

Safety Manual Electrical Safety Program (NFPA 70E)
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Policy Section No.:54
Revision No.: 2

Effective: 01/09
Revision Date: 11/17
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Electrical Safety Program (NFPA 70E)

1. Applicability:

- 1.1 This electrical safety program is applicable to all Therma employees **working on or near live electrical conductors or circuit parts** that are between 50 and 500 volts. ***This program is not applicable to work on systems pushing more than 500 volts.*** Work on systems pushing more than 500 volts may require more stringent safe work practices, and more sophisticated personal protective equipment than what is described in this program. ***The requirements of this program are based on OSHA standards found in 29 CFR 1910 Subpart S – Electrical, 8 CCR, and NFPA 70E - 2018.***

2. Purpose:

- 2.1 The purpose of this program is to:
- 2.1.1 Make employees aware of the potential electrical hazards associated with working on or near live electrical conductors or circuit parts that are between 50 and 500 volts;
 - 2.1.2 Provide employees with the knowledge they need to protect themselves from potential electrical hazards while working on or near live electrical conductors or circuit parts that are between 50 and 500 volts;
 - 2.1.3 Establish safe work practices and procedures for employees while working on or near live electrical conductors or circuit parts that are between 50 and 500 volts; and
 - 2.1.4 Develop self-discipline in the employees who are required to work on or near live electrical conductors or circuit parts that are between 50 and 500 volts so that they will consistently follow the safe work practices and procedures established for Therma.

3. Electrical Safety Program Principles:

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF THERMA LLC. ALL INFORMATION SHALL (A) BE RETAINED IN CONFIDENCE; (B) NOT BE REPRODUCED IN WHOLE OR IN PART; AND (C) NOT BE USED OR INCORPORATED IN ANY PRODUCT EXCEPT UNDER EXPRESSED WRITTEN AGREEMENT WITH THERMA LLC.

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- 3.1 The electrical safety program principles that apply to this program are as follows:
- 3.1.1 Electrical safety inspection and evaluation of each system;
 - 3.1.2 Maintenance of each system's electrical insulation and the integrity of each system's enclosure;
 - 3.1.3 Preplanning of every job;
 - 3.1.4 Documentation of any first-time procedures;
 - 3.1.5 De-energizing of each system immediately after troubleshooting is completed and before repair work/maintenance begins;
 - 3.1.6 Anticipation of unexpected events;
 - 3.1.7 Identification and minimization of potential hazards;
 - 3.1.8 Employee protection from shock, burn, blast, and other applicable hazards due to the work environment;
 - 3.1.9 Use of tools that are appropriate for the job;
 - 3.1.10 Assessment of the abilities of anyone who could be exposed to potential electrical hazards from repair or maintenance work on live electrical conductors or circuit parts;
 - 3.1.11 Occasional audits of the aforementioned principles; and
 - 3.1.12 Protection of ***“Unqualified”*** persons.
- 3.2 An audit of this program shall be performed every year to ensure the requirements in the program are being performed by the employees. The written program shall be updated as necessary.

4. DEFINITIONS:

- 4.1 **Approach Boundaries (Shock):**
- 4.1.1 Limited: An approach limit at a distance from an exposed live part within which a shock hazard exists. Also considered working near a live part.
 - 4.1.2 Restricted: 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 any live part.
 - 4.1.3 Prohibited: 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. Also considered working on a live part.
- 4.2 **Arc Flash**: Energy released during an arcing fault that occurs when current flows through a medium not intended to conduct electrical

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current. Essentially, an Arc Flash is a short circuit through the air emitting extreme heat, sound, pressure, and metal fragments.

- 4.3 **Arc Rating:** The maximum incident energy resistance demonstrated by a material (or a layered system of materials) prior to break-open or at least the onset of a second-degree skin burn, which is expressed in cal/cm².
- 4.4 **De-energized:** A condition that is free from any electrical connection to a source of potential difference and from electrical charge, not having a potential difference from that of Earth.
- 4.5 **Electrical Hazard:** A dangerous condition such that contact with or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.
- 4.6 **Electrically Safe Work Condition:** A state, in which the electrical conductor or circuit part to be worked on or near has been disconnected from energized parts, locked out in accordance with company policy, tested to ensure the absence of voltage, and grounded if deemed necessary.
- 4.7 **Live Parts:** Energized conductive components. Circuit components are considered live until placed into an Electrically Safe Work Condition.
- 4.8 **Qualified Person:** One who has skills and knowledge related to construction and operation of electrical equipment and installations and has received safety training on the hazards involved. Qualified employees shall be capable, as determined by electrical knowledge and skills, of working safely on energized electrical components. This capability includes familiarity with proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools. In addition, qualified employees shall be trained in and familiar with; the skills and techniques necessary to distinguish live components from other components of electric equipment, the skills and techniques necessary to determine the nominal voltage of exposed live components, and the required clearance distances and corresponding voltages to which they will be exposed.

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4.9 **Shock Hazard:** A dangerous condition associated with the possible release of energy caused by contact or approach to live electrical components.

4.10 **Alerting Techniques:** Alerting techniques include safety signs and tags, barricades, and attendants. Safety signs must meet the requirements of ANSI Z535 Table 130.7(F). Barricades must be used in conjunction with safety signs and never by themselves. Any technique used must not increase the potential for employee injury.

5. Electrical Safety Program Controls:

5.1 **THERMA** has established the following electrical safety program controls so that it can measure and monitor the electrical safety program.

- 5.1.1 All affected field personnel and their supervisors are responsible for ensuring that guards or protective measures are satisfactory for the conditions.
- 5.1.2 All affected field personnel will consider every electrical conductor or circuit part to be energized until it is shut off, locked out and tested dead.
- 5.1.3 All affected field personnel will consider the actual process of de-energizing an electrical conductor or circuit part a potentially hazardous task.
- 5.1.4 Affected field personnel will not make bare hand contact with exposed, energized electrical conductors or circuit parts.
- 5.1.5 All affected field personnel will receive electrical safety training as described in this program. The training, in addition to their existing skills and knowledge related to the construction and operation of the electrical equipment, including installations, will qualify the field personnel to work in the prescribed environment influenced by the presence of electrical energy.
- 5.1.6 All affected field personnel will receive a copy of this program.
- 5.1.7 All affected field personnel will obtain answers to any questions they have about the program before they begin work.
- 5.1.8 All affected field personnel will consistently implement this program.

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- 5.1.9 All affected field personnel will use the procedures described in this program to identify potential electrical hazards associated with their work on HVAC systems, and control or eliminate them.
- 5.1.10 Only troubleshooting procedures will be used on or near exposed, energized electrical conductors and circuit parts unless the system being serviced has a built-in interlocking disconnect.
- 5.1.11 Where work is being performed on systems with built-in interlocking disconnects, field personnel will implement safe work practices, including use of the personal protective equipment required for work on all energized systems with exposed live parts.
- 5.1.12 All affected field personnel must be alert when working on or near the systems.
- 5.1.13 Field personnel must not perform work on the systems while they are impaired by illness, fatigue, prescription drugs, nonprescription drugs, illegal drugs, alcohol or other impairments.
- 5.1.14 Field personnel must never reach blindly into areas that could contain exposed live parts.
- 5.1.15 Field personnel must ensure that their work areas are properly illuminated so that their work can be performed safely.
- 5.1.16 Field personnel must not wear conductive articles of jewelry and/or clothing.
- 5.1.17 Any conductive objects being carried by an employee will be handled in a manner that prevents accidental contact with exposed energized parts.
- 5.1.18 Where an employee must work in a confined or enclosed work space, he or she will use protective barriers or insulating materials to prevent contact with exposed energized parts.
- 5.1.19 Housekeeping will not be performed where there is a possibility of contact with exposed energized parts, unless barriers or insulating equipment is used to prevent contact.
- 5.1.20 All affected field personnel will identify and use the precautions that is appropriate for the work environment.
- 5.1.21 If field personnel are subject to handle long dimensional conductor objects (duct or pipe) the following steps shall be taken to prevent accidental contact with energized equipment. The hazard area shall be guarded and /or a minimum of (2) two employees, one at each end, shall be used to handle material.

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5.1.22 Only class 1A (rated 300 pounds) fiberglass step and extension ladders shall be used by field personnel. This applies to all work areas. **Reference: (Ladder Safety Program, Section 42 of EH&S Manual)**

5.1.23 Unqualified persons shall not be permitted to enter spaces that are required to be accessible to qualified employees only.

5.1.24 Only qualified employees are permitted to complete tasks such as testing, troubleshooting and voltage measuring within the limited approach boundary.

6. Training Requirements:

6.1 All Therma field personnel and supervisors will receive electrical safety training that is specific to working on or near live electrical conductors or circuit parts that are between 50 and 500 volts. The training will be substantive so that, coupled with the field personnel' skills and knowledge related to the construction, operation and installation of the systems; they will be considered "**Qualified Persons**." Training will be a combination of classroom and on the job training, which will include the following subjects.

6.1.1 The contents of this electrical safety program, with emphasis on safe work practices, procedures and personal protective equipment requirements.

6.1.2 The company's established **Qualified Person-Approach Boundary** for protection from electrical shock and arc flash hazards.

6.1.3 Identification of electrical hazards associated with working on or near live electrical conductors or circuit parts that are between 50 and 500 volts.

6.1.4 The decision-making process necessary to determine:

- a. The degree of the hazards;
- b. The extent of the hazards; and
- c. Preplanning practices needed to perform the job safely.

6.1.5 Techniques necessary to distinguish energized parts from other parts of the systems.

6.1.6 Techniques necessary to determine the nominal voltage of exposed energized system parts.

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- 6.1.7 Methods of protection from the electrical hazards.
- 6.1.8 Skills necessary to select properly rated test equipment and tools.
- 6.1.9 Selection, inspection and maintenance of personal protective equipment including pre-use leak testing, and biannual dielectric testing of protective rubber gloves.
- 6.2 Retraining shall be performed at intervals not to exceed 3 years.
- 6.3 Additional training is required each time there is new technology or type of equipment, change in process, when an audit or incident investigation determines that it is necessary and may also be required when workplace changes necessitate the use of safety-related work practices that are different from those that are normally used.
- 6.4 Retraining is required when it is discovered the employee is not complying with safety-related work practices.
- 6.5 Employee training documentation shall be maintained in the employee's training file for the duration of the employee's employment.

7. Personal Protective Equipment (PPE) Requirements:

- 7.1 **PPE required for working on or near live electrical conductors or circuit parts that are between 50 and 500 volts:**
 - 7.1.1. **Protective Clothing** – Field personnel will wear ***long sleeve shirts and pants or cover-all made of Flame Resistant (FR) material***. The protective equipment will have a minimum Arc Thermal Protective Value (ATPV) of 8 cal/cm². The ATPV will be displayed outside the clothing or on a tag inside. All under garments must be made of 100% cotton. No synthetic fabrics such as polyester are permitted.
 - 7.1.2. **Eye Protection** – Standard ***safety glasses*** will be worn at all times by field personnel while performing any mechanical service work. The safety glasses must be worn at all times, even while using an arc-rated face shield or double layered switching hood.
 - 7.1.3. **Head and Face Protection** – Field personnel will wear a ***Class E hard hat***, with an attached ***arc-rated face shield and balaclava***. The face shield and balaclava will have an Arc Thermal Protective Value (ATPV) of 12 cal/cm².
 - 7.1.4. **Hearing Protection** – Field personnel will wear ear canal inserts (ear plugs).

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- 7.1.5. **Hand Protection** – Field personnel will wear ***Class 00 Rubber gloves*** and ***leather protector gloves*** over the rubber gloves.
 - a. ***Rubber gloves must be dielectrically tested at a certified testing laboratory at least every six months. Field personnel must field test their gloves before each use by trapping air inside each glove and looking/feeling for leaks. Gloves with leaks or any signs of scratches or other damage will be destroyed and discarded immediately.***
- 7.1.6. **Double Layered Switching Hood** – On rare occasions a Double Layered switching hood may be required in place of the Class E hard hat and 12 calorie arc-rated face shield. Any time work must be completed in an area where an arc flash could occur from either side or behind field personnel, he or she must wear a Double Layered Switching Hood. Safety glasses and ear plugs must be worn underneath the hood.
- 7.1.7. **Insulating PPE must be inspected prior to each days' use and immediately after any incident.**
- 7.2 All PPE used must meet requirements found in applicable laws and regulations.

8. **Electrical Safety Program Procedures:**

- 8.1 Therma procedures for working on or near live electrical conductors or circuit parts that are between 50 and 500 volts.
 - 8.1.1 **Therma employees are not authorized to work equipment with voltages that exceed 500 volts.**
 - 8.1.2 **Under no circumstances shall any employee perform work on energized electrical conductors or circuit parts.**
 - 8.1.3 **Exemptions to 8.1.2 as follows: Work performed within the Limited Approach Boundary of energized electrical conductors or circuit parts by qualified persons related to tasks such as testing, troubleshooting, voltage measuring, and etc. shall be permitted to be performed, provided appropriate safe work practices and PPE in accordance with Section 7. (PPE Requirements)**
 - 8.1.4 **Work on energized electrical conductors or circuit parts that are not placed in an electrically safe work condition shall be**

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considered energized electrical work. This work requires an Energized Electrical Work Permit and supervisor approval.

8.2 Supervisors:

- 8.2.1. Ensure your entire field personnel have received the proper electrical safety training as described in this program before you allow them to begin work. Ensure that they receive a copy of this program and understand the program's principles, controls and specific electrical safety training requirements. Assess their abilities by testing them on the knowledge they need to protect themselves from electrical hazards.
- 8.2.2. Conduct occasional audits to ensure that all of the electrical safety program principles established for Therma are appropriate, and are being followed by the affected field personnel.
- 8.2.3. Supervisors shall review and approve all Energized Electrical Work Permits.

8.3 Field Personnel:

- 8.3.1. Carefully plan each job well before you have to start the work. Make sure that you have all of the proper tools, equipment and permits (if required). Think through the electrical safety program procedures so that you can easily incorporate them into the troubleshooting, maintenance and/or repair processes.
- 8.3.2. Anticipate unexpected events by thinking through all conceivable possibilities. Remain cognizant of possible unexpected events by establishing the state of mind of complete concentration on the task.
- 8.3.3. Never approach an energized system with exposed live parts closer than 4 feet without following the safe work practices and personal protective equipment requirements described in this section. The 4 foot approach and protection boundary is the greater of the two boundaries established for **Qualified Persons** for shock and arc flash protection. The 4 foot boundary applies to any conductive objects that you might be carrying as well.
- 8.3.4. Before opening the access door or removing the panel to any energized system, inspect/evaluate it to ensure that you know its voltage capacity. Also, ensure that all visible parts appear to be in

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good condition. **(If the system is more than 500 volts, this program does not apply). Therma employees are not authorized to work equipment with voltages that exceed 500 volts.**

- 8.3.5. Before opening the access door or removing the panel to any energized system, put on the following personal protective equipment:
 - a. 8 calorie Flame Resistant (FR) long sleeve shirt and pants or cover-all (all undergarments must be 100% cotton);
 - b. Ear plugs;
 - c. Safety glasses;
 - d. Class E hard hat and balaclava;
 - e. 8 calorie arc-rated face shield;
 - f. Class 00 rubber gloves;
 - g. Leather protective gloves (over the rubber gloves); and
- 8.3.6. Be sure to use only properly rated voltage testers (multimeters) and ammeters to test electrical circuits. Visually inspect all testing equipment including the leads, cables, power cords, probes and connectors each time before you use them.
- 8.3.7. If you see any signs of damage do not use the equipment. Attach a “Danger – Do Not Use” sign to the equipment and take it out of service immediately. Remove the equipment from service and notify the owner.
- 8.3.8. Use all testing equipment in conformance with the manufacturers’ recommendations.
- 8.3.9. Only use the testing equipment that is provided by the company. Never rely on light-up type testing equipment. Always confirm voltage with voltmeter.
- 8.3.10. Do not allow “Unqualified Persons” to come within 10 feet of any system that is not in an electrically safe work condition. The system’s door or panel must be closed and there must be no exposed energized parts for an unqualified person to safely approach.
- 8.3.11. As soon as you have identified the problem, stand to one side of the circuit disconnection device. Shut off the power and lockout the device. Follow the company’s lockout procedures as described in this program. **(This step does not apply to systems with built-in interlocking disconnects).**

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- 8.3.12. Use only properly rated insulated tools to conduct troubleshooting as necessary to determine what's wrong with the system. Test instruments must be verified to be in proper working order before and after an absence of voltage test is performed. **The use of multi-tools (leather man) is strictly prohibited while servicing electrical equipment.**
- 8.3.13. Test the system to ensure that the power has been shut off.
- 8.3.14. Discharge any stored energy such as the current in the capacitors.
- 8.3.15. Once the system is "tested dead" you may remove your gloves, hard hat arc-rated face shield and ear plugs. Also, if necessary due to extreme heat or other conditions, you may remove your layer of Flame Resistant (FR) clothing. **(This step does not apply to systems with built-in interlocking disconnects. If you're working on a system a built-in interlocking disconnect, keep all of your personal protective equipment on at all times throughout the troubleshooting and /maintenance process.)**
- 8.3.16. Complete repairs/maintenance on the system.
- 8.3.17. Remove all of your tools and materials.
- 8.3.18. Close the access door or replace the panel.
- 8.3.19. Put on all personal protective equipment described in Step 5.
- 8.3.20. Remove the lockout device.
- 8.3.21. Stand to one side of the circuit disconnection device and reenergize the system.
- 8.3.22. Ensure that the structural integrity of the system (enclosure) is in good condition.
- 8.3.23. If you encounter any unusual first time procedures, write them down and report them to your supervisor. Give the supervisor a copy of your written procedures.

9. Lockout Procedures

- 9.1 Notify all affected persons that the power to the system(s) you will be working on will be shut off and that the circuit disconnection device will be locked out.
- 9.2 Shut off the power supply to the system.
- 9.3 Attach the proper lock and tag out devices to the circuit disconnection device to prevent anyone from accidentally starting the system while work is being performed.

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- 9.4 Attempt to operate the circuit disconnection device to ensure that the lockout device is working properly.
- 9.5 Discharge any stored energy such as the current in the capacitors.
- 9.6 Select the properly rated voltage detecting instrument and check it over carefully for visible damage. Do not use it if there is any indication of damage. Follow company procedures for taking the instrument out of service and select another properly rated, functioning instrument before proceeding.
- 9.7 Verify proper instrument operation and test the system for absence of voltage.
- 9.8 Verify proper instrument operation after testing for voltage.
- 9.9 Complete maintenance and/or repair on the system.
- 9.10 Verify that the job is complete and remove all tools and materials from the system.
- 9.11 Notify all affected persons that the lockout has been completed and the electrical supply is being restored. Instruct affected persons to stay away from the system and electrical supply.
- 9.12 Perform any necessary quality control tests or checks on the system.
- 9.13 Remove the lock and lockout device.
- 9.14 Notify affected persons that the electrical supply is ready to be returned to normal operation.
- 9.15 Turn on the power supply to the system.

10. Hazard/Risk Evaluation Procedures

- 10.1 Anytime work is performed on or near live electrical conductors or circuit parts that are between 50 and 500 volts, the potential for electrical shock, burns, arc-flash explosions, and other hazards exists. The risk of injury is significant only if the electrical safety program's safe work practices and procedures as described in this program are not followed accordingly. However, in addition to carefully following the safe work practices and procedures established by this program, field personnel should inspect/evaluate each system before starting work, determine appropriate safety related work practices, arc flash boundary requirements, and the PPE required to minimize the risk of electric shock. Assessments must be document and reviewed by all personnel prior to work commencement
- 10.2 Look for obvious signs of damage to the system, disconnects (where applicable), and conduit/wiring between service disconnects and the systems (where applicable).

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- 10.3 Look the systems over carefully for common causes of arc flash such as:
- Dust and other impurities that could provide a path for electrical current;
 - Corrosion, which can create impurities on insulating surfaces;
 - High humidity, rain or condensation that could result in water vapor on insulating materials, which can cause flashover to ground;
 - The potential for spark discharge caused by accidental tool or spare parts contacting exposed, energized parts; and
 - Anything else that could cause arc flash.
- 10.4 Report any unusual potential hazards to your supervisor before proceeding.
- 10.5 Conductors and parts of electrical equipment that have been de-energized but not locked out or tagged out shall be treated as live parts.

11. Overhead High-Voltage Lines:

- 11.1 Prior to working below or in close proximity to overhead high-voltage lines, the lines shall be de-energized and grounded or other protective measures shall be provided before work is started.
- 11.2 The following clearances shall be maintained while working below or in close proximity to overhead high-voltage lines:

<u>Voltage</u>	<u>Minimum Clearance Req.</u>
Up to 50 KV	10 ft.
50 KV to 200 KV	15 ft.
200 KV to 350 KV	20 ft.
350 KV to 500 KV	25 ft.
500 KV to 750 KV	35 ft.
750 KV to 1000 KV	45 ft.
Over 1000KV	(as established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).

12. Job Briefing Requirements:

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- 12.1 **Group leaders** will conduct a regular, short-term job briefing before the field personnel leave the shop for the field. He or she will cover anticipated electrical safety hazards, safe work practices and/or personal protective equipment issues as deemed necessary.
- 12.2 Any employee who discovers unique or unanticipated hazards shall report them to their supervisor. In turn, the supervisor will make the host employer aware of the hazard(s) as well as the measures used to correct and prevent them from occurring.