

ELECTRICAL SAFETY TIPS

GENERAL SAFETY TIPS

- ❑ **Check Your Gear:** Inspect electrical tools regularly and remove any faulty ones.
- ❑ **Grounding:** Ensure electrical systems are properly grounded.
- ❑ **Use GFCIs:** Especially for 120-volt outlets.

WORKING WITH LIVE EQUIPMENT

- ❑ **Lockout/Tagout:** De-energize circuits before work and use lockout/tagout procedures.
- ❑ **Qualified Only:** Only trained personnel should work on live parts.

PERSONAL PROTECTIVE GEAR

- ❑ **Wear PPE:** Use insulated tools and wear gloves, boots, and flame-resistant clothing.

SAFE WORK PRACTICES

- ❑ **Keep Distance:** Stay clear of live electrical equipment and power lines.
- ❑ **Use Barriers:** Protect yourself with insulating barriers and tools.
- ❑ **Post Warnings:** Put up clear warning signs.

TEMPORARY WIRING

- ❑ **Check Cords:** Use rated extension cords and avoid damaged ones.
- ❑ **Protect and Remove:** Install temporary wiring properly and remove it when done.

OVERCURRENT PROTECTION

- ❑ **Use Proper Fuses:** Use the right circuit breakers and fuses, don't bypass them.

ENVIRONMENT CONTROLS

- ❑ **Stay Dry:** Avoid working in wet conditions unless equipment is designed for it.
- ❑ **Use GFCIs in Wet Areas:** Always.

TRAINING AND EMERGENCY PROCEDURES

- ❑ **Get Trained:** Ensure everyone is trained in electrical safety.
- ❑ **Be Ready:** Know the emergency procedures and CPR



ELECTRICAL DEFINITIONS

- **Arc Blast:** A violent explosion, similar to a dynamite detonation, that occurs during an arc flash incident, releasing extreme heat and pressure.
- **Arc Fault:** A high-energy discharge between two or more conductors, often leading to fires or electrical hazards.
- **Arc Fault Circuit Interrupter (AFCI):** A protective device that detects arc faults and shuts off power to prevent electrical fires.
- **Arc Flash Boundary:** A designated safety distance from energized conductors where a person could sustain second-degree burns from an arc flash.
- **Assured Equipment Grounding Conductor Program:** A structured plan requiring regular inspections and tests of equipment grounding to ensure safety.
- **Bolted Fault:** A type of short circuit where two conductors at different voltages make direct contact with little to no resistance.
- **Breakdown Voltage:** The voltage level at which an insulating material fails and allows electrical current to pass through.
- **Equipment Grounding Conductor:** A wire that connects electrical enclosures and components to the ground, reducing the risk of shock.
- **Fibrillation:** A condition where the heart's muscle fibers contract rapidly and irregularly, disrupting normal heart rhythm and pulse.
- **Ground Fault Circuit Interrupter (GFCI):** A fast-acting breaker that detects current leakage to ground and shuts off power within milliseconds to prevent shocks.
- **Grounding:** The process of connecting an electrical system to a grounded point to establish a stable voltage reference and enhance safety.
- **Insulation:** A protective layer of nonconductive material, such as plastic or rubber, placed around a conductor to prevent unintended current flow.
- **Shock Hazard:** A dangerous condition where contact with live electrical parts can result in electric shock or severe injury.



LOTO DEFINITIONS

- **Affected Employee:** An employee who operates or works near equipment under lockout/tagout during servicing or maintenance.
- **Authorized Employee:** A person authorized to lock out/tag out equipment for servicing or maintenance. An affected employee becomes authorized when their duties include these tasks.
- **Capable of Being Locked Out:** An energy-isolating device that can be locked with a hasp, built-in lock, or other means without modification.
- **Energized:** Connected to an energy source or containing stored energy.
- **Energy Isolating Device:** A mechanical device that physically prevents energy release, such as a circuit breaker, disconnect switch, line valve, or block. Control switches and push buttons are not included.
- **Energy Source:** Any electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy supply.
- **Hot Tap:** A process of welding on pressurized pipelines, tanks, or vessels to add or replace connections without service interruption.
- **Lockout:** Securing an energy-isolating device with a lock to prevent equipment operation until the lock is removed.
- **Lockout Device:** A locking mechanism that keeps an energy-isolating device in a safe position, preventing equipment from being energized.

HOW ELECTRICAL SHOCK WORKS

- ❑ Occurs when electricity flows through the body, completing a circuit.
- ❑ Severity depends on voltage, current, resistance (skin condition), duration, and path through the body.
- ❑ Can cause muscle contractions, respiratory failure, cardiac arrest, and burns.
- ❑ Even low-voltage shocks can be fatal under the right conditions.

HOW BURNS OCCUR

- ❑ **Electrical Burns:** Heat generated by current passing through body tissues.
- ❑ **Arc Burns:** High-temperature plasma from an arc flash causes severe skin damage.
- ❑ **Thermal Burns:** Contact with overheated electrical equipment or wiring.
- ❑ **Radiation Burns:** Exposure to intense UV light from arc flashes.

ARC FLASH & ARC BLAST HAZARDS

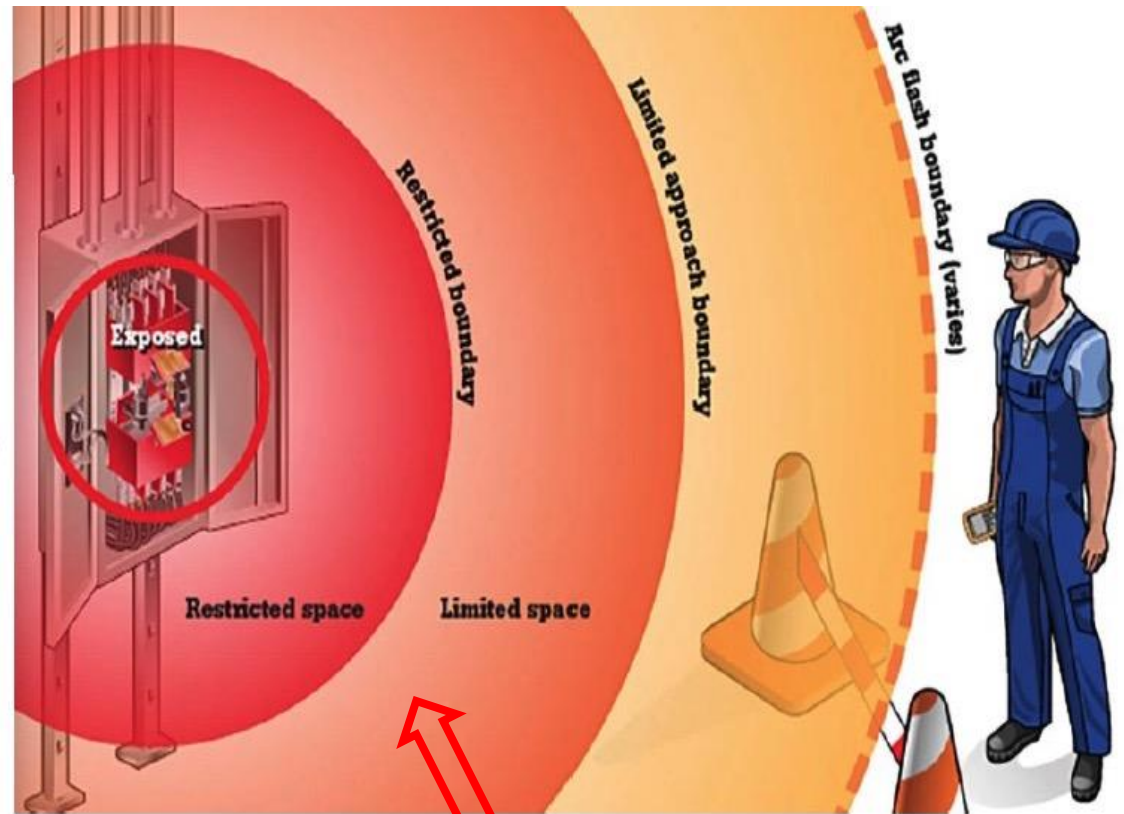
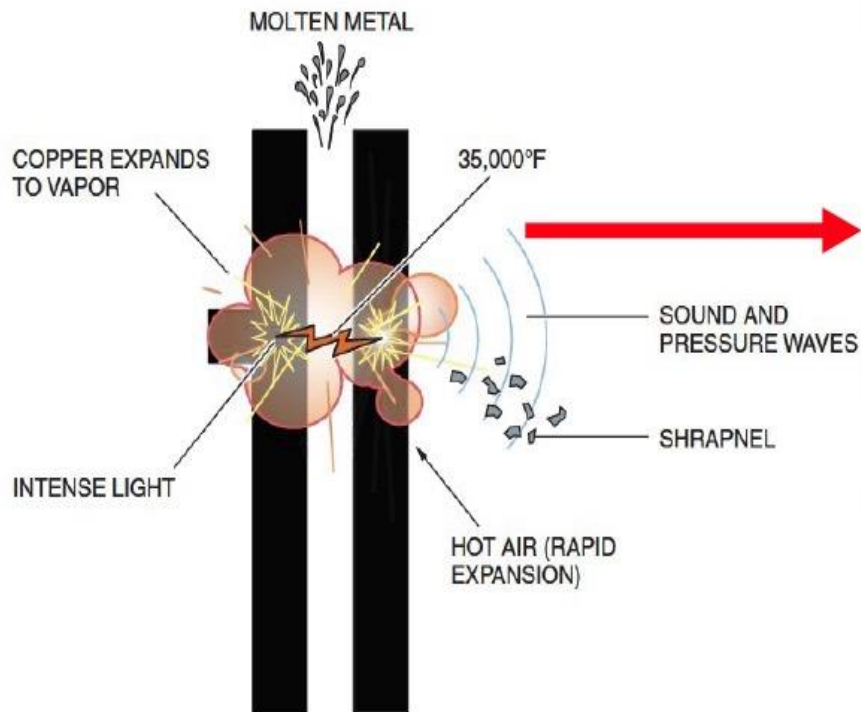
- ❑ Arc Flash: Sudden release of electrical energy due to a fault, creating extreme heat and light.
- ❑ Temperatures can reach 35,000°F, vaporizing metal instantly.
- ❑ Causes severe burns, blindness, and hearing loss.
- ❑ Arc Blast: Violent pressure wave from the arc flash explosion.
- ❑ Can send shrapnel flying at high speeds.
- ❑ Results in serious trauma, concussions, and internal injuries.

EMERGENCY RESPONSE FOR ELECTRICAL INCIDENTS

- ❑ Do NOT touch the victim if they are still in contact with the electrical source.
- ❑ Shut off power at the circuit breaker or disconnect switch before assisting.
- ❑ Call 911 immediately and provide details of the incident.
- ❑ Perform CPR if the victim is unresponsive and not breathing.
- ❑ Treat burns by covering them with a dry, sterile cloth (do NOT apply ointments or ice).
- ❑ Move the victim only if necessary to prevent further injury.
- ❑ Seek medical attention even for minor shocks, as internal injuries may not be immediately visible.



ARC FLASH Guidance Standard is NFPA 70E



ARC FLASH phenomenon (violent event or occurrence) where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground.

BOUNDARIES

1. Exposed/Prohibited
2. Restricted
3. Limited approach
4. Arc flash

Low Voltage is 600v or less

High Voltage greater than 600v

VERIFY PROPER GROUNDING AND INSULATION

- ☐ Ensure all outlets and cords are in good condition and free from damage
- ☐ Use GFCI protection to prevent electric shock hazards
- ☐ Maintain minimum approach distances from power lines of at least 25 feet until line voltage is verified
- ☐ Implement lockout/tagout procedures to de-energize equipment and ensure it cannot be started during maintenance
- ☐ Use CAT 1-4 meters appropriate to the voltage level for safe testing
- ☐ Ensure cords and plugs are free from modifications or damage
- ☐ Regularly inspect equipment for wear or damage
- ☐ Train employees on the risks of electrical shock and proper protective measures
- ☐ Use insulated tools and wear PPE like rubber gloves and mats when working on or near live electrical systems

CAT 1 TO CAT 4 METERS

- ☐ CAT 1: Low-energy circuits such as electronics. (Lowest Level)
- ☐ CAT 2: Single-phase appliances and outlets.
- ☐ CAT 3: Three-phase equipment and distribution panels.
- ☐ CAT 4: Utility-level measurements at service connections. (Highest Level)



LOTO SAFETY SUMMARY FOR MACHINERY & EQUIPMENT HAZARDS

- ❑ Many job site accidents involve machinery and uncontrolled energy release.
- ❑ Failure to lockout/tagout (LOTO) before maintenance causes serious injuries like electrocution, amputation, and crushing.
- ❑ Example: A worker was killed when knocked into a spinning saw blade by unexpected equipment movement.

IMPORTANCE OF LOTO

Prevents accidental equipment startup during maintenance.
Protects against electrical, mechanical, hydraulic, pneumatic, chemical, and thermal energy.
Stored energy can still cause movement even after power is off.
Example: Residual air in a compressor can activate pneumatic tools.

HAZARDS OF STORED ENERGY

Machines may contain hazardous materials like acids, flammable liquids, or high-pressure steam.
Uncontrolled release can cause explosions, burns, and severe injuries.

LOTO PROCEDURES

Shut down, drain, or de-energize systems before maintenance.
Use energy-isolating devices like switches, circuit breakers, and valves with locks and tags.
Only the person who places the lock keeps the key and can remove it.

LOCKOUT VS. TAGOUT

Lockout: Uses a physical lock to prevent operation.

Tagout: Attaches a warning tag to indicate the equipment is disabled.

Multiple locks are used when more than one worker is involved.



LOTO SAFETY RULES

Never operate a locked or tagged device, switch, or valve.
Use only approved tags for the job site.
Ensure proper tags are attached to locked-out equipment.
Lockout/tagout all electrical systems and pipelines with hazardous materials.
Lock and tag motorized equipment during repairs or replacements.
Disconnect or disable starting devices when equipment is locked out.

The Master Lock Company

LOTO covers the servicing and maintenance of machines and equipment where the *unexpected* energization or start up of the machines or equipment, or release of stored energy could cause injury to employees.



4 Components of LOTO

1. Preparation for lockout/tagout
2. Sequence for lockout/tagout
3. Restoration of energy
4. Emergency removal authorization

Emergency removal must be done with written verification after employer/supervisor assures worker is gone. Worker must be briefed before returning to work.

8 Steps of LOTO

1. Notify affected employees
2. Identify procedure and hazards
3. Shut down equipment
4. Isolate machine from energy source
5. Apply lockout tagout devices
6. Check stored energy
7. Verify isolation
8. Bring equipment back on-line

3 Persons in LOTO

1. Authorized
2. Affected
3. Others and all other workers

Notes

1. Tags must be durable for environment
2. Tag affixing device aka zip tie hold 50 lbs
3. All locks/tags must be same size, color or shape
4. Only 1 key per lock



TIMES WHEN EMERGENCY REMOVAL OF A LOCKOUT/TAGOUT DEVICE IS REQUIRED

- ❑ Only an authorized supervisor can remove the lockout/tagout device.
- ❑ If the authorized employee is absent or the key is lost, follow company-specific lockout removal guidelines.
- ❑ Examine the entire line to ensure all hazards are mitigated before removing the lock.
- ❑ Exhaust all efforts to locate the employee and/or key.
- ❑ Inform the authorized employee that the lockout/tagout device has been removed.
- ❑ Record written verification of the removal action and communication in the job journal.



LOTO DEFINITIONS

- ❑ **Energy-isolating device:** A mechanical device that physically prevents the transmission or release of energy (e.g., circuit breakers, valves, switches).
- ❑ **Energy Source:** Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy that can cause injury.
- ❑ **Lockout:** The placement of a lockout device on an energy-isolating device to ensure equipment can't be operated until the device is removed.
- ❑ **Lockout Device:** A device that secures an energy-isolating device in the "off" or safe position using a lock.
- ❑ **Tagout:** The placement of a warning tag on an energy-isolating device to indicate it should not be operated until the tag is removed.
- ❑ **Tagout Device:** A prominent warning device, such as a tag and means of attachment, that can be securely fastened to indicate equipment must not be operated.