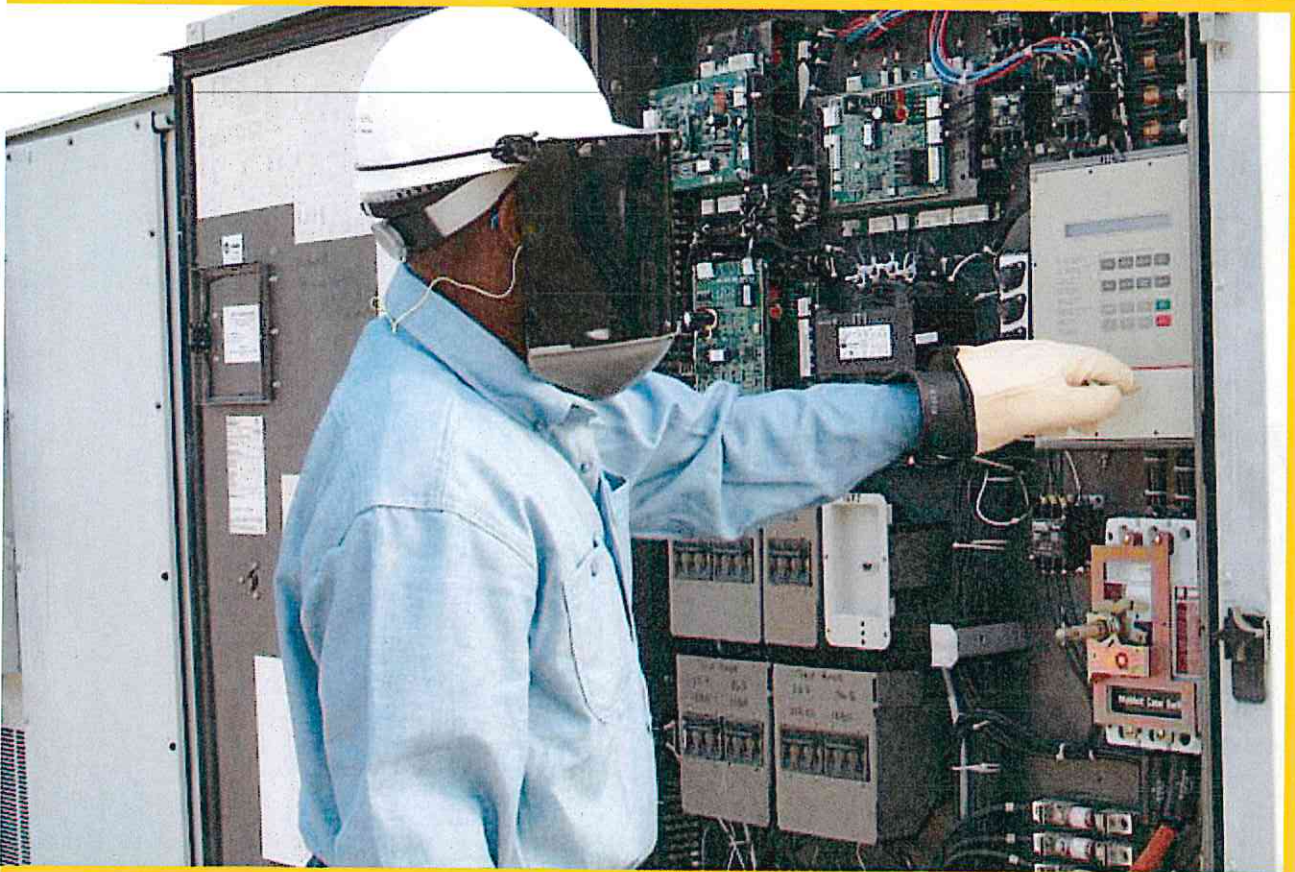


2009
Revision

MODEL NFPA 70E — *ELECTRICAL SAFETY IN THE WORKPLACE*



MCAA Safety Excellence Initiative



Introduction

In the mechanical service industry technicians are often required to work on energized electrical units to perform troubleshooting. This necessary practice exposes technicians to potential electrical shock and arc flash hazards. The effects of electrical shock and arc flash on the human body can be devastating. Fortunately, there are organizations like the National Fire Protection Association (NFPA) that help employers protect their workers from jobsite hazards. NFPA publishes the National Electrical Codes. An addendum to the codes, which is commonly referred to as NFPA 70E, is the current standard for electrical safety in the workplace.

NFPA 70E – 2009 states that each employer should implement an electrical safety program that directs activity appropriate for the voltage, energy level, and circuit condition. This model program, which is based largely on information from NFPA 70E – 2009, Article 130 – *Work Involving Electrical Hazards*, will help you develop an electrical safety program that is specific to your company's needs.

This model program is for mechanical service companies whose technicians perform work on or near exposed energized electrical conductors and/or circuit parts of HVAC units that are pushing 480 volts or less. Work on units pushing more than 480 volts may require more stringent protective measures, and more sophisticated personal protective equipment than what is required at 480 volts or less.

This model program is not intended to provide exhaustive treatment on the subject of electrical safety in the workplace as it pertains to the mechanical service industry. Further, it is not intended to provide legal advice. Employers must make independent determinations regarding the need for legal assistance.

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Instructions

This model program should be tailored to ensure that it meets the specific needs of your company and its workers. Filling in the blanks is only a part of what is necessary to develop an effective, written electrical safety program. However, this model should help make the process quick, easy and cost effective.

1. Read through the model program including the introduction.
2. Tailor the program as necessary by carefully going through each line, filling in the blanks, and making changes where appropriate. Obvious areas that require your attention are in bolded font and underlined.
3. Be sure not to leave any of the bolded, underlined font in your program. Delete these areas, which are only there to prompt you to take action.
4. Implement your Electrical Safety Program.

Electrical Safety Program

For

**Calcasieu Mechanical Contractors, Inc.
(CMC, Inc.)**

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Applicability

This electrical safety program is applicable to all Calcasieu Mechanical, Inc. mechanical service technicians **working on or near exposed, energized electrical conductors and/or circuit parts** on HVAC units/equipment pushing 480 volts or less. ***This program is not applicable to work on units/equipment pushing more than 480 volts.*** Work on units/equipment pushing more than 480 volts may require more stringent safe work practices, and more sophisticated personal protective equipment than what is described in this program.

Purpose

The purpose of this program is to:

- Make mechanical service technicians aware of the potential electrical hazards associated with work on HVAC units/equipment pushing 480 volts or less;
- Provide the technicians with the knowledge they need to protect themselves from potential electrical hazards while working on HVAC units/equipment pushing 480 volts or less;
- Establish safe work practices and procedures for the technicians working on HVAC units/equipment pushing 480 volts or less; and
- Develop self-discipline in the technicians who are required to work on or near HVAC units/equipment pushing 480 volts or less so that they will consistently follow the safe work practices and procedures established for Calcasieu Mechanical, Inc.

Electrical Safety Program Principles

The electrical safety program principles that apply to this program are as follows.

- Electrical safety inspection and evaluation of each HVAC unit/equipment;
- Maintenance of each unit's electrical insulation and the integrity of each unit's enclosure;
- Preplanning of every job;
- Documentation of any first time procedures;
- De-energizing of each unit immediately after troubleshooting is completed and before repair work/maintenance begins;
- Anticipation of unexpected events;
- Identification and minimization of potential hazards;
- The hazard/risk process that is to be used by technicians to evaluate tasks before starting work;
- Technician protection from shock, burn, blast, and other applicable hazards due to the work environment;
- Use of tools that are appropriate for the job;

- Assessment of the abilities of anyone who could be exposed to potential electrical hazards from repair or maintenance work on the HVAC units/equipment;
- Occasional audits of the aforementioned principles; and
- Protection of “*Unqualified*” persons.

Electrical Safety Program Controls

Calcasieu Mechanical, Inc. has established the following electrical safety program controls so that it can measure and monitor the electrical safety program.

- All affected technicians and their supervisors are responsible for ensuring that guards or protective measures are satisfactory for the conditions.
- All affected technicians will consider every electrical conductor or circuit part to be energized until it is shut off, tested dead, and locked out when lockout procedures are required.
- All affected technicians will consider the actual process of de-energizing an electrical conductor or circuit part to be a potentially hazardous task.
- All affected technicians will not make bare hand contact with exposed, energized electrical conductors and/or circuit parts.
- All affected technicians 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 technicians to work in the prescribed environment influenced by the presence of electrical energy.
- All affected technicians will receive a copy of this program.
- All affected technicians will obtain answers to any questions they have about the program before they begin work.
- All affected technicians will consistently implement this program.
- All affected technicians will use the procedures described in this program to identify potential electrical hazards associated with their work on HVAC units/equipment, and control or eliminate them.
- Only troubleshooting procedures will be used on exposed, energized electrical conductors and/or circuit parts unless the unit being serviced has a built-in interlocking disconnect.
- Where work is being performed on units/equipment with built-in interlocking disconnects, technicians will implement safe work practices, including use of the personal protective equipment required for work on all energized units/equipment with exposed, energized electrical conductors and/or circuit parts.
- All affected technicians must be alert when working on or near the units/equipment.

- Technicians must not perform work on the units/equipment while they are impaired by illness, fatigue, prescription drugs, nonprescription drugs, illegal drugs, alcohol or other impairments.
- Technicians must never reach blindly into areas that could contain exposed, energized electrical conductors and/or circuit parts.
- Technicians must ensure that their work areas are properly illuminated so that their work can be performed safely.
- Technicians must not wear conductive articles of jewelry and/or clothing.
- Any conductive objects being carried by a technician will be handled in a manner that prevents accidental contact with exposed, energized electrical conductors and/or circuit parts.
- Where a technician 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 electrical conductors and/or circuit parts.
- Housekeeping will not be performed where there is a possibility of contact with exposed, energized electrical conductors and/or circuit parts, unless barriers or insulating equipment is used to prevent contact.
- All affected technicians will identify and use the precautions that are appropriate for the work environment.

Training Requirements

All Calcasieu Mechanical, Inc. mechanical service technicians and supervisors will receive electrical safety training that is specific to work on HVAC units/equipment pushing 480 volts or less. The training will be substantive so that, coupled with the technicians' skills and knowledge related to the construction, operation and installation of the units/equipment, they will be considered "*Qualified Persons*." Training will be a combination of classroom and on-the-job training, which will include the following subjects.

- The contents of this electrical safety program, with emphasis on safe work practices, procedures and personal protective equipment requirements.
- The company's established *Qualified Person—Approach Boundary* for protection from electrical shock and arc flash hazards.
- Identification of electrical hazards associated with work on HVAC units/equipment pushing 480 volts or less.
- The decision making process necessary to determine:
 - the degree of the hazards;
 - the extent of the hazards; and
 - preplanning practices needed to perform the job safely.
- Techniques necessary to distinguish exposed, energized electrical conductors and/or circuit parts from other parts of electrical equipment.

- Techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts.
- Methods of protection from the electrical hazards.
- Skills necessary to select an appropriate voltage detector and to demonstrate how to use it to verify the absence of voltage, including interpreting indications provided by the device.
- Skills necessary to select properly rated tools.
- Selection, inspection and maintenance of personal protective equipment including pre-use leak testing, and biannual dielectric testing of protective rubber gloves.

Retraining will occur as follows:

- Anytime a supervisor or the results of an annual inspection indicate that the technician is not complying with the safety-related work practices.
- Whenever new technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those that the technician would normally use.
- Anytime a technician will have to employ safety-related work practices that are not normally used during his or her regular job duties.

Personal Protective Equipment (PPE) Requirements

PPE Required for Work on or Near HVAC Units/Equipment with Exposed, Energized Electrical Conductors and/or Circuit Parts Pushing 480 Volts or Less

<u>Voltage</u>	<u>Clothing</u>	<u>Gloves</u>	<u>Other PPE</u>
480 Volts or Less	Flame Resistant (FR) 8 Calorie ATPV Long Sleeve Shirt, Pants & Balaclava	Class 00 Rubber Gloves with Leather Protector Gloves	Safety Glasses, Class- E Hardhat with 8 Calorie ATPV Face Shield, Ear Plugs

Protective Clothing – Technicians will wear *long sleeve shirts, pants, and a balaclava made of Flame Resistant (FR) material*. The protective clothing 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.

Eye Protection – Standard *safety glasses* will be worn at all times by technicians while performing any mechanical service work. The safety glasses must be worn at all times, even while using an arc-rated face shield.

Head and Face Protection – Technicians will wear a *Class E hardhat* with an attached *arc-rated face shield*. The face shield will have a minimum Arc Thermal Protective Value (ATPV) of (8 cal/cm²).

Hearing Protection – Technicians will wear *ear canal inserts (ear plugs)*.

Hand Protection – Technicians will wear *Class 00 Rubber gloves* and *leather protector gloves* over the rubber gloves.

Rubber gloves must be dielectrically tested at a certified testing laboratory at least every six months. Technicians 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.

Electrical Safety Program Procedures

Calcasieu Mechanical, Inc. procedures for work on HVAC units/equipment pushing 480 volts or less are as follows.

Sequential Steps to Electrical Safety Program Procedures

Supervisors

1. Ensure that all of your technicians 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.
2. Conduct occasional audits to ensure that all of the electrical safety program principles established for Calcasieu Mechanical, Inc. are appropriate, and are being followed by the affected technicians.

Mechanical Service Technicians

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.

-
2. Anticipate unexpected events by thinking through all conceivable possibilities. Remain cognizant of possible unexpected events by giving your undivided attention/concentration to the task.
 3. Never approach a unit with exposed, energized electrical conductors and/or circuit 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.
-
4. Before opening the access door or removing the panel to any energized unit/equipment, inspect/evaluate it to ensure that you know its voltage capacity. All HVAC units/equipment are required to be labeled. The labels must show the available incident energy or the required level of personal protective equipment. If there is no label on the equipment/unit, report it in writing to the owner representative and to your supervisor. Also, ensure that all visible parts appear to be in good condition. **(If the unit is pushing more than 480 volts, this program does not apply. Before you proceed, obtain and follow an electrical safety program established for units/equipment pushing the higher voltage of the unit you will be servicing.)**
 5. Before opening the access door or removing the panel to any energized unit, put on the following personal protective equipment:
 - a. 8 calorie Flame Resistant (FR) long sleeve shirt, pants, and balaclava;
 - b. Ear plugs;
 - c. Safety glasses;
 - d. Class E hardhat with attached 8 calorie arc-rated face shield;
 - e. Class 00 rubber gloves;
 - f. Leather protective gloves (over the rubber gloves); and
 6. Be sure to use only properly selected/rated voltage testers (multimeters) and ammeters to test electrical circuits. Visually inspect all testing equipment including the leads, cables, power cords, probes and connectors before each use.
 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.
 8. Use all testing equipment in conformance with the manufacturers’ recommendations.

9. Only use the testing equipment that is provided by the company. Never use light-up-type testing equipment.
 10. Before testing voltage on electrical conductors and/or circuit parts test the meter on a known, live source. Then test the electrical conductors and/or circuit parts. Finish by testing the meter again on a known live source. If you detect any inconsistencies or discrepancies with the meter, take it out of service immediately as described above and repeat this process with a properly selected/rated replacement meter.
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11. Use only properly rated insulated tools to conduct troubleshooting as necessary to determine what's wrong with the unit.
 12. As soon as you have identified the problem, stand to one side of the external service disconnect. Shut off the power. Lockout the disconnect supplying the unit when lockout procedures are required (see Simple Lockout Procedures on page 13). If lockout is necessary, follow the company's lockout procedures as described in this program. **(This step does not apply to units/equipment with built-in interlocking disconnects).**
 13. Test the unit to ensure that the power has been shut off.
 14. Discharge any stored energy such as the current in the capacitors.
 15. Once the unit is "tested dead" and any stored electrical current has been discharged, you may remove your gloves, hardhat, arc-rated face shield, balaclava, and ear plugs. Also, if necessary due to extreme heat or other conditions, you may remove the Flame Resistant (FR) clothing. **(Step 15 does not apply to units/equipment with built-in interlocking disconnects. If you're working on a unit with a built-in interlocking disconnect, keep all of your personal protective equipment on at all times throughout the troubleshooting and repair/maintenance process.)**
 16. Complete repairs/maintenance on the unit.
 17. Remove all of your tools and materials from inside the unit.
 18. Close the access door or replace the panel.
 19. Put on all personal protective equipment described in Step 5.
 20. Remove the lockout device if applicable.

-
21. Stand to one side of the external service disconnect and start the power. (**This step does not apply to units/equipment with built-in interlocking disconnects.**)
 22. Ensure that the structural integrity of the unit (enclosure) is in good condition.
 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.
 24. Do not allow ***“Unqualified Persons”*** to come within 10 feet of any unit that is not in an electrically safe work condition. The unit’s door or panel must be closed and there must be no exposed energized electrical conductors and/or circuit parts for an unqualified person to approach safely.
-

Simple Lockout Procedures

Simple lockout procedures (which are detailed on page 14) will be used whenever equipment is de-energized for mechanical service work unless: (1) The technician will only be performing minor maintenance, servicing, adjusting, cleaning, and/or inspecting; (2) The disconnect is adjacent to the conductor, circuit parts and equipment being serviced; (3) The disconnect is clearly visible to the technician; and (4) The work does not extend beyond one shift.

Complex lockout procedures, which are not typically needed for mechanical service work, are necessary when there are multiple energy sources, multiple crews, multiple crafts, multiple locations, multiple employers, differing disconnects, particular sequences, and/or the job or task will continue for more than one work period. For more information on Complex Lockout Procedures see NFPA 70E – 2009 Article 120.2(D)(3)—*Complex Lockout/Tagout Procedures*.

Simple Lockout Procedures

- Be sure to follow all applicable steps described in the Electrical Safety Program Procedures.
- Notify all affected persons that the power to a unit(s)/equipment you will be working on will be shut off and that access to the external service disconnect will be locked out.
- Shut off the power supply to the unit.
- Attach the proper lockout device and lock to the external service disconnect to prevent anyone from accidentally starting the unit while work is being performed.

- Attempt to operate the external service disconnect to ensure that the lockout device is working properly.
 - Select the properly rated voltage detecting instrument and check it over carefully for visible damage. Test the meter on a known, live source. Then test the equipment/unit for absence of voltage. Finally, test the meter again on a known live source. If you detect any inconsistencies or discrepancies with the meter, take it out of service immediately as described above and repeat this process with a properly selected/rated replacement meter.
 - Discharge any stored energy such as the current in the capacitors.
 - Complete maintenance and/or repair on the unit.
 - Verify that the job is complete and remove all tools and materials from the unit.
 - Notify all affected persons that the lockout procedure has been completed and the electrical supply is being restored. Instruct affected persons to stay away from the unit and the electrical supply.
 - Perform any necessary quality control tests or checks on the unit.
 - Remove the lock and lockout device.
 - Turn on the power supply to the unit.
 - Notify affected persons that the electrical supply is ready to be returned to normal operation.
-

Hazard/Risk Evaluation Process

Anytime work is performed on or near energized HVAC units/equipment pushing 480 volts or less, the potential for electrical shock, burns, arc-flash explosions, and other hazards exists. The risk of injury is significant only if the safe work practices and procedures described in this program are not followed. However, in addition to carefully following the safe work practices and procedures established by this program, technicians are to inspect/evaluate each unit before starting work.

- Look for obvious signs of damage to the unit/equipment, disconnects (where applicable), and conduit/wiring between service disconnects and the unit/equipment (where applicable).
- Look the unit/equipment 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 electrical conductors and/or circuit parts; and
 - Anything else that could cause arc flash.
- Report any unusual potential hazards to your supervisor before proceeding.

Appendix A

Energized Electrical Work Permit

Energized Electrical Work Permits are not required when the work is done by *Qualified Persons* performing tasks such as testing, troubleshooting, and voltage measuring. However, at some point you may come across an owner who requires a permit. The sample permit on the following page may be tailored to help you comply with an owner's requirement that you establish a permit system.

**ENERGIZED ELECTRICAL WORK PERMIT FOR WORK
ON HVAC UNITS/EQUIPMENT PUSHING 480 VOLTS OR LESS**

Job/Work Order Number: _____

- Description of circuit/equipment/job location: _____

- Description of work to be done: _____
- Justification of why the circuit/equipment cannot be de-energized: _____

TO BE COMPLETED BY THE MECHANICAL SERVICE TECHNICIAN

Check When
Complete

- Job description procedure to be used in performing the above detailed work: _____ ☐
- Description of the safe work practices to be employed: _____ ☐
- Necessary personal protective equipment to safely perform the assigned task: _____ ☐
- Means employed to restrict the access of unqualified persons from the work area: _____ ☐
- Evidence of completion of a Job Briefing including discussion of any job-related hazards: _____ ☐

APPROVAL TO PERFORM THE WORK WHILE ELECTICALLY ENERGIZED

Company Supervisor

Date

Client Representative

Mechanical Service Technician

Safety Representative

Once the work is complete, give this form to your immediate supervisor.

Appendix B

Personal Protective Equipment Identification

Personal Protective Equipment Identification

The personal protective equipment needed by mechanical service technicians for work on HVAC units pushing 480 volts or less is shown below.

8 cal/cm² Long Sleeve Shirt and Pants



Class E Hardhat with 8 cal/cm² Arc-Rated Face Shield



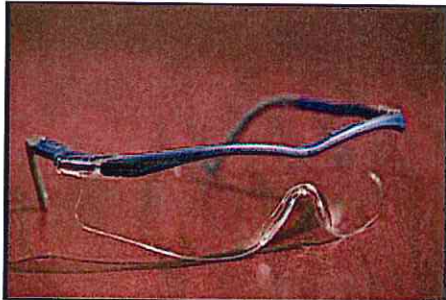
8 cal/cm² Balaclava



Class 00 Rubber Gloves



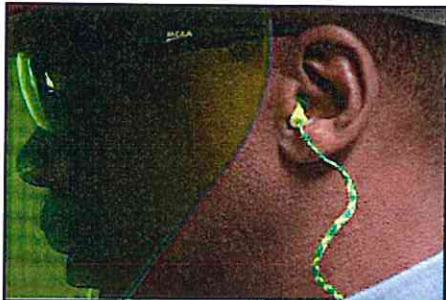
Standard Safety Glasses



Leather Gloves (Worn Over the Class 00 Rubber Gloves)



Ear Canal Inserts (Ear Plugs)



Item Code: MSSE6



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