

*OSHA Consultation's
Construction Industry Series:
Electrical Hazards*



Oklahoma Department of Labor

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Electrical Hazards

Construction can be a safe occupation when workers are aware of the hazards at their worksite and an effective safety and health program is in use.

Electrical hazards are 1 of the 4 main hazards in construction causing serious injury or death. Approximately 350 electrically related fatalities occur each year. That's 350 deaths that could be prevented.

Many people working with electricity do not understand how it works. Operating an electrical switch is like turning on a water faucet. Behind the faucet (or)switch there is a source of water (or electricity), a way to transport it, and pressure to make it flow. The faucet's water source is a reservoir or pumping station. A pump provides enough pressure for the water to travel through the pipes. The switch's electrical source is a power generating station. A generator provides the pressure for the electrical current to travel through electrical conductors, or wires.

Three factors determine the resistance of a substance to the flow of electricity:

- What it is made of
- Its size
- Its temperature

Substances with little resistance to the flow of electrical current are called conductors. Examples are metals. Substances with such a high resistance that they can be used to prevent the flow of electrical current are called insulators. Examples are glass, porcelain, plastic and dry wood.

Pure water is a poor conductor of electricity, but small amounts of impurities, such as salt and acid (perspiration contains both), make it a ready conductor. Therefore, although dry wood is a poor conductor, when saturated with water it becomes a ready conductor. The same is true of human skin. When skin is dry, it is a poor conductor of electrical current. When it is moist, it readily conducts electricity. Use extreme caution when working with electricity where there is water in the environment or on the skin.

How Shocks Occur

Electricity travels in closed circuits, normally through a conductor. Shock results when the body becomes part of the electrical circuit; current enters the body at one point and leaves at another. Typically, shock occurs when a person contacts:

- Both wires of an energized circuit
- One wire of an energized circuit and the ground
- A metallic part in contact with an energized wire while the person is also in contact with the ground

Metallic parts of electric tools and machines can become energized if there is a break in the insulation of their wiring. A low-resistance wire between the metallic

case of the tool/machine and the ground (an equipment grounding conductor) provides a path for the unwanted current to pass directly to the ground. This greatly reduces the amount of current passing through the body of the person in contact with the tool or machine. Properly installed, the grounding conductor provides protection from electric shock.

Effects can range from a barely perceptible tingle to severe burns and immediate cardiac arrest. The following table demonstrates a general relationship for a 60 cycle, hand-to-foot shock of one second's duration.

Current Level (In milliamperes)	Probable Effect on Human Body
1 mA	Perception level. Slight tingling sensation. Still dangerous under certain conditions. (Water/wet conditions)
5 mA	Slight shock felt; not painful but disturbing. Average person can let go. However, strong involuntary reactions to shocks in this range may lead to injuries. (Muscular contraction can prevent the victim from getting free)
6-30 mA	Painful shock, muscular control is lost. This is called the freezing current or "let-go" range.
50-150 mA	Extreme pain, respiratory arrest, severe muscular contractions. Individual cannot let go. Death is possible.
1000-4300 mA	Ventricular fibrillation (the rhythmic pumping action of the heart ceases.) Muscular contraction and nerve damage occur. Death is most likely.
10,000 mA	Cardiac arrest, severe burns and probable death.

A difference of less than 100 mA exist between a current that is barely perceptible and one that can kill.

OSHA requires employees not to work near any part of an electrical power circuit unless protected.

The most frequent causes of electrical injury/death are:

1. Contact with power lines
2. Lack of ground-fault protection
3. Path to ground missing or discontinuous
4. Equipment not used in manner prescribed
5. Improper use of extension and flexible cords

Power Lines

Overhead and buried power lines at your site are especially hazardous because they carry extremely high voltage. Fatal electrocution is the main risk, but burns and falls from elevation are also hazards. Using tools and equipment that can contact power lines increases the risk.

To Avoid Hazards

- Look for overhead power lines and buried power line indicators. Post warning signs.
- Contact utilities for buried power line locations.
- Stay at least 10 feet away from overhead power lines.
- Unless you know otherwise, assume that overhead power lines are energized.
- De-energize and ground lines when working near them. Other protective measures include guarding or insulating the lines.
- Use non-conductive wood or fiberglass ladders when working near power lines.

Equipment Examples That Can Contact Power Lines:

- Aluminum paint rollers
- Backhoes
- Concrete pumpers
- Cranes
- Long-handled cement finishing floats
- Metal building materials
- Metal ladders
- Raised dump truck beds
- Scaffolds

Lack of Ground-Fault Protection

Due to the rugged nature of construction work, normal use of electrical equipment at your site causes wear and tear that results in insulation breaks, short-circuits, and exposed wires. If there is no ground-fault protection, these can cause a ground-fault that sends current through the worker's body, resulting in electrical burns, explosions, fire, or death.

To Avoid Hazards

- Use ground-fault circuit interrupters (GFCIs) on all 120-volt, single-phase, 15- and 20-ampere receptacles, or have an assured equipment grounding conductor program.
- Follow manufacturers' recommended testing procedure to insure GFCI is working correctly.
- Use double-insulated tools and equipment, distinctively marked.
- Use tools and equipment according to the instructions included in their listing, labeling or certification.
- Visually inspect all electrical equipment before use. Remove from service any equipment with frayed cords, missing ground prongs, cracked tool casings, etc.

Apply a warning tag to any defective tool and do not use it until the problem has been corrected.

Path to Ground Missing or Discontinuous

If the power supply to the electrical equipment at your site is not grounded or the path has been broken, fault current may travel through a worker's body, causing electrical burns or even death. Even when the power system is properly grounded, electrical equipment can instantly change from safe to hazardous because of extreme conditions and rough treatment.

To Avoid Hazards

- Ground all power supply systems, electrical circuits, and electrical equipment.
- Frequently inspect electrical systems to ensure that the path to ground is continuous.
- Visually inspect all electrical equipment before use. Take any defective equipment out of service.
- Do not remove round prongs from cord-and-plug connected equipment or extension cords.
- Use double-insulated tools.
- Ground all exposed metal parts of equipment.
- Ground metal parts of the following non-electrical equipment, as specified by the OSHA Standard 1926.404 (f)(7)(v)
 - ▶ Frames and tracks of electrically operated cranes
 - ▶ Frames of non-electrically driven elevator cars to which electric conductors are attached
 - ▶ Hand-operated metal shifting ropes or cables of electric elevators.
 - ▶ Metal partitions, grill work, and similar metal enclosures around equipment of over 1kV between conductors.

Improper Use of Extension & Flexible Cords

The normal wear and tear on extension and flexible cords at your site can loosen or expose wires, creating hazardous conditions. Cords that are not 3-wire type, not designed for hard-usage, or that have been modified, increase your risk of contacting electrical current.

To Avoid Hazards

- Use factory-assembled cord sets.
- Use only extension cords that are 3-wire type.
- Use only extension cords that are marked with a designation code for hard or extra-hard usage.
- Use only cords, connection devices, and fittings that are equipped with strain relief.
- Remove cords from receptacles by pulling on the plugs, not the cords.
- Continually audit cords on-site. Any cords found not to be marked for hard or extra-hard use, or which have been modified, must be taken out of service immediately.

Perhaps the single most successful defense against electrical accidents is the continuous exercising of good judgment or common sense. All employees should be thoroughly familiar with the safety procedures for their particular jobs.

The control of electrical hazards is an important part of every safety and health program. The responsibility for the program should be delegated to individuals who have a complete knowledge of electricity, electrical work practices, and the appropriate OSHA standards for installation and performance.

Everyone has the right to work in a safe environment. Through cooperative efforts, employers and employees can learn to identify and eliminate or control electrical hazards.

For more information about electrical hazards . . .

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