Electrical Safe Work Practices

Scope:
Electricity is a serious workplace hazard, capable of causing both employee injury (shocks, electrocution, fires, and explosions) as well as serious property damage. Using portable electrical tools and lights safely and developing appropriate work practices when working on a conveyance's electrical systems, can help reduce the risk of such incidents at worksites.

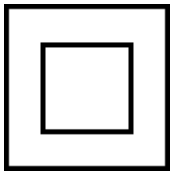
Section 1: Portable Electric Tools and Lights

1. Power tools, portable lights or cord sets shall be protected by ground fault circuit interrupters (GFCIs), even when using double insulated tools.

2. All cords and power tools should be inspected for damage before use. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made.

3. Attachment plugs and receptacles may not be connected or altered in a manner which would prevent proper continuity of the equipment grounding conductor at the point where plugs are attached to receptacles. When grounded outlets are not available (i.e., older installations), adapter plugs shall be used with the grounding wire secured to positive ground. Use your meter or GFCI tester to test for positive ground.

4. Ensure Double-insulated tools, when used, are distinctively marked with the words "Double Insulated" or the symbol shown below:


Double Insulated Symbol

5. When using extension cords, make sure the cord is capable of carrying the expected load. Extension cords shall, be approved by a nationally recognized testing laboratory, company approved, and shall be durably marked on the surface at intervals not exceeding 610 mm (24 in.) with the type designation, size, and number of conductors (12-3 or 14-3 AWG). Never field modify extension cords. Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling.

6. Flexible cords may be used only in continuous lengths without splice or tap.

Flexible cords and cables, where temporarily run through holes in walls, ceilings, floors, doorways, windows, or similar openings, shall be protected from accidental damage, as might be caused, for example, by sharp corners, projections, and doorways or other pinch points.

7. Handlamps of the portable type supplied through flexible cords shall be equipped with a handle of molded composition or other material identified for the purpose, and a substantial guard shall be attached to the lamp holder or the handle.

8. Flexible cords and cables shall be connected to devices and fittings so that strain relief is provided that will prevent pull from being directly transmitted to joints or terminal screws.

9. To prevent tripping hazards and cord damage, work areas, walkways, and similar locations shall be kept clear of all cords.

10. Do not lift or lower portable electric tools by the power cord. Never throw tools, equipment, or material from one work level to another.

11. All hand-held powered circular saws having a blade diameter greater than 2 inches shall be equipped with a constant pressure switch or control that will shut off the power when the pressure is released.

12. All hand-held powered drills, vertical, and angle grinders with wheels greater than 2 inches in diameter, reciprocating saws, saber, scroll, and jig saws with blade shanks greater than a nominal one-fourth inch, and other similarly operating powered tools shall be equipped with a constant pressure switch or control, and may have a lock-on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on.

13. Unplug power when adjusting or cleaning the tool, or when changing accessories such as blades, discs, or bits.

14. Never use electrical tools for purposes other than intended.

15. Keep guards in place and properly adjusted.

16. Have a firm footing and be properly braced when using power tools.

Section 2: Electrical Work Practices

1. Create an electrically safe working condition – If power or movement of the equipment is not required to perform the task, wearing the PPE appropriate for the hazard present, de-energize the circuit or equipment, isolate equipment from sources of energy, perform lock out/tag out, verify absence of voltage and then proceed with the task.

a. Isolate circuits tied in by selector switches or common bus to other operating equipment. Check drawings to verify all sources of energy are isolated. Apply grounding connections as needed to ensure power does not feed into circuits you are working on.
b. Allow capacitors and stored energy to discharge fully according to the manufacturer's instructions. Some equipment, such as variable frequency/speed drives or generators store greater than 50 volts and take 10-15 minutes to discharge fully. Check indicator lights if available and measure voltage on affected circuits to verify energy is fully dissipated.

2. Perform a JHA/ JSA prior to beginning work on or near energized circuits – identify potential hazards specific to the task and equipment and identify what PPE, tools and other precautionary methods will be necessary. Assess the condition of the equipment before beginning work.

3. Secure the area from unauthorized or non-qualified personnel – Keep the machine room door closed and locked. Place barriers and warning signs to protect non-qualified persons in public access areas.

4. Wear the PPE as specified for the voltage present and your working distance from the voltage source(s) – Inspect PPE first and remove conductive objects from your person, such as toolbelts, key chains and jewelry.

5. Use correct metering equipment and ensure it is in good working condition by using the industry standard live-dead-live procedure.

6. Check that your workspace is clear – Make sure there are no tools, materials or other trip hazards that could cause inadvertent or unexpected movement resulting in contact with energized parts.

7. Make sure you have plenty of lighting and can see clearly where hands and tools are being placed – Use temporary lighting if needed. Do not reach blindly into areas containing (or that potentially contain) live parts.

8. Check the work surface on which you will be standing, kneeling, sitting or leaning – Make sure it is dry and clear of any conductive materials or moisture. Use a voltage rated insulated mat to stand or kneel on if work surface could be damp, such as newly cured concrete or after water intrusion into a machine room or pit. Do not enter flooded machine rooms or elevator pits until the hazard has been abated by the building owner.

9. Treat all parts, whether de-energized or not, as if they were live or if they could become live – A controller under LOTO may still have lighting or safety service circuits

energized inside or nearby. Do not handle conductive objects (such as conduit, piping, broom handles, etc.) in a way that they could contact exposed circuits.

10. Protect against contact with any energized contacts or circuits to prevent electric shock – Know your restricted approach zones to energized parts operating at over 50 volts and protect from contact with insulating PPE or an insulating barrier between yourself and energized circuits.

11. Protect from Arc-flash injury. Know your arc-flash boundaries and the arc-flash PPE needed for working inside them. Contact your Supervisor to discuss alternate work methods or necessary PPE to protect head, face, neck or other body parts that are within the arc-flash boundary.

12. Keep controller cabinet doors closed / in place. If able, keep the high voltage side covered or controller door closed when working on the low voltage circuits to provide additional protection from high voltage contacts and arc flash. Close / Replace all cabinet doors before leaving to protect other personnel form exposures.

13. Always stand to the side and turn head away when operating a Main Disconnect switch. Do NOT open a Main or disconnect cover panel. Verify the voltage at the controller to make sure the Disconnect is OFF before performing work. If there are issues with a disconnect switch or you need access inside a main disconnect, contact the building owner and/ or your supervisor.

14. Stay away from overhead power lines. Know the minimum approach distance for overhead power lines, which are movable conductors and have a different set of boundaries than fixed conductors, such as circuits within a controller. Keep all mobile equipment, equipment booms and attachments, scaffolds and materials handled outside of the stated approach boundary.

15. Protect yourself from shock when using power tools and extension cords:
    a. Follow Ground Fault Protection Procedures noted above.
    b. Inspect all electrical cords and plugs for wear, damaged insulation or plug prongs.
    c. Never repair insulation or plug ends and never modify or remove ground / neutral prongs from plugs to adapt to ungrounded outlets.

Section 3: Arc Flash Hazards

An arc flash hazard may exist when energized electrical conductors or circuit parts are exposed or when they are within equipment in a guarded or enclosed condition, provided a person is interacting with the equipment in such a manner that could cause an electric arc. It is a phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground. The results can be violent, and when an individual is in close proximity to the arc flash, there is the potential for serious injury or even death. The extremely high heat is capable of igniting combustible items within the boundary of the flash and can result in a structural fire.

Companies should develop a policy to protect all employees from potential electrical hazards of arc flash. NFPA 70E can be used as a guide to make hazard analyses and select control measures. Incorporating these principles and procedures into a policy will establish work practices, effective application of engineering controls, administrative controls, and the use of personal protective equipment. Please see the attached OSHA handout for more information on Arc Flash.

Through the Alliance between OSHA's 10 Regional Offices and the Elevator Contractors of America (ECA), Elevator Industry Work Preservation Fund (EIWPF), International Union of Elevator Constructors (IUEC), National Association of Elevator Contractors (NAEC), National Elevator Industry Educational Program (NEIEP), and National Elevator Industry Inc. (NEII), collectively known as The Elevator Industry Safety Partners, developed this Industry Specific Best Practice for informational purposes only. It does not necessarily reflect the official views of OSHA or the U.S. Department of Labor. May 2023

Under the Occupational Safety and Health Act, employers are responsible (http://www.osha.gov/as/opa/worker/employer-responsibility.html) for providing a safe and healthy workplace and workers have rights (https://www.osha.gov/workers). OSHA can help answer questions or concerns from employers and workers. OSHA's On-Site Consultation Program (https://www.osha.gov/consultation) offers free and confidential advice to small and medium-sized businesses, with priority given to high-hazard worksites. For more information, contact your regional or area OSHA office (https://www.osha.gov/contactus/bystate), call 1-800-321-OSHA (6742), or visit https://www.osha.gov/. OSHA handout

Understanding "Arc Flash"

Simply put, an arc flash is a phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground. The results are often violent and when a human is in close proximity to the arc flash, serious injury and even death can occur.

Arc flash can be caused by many things including:

- Dust
- Dropping tools
- Accidental touching
- Condensation
- Material failure
- Corrosion
- Faulty Installation

Three factors determine the severity of an arc flash injury:

- Proximity of the worker to the hazard
- Temperature
- Time for circuit to break

Because of the violent nature of an arc flash exposure when an employee is injured, the injury is serious – even resulting in death. It's not uncommon for an injured employee to never regain their past quality of life. Extended medical care is often required, sometimes costing in excess of $1,000,000.

Typical Results from an Arc Flash

- Burns (Non FR clothing can burn onto skin)
- Fire (could spread rapidly through building)
- Flying objects (often molten metal)
- Blast pressure (upwards of 2,000 lbs. / sq.ft)
- Sound Blast (noise can reach 140 dB – loud as a gun)
- Heat (upwards of 35,000 degrees F)

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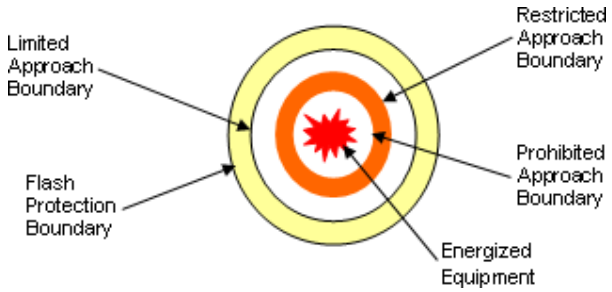
Approach / Protection Boundaries
The National Fire Protection Association (NFPA) has developed specific approach boundaries designed to protect employees while working on or near energized equipment. These boundaries are:



- Flash Protection Boundary (outer boundary)
- Limited Approach
- Restricted Approach
- Prohibited Approach (inner boundary)

Flash Protection Boundary (outer boundary): The flash boundary is the farthest established boundary from the energy source. If an arc flash occurred, this boundary is where an employee would be exposed to a curable second degree burn (1.2 calories/cm^2). The issue here is the heat generated from a flash that results in burns.

Limited Approach: An approach limit at a distance from an exposed live part where a shock hazard exists.

Restricted Approach: An approach limit at a distance from an exposed live part which there is an increased risk of shock.

Prohibited Approach (inner boundary): A distance from an exposed part which is considered the same as making contact with the live part.

This distance is not common between equipment. Some equipment will have a greater flash protection boundary while other equipment will have a lesser boundary.

Ways to Protect the Workers
There exists a number of ways to protect workers from the threat of electrical hazards. Some of the methods are for the protection of qualified employees doing work on electrical circuit and other methods are geared towards non-qualified employees who work nearby energized equipment.

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Here are a few of the protective methods:

- De-energize the circuit
- Work Practices
- Insulation
- Guarding
- Barricades
- Ground Fault Circuit Interrupters (GFCI)
- Grounding (secondary protection)

If You Must Work on Energized Circuits

If it has been determined that deenergizing a circuit is not feasible and the employee must work "hot", the employer shall develop and enforce safety-related work practices to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts.

The specific safety-related work practices shall be consistent with the nature and extent of the associated electrical hazards.

These safety related work practices could include:

- Energized Electrical Work Permit
- Personal Protective Equipment
- Insulated Tools
- Written Safety Program
- Job Briefing

Fast Fact: The most effective and fool-proof way to eliminate the risk of electrical shock or arc flash is to simply deenergize the equipment.

Understanding the Arc Flash Warning Labels

Each piece of equipment operating at 50 volts or more and not put into a deenergized state must be evaluated for arc flash and shock protection. This evaluation will determine the actual boundaries (i.e. prohibited, limited, restricted etc) and will inform the employee of what PPE must be worn.

Once the evaluation is complete an Arc Flash Hazard warning label must be affixed to the equipment and readily accessible to employees who may work on the energized equipment.

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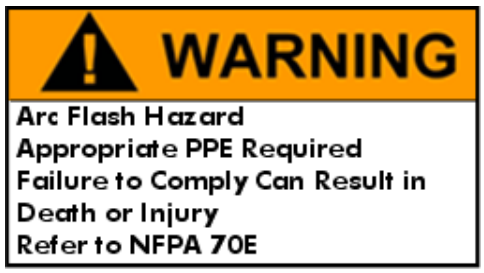
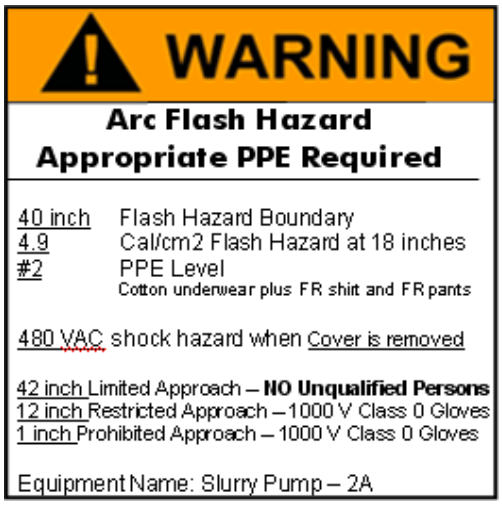


Minimum arc flash label example



Detailed (preferred) arc flash label example

The Employees Obligation

Employees must follow the requirements of the Arc Flash Hazard label by wearing the proper personal protective equipment (PPE), use of insulated tools and other safety related precautions. This includes not working on or near the circuit unless you are a "qualified" worker.

Qualified person: One who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved.

Additional requirements for qualified persons. Qualified persons (i.e. those permitted to work on or near exposed energized parts) shall, at a minimum, be trained in and familiar with the following:

- The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
- The skills and techniques necessary to determine the nominal voltage of exposed live parts, and
- The clearance distances specified in 1910.333(c) and the corresponding voltages to which the qualified person will be exposed.

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