

# Electrical Arc Flash Dangers

## How Does an Arc Flash Happen?

An arc flash happens when electric current flows through an air gap between conductors. Accidents caused by touching a test probe to the wrong surface or slipped tool are the most common cause of an arcing fault. Arc flashes can also be caused by the following:

- Sparks due to breaks or gaps in the insulation.
- Equipment failure due to use of substandard parts, improper installation, or even normal wear and tear.

## What is a Short Circuit or Arc Fault?

Short circuits and arc faults are extremely dangerous and potentially fatal to personnel. An arc fault current and voltage concentrated in one place can result in enormous amounts of energy released and can produce temperatures four times the temperature of the Sun's surface.

## What is an Arc Concussion Wave?

Arc concussion blast wave's result as the high arc temperature vaporizes the conductors from a solid to a vapor, the copper vapor expands to 67,000 times the volume of solid copper producing a considerable pressure wave and sound blast. In some cases, the pressure wave has sufficient energy to snap the heads of 3/8-inch steel bolts and to knock over construction walls.

## Injuries Caused by Arc Blasts:

- Injuries related to being knocked off your feet:
  - Concussion and loss of memory or brain function
  - Other physical injuries from being blown off ladders, into walls, etc.
- Hearing loss from ruptured eardrums. The sound from an arc blast can exceed the sound of a jet engine.
- Exposure risks from flying debris, such as shrapnel wounds from metal parts.
- Shock hazard due to touching energized conductors.
- Severe burns to the body from the electricity, or from clothing set on fire.
- Eye damage from extreme light as well as heat, particles.
- Operating with extreme caution is always the directive when working with electricity, only trained skilled electricians should handle electrical systems.

# Lock-Out Tag-Out Procedures

According to OSHA, an estimated 120 fatalities 50,000 injured result from not following REQUIRED Lock-Out Tag-Out procedures every year. Electrocutions, amputations, and burns can happen from equipment's unexpected release of energy. Lock out tag out procedures can reduce or eliminate this issue.

## Lock-Out Tag-Out (LOTO) Procedures:

Lock-Out Tag-Out procedures control hazardous energy sources. The energy is either supplied (e.g. a power line) or stored within equipment after it is shut down (e.g. an electrical capacitor, pressure in a vessel, or the weight of an object). Examples of hazardous energies are hydraulic, electrical, mechanical, chemical, thermal, pneumatic, and even gravity.

LOTO procedures protect workers by preventing others from turning on equipment or from a release of energy while working on or servicing equipment. Locks are used to prevent unexpected reenergizing of a machine, system, or equipment that has been shut down. This disables power to equipment, and the equipment will have a ZERO energy level, i.e. no stored energy or power from the lines.

Once machines/equipment are shut down, a personal identification tag must also be affixed to the mechanical mechanism in the OFF position. No one but the lock owner can remove the lock: this procedure keeps workers safe from accidental power engagement.

## Lock-Out, Tag-Out, and Try Out:

- Know who on your job site is responsible for equipment's LOTO procedures.
- Know what equipment/machinery needs to be shut down, along with ALL energy sources.
- Determine if equipment/machinery on site has any stored energy sources such as capacitors; springs; elevated components; rotating flywheels; hydraulic systems; piles that can shift; air, gas, steam, or water pressure, etc.
- Properly shut down equipment and machines:
  - Notify affected workers about the shutdown.
  - Shut off all power sources.
  - **Lock out** equipment by applying locks to power sources to keep equipment from coming back on.
- **Tag out** equipment, identifying responsible person for the LOTO procedure. Only the person who put on the lock and tag may remove it.
- **Try out** equipment to make sure that it's locked out.



# Working Around Overhead Power Lines

All construction workers should be aware of electrical hazards on the job site. Many job sites have overhead power lines running over and through them. Employees working from heights, or using tall equipment and tools need to pay attention when working around them, and most of all, LOOK UP!

## General Safety Tips:

- LOOK UP! Identify and pay attention to the location of power lines.
- Conduct initial and daily surveys of the job site and implement control measures and training to address hazards.

## Working Around Overhead Power Lines

- Never get closer than 10 feet to a power line.
- Don't operate equipment around overhead power lines unless you are authorized and trained to do so.
- If an object (scaffolds, crane, etc.) must be moved in the area of overhead power lines, appoint a competent worker (Spotter) whose only responsibility is to observe the clearance between the power lines and the object.
- Remember that power from power lines can arc or jump to an object such as a crane depending on proximity and weather conditions.
- Warn others if the minimum distance is not maintained.
- When working near overhead power lines, the use of non-conductive fiberglass ladders is recommended. Aluminum ladders and metal scaffolds or frames conduct electricity.
- Avoid storing materials underneath or near overhead power lines.

## Safety Precautions When There Are Downed Power Lines

- Never touch an overhead line if it is down or has fallen, or assume that they are dead.
- When a machine comes into contact with an overhead line, DO NOT allow anyone to come near or touch the machine. Summon outside assistance.
- Never touch a person who is in contact with a live power line.

## What About This Job Site?

- Where, if present, are the overhead power lines on this job site?
- Will there be work involving tall equipment, such as cranes or scaffolds, that could come into contact with overhead power lines?

*Work at a safe distance from all power lines.  
Always be aware: LOOK UP!*



# Working with Electricity: Power Cords and Plugs

*The electric current in any commercial building or home has enough power to cause death. People are injured when they become part of the electrical circuit. The most common causes of electrical injuries come from direct or indirect contact with an electric current through power cords and plugs.*

**Direct Contact:** Touching a live wire:

When electricity travels through our bodies, it can interfere with the normal electrical signals between the brain and our muscles (e.g., heart may stop beating properly, breathing may stop, or muscles may spasm).

Muscle contractions can cause a person to fall from a ladder, scaffold or aerial bucket. The fall can cause serious injuries or even death.

**Indirect Contact:** When electricity arcs through the air to a person who is grounded:

Arc flashes result in intense heat causing burns, intense light which can cause blindness, or ignition of other materials.

Arc blasts cause the same conditions as arc flashes, but are more intense and can include a strong pressure wave. These pressure waves can damage machinery, throw a person, collapse a lung or rupture ear drums.

Thermal burns include flash burns from heat generated by an electric arc and flame burns from materials that catch on fire from heating or ignition by electrical currents. High voltage contact burns can burn internal tissues while leaving only very small injuries on the outside of the skin.

## **Apply these checklists for basic electrical safety:**

- Keep Cords and Plugs in Good Condition
- Check power cords and plugs daily. Discard if worn or damaged.
- Have cords that feel more than comfortably warm checked by an electrician.
- Pull the plug, not the cord: Do not disconnect power supply by pulling or jerking the cord from the outlet. Pulling the cord causes wear and may cause a shock.
- Never break off the third prong on a plug.
- Replace broken three prong plugs and make sure the third prong is properly grounded.
- Use Power Cords Safely
- Keep power cords away from heat, water and oil; they can damage the insulation, or cause a shock.
- Eliminate octopus connections. Do not plug several power cords into one outlet.

Never use extension cords as permanent wiring. Use extension cords only to temporarily supply power to an area that does not have a power outlet.





# Working with Electricity and Power Tools

Due to the rugged nature of construction work, normal use of electrical equipment causes wear and tear that results in insulation breaks, short-circuits, and exposed wires. Without ground-fault protection, it can send potentially injuring or fatal current through a worker's body.

One way to combat electrical shock and electrocution is to use ground-fault circuit interrupters (GFCIs). Use them on all 120-volt, single-phase, 15- and 20-ampere receptacles that are not on an existing building's permanent wiring, or use an assured equipment grounding conductor program (AEGCP), and use distinctly marked double-insulated tools and equipment.

## Electrical Safety Tips for Working with Power Tools:

- Inspect electrical equipment before use.
- Ensure that the path to ground is continuous.
- Test the GFCI before use.
- Remove from service any equipment with frayed cords, missing ground prongs, cracked tool casings, missing strain relief, etc.
- Do not remove ground prongs from electrical cords to fit into any electrical source.
- Avoid standing in wet areas when using portable electrical power tools.

**REMEMBER:** Electrical Incidents happen when electrical equipment's power supply is not grounded or the path has been broken, and current travels through a worker's body, causing electrical burns or death.

## If a Colleague is Shocked:

- Look first. Don't touch. The person may still be in contact with the electrical source. Touching the person may pass the current through you, making YOU a victim as well.
- Call or have someone else call 911 or emergency medical help. Give as many specifics as possible: the exact location of the victim, the victim's condition, and what happened.
- Turn off the source of electricity. If not possible, move the source away from you and the shocked person with a non-conducting object. Wet wood can act as a conductor.
- Don't touch burns, break blisters, or remove burned clothing. Electrical shock may also cause burns inside the body, so be sure the person is taken to a medical professional.

