
	Document: ELECTRICAL SAFETY PROGRAM		Subject: NFPA 70E 2012 to 2015 Edition Differences - Changes & Updates		
	Issued by: TWB/RSL	Approved by: TWB	Rev #: 1.0	Rev Date: Feb 19, 2015	

NFPA 70E 2012 TO 2015 EDITION DIFFERENCES CHANGES & UPDATES

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Arc Flash & Shock eLearning for Electrical & Non-Electrical Workers that is affordable and high quality using the Electrical Safety Training System (ESTS) in English or French. Contact ESPS for access to a free evaluation course. Visit www.arcflash-training.ca, www.eclairdarc.com or www.arctested.com.

DOCUMENT REVISION HISTORY

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Important Notice for Use:

1. Not all potential changes to NFPA 70E, 2015 Edition are included in this document.
2. You are cautioned to consult the approved NFPA 70E, 2015 Edition prior to making any changes in any established safe work practices.
3. Written opinions by the author are personal technical opinions. You are advised to consult the NFPA at <http://www.nfpa.org/codes-and-standards/standards-development-process/tias-errata-and-fis/formal-interpretations> for specific formal interpretation when required.
4. NFPA 70E remains technically harmonized with CSA Z462.
5. NFPA 70E, 2015 Edition was approved as an American National Standard on July 29, 2014.

Introduction:

The following list of differences may not be complete, but highlights some of the key differences between the 2012 and 2015 Editions of NFPA 70E. **Employers should have ample quantities of printed or digital copies of 2015 NFPA 70E available for every worker** and will need to review the changes and decide on what revisions may be required to your Electrical Safety Program, supporting Electrical Hazard Analysis Documentation and related Electrical Safe Work Practices and Procedures, etc.

You are NOT immediately required to train all of your workers to the new 2015 NFPA 70E. Where changes are made to your Electrical Safety Program in response to 2015 NFPA 70E, training is then required in a timely manner to ensure electrical safety in the workplace.

Employers are recommended to FIRST update your Electrical Safety Program before training your workers. Otherwise your current documentation will not support the requirements of the 2015 NFPA 70E including arc flash and shock risk assessments. Employers need to be prepared with updated documentation to support a new workflow process. Following their training your workers could return without adequate supporting documentation to allow them to perform their jobs. Training on new industry terminology will be lost and forgotten if employees are not reinforcing this knowledge on the job and in the field.



Training on the new NFPA 70E, 2015 Edition is best coordinated with the required updates to your Electrical Safety Program.

ESPS Electrical Safety Program Solutions Inc. offers an Electrical Safety Program called “Product in a Box”, a licensed product solution comprised of several documents and resources, which as a complete package will provide an Electrical Safety Program.

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Selected Key Changes Are:

1. A key change to the entire content of NFPA 70E, 2015 is a broader inclusion of the concept for “Risk Assessment” related to an energized electrical work task instead of just a hazard analysis. This change has affected numerous definitions and Articles throughout the entire document. To this end a significant change is the addition of three new terms:
 - a. Risk Assessment.
 - b. Arc Flash Risk Assessment replaces Arc Flash Hazard Analysis.
 - c. Shock Risk Assessment replaces Shock Hazard Analysis.
2. New definitions have been added to clarify the difference between hazard, risk and risk assessment, they are: Hazard, Hazardous, Risk and Risk Assessment.
3. The following definitions have been updated: Boundary, Restricted Approach, Incident Energy, Incident Energy Analysis and Qualified Person.
4. The Prohibited Approach Boundary for shock has been deleted.
5. All references to a Hazard Risk Category (HRC) have been deleted. This term has been replaced with the two new terms, Arc Flash Hazard Identification and Arc Flash PPE Category.
6. Article 110.3 Electrical Safety Program was moved to Article 110.1 Electrical Safety Program. This move correctly placed the requirement for a management system as the highest priority in NFPA 70E. Additionally the Electrical Safety Program should be developed and implemented as a part of the overall Occupational Health & Safety Management System. The Electrical Safety Program can be a stand-alone document, but should be implemented and harmonized with the requirements of the overall Occupational Health & Safety Management System.
7. Updated Article 110.1 (B) now requires that a developed Electrical Safety Program outline requirements to consider condition of maintenance of energized electrical equipment. *NFPA 70B Recommended Practice for Electrical Equipment Maintenance* has been the industry Standard for quite some time for reviewing the requirements of an Electrical Equipment Maintenance Program and establishing appropriate strategies for electrical equipment maintenance. Specific technical maintenance tests and results are identified in the *ANSI/NETA MTS Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems*. Similar to NFPA 70E and the requirements for an Electrical Safety Program, NFPA 70B recommends employers develop an Electrical Equipment Maintenance Program (EEMP).
8. Article 110.1 (F) Electrical Safety Program procedures. This section relates to an Electrical Safety Program identifying the need for procedures to be developed and used as a control measure to reduce risk and now reads: “The Electrical Safety Program shall identify the procedures to be utilized before work is started by workers exposed to an electrical hazard.”

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9. Article 110.3 (F) Hazard identification and risk assessment procedure has been changed to Article 110.1 (G) “Risk Assessment Procedure”. This aligns with the overall change of the core section in 2015 NFPA 70E to risk assessment. There are three requirements of completing a “Risk Assessment Procedure.” The procedure shall identify the process to be used by the worker before work is started to carry out the following:

- a. Identify hazards;
- b. Assess risks; and
- c. Implement risk control according to a hierarchy of methods.



New content was added to this section to identify what the expected hierarchy of risk control methods are based on industry accepted Occupational Health & Safety Management System Standards, ANSI Z10 for the United States and CSA Z1000 for Canada. This hierarchy of risk control methods would also be recognized by the OH&S Regulator as appropriate due diligence.

- a. Eliminating the hazard, de-energize;
- b. Substitute with other materials, processes, or equipment;
- c. Engineering controls “Safety by Design;”
- d. Warning signs and barricades, systems that increase awareness of potential hazards;
- e. Administrative controls, training, procedures, instructions and scheduling; and
- f. Electrical Specific PPE, Tools & Equipment and ensure its appropriate selection, use and maintenance.

10. Article 110.1 (I)(1) Electrical safety program falls under Article 110.1 (I) Electrical safety auditing. Auditing your Electrical Safety Program is part of a continuous improvement process; *Plan, Do, Check, and Act*. Many employers already conduct annual internal system audits for their overall Occupational Health & Safety Management System, but it will typically not include a review of practices related to the effective management of arc flash and shock hazards. Typically employers will have an external safety audit performed at intervals of three years. It is recommended that an internal electrical safety audit occur on an annual basis. The re-numbered Article 110.1 (I) reads: *“The Electrical Safety Program shall be audited to verify that the principles and procedures of the Electrical Safety Program are in compliance with this standard. Audits shall be performed at intervals not to exceed three years.”*



11. Article 110.1 (I)(2) Fieldwork reads: *“Field work shall be audited to verify that the requirements contained in the procedures are being followed. When the auditing determines that the principles and procedures developed referencing content from the Electrical Safety Program are not being followed, the appropriate revisions shall be made to the procedures following a Management of Change process.”* This section is actually promoting that an internal electrical safety audit of the program and worker’s understanding and compliance be performed at intervals not to exceed one year. This coordinates with 110.2(D)(3) Refresher training occurs when annual inspections of the employee show they are not complying with the expected safety-related work practices.

12. Article 110.2 Training Requirements. There is a change in the context that training requirements should be reviewed based on the level of risk of exposure of workers to electrical hazards that is not reduced to a safe level by acceptable installation standards. This section covers both electrical workers and non-electrical workers. This article of 2015 NFPA 70E pertains to an Employer’s

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electrical safety training requirements. Previous editions of NFPA 70E explained how Employers are to provide adequate electrical safety training that is determined by the worker’s exposure to electrical hazards. The new alignment of 2015 NFPA 70E with OH&S principles of risk assessment applies to worker training as well. Whether working on the electrical system or working with electrical equipment, potentially every worker, both Electrical and Non-Electrical workers, has a level of risk to exposure to electrical hazards. The level of risk is what determines the level of training required. This section of NFPA 70E applies to every worker, not just Qualified Electrical Workers. When the risk associated with an electrical hazard cannot be reduced, Employers shall provide adequate electrical safety training to all workers, including Non-Electrical Workers.

13. Article 110.2 (B) Type of Training. Previous editions clarified wording to identify that the “type and extent of the training” needs to be considered. Currently this section identifies classroom and on-the-job training. WESS and ESPS’s interpretation of classroom training today in industry has a broad interpretation that includes brick-and-mortar and e-Learning environments. The original training content in NFPA 70E was developed years before the emergence of new forms of electrical safety training, including blended learning systems where e-Learning is used as an effective replacement to classroom training or a prerequisite to brick-and-mortar type classroom training and/or on-the-job instruction. Employers need to decide what type(s) of training is best for their workers and document this within their Electrical Safety Program. Training must be effective to produce adequate understanding by each worker of hazard awareness and mitigation techniques as well as employer directed means to provide safety. Effective training provides feedback during and after the training engagement to gauge worker comprehension and compliance.
14. Additional content has been added to Article 110.2 (C) Emergency Response Training.
 - a. Article 110.2 (C)(1) Contact Release, *“Workers exposed to shock hazards shall be trained in methods of safe release of victims from contact with exposed energized electrical conductors or circuit parts. Refresher training shall occur annually.”*
 - b. Article 110.2 (C)(2) First Aid, Emergency Response and Resuscitation
 - i. *“Employees responsible for responding to medical emergencies shall be trained in first aid and emergency procedures.”*
 - ii. *“Employees responsible for responding to medical emergencies shall be trained in cardiopulmonary resuscitation (CPR). Refresher training shall occur annually.”*
 - iii. *“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.”*
 - c. Article 110.2 (C)(3) Training Verification
Employers shall verify at least annually that worker training required by this section is current.
 - d. Article 110.2 (C)(4) Documentation
The employer shall document that the training required by this section has occurred.



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e. Article 110.2 (D) Employee training. Some updates have been made to this section. There have been slight changes to the Qualified Persons Clause in Article 110.2 (D)(1) now reads: *“Such persons shall be familiar with the proper use of the applicable special precautionary techniques, electrical policies and procedures, PPE, insulating and shielding materials, and insulated tools and test equipment.”*

15. 2012 NFPA 70E Article 110.1 (A)(B) Host and Contract Employer’s Responsibilities was relocated to Article 110.3 (A)(B) to clarify the flow and organization of the information presented in NFPA 70E. It places appropriate emphasis that an Electrical Safety Program is a priority and within the Electrical Safety Program specific content is documented, such as host and contract employer’s responsibilities.
16. Article 110.4 (C) Ground Fault Circuit Interrupter (GFCI) Protection stipulates the use of GFCI protection for 125 volt, 15, 20 or 30 ampere circuits.
17. New Article 130.2 (A)(4) Normal Operation. This adds the inclusion of the concept of **“Normal Operation”** vs **“Abnormal Operation”** of energized electrical equipment to NFPA 70E. With respect to normal conditions of energized electrical equipment, these conditions are assessed as:
 - a. *The equipment is properly installed;*
 - b. *The equipment is properly maintained;*
 - c. *All equipment doors are close and secured;*
 - d. *All equipment covers are in place and secured; and*
 - e. *There is no evidence of impending failure.*

When energized electrical equipment is in a “Normal Condition” it poses a very low and acceptable risk of exposure to electrical hazards for workers and no arc-rated clothing is required to be worn. There is an Informational Note that outlines what the term “properly installed” means in relation to this section. The Information Note reads: “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.”

The normal condition of energized electrical equipment relates to the probability of an arcing fault and arc flash occurring or exposure to shock. If the energized electrical equipment is in a normal operating condition the probability of an arcing fault occurring would be very low.

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18. Article 130.2 (B) Energized Electrical Work Permit. The conditions of when an Energized Electrical Work Permit (EEWP) is required were updated and clarified:
 - a. *“When work is performed inside the Restricted Approach Boundary”*, thus implying that a shock hazard exists.
 - b. *“When a worker interacts with the equipment when conductors or circuit parts are not exposed, but an increased likelihood of injury from an exposure to an arc flash hazard exists.”* An example of this would be through-door racking in or out of power circuit breakers, but would not be required for normal operation of energized electrical equipment.



19. Article 130.2(B)(3) Exemptions to work permit, related to the requirement for an Energized Electrical Work Permit (EEWP) have been revised to clarify that the EEWP is **NOT** required for:
 - a. Testing, troubleshooting and voltage measuring.
 - b. Thermography and visual inspections if the Restricted Approach Boundary is not crossed. This would include Ultrasonic or IR Thermal scan inspections.
 - c. Access and egress to an area with energized electrical equipment if no electrical work is performed and the Restricted Approach Boundary is not crossed.
 - d. General housekeeping and miscellaneous non-electrical tasks if the Restricted Approach Boundary is not crossed.

20. Article 130.4 (A) Shock Risk Assessment. No longer called Shock Hazard Analysis, renamed to align with overall change to NFPA 70E to risk based.

21. Article 130.4 (C) Approach Boundaries to Energized Electrical Conductors and Circuit Parts for Shock Protection. The Prohibited Approach Boundary for shock has been deleted. With respect to the requirement for shock related PPE, tools & equipment there was no difference between the Restricted Approach Boundary and the Prohibited Approach Boundary.

22. 2015 NFPA 70E, Table 130.4(D)(a) Approach boundaries to energized electrical conductors or circuit parts for shock protection for ac systems (distance from energized electrical conductor or circuit parts to worker) some changes have been made to the “Nominal system voltage ranges, phase to phase.” Specifically the existing phase to phase ranges of 50V – 300V has been changed to 50V – 150V and the existing range 301 – 750V has changed to 151V – 750V. This change impacts the Restricted Approach Boundary for shock for 208V or 240V work tasks where the Restricted Approach Boundary will no longer be “Avoid Contact” and will be 0.3 m or 12 inches. Additionally the Prohibited Approach Boundary has been deleted.

23. With respect to 2015 NFPA 70E, Table 130.4(D)(b) Approach boundaries to energized electrical conductors or circuit parts for shock protection for dc systems (distance from energized electrical conductors or circuit parts to worker) the Prohibited Approach Boundary has been deleted. DC voltage tables begin at 100 volts nominal potential difference.

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24. Article 130.5 Arc Flash Risk Assessments. One of the most significant changes to NFPA 70E is the formal inclusion of the requirement for a Risk Assessment Procedure to be followed.

In order for the entire NFPA 70E document to align with a risk assessment methodology, changes were necessary to the terms and explanation of arc flash hazard analysis and shock hazard analysis.

Article 130.5

Refers to risk assessments and when they are to be performed. It reads:



“An Arc Flash Risk Assessment shall be performed and shall:

- 1) Determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment shall determine:
 - a) Appropriate safety-related work practices,
 - b) The arc flash boundary, and
 - c) The PPE that personnel within the arc flash boundary shall use.
- 2) Be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed five years, to account for changes in the electrical distribution system that could affect the results of the analysis.
- 3) Take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.”

Some slight changes have been made to the informational notes:

Informational Notes:

- (1) Improper or inadequate maintenance can result in increased opening time of the overcurrent protective device, thus increasing the incident energy. When equipment is not properly installed or properly maintained, PPE selection based upon incident energy analysis or the PPE category method may not provide adequate protection from arc flash hazards.
- (2) Both larger and smaller available short-circuit currents could result in higher available arc flash energies. If the available short-circuit current increases without a decrease in the opening time of the overcurrent protective device, the arc flash energy will increase. If the available short-circuit current decreases, resulting in a longer opening time for the overcurrent protective device, arc flash energies could also increase.
- (3) The occurrence of arcing fault inside an enclosure produces a variety of physical phenomena very different from a bolted fault. For example, the arc energy resulting from an arc developed in air will cause a sudden pressure increase and localized overheating. Equipment and design practices are available to minimize the energy levels and the number of procedures that could expose a worker to high levels of incident energy.

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Proven designs such as arc-resistant switchgear, remote racking (insertion or removal), remote opening and closing of switching devices, high-resistance grounding of low voltage and 5 kV (nominal) systems, current limitation, and specification of covered bus or covered conductors within equipment are techniques available to reduce the risk associated with an arc flash incident. See Informative Annex O for Safety-Related Design Requirements.

- (4) For maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements
- (5) See IEEE 1584 Guide for Performing Arc Flash Calculations for more information regarding arc flash hazards for three-phase systems.”

Article 130.5 (A) Documentation

It reads: *“The results of the arc flash risk assessment shall be documented.”*

Article 130.5 (B)(1) Arc Flash Boundary

The Arc Flash Boundary shall be the distance at which the incident energy equals 5 J/cm² (1.2 cal/cm²). A note has been added that reads: *“The Arc Flash Boundary shall be permitted to be determined by Table 130.7(C)(15)(A)(b) or Table 130.7(C)(15)(B) when the requirements of these tables apply.”*

You have to reference the Parameters to the Table for AC or the Table for DC systems and use the Arc Flash Boundary distance listed in the parameters after you verify the maximum short circuit current and maximum fault clearing time parameter for the specific equipment and voltages listed. Field workers need detailed paperwork, files or selective coordination studies on the overcurrent protective devices (OCPD) readily at hand other wise they likely will assume the OCPD is within tripping time parameters in the tables. This could result in an injury should an arcing event occur and they are under-protected.

Article 130.5 (C) is now titled Arc Flash PPE



“One of the following methods shall be used for the selection of PPE. Either, but not both, methods shall be permitted to be used on the same piece of equipment. The results of an incident energy analysis to specify an Arc Flash PPE Category in Table 130.7(C)(16) shall not be permitted.” (emphasis by author)

Article 130.5(C)(1) Incident energy analysis method

This section introduces the first of two accepted risk analysis methods where by incident energy that may be imposed on a worker at a specified distance is determined through engineering calculations.

Article 130.5 (C)(2) is now titled Arc flash PPE categories method

“The requirements of 130.7(C)(15) and 130.7(C)(16) shall apply when the Arc Flash PPE Category method is used for the selection of arc flash PPE.” These are newly designed tables which now allow field analysis for whether the arc flash hazard may exist for certain

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tasks and conditions then what Arc Rated PPE would be appropriate for that hazard level. This brings NFPA 70E more in line with globally accepted task risk analysis methodology.

25. Article 130.5 (D) Equipment Labeling has changes made to the body of the section relating to changing the wording used from hazard analysis to risk assessment. Additional information has been added to the end of the section that places the responsibility of label placement and management on the equipment owner. The intent appears to provide inspectors and fire marshals guidance for accountability.

“When the review of the Arc Flash Hazard Risk Assessment identifies a change that renders the label inaccurate, the label shall be updated.

“The owner of the electrical equipment shall be responsible for the documentation, installation, and maintenance of the field-marked label.”

“Exception: Labels applied prior to September 30, 2011 are acceptable if they contain the available incident energy or required level of PPE.”

Label information relating to HRC (Hazard Risk Category) has been removed and replaced with “site specific PPE level” marking.

26. Article 130.6 (D) Wearing of conductive articles. The change to this section relates to wearing conductive articles of clothing and they shall not be worn within the Restricted Approach Boundary or where they present an electrical contact hazard.



27. Article 130.6 (H) Clear spaces. Now reads: *“Working space required by other codes and standards shall not be used for storage. The space shall be kept clear to permit safe operations and maintenance of electrical equipment.”* Temporary tables set up in this mandated clear space to lie out prints and books is an example of a practice specifically no longer permitted.

28. Article 130.6 (M) Reclosing circuits after protective device operation. *“After a circuit is de-energized by the automatic operation of a circuit protective device, the circuit shall not be manually re-energized until it has been determined that the equipment and circuit can be safely energized. There shall be no repetitive manual reclosing of circuit breakers or re-energizing of circuits through replaced fuses. When it is determined from the design of the circuit and the overcurrent devices involved that the automatic operation of a device was caused by an overload rather than a fault condition, examination of the circuit or connected equipment shall not be required before the circuit is re-energized.”*

29. Article 130.7 Selection of personal protective equipment for various tasks. The existing Hazard/risk categories Table Method has been deleted and replaced with a new work task-based table and condition of equipment assessment to determine if arc flash PPE is required. This new Arc Flash Identification Table Method still utilizes the same parameter information for the selection of arc rated clothing for the identified equipment, voltage and work task, but based on an Arc Flash PPE Category. The term HRC has been deleted from NFPA 70E.

The Clause is updated to reflect the new Table. It now reads:

Article 130.7(C)(15)(A) Alternating Current (AC) Equipment

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“When the Arc Flash PPE Category is selected in lieu of the incident energy analysis method specified in 130.5(B)(1), NFPA 70E Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required.”



Example of the format of the new Table 130.7(C)(15)(A)(a):

Task	Equipment Condition (3)	Arc Flash PPE Required
Reading a panel meter while operating a meter switch	Any	No
Normal operation of a circuit breaker (CB), switch, contactor or starter	All of the following: <ul style="list-style-type: none"> • The equipment is properly installed; • The equipment is properly maintained; • All equipment doors are closed and secured; • All equipment covers are in place and secured; and • There is no evidence of impending failure. 	No
	One or more of the following: <ul style="list-style-type: none"> • The equipment is not properly installed; • The equipment is not properly maintained; • Equipment doors are open or not secured; • Equipment covers are off or not secured; or • There is evidence of impending failure. 	Yes
Incomplete Table shown for example purposes ONLY. Consult full version of 2015 NFPA 70E for further guidance		

“When arc flash PPE is required, NFPA 70E Table 130.7(C)(15)(A)(b) shall be used to determine the Arc Flash PPE Category for AC equipment and Table 130.7(C)(15)(B) shall be used to determine the Arc Flash PPE Category for DC equipment.”

Example of the format of the new Table 130.7(C)(15)(A)(b):

Equipment	Arc Flash PPE Category	Arc-Flash Boundary
Panelboards or other equipment rated 240 V and below Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in)	1	485 mm (19 in.)
Panelboards or other equipment rated > 240 V and up to 600 V Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in)	2	900 mm (3 ft.)
Incomplete Table shown for example purposes ONLY. Consult full version of 2015 NFPA 70E for further guidance		

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Example of the format of the new Table 130.7(C)(15)(B):

Equipment	Arc flash PPE category*	Arc flash boundary
Storage batteries, direct-current switchboards and other dc supply sources 100 V > Voltage < 250 V Parameters: Voltage: 250 V Maximum arc duration and working distance: 2 s at 455 mm (18 in)		
Short-circuit current < 4 kA	1	900 mm (3 ft.)
4 kA ≤ short-circuit current < 7 kA	2	1.2 m (4 ft.)
7 kA ≤ short-circuit current < 15 kA	3	1.8 m (6 ft.)
Incomplete Table shown for example purposes ONLY. Consult full version of 2015 NFPA 70E for further guidance		

The estimated maximum available short-circuit current and maximum fault clearing times indicated in the parameters in Table 130.7(C)(15)(A)(b) must be validated for the specific single line diagram related to the work task that will be executed when arc flash PPE is identified as required due to the abnormal condition of energized electrical equipment. After validating this information the Qualified Electrical Worker must apply the minimum working distances listed and the Arc Flash Boundary distance listed in the parameters to the work task.

An incident energy analysis shall be required in accordance with Article 130.7(C)(15)(A) for the following:



- 1) Tasks not listed in Table 130.7(C)(15)(A)(a).
- 2) Power systems with greater than the estimated maximum available short-circuit current.
- 3) Power systems with longer than the maximum fault clearing lines, and
- 4) Tasks with less than the minimum working distance listed.

Article 130.7(C)(15)(B) Direct Current (DC) Equipment is new and reads:

When the Arc Flash PPE Category method specified in 130.5(C)(2) is selected in lieu of the incident energy analysis method specified in 130.5(C)(1). Table 130.7(C)(15)(A)(a) shall be used to identify when arc flash PPE is required.

When arc flash PPE is required, Table 130.7(C)(15)(B) shall be used to determine the Arc Flash PPE Category.

The estimated maximum available short circuit current, and maximum arc duration listed must be complied with for the specific DC work tasks. After validating these parameters the working distances for DC equipment listed must be applied to the specific DC work task as listed in Table 130.7(C)(15)(B).

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An incident energy analysis shall be required in accordance with Article 130.5 for the following:

- 1) Tasks not listed in Table 130.7(C)(15)(A)(a).
- 2) Power systems with greater than the estimated maximum available short circuit current.
- 3) Power systems with longer than the maximum arc duration, or
- 4) Tasks with less than the minimum working distance.

The notes at the end of each table have also been changed.



The related PPE selection table has now been renamed to “Table 130.7(C)(16) - Personal protective equipment (PPE).” There are four (4) Personal Protective Equipment (PPE) Categories, 1 (min 4 cal/cm² ATPV or E_{BT}), 2 (min. 8 cal/cm² ATPV or E_{BT}), 3 (min 25 cal/cm² ATPV or E_{BT}) and 4 (min 40 cal/cm² ATPV or E_{BT}). So instead of the Hazard/risk category Tables we have three (3) tables used to identify the existence of an Arc Flash Hazard and the PPE Category for a selected energized electrical work task.

Table 130.7(C)(16) - New Arc Flash PPE Category Compared to Hazard/risk Categories

2012 Table 130.7(C)(16) Hazard/risk categorization of protective clothing for personal protective equipment	2015 Table 130.7(C)(16) Personal protective equipment (PPE) [Arc Flash PPE Category]	ATPV or E _{BT} of arc-rated clothing
HRC 0	Not Applicable	
HRC 1	Arc Flash PPE Category 1	Minimum 4 cal/cm ²
HRC 2	Arc Flash PPE Category 2	Minimum 8 cal/cm ²
HRC 3	Arc Flash PPE Category 3	Minimum 25 cal/cm ²
HRC 4 [other ATPV ratings greater than 40 cal/cm ² would classify as HRC 4]	Arc Flash PPE Category 4	Minimum 40 cal/cm ² [other ATPV ratings greater than 40 cal/cm ² would classify as Arc Flash PPE Category 4]
<p>Table shown on in part. 2015 NFPA 70E should be consulted for the table and associated information required for appropriate application. . It is for informational purposes only in this document.</p>		

Author’s Notes:

- A. 100% natural fibre clothing shall be worn by the Qualified Electrical Worker at all times.
- B. Arc-rated clothing is available up to an ATPV of 140 cal/cm². This is an arc flash suit available from the Oberon Company. Other similar companies top out their clothing at approximately 125 cal/cm². All arc-rated clothing performs to the same ASTM standard. The arc-rated clothing protects to the 50% probability of the onset of a second degree burn to the skin when the incident energy exposure is equal to the ATPV.

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30. The concept of HRC 0 is deleted, as above the Arc Flash PPE Categories start at Arc Flash PPE Category 1, minimum 4 cal/cm² arc rating. There is NO Arc Flash PPE Category 0. Minimum 100% natural fibre clothing would be required to be worn by a Qualified Electrical Worker performing an energized electrical work task with exposures determined to be less than 1.2 cal/cm² at the specified working distance to the employee or where Table 130.7(C)(15)(A)(a) task list indicates no arc flash PPE required.

31. It is clarified in 130.5(C), 130.5(D) and 130.7(C)(15)(A) and (B) that you cannot use Arc flash PPE Categories when you have completed an engineering based (i.e. calculated) incident energy analysis. You cannot reference an Arc Flash PPE Category 1, 2, 3 or 4 with respect to incident energy analysis calculations. In the case of incident energy analysis arc rated clothing is determined by its ATPV or E_{BT} value, equal to or greater than the incident energy. You can refer to Annex H for recommendations for arc rated clothing when engineering incident energy analysis has been completed, two arc rated levels is recommended to reduce costs, simplify selection and maintenance costs. Employers may define site-specific PPE levels for their workplace and indicate that in employee training and on the arc flash labeling.

32. Article 130.7(E) Barricades. Additions have been made to this section. The first replaces the idea that conductive barricades may not be used where they might increase the likelihood of exposure to an electrical hazard, as opposed to causing the exposure. Also, the following sentence was added to the end of this section: *“Where the Arc Flash Boundary is greater than the Limited Approach Boundary, barricades shall not be placed closer than the Arc Flash Boundary.”*

Two new sections were added at the end of Chapter 1, Article 130 for specific work practice hazards commonly seen around electrical work. 130.9 Underground installations and 130.10 Cutting and Drilling in areas where energized electrical equipment or conductors may be encountered.



33. Article 130.10 Cutting or Drilling. *“Before cutting or drilling into equipment, floors, walls, or structural elements where a likelihood of contacting energized electrical lines or parts exists, the employer shall perform a risk assessment to:*

- a. Identify and mark the location of conductors, cables, raceways, or equipment,*
- b. Create an electrically safe work condition, and*
- c. Identify safe work practices and personal protective equipment to be used.”*

34. Chapter 2, Safety-Related Maintenance Requirements,
Article 205.3, General Maintenance Requirements

“Electrical equipment shall be maintained in accordance with the manufacturer’s instructions or industry consensus standards to reduce the risk associated with failure. The equipment owner or the owner’s designated representative shall be responsible for maintenance of the electrical equipment and documentation.”

Maintenance, tests, and inspections shall be documented.

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205.3 IN: Common industry practice guidance on point of use (i.e. on equipment decals) to indicate test or calibration date and overall condition of the equipment.

- 35.** Article 205.7 Guarding of energized electrical conductors and circuit parts. There has been an addition to this section that reads: *“Covers and doors shall be in place with all associated fasteners and latches secured.”* It is important to note that these latches, fasteners, screws and the like must be manufacturer provided or approved to maintain equipment integrity.
- 36.** Article 205.14(3) Repair and replacement. This new section reads: Cords and cord caps for portable electrical equipment shall be (1) repaired and replaced by qualified personnel and (2) checked for proper polarity, grounding, and continuity prior to returning to service.
- 37.** Article 205.15. This is another new section. It states: *“For overhead electric lines under the employer’s control, grade elevation shall be maintained to preserve no less than the minimum designed vertical and horizontal clearances.”* This assists to coincide with NFPA 70 (NEC) Articles 225 *Outdoor Branch Circuits and Feeders*, 230 *Services* and 399 *Outdoor Overhead Conductors Over 1000 volts*.
- 38.** Article 210 Substations, switchgear assemblies, switchboards, panel boards, motor control centers, and disconnect switches, 210.5 Protective devices. Has a revised informational note indelibly connecting overcurrent protective device maintenance to overall safe operation and employee safety. It now states:
“Improper or inadequate maintenance can result in increased opening time of the overcurrent protective device, thus increasing the incident energy.”
- 39.** Article 225 Fuses and circuit breakers, 225.1 Fuses. Additional wording has been added to this section. It now reads: *“Non-current limiting fuses shall not be modified to allow their insertion into current-limiting fuse-holders.”* The same is true for modifying the current-limiting fuse holder to allow insertion of a non-current limiting fuse.
- 40.** Article 250 Personal safety and protective equipment. Changes have been made to the following sections:

250.2(B) Testing

The beginning of this section has the following insertion: *“The insulation of protective equipment and protective tools that is used as primary protection from shock hazards and requires an insulation system to ensure protection of personnel, shall be verified by appropriate test and visual inspection before initial use to ascertain that insulating capability has been retained. Test intervals are not to exceed 3 years.”* The provision to allow other test intervals greater than 3 years of respective ASTM standards was removed.

Although not specifically stated here, in compliance to 110.1 (I)(2) Field work auditing and 110.2 (D)(3)(1) employee annual electrical safe work practice inspections, employee

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proficiency and understanding of testing and maintenance procedures on their protective tools and equipment is crucial to the overall success of the electrical safety program.

250.4 Test Instruments

Reads: *“Test instruments and associated test leads used to verify the absence or presence of voltage shall be maintained to assure functional integrity. The maintenance program shall include functional verification, as described in 110.4(A)(5).”*

41. Article 310.5(C)(1) Arc flash risk assessment procedure. This section has been changed from Arc Flash Hazard Analysis Procedure to Arc Flash Risk Assessment Procedure and now states:

“Each task performed in the electrolytic cell line working zone shall be analyzed for the likelihood of arc flash injury. If there is a likelihood of personal injury, appropriate measures shall be taken to protect persons exposed to arc flash hazards. These measures shall include one or more of the following:

- a) Provision of appropriate PPE (see 310.5(D)(2)) to prevent injury from the arc flash hazard;*
- b) Alteration of work procedures to reduce the likelihood of occurrence of an arc flash incident; and*
- c) Schedule the task so that work can be performed when the cell line is de-energized.”*

42. Article 320 Safety requirements related to batteries and battery rooms or battery enclosures. This article is related to batteries and battery rooms or battery enclosures, updates have been made to align with risk assessment. Important sections within it are:

320.3(A)(1) Battery risk assessment

Prior to any work on a battery system, a risk assessment shall be performed to identify the chemical, electrical shock, and arc flash hazards and assess the risks associated with the type of tasks to be performed.

320.3(A)(4) Abnormal Battery Conditions

This section has been shortened to now read: *“Instrumentation that provides alarms for early warning of abnormal conditions of battery condition, if present, shall be tested annually.”*

IN: Battery monitoring systems typically include alarms for such conditions as overvoltage, undervoltage, overcurrent, ground fault, and over-temperature. Technology will determine which is utilized. Reference to IEEE 1491 *Guide for the Selection and Use of Battery Monitoring Equipment in Stationary Applications* is provided.

320.3(B)(2) Battery Activities That Do Not Include Handling of Electrolyte

This section now has a new sentence structure and further explanation in an IN. Battery technology is such that newer types use a type of solid electrolyte, which eliminates the splash hazard relevant to liquid electrolyte types.

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Workers performing any activity not involving the handling of electrolyte shall wear safety glasses. The IN guides the user to include other safe practice considerations in their job safety plan where liquid electrolyte is encountered.

Author’s Additional Comments:

In NFPA 70E there never was a “Dangerous” incident energy level where no work task execution is allowed. This is a myth. The value of 40 cal/cm² is historical in nature originally based on available arc-rated cloth that could be layered and 40 cal/cm² was one of the layering combinations available. There is a note in NFPA 70E and Canada’s corresponding standard CSA Z462 that indicates that greater emphasis is required at higher incident energy levels. This statement is not entirely accurate as greater emphasis should be required if incident energy is 1.2 cal/cm² or greater as clothing that is not arc rated will ignite and the clothing burning may cause a significant burn to the skin. Originally back in the late 1990’s the NFPA 70E Technical Committee was going to have two additional HRCs, HRC 5 at 65 cal/cm² and HRC 6 at 100 cal/cm². Many companies have chosen to adopt a “not to exceed” incident energy level to manage their risk while employees perform certain energized tasks. Those that have adopted such limitations tend to default to their misunderstanding that NFPA 70E and CSA Z462 have chosen dictated a 40 cal/cm² limitation.

There is no correlation between incident energy and arc blast pressure. The potential pressure wave released when an arc flash event occurs is related to the amount of arcing current or perhaps power present (i.e. arcing current times voltage) and NOT the incident energy. Equipment can have a low incident energy and higher arc blast pressure, or a higher incident energy and a lower arc blast pressure. There have been no reported fatalities due to physical injury from arc blast pressure. This may be due to varying reporting methods of the investigators after an incident has occurred where arc flashes and the resulting injuries are simply reported as a “fire” or “explosion” and not as an electrical event. Ironically the pressure may actually move the worker away from the arcing fault and resulting arc flash event. A thorough inspection of the surrounding area where energized work is being performed should include anything that may increase a likelihood of injury from any adjacent hazards should an arc flash occur.

The following tables will compare selected 2012 NFPA 70E references to updated, moved or new 2015 NFPA 70E references. Not all updates and changes have been included. It is highly recommended that the user begin their site and work practice audits using these tools but include consulting by an experienced electrical safe work practice professional in the overall assessment process before major any changes to existing programs or practices are implemented.

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2012 NFPA 70E / 2015 NFPA 70E Differences Summary Table – Not all updates and changes will be duplicated in this Table from the information previously provided.

NFPA 70E 2012 and 2015 Edition Differences		
Article 90 – Introduction		
Article/Section	NFPA 70E 2012 Edition	NFPA 70E 2015 Edition
Section 90.2	... <i>Safety-related work practices</i> <i>safety-related maintenance requirements and other administrative controls...</i> [added]. This places emphasis on the need for minimum electrical equipment maintenance to sustain “normal energized electrical equipment operation.”
Section 90.2 IN	No informational note included in 2012 edition	<i>Informational Note: This standard addresses safety of workers whose job responsibilities entail interaction with electrical equipment and systems with potential exposure to energized electrical equipment and circuit parts. Concepts in this standard are often adapted to other workers whose exposure to electrical hazards is unintentional or not recognized as part of their job responsibilities. The highest risk for injury from electrical hazards for other workers involves unintentional contact with overhead power lines and electric shock from machines, tools, and appliances.</i>
Chapter 1 - Article 100 - DEFINITIONS		
Article/Section	NFPA 70E 2012 Edition	NFPA 70E 2015 Edition
Article 100	Arc Flash Hazard Analysis	Deleted. Replaced with new term <i>Arc Flash Risk Assessment</i> which is identified in the body of Section 130.5
Article 100	Boundary, Prohibited Approach [related to shock]	Deleted. Redundant to Restricted Approach Boundary. PPE will already be on for shock when inside the Restricted Approach Boundary.
Article 100	Not in 2012	Added Hazard. A source of possible injury or damage to health.
Article 100	Not in 2012	Added Hazardous. Involving exposure to at least one hazard.



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Article 100	Incident Energy Incident Energy Analysis	Updated to include the words thermal energy instead of just energy. “hazard analysis” changed to “risk analysis”.
Article 100	Luminaire	Updated. A complete lighting unit designed to accommodate the lamp(s) and to connect the lamp(s) to circuit conductors. Aligns with current NEC.
Article 100	Qualified Person (worker)	Definition updated from “one who has the skills and knowledge” to “one who has <u>demonstrated</u> skills and knowledge.” As well the word “recognize” has been changed to “identify and avoid the hazards.”
Article 100	Risk not in 2012 definitions	Added. Refers to “a combination of the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that results from a hazard.” The severity is the harm that could be caused.
Article 100	Risk Assessment not in 2012 definitions	Added. “An overall process that identifies the hazards, estimates the potential severity of injury or damage to health, estimates the likelihood of the occurrence or injury or damage to health, and determines if protective measures are required. Note: As used in this Standard, “arc flash risk assessment” and “shock risk assessment” are types of risk assessments.”



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NFPA 70E 2012 and 2015 Edition Differences

Chapter 1 – SAFETY RELATED WORK PRACTICES

Article/Section	NFPA 70E 2012 Edition	NFPA 70E 2015 Edition
<p>Article 110.1 and Article 110.3</p>	<p>Section 110.1 Host and contract employer’s responsibilities Section 110.3 Electrical safety program</p> <p>Order of these two Articles were swapped in 2015 to more closely align with globally accepted risk assessment methodology.</p>	<p>The order of the Articles have changed, the information is fundamentally the same with some updates.</p> <p>Article 110 General requirements for electrical –safety-related work practices</p> <p>Section 110.1 Electrical Safety Program 110.1 (A) General 110.1 (B) Maintenance (NEW for 2015 emphasizing maintenance must be included in the overall electrical safety program 110.1 (C) Awareness and Self-Discipline 110.1 (D) Electrical Safety Program Principles 110.1 (E) Electrical Safety Program Controls 110.1 (F) Electrical Safety Program Procedures 110.1 (G) Risk Assessment Procedures (deleted Hazard Identification) Section greatly expanded 110.1 (H) Job Briefing 110.1 (I) Electrical Safety Auditing</p> <p>110.3 Host and Contract Employer’s Responsibilities 110.3 (A) Host Employer 110.3 (B) Contract Employer 110.3 (C) Documentation</p>
<p>Section 110.2 Training Requirements</p>		<p>Section 110.2 (A) clarified training required when “exposed to an electrical hazard and not reduced by applicable installation requirements. Section 110.2 (C) Emergency</p>



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		Response – clarified training and verification required for responders.
Section 110.4 (C) GFCI Protection	Section 110.4 (C)(1) General Section 110.4 (C)(2) Outdoors	Section 110.4 (C)(1) General Section 110.4 (C)(2) Maintenance and Construction (Added) <i>GFCI protection shall be provided when an employee is operating or using 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 assured equipment grounding conductor program (AEGCP) shall be implemented.</i> Section 110.4 (C)(3) Outdoors
Section 130.2 (A)(4) Normal Operation	Not in 2012	Not previously defined. Section with IN provides guidance for worker to determine equipment condition and use new Table 130.7(C)(15)(A)(a).
Section 130.4 Shock Risk Assessment	Approach Boundaries to energized electrical conductors and circuit parts for shock protection. Limited – Restricted - Prohibited	Deleted Prohibited Approach Boundary. Reordered the information to improve presentation. More logical order of information now.
Table 130.4	Tables 130.4(C)(a) and (b)	Tables 130.4(D)(a) and (b) Nominal voltage ranges changed 50V - 300V is now 50V -150V [208V now covered and will have a defined Restricted Approach Boundary] 151-300V

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Clause 4.3.7.3.13	Care and maintenance of arc-rated clothing and arc-rated arc flash suits	Laundrying Standards home care and industrial via ASTM. Instructions need to be provided to workers if they home launder.
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Annex

Annex B Safety-related electrical maintenance

Annex C Limits of Approach		Prohibited Approach Boundary being deleted. Incorporates risk procedures: C.1.2.3 (4) Use insulated tools and equipment inside restricted approach boundary
Annex D Incident Energy and Arc Flash Boundary Calculation Methods		Realigned content more user friendly to read and interpret. Now includes information on the Dr. Ralph Lee calculation method and some section name changes as well as some new section information.
Annex E Electrical Safety Program		This Annex has had slight changes made to align with the new Risk Assessment Procedure content of 2015 NFPA 70E.
Annex F Risk Assessment Procedure	Hazard Analysis, Risk Estimation, and Risk Evaluation Procedure	Title changed to “Risk Assessment Procedure” to align with overall 2015 changes.
Annex H Guidance on Selection of Protective Clothing and Other Personal Protective Equipment		Updated to align with risk assessment and updated referencing new Arc-Flash Hazard Identification Tables 130.7(C)(15)(A)(a) and (b) and Arc-Flash Hazard PPE Category Tables 130.7(C)(15)(A)(a) and (B). This Annex has changes made to Table H.3(a). NOTE: Reference TIA #1132 dated 8/14/2014 requiring face shield/balaclava or arc-hood $\geq 1.2 \text{ cal/cm}^2$ and $\leq 12 \text{ cal/cm}^2$. Changes have also been made to change hazard analysis to risk assessment.



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		Section H.4 and H.5 and Table H.4 and H.5 have been removed.
Annex J Sample energized electrical work permit		Changed “hazard analysis” to “risk assessment” for shock and arc flash exposures.
Annex O Safety-related design		This Annex has had changes made to both content related to design options, incident energy reduction and other risk control methods, as well as some minor wording changes.
Annex P – Aligning Implementation of This Standard with Occupational Health and Safety Management Systems		Additional information supplied as to origin and reasoning behind overall 2015 NFPA 70E focus on risk assessment processes.

Good Additional Information Found Only in CSA Z462, 3rd Edition

Annex Q - Arc Flash and Shock Warning and Information Labels	Not in NFPA 70E	Updated with new label examples. Prohibited approach boundary deleted. NFPA 70E has no labeling examples in either 2012 or 2015 editions.
Annex U - Human Performance and Workplace Electrical Safety	Not in NFPA 70E	This new Annex has been added. It relates to human behavior and performance. This is an important topic related to the probability parameter of likelihood of occurrence when completing a risk assessment procedure. Not included in NFPA 70E.

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Please be aware that this document doesn't provide an all-inclusive review of all changes in 2015 NFPA 70E. You are advised to reference the published document and confirm how any changes will affect your existing electrical safety policy and program. Additionally, any comments that are provided in this document that are interpretive opinions are based on a subject matter expert's professional experience and opinions.

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