



## **ELECTRICAL SAFETY**

Electrical work is an important part of our business. Tate Engineering Systems is committed to providing a safe work environment for its employees. This electrical safety program is designed to minimize the hazards associated with electrical work. It establishes minimum standards to prevent hazardous electrical exposures to personnel and ensure compliance with regulatory requirements.

### **PURPOSE**

The purpose of this program is to:

- Ensure the safety of employees who work on or near electrical equipment.
- Ensure understanding and compliance with safe electrical work practices.
- Comply with NFPA 70E.
- Comply with OSHA Standards and focus on the following priorities:
  1. Provide a safety program with defined responsibilities.
  2. Determine the degree of arc flash hazard by qualified personnel.
  3. Use appropriate hazard warnings.
  4. Provide personal protective equipment (PPE) for workers.
  5. Provide documented training to workers on Lockout/Tagout procedures and the hazards of arc flash.
  6. Provide appropriate tools for safe work.

### **SCOPE**

This program applies to all company workers and contractors who are performing electrical work, or work that may have electrical hazards. Employees who work in the vicinity of electrical work are also covered.

### **RESPONSIBILITIES**

Only qualified Tate Service Technicians may work on electric circuit parts or equipment that have not been de-energized. In practice qualified employees are only allowed to work on or near voltages up to 480V when properly equipped. Such persons shall be made familiar with the use of special precautionary techniques, PPE, insulating & shielding materials and insulated tools. An Energized Electric Work Permit must be completed by authorized/qualified employees. In order to maximize safety, all employees will adhere to the following:

- Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 ft. (305 cm) is maintained. If the voltage is higher than 50kV, the clearance shall be increased 4 in. (10 cm) for every 10kV over that voltage.
- Portable ladders used on jobsite shall have non-conductive side rails.
- Overhead power lines shall be de-energized and grounded or other protective measures shall be provided by utility before work is started. When an unqualified person is working in an elevated



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position near overhead lines, the location shall be such that the person and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:

- - For voltages to ground 50kV or below - 10 feet (305 cm);
- - For voltages to ground over 50kV - 10 feet (305 cm) plus 4 inches (10 cm) for every 10kV over 50kV.
- Work only on de-energized equipment, unless it increases the hazard, or it is not possible to complete critical work.
- When a qualified person is working in the vicinity of overhead lines, whether in an elevated position or on the ground, the person may not approach or take any conductive object without an approved insulating handle closer to exposed energized parts than shown in Table S5:

### TABLE S5

Voltage range (phase to phase) | Minimum approach distance:

- 300V and less ..... | Avoid Contact
  - Over 300V, not over 750V ..... | 1 ft. 0 in. (30.5 cm).
  - Over 750V, not over 2kV ..... | 1 ft. 6 in. (46 cm).
  - Over 2kV, not over 15kV ..... | 2 ft. 0 in. (61 cm).
  - Over 15kV, not over 37kV ..... | 3 ft. 0 in. (91 cm).
  - Over 37kV, not over 87.5kV ..... | 3 ft. 6 in. (107 cm).
  - Over 87.5kV, not over 121kV ..... | 4 ft. 0 in. (122 cm).
  - Over 121kV, not over 140kV ..... | 4 ft. 6 in. (137 cm).
- Be well trained in safe electrical work practices.
  - Utilize all required safety and personal protective equipment.
  - Adhere to NFPA 70E.

Safety Manager is responsible to:

- Provide means or assist in the task of specific training for electrical work qualifications.
- Maintain all training records, documents for the duration of the employee's employment.
- Periodically review and update this written program.
- Provide or coordinate general training for work units on the content of this program.
- Evaluate the overall effectiveness of the electrical safety program at least annually and whenever an electrical accident occurs.



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Service Manager is responsible to:

- Lead by example and promote electrical safety awareness to all employees.
- Ensure employees comply with the provisions of the electrical safety program.
- Ensure employees received training appropriate to their assigned electrical tasks.
- Ensure employees are provided with and use appropriate protective equipment.

Workers are responsible to:

- Follow the work practices described in this document, including the use of appropriate protective equipment and tools.
- Attend all training required relative to this program.
- Immediately report any concerns related to electrical safety to supervision on:
  1. (1) Any unique hazards presented by the contract employer's work;
  2. (2) Any unanticipated hazards found during the contract employer's work that the host employer did not mention; and
  3. (3) The measures the contractor took to correct any hazards reported by the host employer to prevent such hazards from recurring in the future
- Do not perform any electrical work without proper training and equipment.
  1. unqualified persons shall not be permitted to enter spaces that are required to be accessible to qualified employees only.

### TRAINING

Employees will receive training in avoiding the electrical hazards associated with working on or near exposed energized parts prior to performing energized electrical work. Such training will be provided when the employee is initially assigned to the job. Refresher training will be provided every three years or when hazards change. Retraining will be conducted when the employee is not complying with safety-related work practices or when workplace changes necessitate the use of safety-related work practices that are different from those that the employee would normally use.

The following items are included in the training:

- The Lockout/Tagout Training Program including safe work practices required to safely de-energize electrical equipment.
- Universal electrical safety procedures.
- Skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
- Skills and techniques necessary to determine the nominal voltage of exposed live parts.
- The approach distances and the corresponding voltages to which the worker will be exposed.
- Selection and use of proper work practices, personal protective equipment, tools, insulating and shielding materials and equipment for working on or near energized parts.




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### PERSONAL PROTECTIVE EQUIPMENT

#### General Requirements

- Employees working in areas where there are potential electrical hazards will be provided with and use personal protective equipment (PPE) that is appropriate for the specific work to be performed. The electrical tools and protective equipment must be specifically approved, rated, and tested for the levels of voltage of which an employee may be exposed and adhere to NFPA 70E. Tate Engineering Systems has limited the work to Level 0 and has equipped and trained technicians to that level of protection.

<b>Hazard/Risk Category</b>  <b>0</b>	Untreated natural fiber Shirt (long sleeve) Pants (long) Safety glasses Hearing protection Heavy duty Leather gloves (as needed)	
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- Employees shall wear nonconductive head protection whenever there is a danger of head injury from electric shock or burns due to contact with live parts or from flying objects resulting from an electrical explosion.
- Employees shall wear protective equipment for the eyes whenever there is a danger of injury from electric arcs, flashes, or from flying objects resulting from an electrical explosion.
- Employees shall wear rubber insulating gloves where there is a danger of hand or arm contact with live parts or possible exposure to arc flash burn.
- Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required. Insulated soles shall not be used as primary electrical protection.
- Face shields without arc rating shall not be used for electrical work. Safety glasses or goggles must always be worn underneath face shields.
- Additional illumination may be needed when using tinted face shields as protection during electrical work.
- Electrical Protective Equipment must be selected to meet the criteria established by the American Society of Testing and Materials (ASTM) and by the American National Standards Institute (ANSI).
- Insulating equipment made of materials other than rubber shall provide electrical and mechanical protection at least equal to that of rubber equipment.
- PPE must be maintained in a safe, reliable condition and be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage.
- Employees are not authorized to use any tools when working on exposed energized conductors or circuits. Level 0 is limited to troubleshooting with an approved volt/amp meter. Any work to be performed must be done while locked out.



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- Protective shields, barriers or insulating materials must be used to protect each employee from shock, burns, or other electrical injuries while that person is working near exposed energized parts that might be accidentally contacted or where dangerous electric heating or arcing might occur.
- All insulating PPE must be inspected before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves shall be given an air test, along with the inspection.
- Test instruments must be verified to be in proper working order before testing on condition at an alternate source of energy, and after voltage test is performed.

### **Flame-Resistant Apparel**

- FR apparel shall be visually inspected before each use. FR apparel that is contaminated or damaged shall not be used. Protective items that become contaminated with grease, oil flammable liquids, or combustible liquids shall not be used.
- The garment manufacturer's instructions for care and maintenance of FR apparel shall be followed.
- When the apparel is worn to protect an employee, it shall cover all ignitable clothing and allow for movement and visibility.
- FR apparel must cover potentially exposed areas as completely as possible. FR shirt sleeves must be fastened and FR shirts/jackets must be closed at the neck.
- Non-melting, cotton garments may be used as underlayers beneath FR apparel.
- Fibers that can melt, such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric underlayers next to skin. (An incidental amount of elastic used on non-melting fabric underwear or socks shall be permitted).
- Garments worn as outer layers over FR apparel (i.e. jackets or rainwear) must also be made from FR material.
- Flash suits must permit easy and rapid removal by the user.

### **Rubber Insulating Equipment**

- Rubber insulating equipment includes protective devices such as gloves, sleeves, blankets, and matting.
- Insulating equipment must be inspected for damage before each day's use and immediately following any incident that could have caused damage.
- An air test must be performed on rubber insulating gloves before each use.
- Insulating equipment found to have defects that might affect its insulating properties must be removed from service until testing indicates that it is acceptable for continued use.



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- Where the insulating capability of protective equipment is subject to damage during use, the insulating material shall be protected by an outer covering of leather or other appropriate materials.
- Rubber insulating equipment must be tested according to the schedule supplied by the manufacturer.
- Rubber insulating equipment must be stored in an area protected from light, temperature extremes, excessive humidity, ozone, and other substances and conditions that may cause damage.
- No repairs to rubber insulating equipment shall be attempted without the approval of the safety Manager.

### **Insulated Tools and Materials**

- No tools may be used while working on or near energized bare conductors.
- If a condition arises where insulated tools must be used on a live conductor, the Safety Manager must be notified and review the worksite conditions prior to use of insulated tools.

### **Entry Restrictions**

- Barricades shall be used in conjunction with safety signs to prevent or limit access to work areas containing live parts. Conductive barricades shall not be used where they might cause an electrical hazard. Barricades shall be placed no closer than the Limited Approach Boundary.
- If signs and barricades do not provide sufficient protection, an attendant will be assigned to warn and protect pedestrians. The primary duty of the attendant shall be to keep an unqualified person out of the work area where an electrical hazard exists. The attendant shall remain in the area as long as there is a potential exposure to electrical hazards.

### **PORTABLE ELECTRICAL EQUIPMENT AND EXTENSION CORDS**

The following requirements apply to the use of cord-and-plug-connected equipment and flexible cord sets (extension cords):

- Extension cords may only be used to provide temporary power.
- Portable cord-and-plug connected equipment and extension cords must be visually inspected before use on any shift for external defects such as loose parts, deformed and missing pins, or damage to outer jacket or insulation, and for possible internal damage such as pinched or crushed outer jacket. Any defective cord or cord-and-plug-connected equipment must be removed from service and no person may use it until it is repaired and tested to ensure it is safe for use.



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- Extension cords must be of the three-wire type and be of at least 12 gauge conductors. Extension cords and flexible cords must be designed for hard or extra hard usage (for example, types S, ST, and SO). The rating or approval must be visible.
- Job-made extension cords are forbidden per the electrical code.
- Personnel performing work on renovation or construction sites using extension cords and where work is performed in damp or wet locations must be provided, and must use, a ground-fault circuit interrupter (GFCI). The GFCI must be tested before initial use daily.
- Portable equipment must be handled in a manner that will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment.
- Extension cords must be protected from damage. Sharp corners and projects must be avoided. Flexible cords may not be run through windows or doors unless protected from damage, and then only on a temporary basis. Flexible cords may not be run above ceilings, or inside or through walls, ceilings or floors, and may not be fastened with staples or otherwise hung in such a fashion as to damage the outer jacket or insulation.
- Cords must be covered by a cord protector or tape when they extend into a walkway or other path of travel to avoid creating a trip hazard.
- Extension cords used with grounding-type equipment must contain an equipment-grounding conductor (i.e., the cord must accept a three-prong, or grounded plug).
- Attachment plugs and receptacles may not be connected or altered in any way that would interrupt the continuity of the equipment grounding conductor. Additionally, these devices may not be altered to allow the grounding pole to be inserted into current connector slots. Clipping the grounding prong from an electrical plug is prohibited.
- Flexible cords may only be plugged into grounded receptacles.
- All portable electric equipment and flexible cords used in highly conductive work locations, such as those with water or other conductive liquids, or in places where employees are likely to contact water or conductive liquids, must be approved for those locations.
- Employee's hands must be dry when plugging and unplugging flexible cords and cord-and-plug connected equipment if energized equipment is involved.
- If the connection could provide a conducting path to employees hands (for example, if a cord connector is wet from being immersed in water), the energized plug and receptacle connections must be handled only with insulating protective equipment.
- Locking-type connectors must be properly locked into the connector.
- Lamps for general illumination must be protected from breakage, and metal shell sockets must be grounded.
- Temporary lights must not be suspended by their cords unless they have been designed for this purpose.



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### ENVIRONMENTAL FACTORS: WET /UNLIT AREAS

Work in *wet* or *damp* work *locations* (i.e., areas surrounded or near water or other liquids) should not be performed unless it is absolutely critical. Electrical work should be postponed until the liquid can be cleaned up. The following special precautions must be incorporated while performing work in *damp locations*:

- Only use electrical cords that have Ground Fault Circuit Interrupters (GFCIs);
- Place a dry barrier over any wet or damp work surface;
- Remove standing water before beginning work. Work is prohibited in areas where there is standing water;
- Eliminate need for cord by using battery powered equipment as much as possible.
- Keep electrical cords away from standing water.

Employees shall not enter spaces containing electrical hazards unless illumination is provided that enables the employees to perform the work safely. Where lack of illumination or an obstruction precludes observation of the work to be performed, employees shall not perform any task within the Limited Approach Boundary of energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists

### WORKING ON DE-ENERGIZED EQUIPMENT

#### **Electrically Safe Condition**

The most important principle of electrical safety is to **assume all electric circuits are energized unless each involved worker ensures they are not**. Follow the lockout/tagout program to properly de-energize and isolate electrical circuits.

### WORKING ON OR NEAR ENERGIZED EQUIPMENT

Working on live circuits means actually touching energized parts. Working near live circuits means working close enough to energized parts to pose a risk even though work is on de-energized parts. Only trained, equipped, and authorized techs are allowed to use protective equipment to perform tasks limited to Level 0 by NFPA 70E. Common tasks where there may be a need to work on or near live circuits include:

- Taking voltage measurements
- Taking amperage measurements
- Troubleshooting by visually observing energized components
- Opening and closing disconnects and breakers
- Opening electric equipment doors for inspection





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### Approach Distances to Exposed Live Parts

The National Fire Protection Association (NFPA) defines 3 approach distances for shock hazards and one for arc flash.

- The **limited approach boundary** is the distance from an exposed live part within which a shock hazard exists.
- The **restricted approach boundary** is the closest distance to exposed live parts a qualified person can approach without proper PPE and tools. Inside this boundary, accidental movement can put a part of the body or conductive tools in contact with live parts or inside the prohibited approach boundary. To cross the restricted approach boundary, the qualified person must:

Have an energized work permit that is approved by the supervisor or manager responsible for the safety plan.

Use PPE suitable for working near exposed live parts and rated for the voltage and energy level involved.

Be certain that no part of the body enters the prohibited space.

Minimize the risk from unintended movement by keeping as much of the body as possible out of the restricted space; body parts in the restricted space should be protected.

- The **prohibited approach boundary** is the minimum approach distance to exposed live parts to prevent flashover or arcing. Approaching any closer is comparable to making direct contact with a live part. To cross the prohibited approach boundary, the qualified person must:
  1. Have specified training to work on exposed live parts.
  2. Have a permit with proper written work procedures and justifying the need to work that close.
  3. Do a risk analysis.
  4. Have (2) and (3) approved by the appropriate supervisor.
  5. Use PPE appropriate for working near exposed live parts and rated for the voltage and energy level involved.
- **Protection Boundary.** The Protection Boundary is the approach limit at a distance from exposed live parts within which a person could receive a second degree burn if an electrical arc flash were to occur.
  1. Use PPE appropriate for working near exposed live parts and rated for the voltage and energy level involved.



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2. For systems of 600 volts and less, the flash protection boundary is 4 feet, based on an available bolted fault current of 50 kA and a clearing time of 6 cycles for the circuit breaker to act, or any combination of fault currents and clearing times not exceeding 300 kA cycles.
3. When working on de-energized parts and inside the flash protection boundary for nearby live exposed parts:
  - a. If the parts cannot be de-energized, use barriers such as insulated blankets to protect against accidental contact or wear proper PPE.

### Other Precautions

Arc Flash Risk Assessment must be reviewed prior to starting work. The risk assessments for shock and arc flash, safe work practices, the arc flash boundary, and the required PPE are completed by the owner of the system. The risk assessment must determine the voltage, the shock boundaries, and the required PPE to protect employees from the shock hazard.

#### Reduce the risk

The energy control requirements must be met before any circuits or equipment can be considered and worked as deenergized. Until the procedures for establishing an electrically safe work condition have been completed, the circuits and equipment are considered energized and all applicable safe work practices and PPE must be used to protect employees from any potential shock or arc flash hazards.

A job briefing should be held before starting each job and include all employees involved to inform employees of potential hazards. The briefing should cover hazards associated with the job, work procedures involved, special precautions, energy source controls, PPE requirements, and the information on the energized electrical work permit, if required. Additional job briefings shall be held if changes that might affect the safety of employees occur during the course of work.

A hazard/risk evaluation must be made prior to work being done within the Limited Approach Boundary. When working on de-energized the parts, but still inside the flash protection boundary for nearby live exposed parts:

- If the parts cannot be de-energized, barriers such as insulated blankets must be used to protect against accidental contact or PPE must be worn.
- Employees shall not reach blindly into areas that might contain exposed live parts.
- Employees shall not enter spaces containing live parts unless illumination is provided that allows the work to be performed safely.
- Conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn where they present an electrical contact hazard with exposed live parts.



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- Conductive materials, tools, and equipment that are in contact with any part of an employee's body shall be handled in a manner that prevents accidental contact with live parts. Such materials and equipment include, but are not limited to long conductive objects such as ducts, pipes, tubes, conductive hose and rope, metal-lined rules and scales, steel tapes, pulling lines, metal scaffold parts, structural members, and chains.
- When an employee works in a confined space or enclosed spaces (such as a manhole or vault) that contain exposed live parts, the employee shall use protective shields, barriers, or insulating materials as necessary to avoid contact with these parts. Doors, hinged panels, and the like shall be secured to prevent them from swinging into employees. Entry must be performed in conjunction with Tate Engineering Systems' confined space entry program.

Audit of field work will be completed by the QA Manager and or Service manager on an annual basis.