

## TECHNICAL INFORMATION PAPER SERIES: NFPA 70E HIGHLIGHTS



## PROTECT YOUR EMPLOYEES BY FOLLOWING THE AUTHORITATIVE GUIDE TO ELECTRICAL SAFETY – THE NFPA 70E.

The Standards Council of the National Fire Protection Association (**NFPA**) appointed a new electrical standards development committee in 1976: the *Committee on Electrical Safety Requirements for Employee Workplaces, NFPA 70E*. This committee was formed to assist **OSHA** in preparing electrical safety standards.

Although OSHA had adopted the 1968 and 1971 editions of the NFPA 70 National Electrical Code (NEC) into their regulations, there were no consensus standards at that time for electrical safety-related work practices and maintenance provisions.

### **NFPA 70E includes safety requirements.**

The NEC is intended for use primarily by those who design, install and inspect electrical installations, but the provisions within the NEC aren't directly related to employee safety. In 1979, *NFPA 70E: Electrical Safety in the Workplace* was published, which included safety requirements for employees performing activities such as installation, operation,

maintenance and demolition. Subsequent editions of NFPA 70E were published in 1981, 1983, 1988, 1995, 2000, 2004 and 2009.

NFPA 70E – 2009 provides clarity for electrical activities that require employees to work on energized electrical conductors or circuit parts, commonly called “hot work.”

### **PROTECTING WORKERS FROM ELECTRICAL HAZARDS**

NFPA 70E – 2009 is designed to protect workers from both direct electrical shocks and arc flash and includes three chapters as follows:

- Chapter 1 Safety-Related Work Practices
- Chapter 2 Safety-Related Maintenance Requirements
- Chapter 3 Safety Requirements for Special Equipment

Chapter 4 (Installation Safety Requirements) was removed from the 2009 edition because it was a duplicate of the NEC installation

requirements. In addition, the 70E Committee noted that the NEC and NFPA 70E are on different revision cycles, which could have led to confusion and misapplications.

**NFPA 70E is considered an industry consensus standard.** It's intended for use by employers and employees in all workplaces (i.e., manufacturing, assembly, construction, etc.).

OSHA has not adopted NFPA 70E into their regulations because adoption would require the lengthy and expensive process outlined in Section 6(b) of the Act. In addition to the time and expense to adopt NFPA 70E, OSHA has determined that following 6(b) regulatory procedures may result in requirements different from those in the NEC and NFPA 70E, which would lead to more conflict and confusion.

**Use of the general duty clause.** Instead, OSHA may reference compliance to NFPA 70E using Section 5(a)(1) of the Occupational Safety and Health Act of 1970, commonly referred to as the “general duty clause,” as their basis for implementation. The general duty clause states that employers “shall furnish to each of its employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees.”

## SAFETY-RELATED WORK PRACTICES

Chapter 1 of NFPA 70E, titled *Safety-Related Work Practices*, is divided into four articles. Article 100 provides definitions; Article 110 provides requirements for electrical safety-related work practices; Article 120 provides requirements for establishing an electrically safe work condition; and Article 130 provides requirements for work involving electrical hazards.

### Article 100

Many of the definitions in Article 100 were revised in the 2009 edition to be more consistent with the defined terms contained in Article 100 of the NEC. The term “live or hot” has been replaced with “working on energized electrical conductors or circuit parts.”



This new definition clarifies that this is a condition of contact with energized electrical circuit conductors or circuit parts that's different from conditions in which workers aren't in contact but are within the approach boundary and are required to be protected based on the incident energy level present.

The 2009 edition also includes two new categories of “working on” as follows:

- *Diagnostic (testing):* Taking readings or measurements of electrical equipment with approved test equipment that doesn't require making any physical change to the equipment
- *Repair:* Any physical alteration of electrical equipment (such as making or tightening connections, removing or replacing components, etc.)

The 2009 edition revised the definition of arc flash hazards. Previous editions used a contradiction of terms between “flash” and “arc flash hazard.” This was corrected in the new edition as the flash hazards were redefined as “arc flash hazards.”

It's very important to examine the committee's approach on redefining arc flash hazards. In the previous versions, flash hazard was defined as, “a dangerous condition associated with the release of energy caused by an electric arc.” This implied that workers didn't need to protect themselves from a hazard unless an electric arc occurred, which defeats the purpose of the safety standard all together.

Arc flash hazard is now defined 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.

The 70E committee revised the boundary definitions in the new edition to clarify these boundaries and offer additional guidance. The words “exposed live parts” have been replaced with “exposed energized electrical conductor(s) or circuit part(s).”

### Article 110

Article 110 of NFPA 70E, titled *General Requirements for Electrical Safety-Related Work Practices*, addresses work practices and procedures that minimize or eliminate the exposure to hazards or potential hazards associated with electrical energy. The purpose of Article 110 is to cover both work practices and procedures that provide for employee

safety. Many revisions to Article 110 were included in the 2009 edition of the standard.

Article 110.5 was expanded to clarify responsibilities and liabilities between host employers (i.e., facility owner or general contractor) and contract employers (i.e., subcontractor, outside service personnel) to adequately protect employees from both parties.

The host employer is responsible for informing the contract employer of:

- Any known hazards associated with the contracted work
- Arc flash hazard analysis and labeling data
- Personal protective equipment (PPE) requirements

It's the responsibility of the contract employer to:

- Ensure their employees have been trained in the hazards indicated by the host employer
- Provide basic training to their employees as required in 70E
- Ensure their employees follow the work practices required by 70E and safety-related work rules required by the host employer
- Advise the host employer of any unique hazards created by the contact work; the finding of any additional hazards during the work performed that wasn't mentioned; and corrective action that was taken to correct any violations that were reported by the host employer

The training requirements in Article 110 were revised in the 2009 edition to help reduce electrical accidents through increased knowledge and awareness. The training revisions include:

- Section 110.6(C): Requires employees to receive CPR training, as it did in the 2004 edition, but it now requires annual recertification.
- Section 110.6(D)(1)(d): A new provision that requires retraining for job tasks that are performed less often than once per year.
- Section 110.6(D)(1)(e): A new provision that requires employees to demonstrate the ability to use voltage-detectors. This new provision requires specific training in voltage-



detection equipment selection and use. Testing for the absence of voltage is an essential part of establishing an electrically safe work condition. Many accidents have resulted from inappropriate selection of voltage detection equipment, use of improper equipment settings, and/or not following safe testing procedures. With this new provision, employees must demonstrate competence in voltage detector use, settings and understanding of readings.

- Section 110.6(D)(3) now requires retraining whenever an employee is found not complying with safety-related work practices; when new technology, new equipment, or changes in procedures necessitate the use of different work practices; or whenever an employee must perform an unfamiliar safe work practice.
- Section 110.6(E) now requires employee training to be documented and employee proficiency must be demonstrated.
- Section 110.7 requires employers to implement an overall electrical safety program that directs activity appropriate for the voltage, energy level and circuit conditions. Section 110.7 references ANSI/AIHA Z10-2005 American National Standard for Occupational Safety and Health Management Systems as a framework for establishing a comprehensive electrical safety program as a component of an employer's safety and health program. The 2009 edition of NFPA 70E requires documentation of the electrical safety program along with a procedure to audit its effectiveness.
- Section 110.7(H) requires the employer to establish the frequency of these audits based on the complexity of the procedures and the type of work performed. The goal of these audits is to ensure that the principles and procedures outlined in the electrical safety program are being followed.
- Section 110.9 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. This section references ANSI/ISA-61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part I: General Requirements for more information.

**Article 120**

Article 120 of NFPA 70E, titled *Establishing an Electrically Safe Work Condition*, includes lockout/tag-out procedures to safeguard employees from exposure to electrical hazards while they're working on or near energized electrical conductors or circuit parts.



Section 120.2(C)(1) requires employers to:

- Establish lockout/tag-out procedures
- Provide training to employees
- Provide equipment necessary to execute the details of the procedure
- Audit the procedures to ensure employee understanding and compliance
- Audit the procedure for improvement opportunity and completeness

Article 120 lists three forms of hazardous electrical energy control as follows:

- **Individual employee control procedure** to be used when equipment with exposed conductors and circuit parts is de-energized for minor maintenance, servicing, adjusting, cleaning, inspection, or operating corrections.
- **Simple lockout/tag-out procedure** to be used when qualified personnel de-energize one set of conductors or circuit part source for the sole purpose of performing work within the limited approach boundary (LAB). The LAB is based solely on the nominal voltage and is specified in Table 130.2(C) of NFPA 70E.
- **Complex lockout/tag-out procedure** to be used whenever one or more of the following exist:
  1. Multiple energy sources
  2. Multiple crews
  3. Multiple crafts
  4. Multiple locations
  5. Multiple employers
  6. Different disconnecting means
  7. Particular sequences
  8. A job or task that continues for more than one work period

The most significant change to Article 120 in the 2009 edition of the standard relates to the complex lockout/tag-out procedure. For all work to be performed using the complex lockout/tag-out procedure, the new edition now requires:

- The procedure to be documented in writing, identifying the person in charge.
- Primary responsibility must be given to an authorized employee for all personnel involved under the protection of a group lockout or tag-out device.
- Each authorized person involved in the lockout procedure must affix a personal lockout or tag-out device to the group lockout device when they begin their work and must remove the device when the work is completed.

Section 120.2(F)(2)(f)(1) requires:

- Selection of what voltage detector will be used
- Personal protective equipment (PPE), and who will use it to verify proper operation of the voltage detector before and after use.

This revision in the 2009 edition is significant since it specifically addresses the mandatory use of PPE in the voltage-detection step of verifying the absence of voltage.

**Article 130**

Article 130 of NFPA 70E, titled *Work Involving Electrical Hazards*, states that electrical conductors shall be de-energized before an employee works on or near them, unless the employer can demonstrate that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations.

There are many significant revisions to Article 130 in the 2009 edition of NFPA 70E, as follows:

- The term “working on or near” from previous editions has been replaced with “working within the limited approach boundary” or “working within the arc flash protection boundary” to provide more clarity to workers when working with energized electrical conductors or circuit parts.
- Visual inspections are permitted without the completion of an energized electrical work permit (EEWP), provided the restricted approach

boundary (RAB) isn't crossed. Similar to the limited approach boundary, the RAB is based solely on the nominal voltage and is specified in Table 130.2(C) of NFPA 70E.

- An EEWP is also not required for work performed within the Limited Approach Boundary by qualified persons for tasks such as testing, troubleshooting, and voltage measuring, provided that the appropriate safe work practices and PPE are used.



- The arc flash hazard analysis (FHA), used to determine the arc flash protection boundary, is now also used to determine the personal protective equipment (PPE) that persons within that boundary must use.
- The arc FHA must be updated when a major modification or renovation takes place.
- The arc FHA must be reviewed periodically with intervals not exceeding five years to account for changes in the electrical distribution system that could affect the result of the initial analysis.
- NFPA 70E defines six hazard risk categories for electrical exposures, from 0 to 4 in increasing severity (*Note - There are two Hazard Risk Category 2 listed in the NFPA 70E Table 103.7(C) (10) - Hazard Risk Category 2 and 2\**). Employers can now use Hazard/Risk Category tables 130.7(C) (9 - 11) for the selection and use of personal protective equipment (PPE) instead of performing an arc FHA. In addition, the hazard/risk category has increased for several tasks in the table with the new edition.

- There's a new labeling requirement which mandates field markings on equipment that indicate the available incident energy or required level of PPE. The previous versions of NFPA 70E only required that equipment labels warn workers of an arc flash hazard.
- Workers are now required to wear arc-rated flame resistant (FR) PPE when any part of their body is within the arc flash protection boundary.
- Full head-area protection is required where there's a danger of head injury from electric shock or burns resulting from contact with energized electrical conductors or circuit parts or from flying debris resulting from an electrical explosion (arc blast).
- Hazard/risk category 1 (HRC 1) now requires an arc-rated face shield with a minimum arc rating of 4 cal/cm<sup>2</sup> in addition to safety glasses or goggles.
- The use of denim cotton blue jeans for a HRC 1 is no longer permitted. HRC 1 now requires that pants and shirts be arc-rated and flame resistant with a minimum arc-rating of 4 cal/cm<sup>2</sup>.
- Employees that are required to wear hair and/or beard nets must wear non-melting and flame resistant (FR) nets.
- Employees must wear rubber insulating gloves with leather protectors where there's a danger of hand injury due to contact with energized electrical conductors or circuit parts. 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.
- Hearing protection (ear canal inserts) are now required for all HRC levels 0 - 4.
- Flame resistant (FR) clothing must be stored in a manner that prevents physical damage as well as damage from moisture, dust, or any other

deteriorating agents including contamination by flammable or combustible materials.

- Cleaning and repairing of FR clothing must be per the manufacturer’s instructions to avoid the loss of protection.
- Insulated tools and equipment must be inspected for damage prior to every use to decrease the potential of an incident occurring.
- Annex J of the 2009 edition includes a sample EEWP and flow chart.



**Hazard Risk Category Tables.** The Hazard/Risk Category tables 130.7(C)(9 - 11) in NFPA 70E make it easy for employees to determine the level of protection needed for a particular task.

- **Table 130.7(C)(9):** Specifies the hazard category for the task (HRC 0 - 4) which will be performed.
- **Table 130.7(C)(10):** Provides the required clothing and equipment based on the hazard/risk category that was determined.
- **Table 130.7(C)(11):** Specifies what ATPV rating is necessary. The ATPV (arc thermal performance value) is the amount of heat that can be exposed to a flame resistant garment before a second degree burn injury is expected to occur. It also signifies the amount of protection the clothing provides when an electrical arc comes in contact with the fabric. Flame retardant clothing is assigned an ATPV rating by the manufacturer.

## SAFETY-RELATED MAINTENANCE REQUIREMENTS

Chapter 2 of NFPA 70E, titled *Safety-Related Maintenance Requirements*, addresses safety-related maintenance requirements for electrical equipment and installations, or parts of either, for the safety of employees who work on, near, or with such equipment. Chapter 2 is divided into 11 articles as follows:

- Article 200 Introduction
- Article 205 General Maintenance Requirements
- Article 210 Substations, Switchgear Assemblies, Switchboards, Panel-boards, Motor Control Centers, and Disconnect Switches

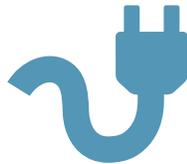
- Article 215 Premises Wiring
- Article 220 Controller Equipment
- Article 225 Fuses and Circuit Breakers
- Article 230 Rotating Equipment
- Article 235 Hazardous (Classified) Locations
- Article 240 Batteries and Battery Rooms
- Article 245 Portable Electric Tools and Equipment
- Article 250 Personal Safety and Protective Equipment

Chapter 2 doesn’t prescribe specific maintenance methods or testing procedures that must be followed. Instead, the employer must choose from the various maintenance and testing methods available to satisfy the requirements in this chapter. Chapter 2 defines maintenance as “preserving or restoring the condition of electrical equipment and installations, or parts of either, for the safety of employees who work on, near, or with such equipment.” The revisions to Chapter 2 in the 2009 edition of NFPA 70E include:

- Article 200 references NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance* and ANSI/NETA MTS2007, *Standard for Maintenance Testing Specification*, for guidance on maintenance frequency, methods and tests.
- Article 205 requires overcurrent protective devices be maintained in accordance with the manufacturer’s instructions or industry consensus standards.
- Article 210 includes a note emphasizing the importance of properly maintaining protective devices and maintaining a consistent level of awareness relative to devices being used within their rating ranges. Protective devices must operate during fault events in a timely manner that minimizes equipment damage and possible injuries to personnel. As the available fault current experiences changes over time, proper maintenance operations often can identify the need for equipment upgrades or even replacements that are necessary to ensure sufficient ratings for the amount of fault current that must be interrupted.
- Article 225 has been revised to address fuse holders for current-limiting fuses. The NEC

includes a requirement that fuse holders for current-limiting fuses shall not permit the insertion of a fuse that isn't current-limiting. This is an important safety feature for equipment and workers. The revision to 225.1 clarifies that fuse holders for current-limiting fuses shall not be modified to permit the insertion of fuses that aren't current-limiting.

- Article 250 has been revised to add bypass jumpers and insulated tools to the list of personal safety and protective equipment that are required to be maintained in safe working condition.
- Section 250.3(B) requires safety grounds that have been repaired or modified be tested prior to being returned to service. The new edition references ASTM F2249, *Standard Specification for In-Service Test Methods for Temporary Grounding Jumper Assemblies Used on De-Energized Electric Power Lines and Equipment*, for guidance on inspecting and testing safety grounds.



### SAFETY REQUIREMENTS FOR SPECIAL EQUIPMENT

Chapter 3 of NFPA 70E, titled *Safety Requirements for Special Equipment*, covers electrical safety installation requirements and safety-related work practices and procedures for employees who work on or near special electrical equipment in the workplace.

Chapter 3 is divided into six articles as follows:

- Article 300 Introduction
- Article 310 Safety-Related Work Practices for Electrolytic Cells
- Article 320 Safety Requirements Related to Batteries and Battery Rooms
- Article 330 Safety-Related Work Practices for Use of Lasers
- Article 340 Safety-Related Work Practices: Power Electronic Equipment
- Article 350 Safety-Related Work Requirements: Research and Development Laboratories

Article 350 is new to Chapter 3 in the 2009 edition of NFPA 70E. This article addresses unique hazards and conditions that might exist in laboratory and research centers. Many experiments and test operations can present hazards for workers and thus this new article is an effort to address electrical installations in those types of environments. The article applies only to those areas designated by the facility management as research and development or laboratories, and it applies to entire facilities in some cases and is applicable to designated areas within educational facilities or other facilities.

### ANNEXES TO NFPA 70E

The 2009 edition of NFPA 70E includes 15 annexes as follows:

- Annex A Referenced Publications
- Annex B Informational References
- Annex C Limits of Approach
- Annex D Incident Energy and Flash Protection Boundary Calculation Methods
- Annex E Electrical Safety Program
- Annex F Hazard/Risk Evaluation Procedure
- Annex G Sample Lockout/Tag-out Procedure
- Annex H Simplified, Two-Category, Flame-Resistant (FR) Clothing System
- Annex I Job Briefing and Planning Checklist
- Annex J Energized Electrical Work Permit
- Annex K General Categories of Electrical Hazards
- Annex L Typical Application of Safeguards in the Cell Line Working Zone
- Annex M Layering of Protective Clothing and Total System Arc Rating
- Annex N Example Industrial Procedures and Policies for Working Near Overhead Electrical Lines and Equipment
- Annex O Safety-Related Design Requirements

**Annex A** is considered part of the requirements of NFPA 70E.

**Annexes B-O** are referenced for informational purposes only and thus aren't part of the requirements of NFPA 70E unless also listed in Annex A.

**Annexes D, F and J** had significant revisions.

**Annexes M, N and O** are new additions with the 2009 edition.

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