



# Commonwealth of Massachusetts Executive Office of Labor and Workforce Development Department of Labor Standards

Executive Order #511

## **Electrical Safety for Electricians**

### Summary of Standards and Recommendations

*This summary of standards was prepared by the Massachusetts Department of Labor Standards (“DLS”) for informational purposes and does not constitute an official interpretation by OSHA or any other agencies/entities listed as a source of standards or guidance in this document, nor an exhaustive recitation of the requirements therein. Rather, the summary is provided for the health and safety committees to assess current health and safety management of this hazard against the nationally-recognized standard. As the information provided in this document is only a summary, please consult the full standard(s) as well as any other needed sources of technical assistance for developing or improving your electricians’ safety program.*

*It is important to note that state workers are not covered by OSHA standards; the information generated by the health and safety committees will serve to guide the Massachusetts Employee Safety and Health Advisory Committee in identifying effective and practical strategies and policies for improving the health and safety of state workers.*

#### Technical Standard or Guideline:

National Fire Protection Association (NFPA) 70E Standard for Electrical Safety in the Workplace\*, 2009 Edition

National Fire Protection Association (NFPA) Electrical Safety Program Guide is a useful tool in practical implementation of the 70E standard.

Note 1: The scope of this hazard assessment is limited to interior electrical work only. Work on power transmission lines bringing power to a building falls under a different safety standard (OSHA 29 CFR 1926 {Construction Industry Standards} Subpart V – Power Transmission and Distribution), and is not covered in this document. The health and safety committees do not need to assess power line work hazards at this time as part of the current assessments being conducted.

Note 2: Lockout/tagout requirements for control of hazardous energy to electrical infrastructure (such as panel boxes, wiring, etc.) generally fall under the NFPA 70E standard, and is covered in this document. Control of hazardous electricity during repair and maintenance of electrified machinery and equipment generally falls under the OSHA 1910.147 standard, and is covered in the answers document for Lockout/Tagout. The same basic safety principles and steps for lockout/tagout are used in both of these standards.

*\* This is the primary national or state standard/guideline for this hazard. Your agency may be following an internal standard of practice or a standard from another source for this hazard. For the gap analysis, if you are following a standard other than the primary worker protection standard listed above, please indicate which standard, if any, is being followed by your agency. If this is an internal standard of practice, please report the basis upon which the determination was made to adopt the standard.*

Other Electrical Standards:

OSHA 29 CFR 1910 (General Industry Standards), Subpart S Electrical Work. This standard contains worker protection requirements as well as general electrical safety requirements (covered under the Electrical – General document). Worker protection requirements in this standard are based on previous editions of the NFPA 70E Standard. Following the most current version of the NFPA 70E standard is recommended by DOS. The current NFPA 70E standard is more protective and following this standard will also ensure compliance with OSHA requirements.

NFPA 70 National Electrical Code, 2011 Edition. This standard describes how to design and install electrical systems but does not cover safety measures for performing this work.

Massachusetts Electrical Code, 527 CMR 12.00, Board of Fire Prevention. This covers permitting requirements from local authorities for conducting electrical work. This standard does not cover safety measures for workers performing electrical work.

If electrical work conducted by your employees falls under a standard not listed above:

Use the key concepts provided in this document for the NFPA 70E standard to assess protections for electrical work being conducted by your employees. The major concepts are:

- Employees who will conduct electrical work have sufficient training to recognize, understand, and protect themselves from electrical hazards for the tasks they will be doing. Note that safety training in NFPA 70E is not required as part of licensing, so do not automatically assume that licensed electricians have this knowledge.
- Do not work live unless shutting off power is truly infeasible (note that inconvenient does not mean infeasible). If live work does occur, this must be carefully evaluated, planned for, and approved, e.g., through use of a live work permit. Live work should rarely, if ever, be necessary.
- Use lockout/tagout procedures to ensure that the source of power is shut off and remains off to the equipment/device/section of electrical infrastructure that is

- being worked on. This includes having accurate knowledge of all sources of power into the equipment/device/electrical circuit, for example through current and accurate diagrammatic drawings.
- Employees have a readily available source of information or have enough training to accurately identify what protective practices and protective equipment are needed before they start each work task.
  - All of the needed protective equipment (e.g., insulated tools, insulating gloves, line hose, etc.) is readily available to every employee conducting electrical work so they can safely conduct every task assigned to them.
  - Insulating equipment is properly inspected, maintained, and tested to ensure that insulating properties are still in place.

Highlights of the NFPA 70E Standard:

This standard uses a four-step approach for safe electrical work:

1. **Turn Off the Power/ Do Not Work Live.** Working live is only allowable when working de-energized is not feasible or will lead to a greater hazard. Not feasible means truly not possible, NOT inconvenient. When de-energizing is not feasible, use of methods 2 through 4 below is required.
2. **Live Work Permit.** Use an energized electrical work permit. Live work must be authorized by the customer, engineers, or other person in charge.
3. **Plan the Work.** Have a written plan for conducting the live work safely.
4. **Use Personal Protective Equipment (PPE).** This includes flame-resistant clothing, insulated tools, face shields, and flash suits. The specific set of PPE for each task must be selected in accordance with the NFPA 70E standard.

Policy:

A policy to follow the most current version of the NFPA 70E is strongly recommended. This should include as a matter of policy to eliminate live work, with only very limited and necessary exceptions allowed (for example life support equipment with no alternate energy source). De-energizing is not required at voltage levels of 50 volts or less. *Stopping the practice of working live when this is not necessary is the strongest and most effective measure you can take to prevent electrocutions, electrical shocks, electrical burns, flash burns, and other electrically-related injuries and fatalities.*

## Training and Certification/Licensing Requirements:

### *Training*

The NFPA 70E indicates that employees who face a risk of exposure to unsafe levels of electricity shall be trained:

- To understand the specific hazards associated with electrical energy and the relationship between electrical hazards and possible injury.
- In safety-related work practices and procedural requirements necessary to provide protection from electrical hazards associated with their job and job tasks. This includes:
  - Use of precautionary techniques.
  - Personal protective equipment including: arc-flash, insulating and shielding materials, and insulated tools and test equipment.
  - Knowledge of the construction and operation of specific electrical equipment or a specific work procedure to avoid electrical hazards associated with specific electrical equipment.
  - Appropriate use of voltage detectors to verify the absence of voltage.
  - Emergency Procedures (e.g., release of victims from contact with exposed energy)
- Employees working with potential exposure to 50 volts or greater require additional training including: the skills and techniques to distinguish exposed energized electrical conductor and circuit parts and the nominal voltage of exposed parts, approach distances, and the decision-making process necessary to determine needed PPE and job planning.

### *Licensing*

Under MGL Chapter 141, Supervision of Electricians, “No person, firm or corporation shall enter into, engage in, or work at the business or occupation of installing wires, conduits, apparatus, devices, fixtures, or other appliances for carrying or using electricity for light, heat, power, fire warning or security system purposes, unless such person, firm or corporation shall be licensed by the state examiners of electricians in accordance with this chapter and, with respect to security systems, unless such person, firm or corporation shall also be licensed by the commissioner of public safety in accordance with the provisions of sections fifty-seven to sixty-one, inclusive, of chapter one hundred and forty-seven.”

Becoming a licensed electrician will require extensive apprentice work as well as passing written exams.

Note that knowledge of NFPA 70E is not part of the electrician's licensing requirements. Therefore, even though employees may be licensed electricians, this in no way ensures that they have sufficient knowledge of the practices and equipment necessary to keep them safe while conducting electrical work. Keeping your electricians safe will require additional training, policies, and procedures beyond the licensing requirements.

The link to the Massachusetts Board of State Examiners of Electricians is below:

<http://www.mass.gov/?pageID=ocasubtopic&L=4&L0=Home&L1=Licensee&L2=Division+of+Professional+Licensure+Boards&L3=Board+of+State+Examiners+of+Electricians&sid=Eoca>

Engineering Controls – Requirements:

None.

Administrative Controls – Requirements:

Designation of an electrical safety program manager is recommended.

A **Lockout/Tagout** program including the lockout/tagout program elements and lockout/tagout process/procedures outlined below.

Process for Achieving an Electrically Safe Work Condition:

- Determine all possible sources of electrical supply to the specific equipment.
- After properly interrupting the load current, open the disconnecting devices for each source.
- When possible, visually verify that all blades of the disconnecting devices are fully open or that drawout-type circuit breakers are withdrawn to the fully disconnected position.
- Apply lockout/tagout devices in accordance with your written policy.
- Use voltage testing to verify that de-energization has occurred. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground.
- Where the possibility of induced voltages or stored electrical energy exists, ground the phase conductors and circuit parts before touching them. Where deenergized conductors or parts could reasonably contact energized conductors or parts, apply ground connecting devices rated for the available fault duty.

Lockout/Tagout Program Principles and Execution

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- Written energy control procedures including lockout/tagout appropriate for the experience and training of employees and conditions as they exist in the workplace.
- Assume that all electrical circuit conductors and circuit parts are energized until the process for achieving an electrically safe work condition as outlined above has been fully executed.
- Involvement of each employee who could be exposed to a source of electrical energy, directly or indirectly, in the lockout/tagout process.
- Training of all employees who could be exposed in understanding the written energy control procedures and their duties within these procedures.
- A lockout/tagout plan based on existing electrical equipment and systems, using up-to-date diagrammatic drawings as the basis.
- Control of electrical energy to minimize employee exposure to electrical hazards.
- Use of a unique device such that it is readily identifiable as a lockout/tagout device.
- Voltage shall be removed and absence of voltage verified.
- Coordination of electrical lockout/tagout procedures with all other lockout/tagout procedures associated with other forms of stored energy (hydraulic pressure, kinetic energy, etc.).
- Lockout/tagout procedures for hazardous electrical control may be of three types listed below. A sample lockout/tagout procedure from the NFPA 70E including all three types is attached to this document.
  - Individual employee control
  - Simple lockout/tagout
  - Complex lockout/tagout.

**Energized Electrical Work Permit.** Energized electrical conductors and parts to which an employee might be exposed shall be put into an electrically safe work condition, which includes deenergization, with the following exceptions:

- If deenergizing will lead to a greater hazard, such as interruption of life support equipment or hazardous location ventilation equipment.
- If deenergization is not feasible due to equipment design or operational limitations.
- If energized electrical conductors and circuit parts operate at less than 50 volts to ground, and assessment of source capacity and overcurrent protection shows that there will be no increased exposure to electrical burns or explosion due to electric arcs.

When an employee will be working on energized electrical conductors or parts due to a greater hazard or infeasibility, a written Energized Electrical Work Permit (aka Live Work Permit) is required. This includes:

- A description of the circuit and equipment to be worked on and their location.
- Justification for why the work must be conducted in an energized condition.

- A description of the safe work practices to be used.
- Results of the shock hazard analysis.
- Determination of shock protection boundaries (limited approach boundary, restricted approach boundary, and prohibited approach boundary).
- Results of the arc flash hazard analysis.
- The arc flash protection boundary.
- The necessary PPE to safely perform the task.
- Means to keep unqualified persons out of the work area.
- Evidence of a job briefing, including any job-specific hazards.
- Energized work approval.

**Insulating PPE and other insulating equipment must be periodically tested** to ensure their insulating abilities are still present. Testing must occur as per manufacturer's requirements or the relevant ANSI standard. Ensure that back-up PPE and equipment is available to cover the period when equipment is sent out for testing. For example, purchase two pairs of insulated gloves so one is available during the period every six months when gloves must be sent out for testing.

**Electrical Job Planning.** Use of electrical task assessments (attached) is recommended. Developing written procedures for all electrical work tasks is also recommended.

#### Equipment Controls – Requirements:

The required safety equipment and PPE will vary greatly depending on the energetic level (e.g., voltage) and the risk of electrical exposure with the task being performed. The key is to ensure that the energetic level (e.g., voltage) and task hazard level are understood in advance of starting work, so that the appropriate PPE and insulating equipment is selected and used. Very detailed guidance on the varying PPE requirements is provided in the NFPA 70E. Types of insulating equipment and PPE are listed below:

#### **Rubber Insulating Equipment**

- Blankets
- Covers
- Line hose

#### **Personal Protective Equipment (PPE).**

- Leather gloves
- Rubber insulating gloves (selected for appropriate voltage)
- Rubber insulating sleeves
- Insulated hand tools
- Insulated footwear

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- Nonconductive head protection
- Nonconductive face protection
- Eye protection (with risk of electric arcs or explosions)
- Fire Resistant (FR) clothing
- Arc flash jacket and pants

To ensure that employees are adequately protected with PPE while performing electrical work, you should have “yes” answers to the following questions.

- Are employees able to easily identify the appropriate PPE for the work they will perform?
  - Do employees have readily available information to determine what is the voltage rating and hazard/risk level for the work they will perform? OR
  - Are employees provided with task-based lists or guidance for what PPE should be worn? OR
  - Do supervisors select the necessary level of PPE for employees for each task? OR
  - Have employees have received sufficient training to accurately select the necessary PPE for all tasks they perform? OR
  - Is another method used so that employees can readily determine the appropriate PPE?
- Is the full range of needed PPE readily available to all employees conducting electrical work?
- Is all PPE used by employees in good condition, such that it still provides the intended electrical (insulation) or burn protection?
- Is there a method of accountability to ensure that employees always use required PPE?
- Has the PPE been appropriately tested and maintained? (e.g., gloves voltage tested every 6 months, arc flash clothing laundered in accordance with manufacturer’s specifications)

*Additional Safety Equipment*

- If lockout/tagout is required, necessary locks (keyed or combination) and any other needed hardware for isolating/blocking energy must also be available.
- A voltage detector is needed if voltage testing to confirm de-energization is required as part of lockout/tagout.

Web link to full standard or guideline:

*Informational resources identified below can also be found on our website at [www.mass.gov/dols/eo511](http://www.mass.gov/dols/eo511).*

The NFPA 70E is not available for free download from NFPA. The document can be viewed for free in read-only mode from the NFPA website, you will need to log in as a visitor to access the document:

<http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=70E&cookie%5Ftest=1>

The NFPA 70E can be purchased from NFPA for \$48.50 as a book or pdf file at the NFPA website [www.nfpa.org](http://www.nfpa.org):

<http://www.nfpa.org/catalog/category.asp?category%5Fname=Codes+and+Standards&Page=19&sort=codenum>

The NFPA Electrical Safety Program Guide can be purchased from NFPA as a book for \$106.95 from the NFPA website [www.nfpa.org](http://www.nfpa.org):

<http://www.nfpa.org/catalog/product.asp?pid=ESM10&query=electrical+safety+program+guide&target%5Fpid=ESM10&link%5Ftype=search>

OSHA Standards:

[www.osha.gov](http://www.osha.gov), select the “Regulations” tab from the top menu bar. For 1910 standards select the “General Industry” tab. For 1926 standards, select the “Construction” tab. Then, scroll down to find the standard by number.

OSHA 29 CFR 1910 (General Industry Standards), Subpart S - Electrical