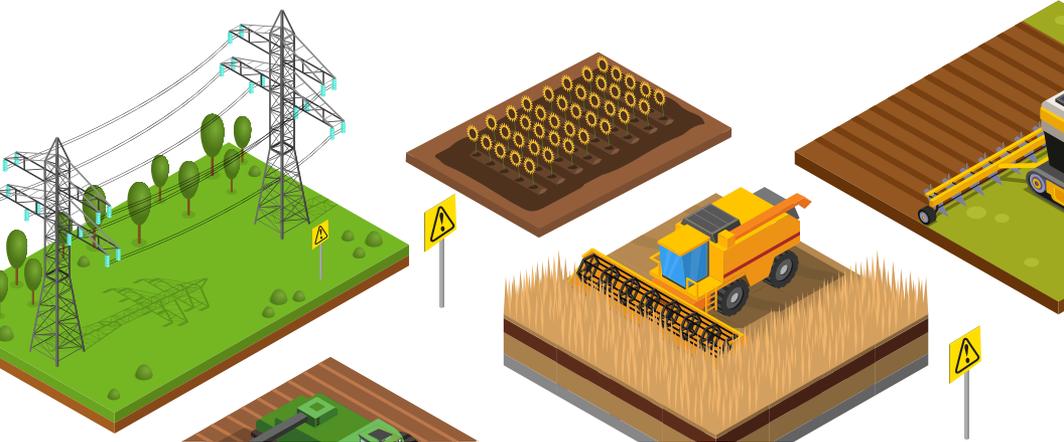
RESOURCES

To learn more about farm safety, visit:

National Fire Protection Association:
www.nfpa.org

Occupational Safety and Health Administration:
www.osha.gov/agricultural-operations

National Ag Safety Database:
www.nasdonline.org



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