

Electrical and Arc Flash Safety Program



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Scope:

The design of this program is to establish safety-related work practices to safeguard employees from injury while they are working on or near exposed electric conductors or circuit parts that are or can become energized. The specific related work practice shall be consistent with the nature and extent of the work associated electrical hazard.

This program and its implementation is R.W. LaPine, Inc. means of meeting the NFPA 70e Standard for Electrical Safety in the Workplace.

Responsibilities:

Safety Manager:

- Assure that all elements of this program is implemented
- Verify training for electrical work qualifications
- Periodically review and update this written program
- Evaluate the overall effectiveness of this program on a periodic basis

Superintendents/ Foreman:

- Determine the applicability of the Electrical & Arc Flash Safety Program to workplace activities under their responsibility
- Ensure that employee comply with the provisions of this program
- Ensure that employees have received the training appropriate for their assigned electrical tasks
- Ensure that employees are provided with and utilize the appropriate Personal Protective Equipment for the task at hand

Employees:

- Follow the work practices as set out in this program
- Wear the appropriate Personal Protective Equipment for the task they are performing.
- Immediately report any concerns related to electrical safety or safety hazards to their supervisor

Definitions:

Arc rating: The maximum incident energy resistance demonstrated by material (or a layered system of materials) prior to “breaking open” or at the onset of a second-degree skin burn. This rating is assigned to electrical protective clothing and is normally expressed in calories per square centimeter cal/cm².

Electrically safe work condition: A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

Exposed (as applied to live parts): Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts that are not suitably guarded, isolated, or insulated.

Flash hazard analysis: A study to investigate a worker’s potential exposure to arc-flash energy, conducted for the purpose of injury prevention and the determination of safe work practices along with appropriate levels of PPE.

Flash protection boundary: An 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.

Limited approach boundary: An approach limit at a distance from an exposed live part within which a shock hazard exists.

Live parts: Energized conductive components.

Prohibited approach boundary: An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part.

Qualified person: One who has skills and knowledge related to the construction and operation of the electrical equipment and installation and has received training on the hazards involved.

Restricted approach boundary: An approach limit at a distance from an exposed live part within which there is an increased risk of shock (due to electrical arc-over combined with inadvertent movement) for personnel working in close proximity to the live part.

Unqualified person: Any person who does not meet the definition of a qualified person.

Working on (live parts): Coming in contact with live parts via tools, probes, test equipment, hands, feet, or other body parts regardless of the level of PPE worn.

Training:

R.W. LaPine, Inc. employees who face a risk of electrical hazard that is not reduced to a safe level by electrical installation requirements shall receive the following training.

- Such employees shall be trained to understand the specific hazards associated with electrical energy.
- They shall be trained in safety-related work practices and procedural requirements as necessary to provide protection from the electrical hazards associated with their respective job or task assignments.
- Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury.

Type of Training:

This training shall be classroom or on-the-job type, or a combination of the two. The degree of training provided shall be determined by the risk to the employee.

Qualified person:

A qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

Such persons shall also be familiar with the proper use of the special precautionary techniques, personal protective equipment, including arc-flash, insulating and shielding materials, and insulated tools and test equipment.

Note: A person can be considered qualified with respect to certain equipment and methods but still be unqualified for others.

An employee, who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person shall be considered to be a qualified person for the performance of those duties.

Training/Qualified Person Continued:

An employee permitted to work within the Limited Approach Boundary of exposed live parts operating at 50 volts or more shall, at a minimum, be additionally trained in all of the following:

- The skills and techniques necessary to distinguish exposed energized parts from other parts of electrical equipment.
- The skills and techniques necessary to determine the nominal voltage of exposed live parts.
- The approach distances specified in NFPA 70e Table 130.2(C) and the corresponding voltages to which the qualified person will be exposed.
- The decision-making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely.

Job Briefing:

Before starting each job, the superintendent or foreman for R.W. LaPine, Inc. will conduct a job briefing with the employees involved. The briefing will cover such subjects as hazards associated with the job, work procedures involved, special precautions, energy source controls, and personal protective equipment requirements.

If the work or operation to be performed is repetitive and similar, at least one job briefing will be conducted before the start of the first job. Additional job briefings will be held if significant changes that might affect the safety of employees occur during the course of the work.

A brief discussion will be satisfactory if the work involved is routine and if the employee, by virtue of training and experience can reasonably be expected to recognize and avoid the hazards involved in the job. A more extensive discussion will be conducted if either of the following applies:

- The work is complicated or particularly hazardous.
- The employee cannot be expected to recognize and avoid the hazards involved in the job.

Working on or near Live Parts:

Energized electrical work **under 600 volts** does not require a work permit if the employee performing the work follows the guidelines in this program and uses the appropriate PPE as referenced by NFPA 70e. There may however be **Host Employers** that require an electrical work permit on any work performed on energized equipment. If this is the case, R.W. LaPine, Inc. will utilize either the host employer's electrical permit or the electrical permit found in this program at appendix A.

Energized work over 600 volts

If live parts are not placed in an electrically safe condition, work to be performed shall be considered energized electrical work and will be performed by written permit only. A copy of the work permit can be found in appendix A of this program. The intent of this permit is to ensure that all appropriate safety precautions are taken prior to starting energized electrical work.

Work related to testing, troubleshooting, and voltage measuring may be completed without a permit provided appropriate safe work practices and PPE are used.

All electrical work permits should be submitted to the site superintendent/ foreman for approval. Approval may also be required by the host employer before work may be started. The permit must be posted in the area where the energized work is taking place for the duration of the task.

After work completion a copy of the permit must be filed with R.W. LaPine, Inc. along with a copy provided to Host Employer upon request.

When working on or near exposed de-energized parts they are treated as live. Conductors and parts of electrical equipment that have been de-energized but not been locked or tagged out shall be treated as live parts.

Any qualified person working in the vicinity of overhead power lines shall adhere to the approach distances in the NFPA 70e Table 130.2(c).

Utilization of the lockout and tagout program.

While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been de-energized, the circuits energizing the parts shall be locked out or tagged or both.

Approach Boundaries to Live Parts:

Observing a safe approach distance from exposed energized parts is an effective means of maintaining electrical safety. As the distance between an individual and live parts

increases, the potential for an electrical injury decreases. Safe approach distances will be determined for all tasks in which approaching personnel are exposed to live parts.

Safe approach distances to fixed live parts can be determined by referring to appendix B. This appendix can be used to identify the Limited, Restricted, and Prohibited Approach Boundaries associated with various system voltages.

Unqualified persons may only cross the Limited Approach Boundary when they are under the direct supervision of a qualified person.

Approach Boundaries to Live Parts:

Qualified persons may not cross or take any conductive object closer than the Restricted Approach Boundary unless one of the following conditions applies:

- The qualified person is insulated or guarded from the live parts and no non-insulated part of the qualified person's body crosses the Prohibited Approach Boundary.
- The live parts are insulated from the qualified person and from any other conductive object at a different potential.

Crossing the Prohibited Approach Boundary is considered the same as making contact with energized parts. Qualified persons may only cross this boundary when all of the following precautions have been taken:

- The qualified person has specific training to work on energized parts.
- The qualified person uses PPE appropriate for working on energized parts, which are rated for the voltage and energy level involved.

Vehicular and Mechanical Equipment:

Vehicular and mechanical equipment shall be operated so that a clearance of 10 ft. (305cm) is maintained from energized overhead lines. 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.

Safe Work Precautions:

- 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.
- 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 space (such as a manhole or vault) that contains exposed live parts, the employee shall obtain a Confined Space Entry Permit (following R.W. LaPine, Inc.'s Confined Space Program) and 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.

Personal Protective Equipment:General Requirements

Employees working in areas where electrical hazards are present shall be provided with, and shall use, protective equipment (Arc Flash Gear) that is designed and constructed for the specific body part to be protected and for the work to be performed.

R.W. LaPine, Inc. will provide electrical protective equipment (Arc Flash Gear) required by this program at no cost to employees. Such equipment shall include an Arc Flash rated apparel, eye protection, head protection, hand protection, insulated footwear, and face shields where necessary along with hearing protection. R.W. LaPine, Inc. is not responsible for providing under layers of clothing.

Clothing

R.W. LaPine, Inc. will follow **Arc rated** as the acceptable way to refer to PPE as FR is a very generic term. “Arc rated” refers to the performance of material when exposed to an electric arc. Arc rated material is flame resistant, but flame resistant material may not be arc rated. Garments that are not arc rated shall not be permitted to be used to increase the arc rating of a garment or of a clothing system.

Hearing Protection

Employees shall wear hearing protection whenever working within the arc flash boundary.

Head and Face Protection

An **arc-rated balaclava** shall be used with an **arc-rated face shield** when the back of the head is within the arc flash boundary. An arc-rated hood shall be permitted to be used instead of an arc-rated face shield and balaclava.

The balaclava in NFPA 70E 2012 is now described as follows:

“Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area shall be used.”

An **arc-rated hood** shall be used when the anticipated incident energy exposure exceeds 12 cal/cm²

Employees shall wear protective equipment for the eyes and face whenever there is a danger of injury from electric arcs, flashes, or from flying objects resulting from an electrical explosion.

Personal Protective Equipment:

Hand Protection

Employees shall wear rubber-insulating gloves where there is a danger of hand and arm injury due to contact with live parts or possible exposure to arc flash burn.

Foot Protection

If an employee is wearing shoes other than hard-soled type (tennis shoes are not considered hard soled), he/she must wear dielectric overshoes, which will be provided by R.W. LaPine, Inc.

Arc-rated apparel and Under layers

Arc-rated apparel shall be visually inspected before each use. Arc-rated 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 arc-rated apparel shall be followed. When arc-rated apparel is worn to protect an employee, it shall cover all ignitable clothing and allow for movement and visibility.

Arc-rated apparel must cover potentially exposed areas as completely as possible. Shirt sleeves must be fastened and shirts/jackets must be closed at the neck.

Non-melting, flammable garments (i.e. cotton, wool, rayon, silk, or blends of these materials) may be used as under layers beneath arc-rated apparel.

Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric under layers next to the skin. (An incidental amount of elastic used on non-melting fabric underwear or sock shall be permitted)

Arc-rated garments worn as outer layers over arc-rated apparel (i.e. jackets or rainwear) must also be made of arc-rated 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.
- Where insulating capability of protective equipment is subject to damage during the use, the insulating material shall be protected by an outer covering of leather or other appropriate material.

- Rubber insulating equipment must be tested according to the schedule contained in appendix E.
- 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.

Insulating Tools and Materials:

- Only insulated tools and equipment shall be used within the Limited Approach Boundary of exposed energized parts.
- Insulated tools shall be rated for the voltages on which they are used.
- Insulated tools shall be designed and constructed for the environment to which they are exposed and the manner in which they are used.
- Insulated tools shall be protected from damage and degradation of the integrity of the insulation.
- Fuse or fuse holder handling equipment, insulated for the circuit voltage, shall be used to remove or install a fuse if the fuse terminals are energized.
- Ropes and hand lines used near exposed energized parts shall be nonconductive.
- Portable ladders used for electrical work shall have nonconductive side rails.

Barricades and Signs:

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 unqualified persons 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.

Appendix A: Energized Electrical Work Permit

Part 1: To be completed by the requestor or supervisor of the job		
Description of Circuit & Equipment:	Job Location:	
Description of Work to be Done:		
Justification of why the circuit cannot be de-energized or the work delayed until the next scheduled outage:		
Part 2: To be completed by the qualified person(s) completing the work		
(1) Detailed description of procedure to be used in performing the above work		
(2) Description of safe work practice employed:		
(3) Voltage exposure (shock hazard analysis):		
(4) Determination of shock boundaries:		
(5) Results of flash hazard analysis:		
(6) Determination of flash protection boundaries:		
(7) PPE required to safely perform the task:		
(8) Method used to restrict access to the work area		
(9) Do you agree the above work can be done safely? YES (proceed to Part 3) NO (return to requestor)		
Qualified Person: _____	Date: ____/____/____	
Qualified Person: _____	Date: ____/____/____	
Qualified Person: _____	Date: ____/____/____	
Part 3: To be completed by Supervisor		
Approvals:		
Name	Job Title	Date
_____	_____	_____
_____	_____	_____


Note: A supervisor must approve all energized work before starting
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**Appendix B:
Approach Boundaries to Live Parts for Shock Protection**

(All dimensions are distance from live part to employee)

Nominal System Voltage (phase to phase)	Limited Approach Boundary (fixed circuit parts)	Restricted Approach Boundary (includes inadvertent movement adder)	Prohibited Approach Boundary
Less than 50V	Not specified	Not specified	Not specified
50V to 300V	3 feet, 6 inches	Avoid contact	Avoid contact
301V to 750V	3 feet, 6 inches	1 foot	1 inch
751V to 15kV	5 feet	2 feet, 2 inches	7 inches
Over 15kV or moveable conductor		See NFPA 70E Table 130.2 (c)	

- Limited Approach Boundary:** Distance from an exposed live part within which a shock hazard exists. An unqualified person may not cross this boundary unless they are continuously escorted by a qualified person.
- Restricted Approach Boundary:** Distance from an exposed live part within which there is an increased risk of shock (due to electrical arc-over combined with inadvertent movement) for personnel working in close proximity to the live part. This boundary may only be crossed by a qualified person who is safely insulated or guarded from the live parts.
- Prohibited Approach Boundary:** Distance from an exposed live part within which work is considered the same as making contact with the live part. This boundary may only be crossed by a qualified person who has specific training to work on energized parts; as obtained an approved Energized Electrical Work Permit; and uses PPE appropriate for working on energized parts which are rated for the voltage and energy level involved. (Note: A permit is not required for work related to testing, troubleshooting, and voltage measuring).
- Flash Protection Boundary (not listed in table):** Distance from exposed live parts within which a person could receive a second-degree burn if an electrical arc flash were to occur. This boundary may only be crossed by a qualified person wearing the appropriate PPE. For systems that are 600 volts or less, the Flash Protection Boundary shall be a minimum of four feet. An analysis must be performed to determine the Flash Protection Boundary for systems that are above 600 volts.

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Unqualified Personnel: An unqualified person along with their tools and equipment shall not be closer than 10 feet to any exposed electrical line from 300v to 50kv.






Appendix C: Hazard/Risk Category Classification

Hazard/Risk Category	Clothing Description	Required Minimum Arc Rating of PPE cal/cm2
1 HRC	Arc-rated FR shirt and FR pants or FR coverall (1 layer)	4 cal/cm2
2 HRC	Arc-rated FR shirt and FR pants or FR coverall (1 or 2 layers)	8 cal/cm2
3 HRC	Arc-rated FR shirt and FR pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum (2 or 3 layers)	25 cal/cm2
4 HRC	Arc-rated FR shirt and FR pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum (3 or more layers)	40 cal/cm2

Task (Assumes equipment is energized, and work is done within the Flash Protection Boundary)	Hazard/Risk Category	V-rated Gloves	V-rated Tools
Panel boards Rated 240V and Below			
Circuit breaker (CB) or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	0	N	N
Work on energized parts, including voltage testing	1	Y	Y
Remove/install CBs or fused switches	1	Y	Y
Removal of bolted covers (to expose bare, energized parts)	1	N	N
Opening hinged covers (to expose bare, energized parts)	0	N	N
Panel boards or Switchboards Rated > 240V and up to 600V (with molded case or insulated case circuit breakers)			
CB or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers			

off	1	N	N
Work on energized parts. Including voltage testing	2 (*)	Y	Y

Additional Information:

-  V-rated Gloves are gloves rated and tested for the maximum line-to-line voltage upon which work will be done.
-  V-rated Tools are tools that are rated and tested for the maximum line-to-line voltage upon which work will be done
-  2(*) means that a double-layer switching hood and hearing protection are required for this task in addition to the other Hazard/Risk Category requirements of appendix D
-  Y = Yes (required)
-  N = No (not required)

Appendix D: Personal Protective Equipment Matrix

Hazard/Risk Category Number	0	1	2	3	4
Non-melting (according to ASTM F 1506-00) or Untreated Natural Fiber					
T-shirt (short sleeve)			X	X	X
Shirt (long sleeve)	X				
Pants (long)	X	X	X (6)	X	X
Arc-rated FR Clothing					
Long-sleeve shirt		X	X	X	X
Pants		X	X (6)	X	X
Coverall		(5)	(7)	X	(5)
Jacket, parka or rainwear		AN	AN	AN	AN
Arc-rated FR Protective Equipment					
Flash suit, jacket (multilayer)					X
Flash suit pants (multilayer)					X
Hard Hat		X	X	X	X
FR Hard Hat Liner				AR	AR
Safety glasses	X	X	AL	AL	AL
Safety goggles			AL	AL	AL
Arc rated face shield or hood			X (8)		
Flash suit hood				X	X
Hearing protection			X (8)	X	X
Leather gloves		AN	X	X	X
Leather work shoes		AN	X	X	X
PPE Arc Flash Gear Required	N/R	4 cal	8 cal	25 cal	40 cal

AN = As needed AR = As required AL = Select one in group X = Minimum required

Notes:

- (1) See Table 130.7 (c) (11). Arc rating for a garment is expressed in cal/cm²
- (2) If voltage-rated gloves are required, the leather protectors worn external to the rubber gloves satisfy this requirement
- (3) Blank
- (4) Rescinded
- (5) Alternative is to use FR coveralls (minimum arc rating of 11 cal) Instead of FR shirt and FR pants

- (6) If the FR pants have a minimum arc rating of 11 cal, long pants of non-melting or untreated fiber are not required beneath the FR pants
- (7) Alternate is to use FR coveralls (minimum arc rating of 11 cal) over non-melting or untreated natural fiber pants and T-shirt
- (8) A face shield with a minimum arc rating of 11 cal, with wrap around guarding to protect not only face, but also the forehead, ears and neck is required

**Appendix E:
Inspection Schedule for Rubber Insulating Equipment**

Type of Equipment	When to Test
Rubber insulating line hose	Upon indication that insulating value is suspect
Rubber insulating covers	Upon indication that insulating value is suspect
Rubber insulating blankets	Before first issue and every 12 months thereafter (*)
Rubber insulating sleeves	Before first issue and every 12 months thereafter (*)
Rubber insulating gloves	Before first issue and every 6 months thereafter (*)

(*) – If the insulating equipment has been electrically tested but not issued for service, it may not be place into service unless it has been electrically tested within the previous 12 months.