# NFPA 70E

## *Standard for Electrical Safety in the Workplace*

## *2018 Edition*

ES Squared, Inc.

# COPYRIGHT NOTICE



# LIABILITY STATEMENT

Due to the constantly changing nature of government regulations, it is impossible to guarantee absolute accuracy of the material contained in this document. The author, editors and auxiliaries, therefore, cannot assume any responsibility for omissions, errors, misprinting, or ambiguity contained within this material and shall not be held liable in any degree for any loss or injury caused by such omission, error, misprinting or ambiguity presented in this paper.

This document is designed to provide reasonably accurate and authoritative information in regard to the subject matter covered. It is provided with the understanding that ES Squared, Inc. is not engaged in rendering legal or other professional service. If legal advice or other expert assistance is required, the services of a competent professional person should be obtained.

ES Squared, Inc.
1414 Woodbourne Avenue
Pittsburgh, PA 15226-2428
(330) 607-2139
contactus@es2safety.com

2015

2012

2009

2004

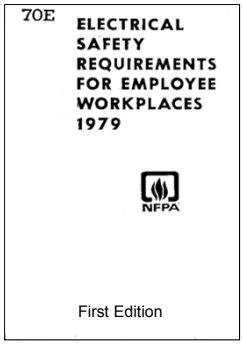
2000

1995

1988

1983

1981


This presentation assumes you have at least a basic knowledge of the NFPA 70E standard. Ask questions if you need to!

## 2018 Edition Global Changes

- All mathematical symbols are replaced with alphanumeric values
  - "≤" to "Less than or equal to"
- "Accident" is changed to "incident"
- "Accidental" is changed to "unintentional"
- "Short circuit current" is changed to "available fault current"


contactus@es2safety.com www.es2safety.com

## 2018 Edition Global Changes

- Cal/cm$^2$ will be used as the primary value
  - J/cm$^2$ will be in parenthesis
- Boundary, Arc Flash. When an arc flash hazard exists, an approach limit from an arc source at which incident energy equals 1.2 cal/cm$^2$ (5 J/cm$^2$).
  - Informational Note: According to the Stoll skin burn injury model, the onset of a second degree burn on unprotected skin is likely to occur at an exposure of 1.2 cal/cm$^2$ (5 J/cm$^2$) for one second.

## 2018 Edition Global Changes

Shaded text = Revisions.
△ = Text deletions and figure/table revisions.
• = Section deletions.
***N*** = New material.

All “required” standards are no longer part of requirements, and therefore only referenced, per NFPA Technical Correlating Committee

## 2018 Edition Global Changes

- The DC voltage threshold in all locations of the standard (except Article 350) is back to 50 VDC, instead of 100 VDC.

N **Table 130.4(D)(b) Shock Protection Approach Boundaries to Exposed Energized Electrical Conductors or Circuit Parts for Direct-Current Voltage Systems**

| (1) | (2) | (3) | (4) |
|---|---|---|---|
| | Limited Approach Boundary | | Restricted Approach Boundary; Includes Inadvertent Movement Adder |
| Nominal Potential Difference | Exposed Movable Conductor* | Exposed Fixed Circuit Part | |
| Less than 50 V | Not specified | Not specified | Not specified |
| 50 V–300 V | 3.0 m (10 ft 0 in.) | 1.0 m (3 ft 6 in.) | Avoid contact |
| 301 V–1 kV | 3.0 m (10 ft 0 in.) | 1.0 m (3 ft 6 in.) | 0.3 m (1 ft 0 in.) |
| 1.1 kV–5 kV | 3.0 m (10 ft 0 in.) | 1.5 m (5 ft 0 in.) | 0.5 m (1 ft 5 in.) |
| 5 kV–15 kV | 3.0 m (10 ft 0 in.) | 1.5 m (5 ft 0 in.) | 0.7 m (2 ft 2 in.) |
| 15.1 kV–45 kV | 3.0 m (10 ft 0 in.) | 2.5 m (8 ft 0 in.) | 0.8 m (2 ft 9 in.) |
| 45.1 kV– 75 kV | 3.0 m (10 ft 0 in.) | 2.5 m (8 ft 0 in.) | 1.0 m (3 ft 6 in.) |
| 75.1 kV–150 kV | 3.3 m (10 ft 8 in.) | 3.0 m (10 ft 0 in.) | 1.2 m (3 ft 10 in.) |
| 150.1 kV–250 kV | 3.6 m (11 ft 8 in.) | 3.6 m (11 ft 8 in.) | 1.6 m (5 ft 3 in.) |
| 250.1 kV–500 kV | 6.0 m (20 ft 0 in.) | 6.0 m (20 ft 0 in.) | 3.5 m (11 ft 6 in.) |
| 500.1 kV–800 kV | 8.0 m (26 ft 0 in.) | 8.0 m (26 ft 0 in.) | 5.0 m (16 ft 5 in.) |

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.
**Exposed movable conductor* describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

## 2018 Edition Global Changes

- "Maintains", "maintain" and "maintained" are changed to other words, as appropriate:
  - Section 130.7(D)(1)(i), "*While the barrier is being installed, the restricted approach boundary distance specified in Table 130.4(D)(a) and Table 130.4(D)(b) shall be ~~maintained~~ adhered to, or the energized conductors or circuit parts shall be placed in an electrically safe work condition.*

2018 Edition Global Changes

- New Section 110.1(H) Job Safety Planning
- All training requirements are now in 110.2
  - LOTO training moved from Article 120
- All auditing requirements are in 110.1(K)
  - LOTO auditing moved from Article 120
- Article 120 reorganized to be more user friendly

2018 Change

**90.2 – Scope**

- (A) Covered. This standard addresses electrical safety-related work practices, safety-related maintenance requirements, and other administrative controls for employee workplaces that are necessary for the practical safeguarding of employees relative to the hazards associated with electrical energy during activities such as the installation, removal, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways.

## 90.2 – Scope

- (A) Covered. ... This standard also includes safe work practices for employees performing other work activities that can expose them to electrical hazards as well as safe work practices for the following:

  (1) Installation of conductors and equipment that connect to the supply of electricity

  (2) Installations used by the electric utility, such as office buildings, warehouses, garages, machine shops, and recreational buildings that are not an integral part of a generating plant, substation, or control center

## 90.4(D) – Informative Annexes

2018 Change

- Nonmandatory information relative to the use of this standard is provided in informative annexes. Informative annexes are not part of the requirements of this standard, but are included for information purposes only.

## 2018 Edition Changes

| 2015 NFPA 70E | 2018 NFPA 70E |
|---|---|
| • **Arc Flash Hazard.** | • **Arc Flash Hazard.** |
| A dangerous condition associated with the possible release of energy caused by an electric arc. | A source of possible injury or damage to health associated with the release of energy caused by an electric arc. |

## 2018 Edition Changes

2018 Change

| 2015 NFPA 70E | 2018 NFPA 70E |
|---|---|
| • New | • **Electrical Safety Program.** A documented system consisting of electrical safety principles, policies, procedures, and processes that directs activities appropriate for the risk associated with electrical hazards. |

2018 Change

## 2018 Edition Changes

| 2015 NFPA 70E | 2018 NFPA 70E |
|---|---|
| • New | • **Fault Current.** The amount of current delivered at a point on the system during a short-circuit condition. |
| | • **Fault Current, Available.** The largest amount of current capable of being delivered at a point on the system during a short-circuit condition. |

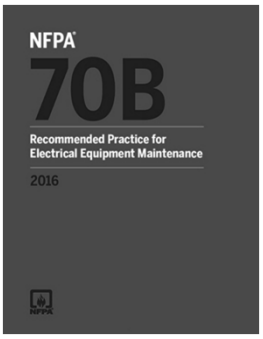
2018 Change

## 2018 Edition Changes

| 2015 NFPA 70E | 2018 NFPA 70E |
|---|---|
| • New | • **Maintenance, Condition of.** The state of the electrical equipment considering the manufacturers' instructions, manufacturers' recommendations, and applicable industry codes, standards, and recommended practices. |

## 2018 Edition Changes

2018 Change




- **110.1(~~B~~C) Condition of Maintenance.**

The electrical safety program shall include elements that consider condition of maintenance of electrical equipment and systems.

## 2018 Edition Changes

2018 Change

2015 NFPA 70E

- **Qualified Person.**

One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoid the hazards involved.

2018 NFPA 70E

- **Qualified Person.**

One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify the hazards and reduce the associated risk.

## 2018 Edition Changes

2018 Change

2015 NFPA 70E

- **Risk Assessment.**

An overall process that identifies hazards, estimates the potential severity of injury or damage to health, estimates the likelihood of occurrence of injury or damage to health, and determines if protective measures are required.

2018 NFPA 70E

- **Risk Assessment.**

An overall process that identifies hazards, estimates the likelihood of occurrence of injury or damage to health, estimates the potential severity of injury or damage to health, and determines if protective measures are required.

## Risk Assessment

Combination of: Likelihood and Severity

| | Negligible | Minor | Moderate | Significant | Severe |
|---|---|---|---|---|---|
| Very Likely | Low Med | Medium | Med Hi | High | High |
| Likely | Low | Low Med | Medium | Med Hi | High |
| Possible | Low | Low Med | Medium | Med Hi | Med Hi |
| Unlikely | Low | Low Med | Low Med | Medium | Med Hi |
| Very Unlikely | Low | Low | Low Med | Medium | Medium |

## Risk Assessment

### Acceptable (Tolerable) Risk

| | Negligible | Minor | Moderate | Significant | Severe |
|---|---|---|---|---|---|
| Very Likely | Low Med | Medium | Med Hi | High | High |
| Likely | Low | Low Med | Medium | Med Hi | High |
| Possible | Low | Low Med | Medium | Med Hi | Med Hi |
| Unlikely | Low | Low Med | Low Med | Medium | Med Hi |
| Very Unlikely | Low | Low | Low Med | Medium | Medium |

## 2018 Edition Changes

2018 Change

### 2015 NFPA 70E

- **Shock Hazard.**

A dangerous condition associated with the possible release of energy caused by contact or approach to energized electrical conductors or circuit parts.

### 2018 NFPA 70E

- **Shock Hazard.**
- A source of possible injury or damage to health associated with current through the body caused by contact or approach to energized electrical conductors or circuit parts.

*Informational Note: Injury and damage to health resulting from shock is dependent on the magnitude of the electrical current, the power source frequency (e.g., 60 Hz, 50 Hz, dc), and the path and time duration of current through the body. The physiological reaction ranges from perception, muscular contractions, inability to let go, ventricular fibrillation, tissue burns, and death.*

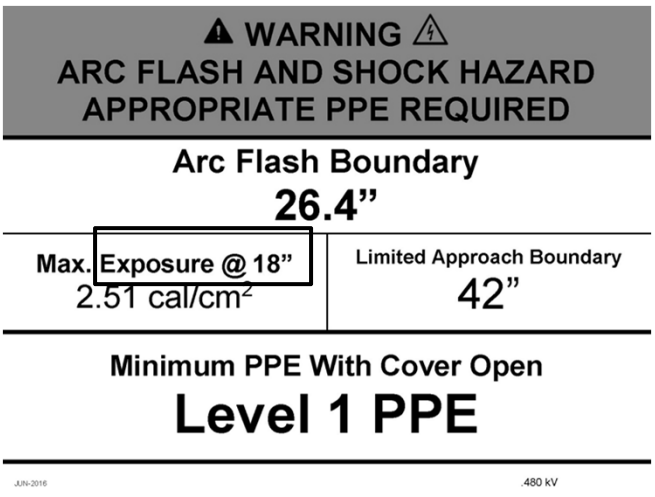
## 2018 Edition Changes

2018 Change

| 2015 NFPA 70E | 2018 NFPA 70E |
|---|---|
| • New | • **Working Distance.** The distance between a person's face and chest area and a prospective arc source. |

## 130.5(H) – Equipment Labeling

2018 Change



***N*** = New material.

2018 Change

105.3 – Responsibility

(A) Employer Responsibility: The employer shall have the following responsibilities:

(1) Establish, document, and implement the safety-related work practices and procedures required by this standard.

(2) Provide employees with training in the employer's safety related work practices and procedures.

***N*** = New material.

2018 Change

105.3 – Responsibility

(B) Employee Responsibility

The employee shall comply with the safety-related work practices and procedures provided by the employee.

***N*** = New material.

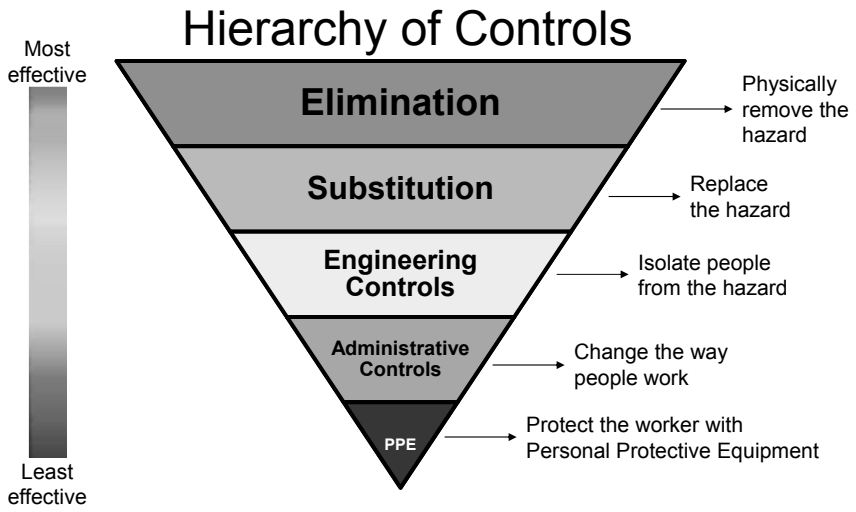
2018 Change

## 2018 Edition Changes

105.4 Priority.

Hazard elimination shall be the first priority in the implementation of safety-related work practices.

## 110.1(H) – Safety Program



## Hierarchy of Controls - Elimination

Example Permanently-Mounted Voltage Detectors



## Hierarchy of Controls - Substitution

### Arc-reducing maintenance switching

- Manually or Automatically enables an instantaneous pickup
- Trip Times May Vary Between Manufacturers
  - Some may be same as Instantaneous
  - Some my be faster than Instantaneous
- Reduces arc energy to downstream equipment/personnel
- Limits energy available during maintenance


Door Mounted Hardware

EXAMPLE:

•Normal settings calculates to 10.7 cal (Cat. 3)

**•With Arcflash Reduction Maintenance Switch 2.2 cal (Cat. 1)**

EATON
Powering Business Worldwide

New Technologies?


Follow-ups?

110.1(A) – Safety Program

- The employer shall implement and document an overall electrical safety program that directs activity appropriate to the risk associated with electrical hazards. The electrical safety program shall be implemented as part of the employer's overall occupational health and safety management system, when one exists.

***N*** = New material.

2018 Change

## 2018 Edition Changes


- **110.1(B) Inspection**

The electrical safety program shall include elements to verify that newly installed or modified electrical equipment or systems have been inspected to comply with applicable installation codes and standards prior to being placed in service.

2018 Change

## 110.1(H) – Safety Program

**(H) Risk Assessment Procedure.** The electrical safety program shall include a risk assessment procedure and shall comply with:

**(1) Elements of a Risk Assessment Procedure.**

The risk assessment procedure shall address employee exposure to electrical hazards and shall identify the process to be used by the employee before work is started to carry out the following:

(1) Identify hazards

(2) Assess risks

(3) Implement risk control according to the hierarchy of risk control methods

***N*** = New material.

2018 Change

110.1(H) – Safety Program

**(2) Human Error.**

The risk assessment procedure shall address the potential for human error and its negative consequences on

people,

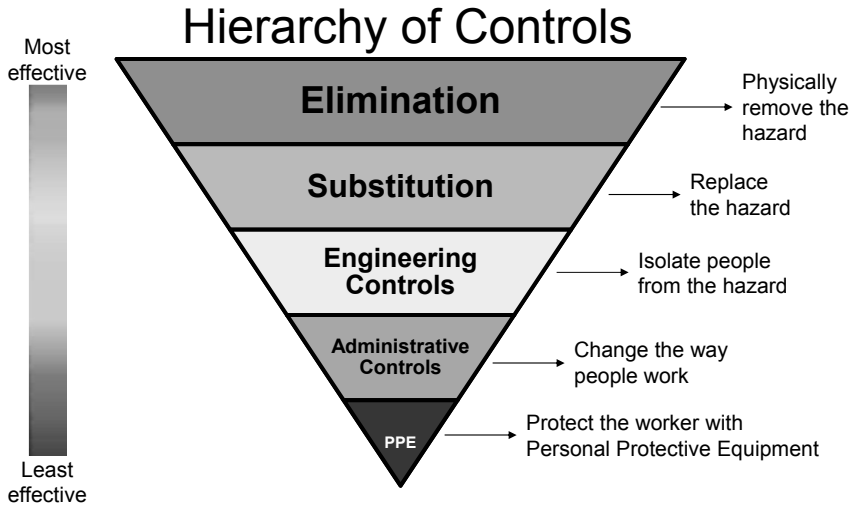
processes,

the work environment,

and equipment.

**Annex Q**

110.1(H) – Safety Program



2018 Change

110.1(H) – Safety Program

**(3) Hierarchy of Risk Control Methods.**
*[no longer a Fine Print Note]*

The risk assessment procedure shall require that preventive and protective risk control methods be implemented in accordance with the following:

(1) Elimination

(2) Substitution

(3) Engineering controls

(4) Awareness

(5) Administrative Controls

(6) PPE

2018 Change

110.1(I) – Safety Program

**Job Safety Planning and Job Briefing.**

Before starting each job that involves exposure to electrical hazards, the employee in charge shall complete a job safety plan and conduct a job briefing with the employees involved.

***N*** = New material.

2018 Change

110.1(I) – Safety Program

**(1) Job Safety Planning.**

The job safety plan shall be in accordance with the following:

(1) Be completed by a qualified person

(2) Be documented

***N*** = New material.

2018 Change

110.1(I) – Job Safety Planning
(continued)

**(3) Include the following information:**

a. A description of the job and the individual tasks
b. Identification of the electrical hazards associated with each task
c. A shock risk assessment in accordance with 130.4 for tasks involving a shock hazard
d. An arc flash risk assessment in accordance with 130.5 for tasks involving an arc flash hazard
e. Work procedures involved, special precautions, and energy source controls

***N*** = New material.

2018 Change

110.1(I) – Safety Program

**(2) Job Briefing.**

The job briefing shall cover the job safety plan and the information on the energized electrical work permit, if a permit is required.

***N*** = New material.

2018 Change

110.1(I) – Safety Program

**(3) Change in Scope.**

Additional job safety planning and job briefings shall be held if changes occur during the course of the work that might affect the safety of the employee.

***N*** = New material.

2018 Change

110.1(J) – Safety Program

**Incident Investigations.**

The electrical safety program shall include elements to investigate electrical safety incidents.

***N*** = New material.

2018 Change

110.1(K) – Safety Program

**(3) Lockout/Tagout Program and Procedure Audit.**

The lockout/tagout program and procedures required by Article 120 shall be audited by a qualified person at intervals not to exceed 1 year. The audit shall cover at least one lockout/tagout in progress. The audit shall be designed to identify and correct deficiencies in the following:

***N*** = New material.

2018 Change

110.1(K)(3) – Safety Program

…identify and correct deficiencies in the following:

(1) The lockout/tagout program and procedures

(2) The lockout/tagout training

(3) Worker execution of the lockout/tagout procedure

*Auditing of LOTO already required by OSHA 10 CFR 1910.147, but electrical is excluded.*

2018 Edition Changes

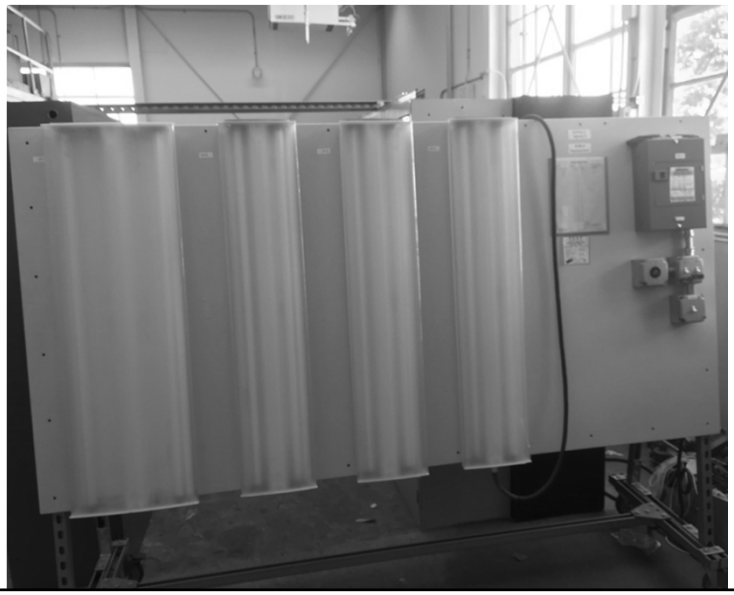
- Section 110.2
  - Rearranged so that “Qualified” is now (A)(1)

110.2(A)(1)(e) – Qualified Training

Employees shall be trained to select an appropriate test instrument and shall demonstrate how to use a device to verify the absence of voltage, including interpreting indications provided by the device. The training shall include information that enables the employee to understand all limitations of each specific test instrument that may be used.

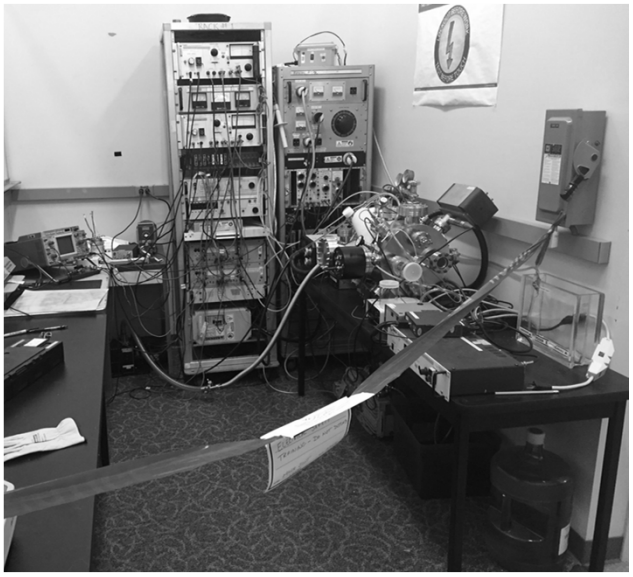
Demonstration Examples

Demonstration Examples



Demonstration Examples

## Demonstration Examples



## Demonstration Examples

## 110.2(A)(3)

2018 Change

Retraining. Retraining in safety-related work practices and applicable changes in this standard shall be performed at intervals not to exceed 3 years. An employee shall receive additional training (or retraining) if any of the following conditions exists:

(1) The supervision or annual inspections indicate the employee is not complying with the safety-related work practices.

(2) New technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices different from those that the employee would normally use.

(3) The employee needs to review tasks that are performed less often than once per year.

(4) The employee needs to review safety-related work practices not normally used by the employee during regular job duties.

(5) The employee's job duties change.

***N*** = New material.

2018 Change

## 110.1(B) – LOTO Procedure Training

(1) Initial Training. Employees involved in or affected by the lockout/tagout procedures required by 120.2 shall be trained in the following:

- (1) The lockout/tagout procedures
- (2) Their responsibility in the execution of the procedures

(2) Retraining. Retraining in the lockout/tagout procedures shall be performed as follows:

- (1) When the procedures are revised
- (2) At intervals not to exceed 3 years
- (3) When supervision or annual inspections indicate that the employee is not complying with the lockout/tagout procedures

(3) Lockout/Tagout Training Documentation.

Same requirements as all other training (110.2(A)(5)).

## 2018 Edition Changes

2018 Change

**110.2 Training Requirements.**

**(C) Emergency Response Training.**

**(1) Contact Release.** Employees exposed to shock hazards and those responsible for the safe release of victims from contact with exposed energized electrical conductors or circuit parts shall be trained in methods of. ~~Refresher training shall occur annually.~~

**(2) First Aid, Emergency Response, and Resuscitation.**

a) Employees responsible for responding to medical emergencies shall be trained in first aid and emergency procedures.

b) Employees responsible for responding to medical emergencies shall trained in cardiopulmonary resuscitation (CPR). ~~Refresher training shall occur annually.~~

c) Employees responsible for responding to medical emergencies shall be trained in the use of an automated external defibrillator (AED) if an employer's emergency response plan includes the use of this device. ~~Refresher training shall occur annually.~~

**(3) Training Verification.** Employers shall verify at least annually that employee training required by this section is current

**(4) Documentation.** The employer shall document that the training required by this section has occurred.

***N*** = New material.

## 110.2(C)(2) – First Aid, Emer Resp…

2018 Change

Informational Note:

Employees responsible for responding to medical emergencies might not be first responders or medical professionals. Such employees could be a second person, a safety watch, or a craftsperson.

2018 Change

## 110.4(B) – Rating

Test instruments, equipment, and their accessories shall be rated as follows:

(1) Rated for circuits and equipment where they are utilized

(2) Approved for the purpose

(3) Used in accordance with any instructions provided by the manufacturer


*Calibration is part of manufacturers instructions.*

***N*** = New material.

2018 Change

## 110.6 – GFCI Protection

(B) Maintenance and Construction.

GFCI protection shall be provided where an employee is operating or using cord sets (extension cords) or cord- and plug-connected tools related to maintenance and construction activity supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented.

Informational Note: Where an assured equipment grounding conductor program is used, a special purpose ground-fault circuit interrupter may provide additional protection. See Informative Annex O.

*Annex O adds twelve (12) "Safety-by-Design" methods (see O.2.4(12))*

***N*** = New material.

2018 Change

## 110.6 – GFCI Protection

(C) Outdoors. GFCI protection shall be provided when an employee is outdoors and operating or using cord sets (extension cords) or cord- and plug-connected equipment supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees working outdoors operate or use equipment supplied by greater than 125-volt, 15-, 20-, or 30-ampere circuits, GFCI protection or an assured equipment grounding conductor program shall be implemented.

Informational Note: Where an assured equipment grounding conductor program is used, a special purpose ground-fault circuit interrupter may provide additional protection. See Informative Annex O.

*Annex O adds twelve (12) "Safety-by-Design" methods (see O.2.4(12))*

***N*** = New material.

2018 Change

## Annex O – O.2.4(12)

***Before*** **working on or near… #1 Protection is *training***

***While*** **working on or near… #1 Protection is LOTO**


**Live parts to which an employee might be exposed shall be put into an electrically safe work condition before an employee works on or near them…**

**So, where do we find instruction on establishing "an electrically safe work condition" ?**

Article 120

Establishing an Electrically Safe Work Condition

2018 Edition Changes

Reorganization of Article 120

120.1 Lockout/Tagout Program
120.2 Lockout/Tagout Principles
120.3 Lockout/Tagout Equipment
120.5 Achieving an Electrically Safe Work Condition

- Better flow of material
- More logical

***N*** = New material.

## 120.1(A) – Lockout/Tagout Program

2018 Change

General. Each employer shall establish, document, and implement a lockout/tagout program. The lockout/tagout program shall specify lockout/tagout procedures to safeguard workers from exposure to electrical hazards. The lockout/tagout program and procedures shall also incorporate the following:

(1) Be applicable to the experience and training of the workers and conditions in the workplace

(2) Meet the requirements of Article 120

(3) Apply to fixed, permanently installed equipment, temporarily installed equipment, and portable equipment

***N*** = New material.

## 120.1(B) – Lockout/Tagout Program

2018 Change

Employer Responsibilities. The employer shall be responsible for the following:

(1) Providing the equipment necessary to execute lockout/tagout procedures

(2) Providing lockout/tagout training to workers in accordance with 110.2

(3) Auditing the lockout/tagout program in accordance with 110.1

(4) Auditing execution of the lockout/tagout procedures in accordance with 110.1

***N*** = New material.

## 120.2(A) – Lockout/Tagout Principles

2018 Change

General.

Electrical conductors and circuit parts shall not be considered to be in an electrically safe work condition until all of the requirements of Article 120 have been met.

Safe work practices applicable to the circuit voltage and energy level shall be used in accordance with Article 130 until such time that electrical conductors and circuit parts are in an electrically safe work condition.

***N*** = New material.

## 120.4(A)(4) – Lockout/Tagout Procedures

2018 Change

Exception: Lockout/tagout is not required for work on cord- and plug-connected equipment for which exposure to the hazards of unexpected energization of the equipment is controlled by the unplugging of the equipment from the energy source, provided that the plug is under the exclusive control of the employee performing the servicing and maintenance for the duration of the work.

*Already contained in OSHA 10 CFR 1910.147.*

2015 Edition

**ARTICLE 120**
**Establishing an Electrically Safe Work Condition**

**120.1 Verification of an Electrically Safe Work Condition.** An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

(1) Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.

(2) After properly interrupting the load current, open the disconnecting device(s) for each source.

(3) Wherever 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.

(4) Apply lockout/tagout devices in accordance with a documented and established policy.

(5) Use an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.

*Now covered by 120.5 – Process for Establishing and Verifying an ESWC*

120.5 – Process for Establishing and Verifying…

Establishing and verifying an electrically safe work condition shall include all of the following steps, which shall be performed in the order presented, if feasible:

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.
2. After properly interrupting the load current, open the disconnecting device(s) for each source.
3. Wherever 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.

2018 Change

120.5 – Process for Establishing and Verifying…

Establishing and verifying an electrically safe work condition shall include all of the following steps, which shall be performed in the order presented, if feasible:

4. Release stored electrical energy.
5. Release or block stored mechanical energy.
6. Apply lockout/tagout devices in accordance with a documented and established procedure.

2018 Change

120.5 – Process for Establishing and Verifying…

Establishing and verifying an electrically safe work condition shall include all of the following steps, which shall be performed in the order presented, if feasible:

7. Use an adequately rated portable test instrument to test each phase conductor or circuit part to verify it is deenergized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on any known voltage source.

2018 Change

## 120.5 – Process for Establishing and Verifying…

Exception No. 1: An adequately rated permanently mounted test device shall be permitted to be used to verify the absence of voltage of the conductors or circuit parts at the work location, provided it meets the all following requirements:

1. It is permanently mounted and installed in accordance with the manufacturer's instructions and tests the conductors and circuit parts at the point of work;
2. It is listed and labeled for the purpose of verifying the absence of voltage;
3. It tests each phase conductor or circuit part both phase-to-phase and phase-to-ground;
4. The test device is verified as operating satisfactorily on any known voltage source before and after verifying the absence of voltage.

2018 Change

***N*** = New material.

## 120.5 – Process for Establishing and Verifying…

Example Permanently-Mounted Voltage Detector

120.5 – Process for Establishing and Verifying…


120.5 – Process for Establishing and Verifying…

Exception No. 2: On electrical systems over 1000 volts, noncontact test instruments shall be permitted to be used to test each phase conductor.

2018 Change

***N*** = New material.

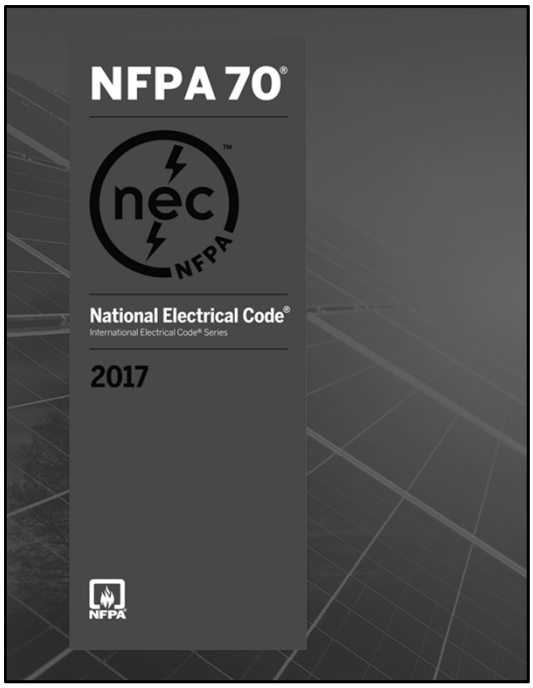
130.2(A)(4) – Normal Operation

Permitted if equipment is:

1. The equipment is properly installed

130.2(A)(4) – Normal Operation

Informational Note: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.



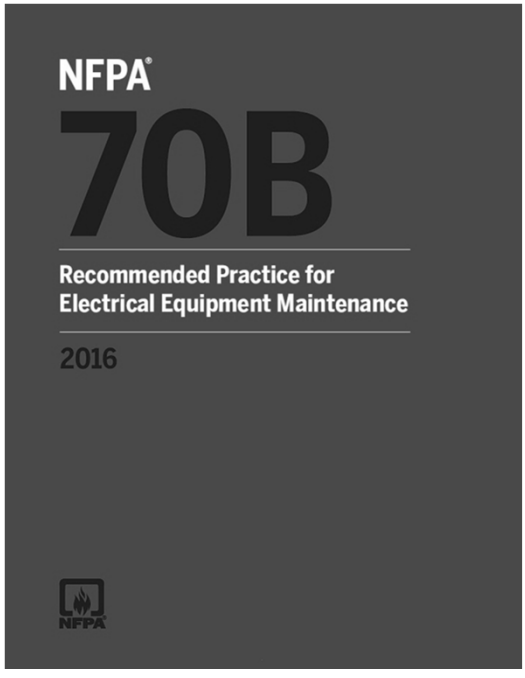

130.2(A)(4) – Normal Operation

Permitted if equipment is:

1. The equipment is properly installed
2. The equipment is properly maintained

130.2(A)(4) – Normal Operation

Informational Note: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.



130.2(A)(4) – Normal Operation

2018 Change

Permitted if equipment is:

1. The equipment is properly installed
2. The equipment is properly maintained
3. The equipment is being used in accordance with instructions included in the listing, labeling & mfg instructions

130.2(A)(4) – Normal Operation

2018 Change

Permitted if equipment is:

1. The equipment is properly installed
2. The equipment is properly maintained
3. The equipment is being used in accordance with instructions included in the listing, labeling & mfg instructions
4. The equip doors are closed and secured
5. The equip covers are in place & secured

130.2(A)(4) – Normal Operation

2018 Change

Permitted if equipment is:

1. The equipment is properly installed
2. The equipment is properly maintained
3. The equipment is being used in accordance with instructions included in the listing, labeling & mfg instructions
4. The equip doors are closed and secured
5. The equip covers are in place & secured
6. No evidence of impending failure

130.2(A)(4) – Normal Operation

Informational Note: The phrase properly installed means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase properly maintained means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase evidence of impending failure means that there is evidence such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.

2018 Change

***N*** = New material.

2018 Change

130.4(A) – Shock Risk Assessment

General. A shock risk assessment shall be performed:

1. To identify shock hazards
2. To estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health
3. To determine if additional protective measures are required, including the use of PPE

***N*** = New material.

2018 Change

130.4(B) – Shock Risk Assessment

If additional protective measures are required, they shall be selected and implemented according to the hierarchy of risk control identified in 110.1(H). When the additional protective measures include the use of PPE, the following shall be determined:

1. The voltage to which personnel will be exposed
2. The boundary requirements
3. The personal and other protective equipment required by this standard to protect against the shock hazard

***(C) Shall be documented***

***N*** = New material.

2018 Change

130.5(A) – Arc Flash Risk Assessment

General. An arc flash risk assessment shall be performed:

1. To identify arc flash hazards
2. To estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health
3. To determine if additional protective measures are required, including the use of PPE

***N*** = New material.

2018 Change

130.5(B) – Arc Flash Risk Assessment

Estimate of Likelihood and Severity. The estimate of the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health shall take into consideration the following:

1. The design of the electrical equipment, including its overcurrent protective device and its operating time
2. The electrical equipment operating condition and condition of maintenance

***See Table 130.5(C)***

***N*** = New material.

2018 Change

## 130.5(C) – Arc Flash Risk Assessment

Additional Protective Measures. If additional protective measures are required they shall be selected and implemented according to the hierarchy of risk control identified in 110.1(H). When the additional protective measures include the use of PPE, the following shall be determined:

1. Appropriate safety-related work practices
2. The arc flash boundary
3. The PPE to be used within the arc flash boundary

***(D) Shall be documented***

2018 Change

## 130.5(C) – Likelihood of Occurrence Table

**Table 130.5(C) Estimate of the Likelihood of Occurrence of an Arc Flash Incident for ac and dc Systems**

| Task | Equipment Condition | Likelihood of Occurrence* |
|---|---|---|
| Reading a panel meter while operating a meter switch.<br>Performing infrared thermography and other non-contact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.<br>Working on control circuits with exposed energized electrical conductors and circuit parts, nominal 125 volts ac or dc, or below without any other exposed energized equipment over nominal 125 volts ac or dc, including opening of hinged covers to gain access.<br>Examination of insulated cable with no manipulation of cable.<br>For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack.<br>For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack. | Any | No |
| For ac systems, work on energized electrical conductors and circuit parts, including voltage testing.<br>For dc systems, working on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing.<br>Removal or installation of CBs or switches.<br>Opening hinged door(s) or cover(s) or removal of bolted covers (to expose bare, energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.<br>Application of temporary protective grounding equipment, after voltage test.<br>Working on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 volts.<br>Insertion or removal of individual starter buckets from motor control center (MCC).<br>Insertion or removal (racking) of circuit breakers (CBs) or starters from cubicles, doors open or closed.<br>Insertion or removal of plug-in devices into or from busways.<br>Examination of insulated cable with manipulation of cable.<br>Working on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center.<br>Insertion or removal of revenue meters (kW-hour, at primary voltage and current).<br>Removal of battery conductive intercell connector covers.<br>For dc systems, working on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source.<br>Opening voltage transformer or control power transformer compartments.<br>Operation of outdoor disconnect switch (hookstick operated) at 1 kV through 15 kV.<br>Operation of outdoor disconnect switch (gang-operated, from grade) at 1 kV through 15 kV. | Any | Yes |
| Operation of a CB, switch, contactor, or starter.<br>Voltage testing on individual battery cells or individual multi-cell units.<br>Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare, energized electrical conductors and circuit parts.<br>Opening a panelboard hinged door or cover to access dead front overcurrent devices.<br>Removal of battery nonconductive intercell connector covers. | Normal | No |
| Maintenance and testing on individual battery cells or individual multi-cell units in an open rack.<br>Insertion or removal of individual cells or multi-cell units of a battery system in an open rack.<br>Arc-resistant switchgear Type 1 or 2 (for clearing times of less than 0.5 sec with a prospective fault current not to exceed the arc-resistant rating of the equipment) and metal enclosed interrupter switchgear, fused or unfused of arc resistant type construction, 1 kV through 15 kV.<br>Insertion or removal (racking) of CBs from cubicles;<br>Insertion or removal (racking) of ground and test device; or<br>Insertion or removal (racking) of voltage transformers on or off the bus. | Abnormal | Yes |

*(continues)*

***Revised for ease of use***

***N*** = New material.

## 130.5(G) – Likelihood of Occurrence Table

2018 Change

**Table 130.5(G) Selection of Arc-Rated Clothing and Other PPE When the Incident Energy Analysis Method Is Used**

| |
|---|
| **Incident energy exposures equal to 1.2 cal/cm² up to 12 cal/cm²** |
| Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy[a] |
| Long-sleeve shirt and pants or coverall or arc flash suit (SR) |
| Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR)[b] |
| Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) (AN) |
| Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with leather protectors (SR)[c] |
| Hard hat |
| Safety glasses or safety goggles (SR) |
| Hearing protection |
| Leather footwear |
| **Incident energy exposures greater than 12 cal/cm²** |
| Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy[a] |
| Long-sleeve shirt and pants or coverall or arc flash suit (SR) |
| Arc-rated arc flash suit hood |
| Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner) (AN) |
| Arc-rated gloves or rubber insulating gloves with leather protectors (SR)[c] |
| Hard hat |
| Safety glasses or safety goggles (SR) |
| Hearing protection |
| Leather footwear |

SR: Selection of one in group is required.
AN: As needed.
[a]Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system if tested as a combination consisting of an arc-rated shirt and pants, coverall, and arc flash suit.
[b]Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). Where the back of the head is inside the arc flash boundary, a balaclava or an arc flash hood shall be required for full head and neck protection.
[c]Rubber insulating gloves with leather protectors provide arc flash protection in addition to shock protection. Higher class rubber insulating gloves with leather protectors, due to their increased material thickness, provide increased arc flash protection.

***Table 130.5(G) identifies the arc-rated clothing and other PPE requirements of Article 130 and shall be permitted to be used with the incident energy analysis method of selecting arc flash PPE.***

***Pulled from Annex H***

***N*** = New material.

## 130.7(C)(14)(b) – Conformity Assessment

2018 Change

Conformity Assessment. All suppliers or manufacturers of PPE shall demonstrate conformity with an appropriate product standard by one of the following methods:

1. Self-declaration with a Supplier's Declaration of Conformity
2. Self-declaration under a registered quality management system and product testing by an accredited laboratory and a Supplier's Declaration of Conformity
3. Certification by an accredited independent third-party certification organization

***See Annex H.4 & ANSI/ISEA 125***

***Beware of counterfeiting!!***

2018 Edition Changes

- Article 310 (Lasers) Revised
- Article 350 (R&D) Revised
- Annexes F, H, K, O, and Q Significant revisions

*Safe Travels &*

*Be safe out there !*


contactus@es2safety.com www.es2safety.com

Last year in the United States, over

**300 people were killed**

by electricity in the workplace.

That's why the professional men and women of

# ES Squared, Inc.

***Electrical Safety Specialists***

are dedicated to safety in the workplace

...because one life saved means a successful career…
...because one life saved means a satisfied employer…
...because one life saved means a joyful family…

**Who are you saving today?**

---


ES Squared, Inc.
1414 Woodbourne Avenue
Pittsburgh, PA 15226-2428

**(330) 607-2139**
**Direct Line**

**mkovacic@es2safety.com**

---

There Exists Electrical Safety for Every Site

**No job is so urgent**
**nor any action so vital**
**that we cannot take time**
**to perform our work safely**

---

## Today's Instructor

Michael Kovacic is a full-time Occupational Safety Instructor and Consultant and President of ES Squared, Inc., a Pittsburgh, PA based organization specializing in electrical safety and lockout/tagout.

Mr. Kovacic has over 20 years of experience in the electrical safety industry. He has participated in or managed teams for safety audits for literally millions of square feet of facility, representing over 150 heavy industrial facilities for major corporations and government organizations. Mr. Kovacic is involved in the development of several computer database applications which aid in the record keeping and reporting portions of the assessment function. He has participated in flash hazard analysis projects for numerous facilities, and has background in accident investigation and legal assistance, and has a strong knowledge of European safety requirements as well.

Mr. Kovacic has an extensive knowledge of various standards, including DOD/DOE requirements and Army, Navy and Air Force safety programs, which has allowed him to successfully conduct various standard and customized courses on the OSHA Standards, the National Electrical Code, and NFPA 70E for the U.S. Department of Labor at the OSHA Training Institute in Chicago, IL., various State OSHA Departments, Federal Aviation Administration (FAA), the American Society of Safety Engineers (ASSE), Bureau of Worker's Compensation (Ohio) and numerous major private corporations such as Aluminum Company of America (Alcoa) and Heinz, and is a specialist in NFPA 70E, including arc flash hazard and safety-related work practices.

Additionally, this expertise in electrical safety and knowledge of standards has allowed for coauthoring and rewriting of complete electrical safety programs for major corporations and government entities around the country.

Due to his expertise and years of experience, Michael Kovacic also provides expert witness testimony both in pre-trial deposition and in court.

His unique experience in engineering, manufacturing, installation, and occupational safety allows him to relate extremely well to students from many different backgrounds.

---

**In the time it takes you to listen to this presentation,**
**there will be two**
***preventable* electrical-related workplace accidents**