

Critical Changes to the NFPA 70E Standard 2009 Edition

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Special points of interest:

Expansion of standard definitions

Electrical Safety Program must be written, documented and audited

Expansion of Article 110.5 Relationships with Outside Contractors

Employee training documentation is now required

New labeling requirements

Significants changes to PPE requirements

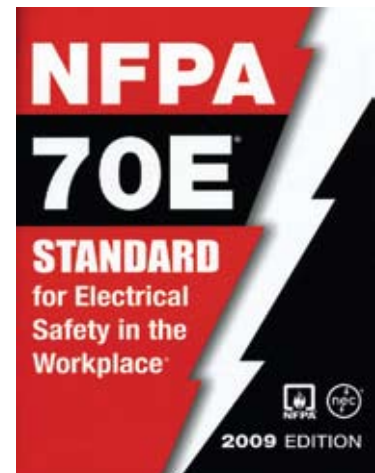
Introduction

Since its inception in 1979, *NFPA 70E: Standards for Electrical Safety in the Workplace®* has evolved to incorporate the latest concepts in electrical safety. The recent 2009 edition contains clarifications, enhancements and changes that may have critical implications for your electrical safety program. This Tech Topics will provide the background and details on what I believe to be the most significant changes. It should be used as an aid in creating an electrically safe workplace not a substitute to the 70E Standard.

Background

In 1975, OSHA asked for help from the National Fire Protection Association (NFPA) to outline electrical safe work practices including installation requirements necessary for personnel safety. The NFPA 70E committee was appointed in 1976 with the purpose of assisting OSHA in preparing electrical safety standards, which culminated in the 1979 publishing of the first edition of *NFPA 70E: Standards for Electrical Safety in the Workplace®*. The creation of the NFPA 70E standard helped OSHA in several aspects:

- The NEC was primarily intended for designers, installers, and electrical installation inspectors. OSHA's regulations are intended to address the employer and employee in their workplace. Something had to be done to bridge the gap.
- Some detailed provisions of the NEC are not directly related to employee safety; thus it was of little value for OSHA's needs.
- Critical items like electrical safety-related work practices and maintenance of electrical systems, which must be considered by OSHA, are not included in the NEC requirements.



With the above issues, it became apparent that a new standard was needed to address OSHA's responsibilities. The NFPA 70E Standard became the basis for OSHA's current general industry standard. Referenced in OSHA 29CFR Part 1910, Subpart S, Appendix A, NFPA 70E is considered by OSHA to be the recognized industry practice for electrical safety. In its standard interpretation of the relevance of NFPA 70E, OSHA states, "Industry consensus standards, such as NFPA 70E, can be used by employers as guides to making the assessments and equipment selections required by the standard." Similarly, in OSHA enforcement actions, they can be used as evidence of whether the employer acted reasonably.

Improved Clarity Throughout the Updated Standard

Overall, you'll find increased clarity throughout the 2009 Edition of the *NFPA 70E: Standards for Electrical Safety in the Workplace®*. For example:

- The term "working on or near" has been replaced by "working within the Limited Approach

Boundary” or “working within the Arc Flash Protection Boundary”. These terms give more clarity to the task being performed.

- The terms “live or hot” as they pertain to electrical equipment has been replaced throughout the standard with “energized electrical conductors or circuit parts”.
- The 2009 enhancements include an expansion of the standard definitions. The previous code standard used a contradiction of terms between “Flash” & “Arc Flash Hazard.” This was corrected in this revision of the standard and the Flash Hazards were redefined as Arc Flash Hazards.
- Article 100, Arc Flash Hazard FPN No. 1 makes note that arc flash hazards can exist when there are energized electrical conductors or circuit parts within equipment whether in a guarded or enclosed condition, provided that a person(s) is interacting with the equipment in such a manner that could cause an electric arc, i.e. operating a Bolted Pressure Switch in an enclosure with vented covers or doors.
- Article 100 Definitions. Addition of “Arc Flash” to the definitions: Arc Flash Hazard, Arc Flash Hazard Analysis, Arc Flash Suit, Arc Rating, and Arc-Resistant Switchgear.

It is very important to examine the standard's approach on redefining the definition of Flash Hazard to Arc Flash Hazard. In the previous version of the 70E standard, Flash Hazard was defined as, “A dangerous condition associated with the release of energy caused by an electric arc.” This somewhat implied that you did not need to protect yourself from a hazard unless an electric arc occurred, which defeats the purpose of the safety standard all together. The new definition of Arc Flash Hazard defines the hazard as, “A dangerous condition associated with the possible release of energy caused by an electric arc” and clearly aims at the protection of workers from a potential hazard.

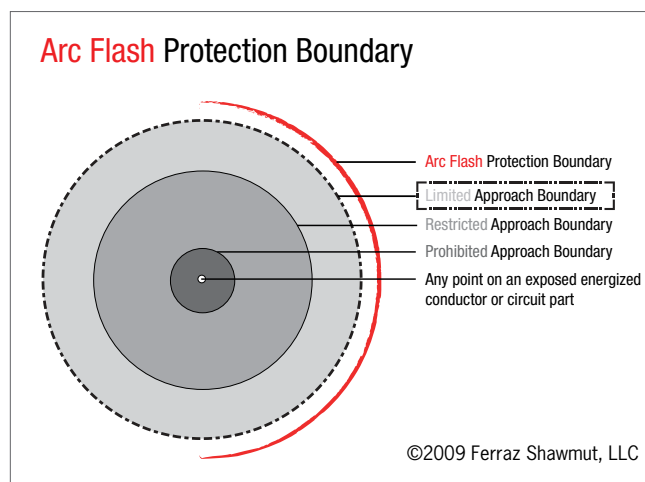
Chapter 4: Installation Safety Requirements has been removed from the 2009 NFPA 70E in an attempt to simplify the safety standard. The 70E committee noted that since this chapter included the same information as Article 110 of the National Electric Code, coupled with the fact that the two standards are on different revision cycle, there is a greater likelihood of misapplication. Hence, chapter 4 was removed.

“...it is a documented overall safety program that directs activity within the Limited Approach Boundary...”

A Summary of Critical Changes to the 2009 Edition

Article 110.7 Electrical Safety Program

Documentation Article 100.7(A) now requires employers to implement and **document** an overall safety program that directs activity appropriate for voltage, energy level, and circuit conditions. The safety program must identify the procedures to be used for working within the Limited Approach Boundary as well as the type of hazard/risk evaluation procedure that will be used to determine the potential arc flash hazard. It should also include things like identifying when a second person



may be required to assist with a particular job task, due to additional risk to a single worker, and the types of training and equipment that person(s) should have available.

Under the 2009 70E Standard Article 110.7(H), **employers must now audit their electrical safety program** to help ensure that the principles and procedures are properly being followed. The employer is allowed the opportunity to determine how often this audit procedure should take place and any findings of failure to comply would require a revision to the program or additional worker training, if necessary.

Expansion of Article 110.5 Relationships with Contractors (Outside Services Personnel, etc.)

This expansion was necessary to more clearly define the responsibilities and liabilities of the Host & Contractor employers with regard to the protection of both parties employees. To summarize this article: **The Host Employer is responsible for informing the Contractor Employer** of any known hazards associated with the contracted work including arc flash hazard analysis and labeling data, personal protective equipment (PPE) requirements, etc. Failure of the Contract Employees to follow any safety guidelines set forth by this standard & the Host Employer shall (must) be reported back to the Contract Employer.

Under Article 110.5(B) Contract Employer Responsibilities, it is the responsibility of the Contract Employer to: (1) ensure that his/her employees have been trained/instructed in the hazards indicated by the Host Employer in addition to the basic training required by the 70E standard. (2) Ensure that the Host Employer's safety related work rules are followed in accordance with this standard. (3) Advise the Host Employer of the following: any unique hazards created by the contact work, the finding of any additional hazards during the work performed that was not mentioned by the Host Employer, and what corrective action was taken to correct any violations that were reported by the Host Employer.

Article 110.6 Training Requirements

Additional requirements regarding employee training have been added to the standard. The goal of the expanded requirements is to reduce potential accidents through increased knowledge and awareness.

- Employees whose duties warrant such training must be trained in approved methods of resuscitation, including CPR. Employers are responsible for the training certification. Article 110.6(C).
- Job tasks that are performed less often than once a year require employees performing the task to be retrained before the starting the task. Article 110.6(D)(1)(d).
- When employees are found to not be complying with the proper safety-related work practices or there have been changes to the procedures of the employers safety-related work practices additional training and/or retraining is required. This is also true when new equipment is installed or newer technologies are added to existing equipment that may require different procedures when using safety-related work practices. Article 110.6(D)(3)(a-c).
- Employees must be trained on how to select the appropriate voltage detector and demonstrate their proficiency with verifying the absence of voltage and the interpretation of the indicators used by the device. Employees must also understand all device limitations associated with a particular voltage detection device. Article 110.6(D)(1)(e).
- **Employee training documentation is now a requirement of the 2009 70E.** An employer must document that each employee has received the training required under this article of the standard and that they can show proficiency with the work practices involved. This documentation must contain each employee's name and date of training and be kept for the duration of the



“It is the responsibility of the Contract Employer to ensure that employees have been trained/instructed...”

employee's employment. Article 110.6(E).

Article 110.9(A) Use of Equipment - New Requirements for Test Instruments

A new requirement for operation verification, Article (A)(4), requires that test instruments used for verifying the absence of voltage on conductors or circuit parts operating at 50 volts or more be verified for proper operation before and after an absence of voltage test is performed. A fine print note was also added to direct the reader to ANSI for more details.

Article 120 Establishing an Electrically Safe Work Condition

The most significant change to this section of the code addresses the Complex Lockout/Tagout procedure. There are three major additions: (1) The identification of the person in charge of the lockout/tagout procedure must be established in a **written** plan of execution; (2) Primary responsibility shall be given to an authorized employee for all personnel involved under the protection of a group lockout or tagout device. (3) Each authorized person involved in the lockout procedure must affix a personal lockout or tagout device for which he or she is responsible from removing when their portion of work is completed. See 120.2(D)(3) for details.

Article 130.1(B) Energized Electrical Work Permit

The energized electrical work permit in the past edition led to some confusion on how employers and employees could comply with this requirement. The 2009 70E Edition gives additional guidance with an addition a sample work permit and of a flow chart, which can be found in Annex J page 70E-85 & 86. Part B Section 3 includes an expansion of the exceptions to the work permit.

Employers need to ask two questions when energized electrical work must be performed; first, is work being performed on energized electrical conductors or circuit parts above 50 volts to ground? Secondly, when can I take exception to the work permit requirement?

Visual inspections are now permitted without the completion of a work permit provided the Restricted Approach Boundary is NOT crossed. De-energizing electrical circuits that operate at less than 50 Volts is not required by the 70E standard; therefore, no work permit is required. A work permit is also not required for work performed within the Limited Approach Boundary by qualified persons for task such as testing, troubleshooting, voltage measuring, etc., provided that the appropriate safe work practices and PPE are used.

Article 130.3 Arc Flash Hazard Analysis

There are several notable changes/additions to the requirement of the arc flash hazard analysis:

- (1) The arc flash hazard analysis is not only used to determine the Arc Flash Protection Boundary but also the personal protective equipment (PPE) that persons within that boundary must use.
- (2) The standard now requires that the analysis must be updated when major modifications or renovations occur and to account for any changes to the electrical distributions system (utility upgrades, etc.) employers must conduct periodic reviews of the arc flash analysis NOT to exceed five years.
- (3) Two exceptions to the arc flash hazard analysis have been added:

Exception No. 1 Removes the requirement for performing an arc flash hazard analysis provided that the following criteria are met:

- The circuit is rated 240 volts or less
- The circuit is supplied by one transformer
- The transformer supplying the circuit is rated less than 125kVA

“...identification of the person in charge of the lockout/tagout procedure must be established in a written plan of execution”

“...employers must conduct periodic reviews of the arc flash analysis NOT to exceed five years.”

Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE)

Hazard/Risk Category	Protective Clothing and PPE
Hazard/Risk Category 0	
Protective Clothing, Nonmelting (according to ASTM F 1506-00) or Untreated Natural Fiber	Shirt (long sleeve) Pants (long)
FR Protective Equipment	Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather gloves (AN) (Note 2)
Hazard/Risk Category 1	
FR Clothing, Minimum Arc Rating of 4 (Note 1)	Arc-rated long-sleeve shirt (Note 3) Arc-rated pants (Note 3) Arc-rated coverall (Note 4) Arc-rated face shield or arc flash suit hood (Note 7) Arc-rated jacket, parka, or rainwear (AN)
FR Protective Equipment	Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather gloves (Note 2) Leather work shoes (AN)

Table 130.7(C)(10) Protective Clothing & PPE Matrix - Categories 0 & 1 (see Code for additional categories)

Exception No. 2 allows employers to use the requirements of hazard/risk category tables 130.7(C)(9), 130.7(C)(10), and 130.7(C)(11) instead of performing a detailed incident energy analysis. Since so many facilities do not have an overall maintenance program that is consistent with breaker manufacturer’s recommended maintenance schedules, the NFPA 70E technical committee added the fine print note (FPN No. 1) to Article 130.3 that highlights that overcurrent protective devices can have increased opening times as a result of improper or inadequate maintenance, which would increase the available incident energy. In addition to this statement, Article 205.3 was added to the General Maintenance Requirements in Article 205 requiring that overcurrent protective devices must be maintained in accordance with the manufacture’s instructions or an acceptable industry consensus standard (NFPA 70B is one).

(4) The 2009 edition has a new requirement for labeling in Article 130.3(C), which requires field markings on equipment that indicate either the available incident energy or the required level of PPE. Article 400.11 of the previous standard only required that equipment labels warn workers of an arc flash hazard.

(5) There have been several significant changes to table 130.7 (C)(9) which have implications for employers who have elected to use the table method identified in Exception No. 2 of 130.3 arc flash hazard analysis.

- The hazard/risk category has increased for several tasks in the table. For example, “Insertion and removal of circuit breakers from cubicles, doors open or closed” for 600V class switchgear has increased to Category 4. See Table 130.7(C)(9) page 70E-32. Employers that use the table method will need to ensure that their safety programs and labels are changed accordingly.
- There have been several tasks added to table 130.7 (C)(9). For example, for 600 volt class motor control centers (MCCs) work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the motor control center, i.e. work performed on motor.
- It is important to bring attention to the general notes associated with table 130.7(C) (9); note (f) indicates that equipment protected upstream by a current-limiting fuse with arcing fault current in their current-limiting range (1/2 cycle fault clearing time or less), the PPE required by the hazard/risk category can be reduced by one number.

“The Arc Flash Hazard Analysis... must be updated when major modifications or renovations occur.”

“...equipment protected upstream by a current-limiting fuse with arcing fault current in their current-limiting range (1/2 cycle fault clearing time or less), the PPE required by the hazard/risk category can be reduced by one number..”

“...the standard now allows for the use of a properly rated face shield in conjunction with a properly rated balaclava as a substitute whenever a flash hood is required.”



Balaclava



Face Shield



Flash Hood

There are two ways to perform an arc flash hazard analysis; (1) **Incident Energy Analysis** uses IEEE 1584 equations (Annex D) to determine the amount of incident energy exposure of a worker and is measured in cal/cm². The incident energy analysis requires that some electrical system data be obtained before the arc flash hazard analysis can be completed. For example: incoming transformer characteristics, overcurrent protective device operations including fault clearing times, approximate length and size of electrical conductors, and other downstream components that may affect an electrical systems performance if a fault were to occur. Once the available incident energy is calculated then the appropriate PPE can be selected and used. (2) **Hazard/risk Categories** which permits the use of tables 130.7(C)(9), 130.7(C)(10), and 130.7(C)(11) to select the appropriate PPE for the task specified in the tables. **If an employer has a particular task that is not specifically specified in the hazard/risk category tables the incident energy method must be used.**

Protective Clothing and Personal Protective Equipment (PPE)

Article 130.7 covers the personal and other protective equipment that is required by the standard anytime a person(s) perform work on energized electrical conductors or circuit parts. There have been some significant changes to this section. It is important to note that **all parts of the body inside the Arc Flash Protection Boundary must be protected.** The following are the most notable changes:

- HRC 1 now requires an arc-rated face shield with a minimum arc rating of 4 cal/cm² in addition to safety glasses or goggles. Table 130.7(C)(10), note 7.

- FPN No 1 in Article 130.7(A) states, "The PPE requirements of 130.7 are intended to protect a person from arc flash and shock hazards. While some situations could result in burns to the skin, even with the protection selected, burn injury should be reduced and survivable.

Due to the explosive effect of some arc events, physical trauma injuries could occur.

The PPE requirements of 130.7 do not address protection against

physical trauma other than exposure to the thermal effects of an arc flash."

- When the HRC tables 130.7(C)(9) are used in lieu of an incident energy analysis, HRC 2* now has a provision that allows either an arc-rated arc flash suit hood or a face shield with a minimum arc rating of 8 cal/cm² and balaclava (sock hood). This is a good alternative because sometimes

Table 130.7(C)(11) Protective Clothing Characteristics

Hazard/Risk Category	Clothing Description	Required Minimum Arc Rating of PPE [J/cm ² (cal/cm ²)]
0	Nonmelting, flammable materials (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a fabric weight at least 4.5 oz/yd ²	N/A
1	Arc-rated FR shirt and FR pants or FR coverall	16.74 (4)
2	Arc-rated FR shirt and FR pants or FR coverall	33.47 (8)
3	Arc-rated FR shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum	104.6 (25)
4	Arc-rated FR shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum	167.36 (40)

Table 130.7(C)(11) Protective Clothing Characteristics

Table 130.7(C)(9) Continued

Tasks Performed on Energized Equipment	Hazard/Risk Category	Rubber Insulating Gloves	Insulated and Insulating Hand Tools
Insertion or removal (racking) of CBs from cubicles, doors open or closed	4	N	N
Application of safety grounds, after voltage test	2*	Y	N
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	4	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	2	N	N
Other 600 V Class (277 V through 600 V, nominal) Equipment — Note 2 (except as indicated)			
Lighting or small power transformers (600 V, maximum)			
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	2*	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2*	Y	Y
Application of safety grounds, after voltage test	2*	Y	N
Revenue meters (kW-hour, at primary voltage and current) Insertion or removal	2*	Y	N
Cable trough or tray cover removal or installation	1	N	N
Miscellaneous equipment cover removal or installation	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2*	Y	Y
Application of safety grounds, after voltage test	2*	Y	N
Insertion or removal of plug-in devices into or from busways	2*	Y	N

Partial Sample of Table 130.7(C)(9) Hazard/Risk Category Classifications

the arc flash suit hood can increase the chances of an accident because of limited visibility and reduced oxygen flow to the body.

- The use of denim cotton blue jeans (minimum 12 oz/yd² fabric weight) for a hazard/risk category (HRC) 1 are NO LONGER PERMITTED. HRC 1 now requires that pants and shirts must be arc-rated and flame resistant with a minimum arc-rating of 4 cal/cm². Table 130.7(C)(10), note 3.
- Employees that are required to wear hair and/or beard nets must wear non-melting and flame resistant (FR) hair or beard nets. Article 130.7(C)(3) & 130.7(C)(15).
- Hand and arm protection has been expanded in Article 130.7(C)(6)(a-c). Employees must wear rubber insulating gloves with leather protectors where there is a danger of hand injury due to contact with energized electrical conductors or circuit parts. The addition of rubber insulating sleeves is required if there is a danger of arm contact with energized components. The employer must verify that rubber insulating protective equipment is properly rated for the voltage for which they were intended for use.
- Electrical protective equipment must be maintained in a safe, reliable condition and should be inspected before each day's use and immediately following any incident that may have caused damage to the material. Employees must be trained to give an air test to all insulating gloves in addition to visual inspections. Refer to table 130.7(C)(6)(c) for rubber insulating equipment testing requirements.
- Hearing protection (ear canal inserts) are now required for all HRC levels 0 - 4.
- Addition of a maintenance and storage requirement has been added to Article 130.7(C)(16). This requires that flame resistant clothing be stored in a manner that prevents physical damage; damage from moisture, dust, or any other deteriorating agents including contamination by flammable or combustible materials. Cleaning and repairing must be per the manufacturer's instructions to avoid the loss of protection. When repairs are necessary for

“FR clothing (must) be stored in a manner that prevents physical damage;”



“Insulated tools and equipment must be inspected for damage prior to every use...”



Fuses for Reducing Arc Flash Energy

The fuses shown here are UL Listed for branch circuit protection and have been proven in laboratory tests to reduce arc flash energy to very low values for arc fault currents within their current-limiting range.

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flame resistant clothing they must be performed using the same flame resistant material as originally supplied by the manufacturer.

- Insulated tools and equipment must be inspected for damage prior to every use to decrease the potential of an incident occurring (e.g., damaged tip on a screwdriver).
- Article 130.7(C)(16)(E)(4) addresses the additional hazard that Look - Alike Equipment brings to the workplace. Many facilities have electrical rooms that are filled with equipment that are similar in size, shape, and construction which if ignored could be a potential hazard to workers. One or a combination of three methods must be used as a preventative measure against someone opening a door or removing a cover on energized electrical equipment. These are safety signs and tags, barricades, or attendants.

Conclusion

It is important to note that achieving an electrical safety program that is compliant with the requirements of the NFPA 70E is not an overnight process. New equipment, new employees, and growth of electrical systems are just a few of the elements that constantly change and evolve within the workplace. Therefore, your electrical safety program will continue to evolve as components of the program change. It is the responsibility of the employer to properly educate and protect employees from the hazards associated with work on energized electrical conductors or circuit parts.

Disclaimer

The information and advice provided in this Tech Topics Data Sheet is so provided solely on the basis that readers will be responsible for making their own assessment of the matters discussed herein and are advised to verify all relevant representations, statements and information. The contents of this white paper are not intended to be all inclusive of all of the changes and requirements of the NFPA 70E. It is recommended that you carefully apply the concepts of 70E to your own unique situation.

Additional Resources

- **NFPA 70E: Standard for Electrical Safety in the Workplace®**
Access via: http://us.ferrazshawmut.com/arcflash/getting_help/books_standards.cfm
- **NFPA 70E: Handbook for Electrical Safety in the Workplace®**
Access via: http://us.ferrazshawmut.com/arcflash/getting_help/books_standards.cfm
- **Ferraz Shawmut Arc Flash Info Center**
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