Significant Changes to the 2018 NFPA 70E Standard for Electrical Safety in the Workplace

- NFPA 70E Standard for Electrical Safety in the Workplace is revised on a three-year cycle. Each edition brings significant changes. This presentation is intended to identify what has changed from the previous edition and how it impacts employers and employees relative to their shared responsibilities in compliance with the contained rules as revised.
Learning Objectives

Learning Objectives Specific to the Significant Changes in NFPA 70E

- To identify the major revisions and new requirements in this edition of NFPA 70E.
- To assist in the understanding of revised definitions of words and terms used in the standard.
- To develop an understanding of each revision and the impact on both employers and employees.
- To develop an understanding of the importance of the hierarchy of controls and how it applies specifically to electrical safety requirements covered in NFPA 70E.
- To understand the evolving role of equipment maintenance as it relates to applying the rules in NFPA 70E.
- To assist users in proper application of the Table Method of PPE selection related to revisions in the 2018 edition.

Section 90.2(A) Covered

Change Summary
- Adding the word "removal" to the scope of NFPA 70E correlates with the NEC.
- Renovation, remodeling and general maintenance all involve removal of conductors or equipment.
- Complete or partial demolition of buildings or structures involves removal of conductors and equipment.

Courtesy of Wesley Wheeler
Article 100 Arc Flash Hazard

**Change Summary**

- An arc flash hazard is a “source of possible injury or damage to health”
- The likelihood of an incident increases where energized conductors or circuit parts are exposed or there is or “interaction” in a manner that could cause an electric arc
- See Table 130.5(C) for examples of tasks that increase the likelihood of an arc flash

Courtesy of Morrow Meadows

Article 100 Boundary, Arc Flash

**Change Summary**

- The definition of "arc flash boundary" is revised to add clarity by removing subjective text
- This revision correlates with existing requirements in section 130.5
- The IN is modified to clarify that according to the Stock skin burn injury model, the onset of a second degree burn on unprotected skin is likely to occur at an exposure of 1.2 cal/cm² for one second

Courtesy of Milwaukee
**Article 100 Electrical Safety Program**

**Change Summary**

- The definition of “electrical safety” is revised for clarity. It is the reduction of risk associated with electrical hazards.
- A new definition of “electrical safety program” is added to clarify that it must be a “documented system.”
- An “electrical safety program” contains principles, policies, procedures and processes directing activity appropriate for the associated risks associated with electrical hazards.

**Article 100 Electrically Safe Work Condition**

**Change Summary**

- The definition of “electrically safe work condition” is modified for clarity.
- The steps taken to develop an electrically safe work condition include an action to “verify” absence of voltage.
- If necessary due to induced voltage or possibility of contact with energized conductors or circuit parts, the last step is to temporarily ground for personnel protection.

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Courtesy of NECA
Article 100  
Fault Current

Change Summary

• Fault Current is the amount of current delivered at a point on the system during a short-circuit condition.
• Electrical equipment is marked with a short circuit current rating (SCCR).
• This definition illustrates that “fault current” is a type fault that leaves the circuit path to return to the source of supply.

Article 100  
Maintenance, Condition of

Change Summary

• All shock and arc flash risk assessments must evaluate electrical equipment operating conditions and the condition of maintenance.
• Electrical equipment must be maintained in accordance with manufacturer’s instructions, recommendations, applicable codes and standards, and recommended practices.
• NFPA 70B is the Recommended Practice for Electrical Equipment Maintenance.
Article 100

Qualified Person

**REVISION**

**Change Summary**

- The defined term "qualified person" is revised to correlate with the risk assessment principles used throughout this standard.
- The previous wording required that this person be capable of "identifying and avoiding the hazards involved".
- This revision modifies the requirement and mandates that qualified persons be capable of "identifying the hazards and reducing the associated risk".

Courtesy of Salisbury by Honeywell

Article 100

Risk Assessment

**REVISION**

**Change Summary**

- The definition of "risk assessment" is modified to correlate with the defined term "risk".
- Risk assessments play a critical role in ensuring that persons: evaluate hazards, estimate likelihood of occurrence, estimate severity and the need for additional protective measures.
- Arc flash and shock risk assessments are required by this standard. A JSA/JHA are another form of a risk assessment.

Courtesy of NECA
**Article 100**

**Shock Hazard**

**Change Summary**

- A shock hazard is a source of possible injury or damage to health
- A shock occurs where current flows through the body caused by contact or approach to energized conductors or circuit parts
- A new informational note explains that damage is dependent on the amount of current, frequency, the path of the current flow and the duration of time

*Courtesy of Salisbury by Honeywell*

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**Article 100**

**Working Distance**

**Change Summary**

- The term "working distance" is used throughout NFPA 70E
- *Working Distance* is the distance between a person’s face and chest area and a prospective arc source
- The parameters of the Table 130.7(C)(15)(a) include "minimum working distance". Below 600 volts is typically a working distance of 18 inches and over 600 volts is 36 inches

*Courtesy of NECA*
Section 105.4 Priority

**NEW**

Change Summary

- The title of Article 105 is modified to include, *Application of Safety Related Work Practices and Procedures*.
- New section 105.4 mandates that elimination of hazards is the first priority in the implementation of safety-related work practices.
- Where additional protective measures are required by this standard, the first list item in the hierarchy of control is "elimination."

Section 110.1(B) Inspection

**NEW**

Change Summary

- Newly installed or modified electrical equipment or systems must be inspected to comply with applicable installation codes and standards prior to being placed into service.
- Where electrical inspections are required before equipment is placed into service, this new requirement is easily met.
- Where equipment is modified, this new requirement mandates an inspection before it is energized.

Courtesy of Cogburn Bros., Inc.
Section 110.1(H)  
Risk Assessment Procedure

**Change Summary**

- The hierarchy of risk control methods is relocated from an informational note to positive text in 110.1(H)(3)
- The risk assessment procedure must now address the potential for “human error” and its negative consequences
- A new informational note explains that elimination, substitution, and engineering controls are the most effective risk control methods

Section 110.1(I)  
Job Safety Planning and Job Briefing

**Change Summary**

- The employee in charge must perform a job safety plan and conduct a job briefing before starting any job that involves exposure to electrical hazards
- Three new subdivisions address; job safety planning, job briefings and changes in scope
- Job planning must be documented and be performed by a qualified person. It must include a description of the tasks and the associated electrical hazards
Section 110.1(J)  Incident Investigations

**Change Summary**

- The employer's electrical safety program must now include elements to investigate electrical incidents.
- Incident investigations should address gaps in the electrical safety program and recommend necessary changes.
- All incidents have root causes which must be determined to identify necessary corrective actions.

Sections 110.1(K)(3)  LO/TO Program and Procedure Audit

- Audit requirements for written lockout tagout programs and procedures are revised and relocated into 110.1(K)(3).
- Lockout tagout procedure training requirements are revised and relocated into 110.2(B).
- Lockout tagout training is now required to be audited. Retraining in lockout tagout procedures is required when supervision or annual inspections indicate noncompliance.

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Section 110.2(A)  Electrical Safety Training

**Change Summary**

- Training requirements in 110.2 are reformatted for clarity. The section title is modified to “Electrical Safety Training”
- 110.2(A) applies to employees exposed to an electrical hazard when the risk associated with that hazard is not reduced to a safe level by applicable installation requirements
- Requirements for retraining of tasks performed less often than once per year are relocated into 110.2(A)(3)

Section 110.2(C)  Emergency Response Training

**Change Summary**

- Contact release training is required for employees responsible for the safe release of victims from contact and employees exposed to shock hazards
- The requirement for annual CPR refresher training has been deleted and the requirements of the certifying body must be met
- A new informational note now provides examples of who may respond in a medical emergency

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Section 110.3  Host and Contract Employers’ Responsibilities

Change Summary

- A new informational note is provided to clarify types of "host employers"
- In construction and renovation projects the host employer, in most cases, has no knowledge of hazards covered by NFPA 70E
- Where the host employer has no knowledge of electrical hazards covered by NFPA 70E there is no requirement for a documented meeting.

Section 110.4(E)  Operation Verification

Change Summary

- Section 110.4 is retitled to clarify that in addition to electrical equipment, requirements for “test instruments" are included
- The operation of a test instrument is required to be verified on "any known voltage source" before and after an absence of voltage test is performed
- 110.4(E) requires that only qualified persons use test instruments for troubleshooting, voltage measuring etc.
Article 120  
Establishing an Electrically Safe Work Condition

Change Summary

• Article 120 is completely reorganized for clarity and usability into five new sections
• Training and auditing requirements are logically relocated into Article 110
• This reorganization is primarily based upon multiple actions needed for effective LOTO procedures to create an ESWC

Sections 120.2 120.4
Lockout/Tagout Principles Lockout/Tagout Procedures

Change Summary

• 120.2(A) clarifies that all requirements of Article 120 must be met to create an ESWC and that safe work practices in accordance with Article 130 apply during this process
• A new exception is added to the simple LOTO procedure in 120.4(A)(4) for work on cord and plug connected equipment
• 120.4(A)(6) is modified to add the phrase “on a known voltage source” for correlation. The term “voltage detector” is deleted and replaced with the correct term, “test instrument”

Courtesy of NECA
### Section 120.5 Process for Establishing and Verifying an Electrically Safe Work Condition

**Revision**

#### Change Summary

- Requirements for verification of an electrically safe work condition are correctly relocated as the last section in Article 120.
- New exceptions permit permanently mounted test devices and noncontact voltage detectors over 1000 volts.
- The verification steps are now modified to include the release of “stored electrical energy” and the release or blocking of “stored mechanical energy.”

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### Sections 130.1 130.2 General Electrically Safe Work Conditions

**Revision**

#### Change Summary

- 130.1 now clarifies that Article 130 contains "requirements for work involving electrical hazards" including work practices, "assessments, precautions, and procedures" when an ESWC cannot be established.
- The exception in 130.2 is no longer necessary and is deleted.
- The parent text of 130.2 is modified to clarify that an ESWC must be established where voltages are equal to or greater than 50 volts.

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*Courtesy of Salisbury by Honeywell*

*Courtesy of Morrow Meadows and NECA*
### Sections 130.2(A) Energized Work
130.2(B) Energized Electrical Work Permit

#### Change Summary

- Informational notes are editorially relocated for clarity directly below 130.2(A)(1) and (A)(2)
- 130.2(A)(4) is revised to "Normal Operating Condition" and a new list item (3) is added to require compliance with instructions, listing and labeling
- Elements of an energized electrical work permit now include "a description of the work to be performed". Ultrasound inspections are added to the work permit exemptions in 130.2(B). (2)

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### Section 130.4 Shock Risk Assessment

#### Change Summary

- The title of section 130.4 is revised for clarity and correlation with 130.5 to "Shock Risk Assessment"
- 130.4(A) is revised into parent text with three prescriptive steps necessary to perform a shock risk assessment
- New 130.4(B) now requires additional protective measures be selected according to the hierarchy of risk control. New 130.4(C) requires that the shock risk assessment be documented
### Change Summary

- The approach boundary tables are retitled: "Shock Protection Approach Boundaries to Exposed Energized Electrical Conductors or Circuit Parts"
- The minimum dc voltage threshold is returned to 50 volts. Numerical symbols have been replaced.
- Text is added to clarify that insulating gloves and sleeves are considered insulation with regard only to the energized parts on which work is performed.

### Sections 130.5 - General

#### 130.5(A) General

- Section 130.5 Arc Flash Risk Assessment is significantly revised for clarity into three subdivisions.
- 130.5(A) now requires identification of arc flash hazards, estimates of likelihood of occurrence and potential severity of injury or damage to health, and additional protective measures.
- 130.5(B) Estimate of Likelihood and Severity continues to require that the estimate of the likelihood of occurrence of injury.
- 130.5(C) requires implementation of the hierarchy of risk control where additional protective measures are required.

### Table 130.4(D)(b) & Section 130.4(F)

<table>
<thead>
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<tr>
<td>50V-100V</td>
<td></td>
</tr>
<tr>
<td>100V-1 kV</td>
<td></td>
</tr>
<tr>
<td>1.1 kV-5 kV</td>
<td></td>
</tr>
<tr>
<td>5 kV-15 kV</td>
<td></td>
</tr>
</tbody>
</table>
Section 130.5(C)  
Additional Protective Measures  

NEW

Change Summary

- New 130.5(C) Additional Protective Measures requires the hierarchy of risk control be used to determine additional protective measures
- Appropriate safety-related work practices, the arc flash boundary and PPE to be used within the arc flash boundary must be determined
- New Table 130.5(C) is permitted to be used to estimate the likelihood of occurrence of an arc flash event

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

NEW

Change Summary

- The arc flash hazard identification table in 130.7(C)(15)(A)(a) in the 2015 standard is revised and relocated as Table 130.5(C)
- This table now applies to both the arc flash PPE and incident energy analysis methods
- 130.5(C) permits this table to be used to estimate the likelihood of occurrence of an arc flash event to determine if additional protective measures are required
Section 130.5(G) 
Incident Energy Analysis Method

**Change Summary**

- An incident energy analysis must consider the "condition of maintenance" of the OCPD
- Table 130.5(G) is now permitted to be used for the selection of arc rated clothing and other PPE where an incident energy analysis is performed
- 130.5(F) continues to prohibit the results of an incident energy analysis to be used to specify an arc flash PPE category

Section 130.5(H) 
Equipment Labeling

**Change Summary**

- New exception No. 2 for supervised industrial installations permits equipment labeling to be documented in a manner that is readily available
- Exception No. 1 is modified to clarify that older labels are compliant provided they meet the labeling requirements at the time they were applied
- Labels are no longer required to be "field-marked", this permits a manufacturer applied label

Courtesy of James T. Dollard

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Section 130.7

Personal and Other Protective Equipment

Change Summary

- The parent text of 130.7 is revised to clarify when employees must be provided with and use PPE
- An informational note placing greater emphasis on exposures over 40 cal/cm² is deleted
- All mandatory references to other codes and standards including ASTM standards are deleted for compliance with the NEC style manual

Section 130.7(C)(7)(a) Shock Protection

Change Summary

- The exception in 130.7(C)(7)(a) that referenced ASTM F496 for the use of rubber insulating gloves without leather protectors is deleted
- The NEC style manual prohibits mandatory references to other standards. The references deleted and positive text is added where necessary for clarity and usability
- Leather protectors should always be worn over rubber insulating gloves
Section 130.7(C)(7)(c)  Maintenance and Use

Change Summary

- Test voltages and maximum intervals between electrical tests of rubber insulating PPE must be in accordance with all applicable state, federal or local codes and standards
- Additional text is added to provide clarity with respect to electrical testing intervals of new and used PPE
- Mandatory ASTM references are deleted. The requirements are located in applicable OSHA standards

Section 130.7(C)(14)  Standards for Personal Protective Equipment (PPE)

Change Summary

- PPE is now required to conform to all applicable state, federal, or local codes and standards
- Existing Table 130.7(C)(14) is now an "informational note table" that contains examples of standards that may contain useful information
- New requirements are added for "conformity assessment" and "marking" of PPE that will apply to all suppliers or manufacturers of PPE

Courtesy of James T. Dollard
**Sections**

130.7(C)(15)

130.7(C)(15)(a)

130.7(C)(15)(b)

**Arc Flash PPE Category Method**

**Alternating Current (ac) Equipment**

**Direct Current (dc) Equipment**

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**Change Summary**

- The title of 130.7(C)(15) is revised to "Arc Flash PPE Category Method". The tasks that existed in the previous arc flash hazard identification table are relocated to table 130.5(C)
- 130.7(C)(15)(a) is modified to require an arc flash risk assessment in accordance with 130.5
- These revisions occurred in both 130.7(C)(15)(a) for ac equipment and 130.7(C)(15)(b) for dc equipment

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**Table 130.7(C)(15)(a) Arc Flash PPE Categories for Alternating Current (ac) Systems**

**Change Summary**

- "Short-circuit current available" is replaced with "Available fault current" throughout the table
- A new informational note No. 1 is added to provide the user of the standard with typical fault clearing times of overcurrent protective devices
- New informational note No. 2 sends the user to IEEE 1584-2002 for further information regarding typical fault clearing times of overcurrent protective devices (OCPD)
Informational Note to Table 130.7(C)(15)(a): The following are typical fault clearing times of over-current protective devices:

1) 0.5 cycle fault clearing time is typical for current limiting fuses when the fault current is within the current limiting range.
2) 1.5 cycle fault clearing time is typical for molded case circuit breakers rated less than 1000 volts with an instantaneous integral trip.
3) 3.0 cycle fault clearing time is typical for insulated case circuit breakers rated less than 1000 volts with an instantaneous integral trip or relay operated trip.
4) 5.0 cycle fault clearing time is typical for relay operated circuit breakers rated 1 kV to 35 kV when the relay operates in the instantaneous range (i.e., “no intentional delay”).
5) 20 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay for motor inrush.
6) 30 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay without instantaneous trip.

Table 130.7(C)(15)(b) Arc Flash PPE Categories for Direct Current (dc) Systems

Usage Summary
- The voltage parameters in both parts of the DC are flash PPE category table are clarified
- The mathematical symbols in the table parameters are removed and replaced with text for clarity and usability
- A new table note explains that a two second arc duration is assumed if there is no OCPD or if the clearing time is not known
Table 130.7(C)(15)(c)  Personal Protective Equipment (PPE)

**Change Summary**

- Prescriptive requirements for arc flash PPE category personal protective equipment are relocated to Table 130.7(C)(15)(c)
- A new note to the table permits other types of hearing protection to be used instead of, or with ear canal inserts provided they are worn under an arc rated flash suit hood
- Other notes to the table are revised for clarity

Section 130.7(D)(1)  Insulated Tools and Equipment

**Change Summary**

- The term "accidental" is replaced globally throughout this standard with the term "unintentional" for clarity
- Portable ladders used inside the LAB or where the employee or ladder could contact exposed energized electrical conductors or circuit parts are required to have nonconductive side rails
- Ropes and handlines used within the LAB must be nonconductive
Section 130.7(E)(4)  
Cutting, Removing or Rerouting of Conductors

**NEW**

Change Summary

- A new requirement is added in section 130.7(E) Alerting Techniques to address cutting, removing or rerouting of conductors
- Additional steps to verify absence of voltage or identify conductors must be taken prior to cutting, removing or rerouting of conductors
- Use of test instruments, pulling the conductors, remote spiking and remote cutting are examples of additional steps

Section 205.3  
General Maintenance Requirements

**REVISION**

Change Summary

- A new IN No.2 is added to emphasize the importance of properly maintaining electrical equipment
- This new IN references noncontact diagnostic methods in addition to scheduled maintenance activities of electrical equipment to assist in the identification of electrical anomalies
- Electrical equipment that is not properly maintained will not function as designed and initially installed
Section 320.3(A)(1) Energy Thresholds

**NEW**

**Change Summary**

- The general energy thresholds in chapter 1 are modified in Article 320 work in/on batteries and battery rooms.
- This revision is based upon the removal of the 100 volt dc threshold in 130.4.
- These energy thresholds are extracted from the DOE electrical safety handbook DOE-1092-2013.

Informative Annex F Risk Assessment and Risk Control

**NEW**

**Change Summary**

- Annex F is completely revised providing the user of the standard with information on risk assessment and risk control.
- Risk assessment includes hazard identification, risk analysis, and risk evaluation.
- There are multiple risk assessment methods including but not limited to brainstorming, checklists, and the use of a risk assessment matrix.
Informative Annex H.4  Conformity Assessment of Personal Protective Equipment (PPE)

Change Summary

• Section 130.7(C)(14)(b) requires all suppliers or manufacturers of PPE demonstrate conformity with an appropriate product standard
• New section H.4 in Annex H provides information on level of conformity, equivalence, and supplier’s declaration of conformity
• The three methods for level of conformity in section 130.7(C)(14)(b) come from ANSI/ISEA 125 which is discussed in H.4.2

Informative Annex K  General Categories of Electrical Hazards

Change Summary

• Annex K is revised with the latest information on electrical injuries and fatalities
• Between 1992 and 2012 there were nearly 6000 fatal electrical injuries to workers in the United States
• Almost 98% of fatal occupational electrical injuries are due to electrical shock and 40% of electrical incidents occurred at 250 volts or less
Informative Annex O  Safety-Related Design Requirements

**Change Summary**

- The methods provided in Annex O.2.4 for incident energy reduction are relocated to O.2.3
- A new section O.2.4 provides additional safety by design methods that are proven to be effective in reducing risk associated with arc flash and shock hazards
- A few of these additional safety by design methods include, finger safe components, inspection windows, remote voltage monitoring, and arc resistant equipment

Informative Annex Q  Human Performance and Workplace Electrical Safety

**Change Summary**

- A new annex Q introduces the concept of human performance and how this concept can be applied to electrical safety in the workplace
- This new annex provides the employer with necessary information to address human error in risk assessment procedures
- The potential for human error varies with factors such as tasks and the work environment

**Human Performance Principles**

- People are fallible
- Error-likely situations are predictable
- Individual behaviors are influenced
- Operational upsets can be avoided
- People's achievements are based on encouragement and reinforcement
- Events (incidents) “Are” avoidable