

NFPA® 70 and NFPA® 70E Battery-Related Codes Update 2016

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Abstract

Some significant changes related to stationary batteries are occurring in the *National Electrical Code*® (NEC®/NFPA 70®)¹ and the *Standard for Electrical Safety in the Workplace*® (NFPA 70E®)². These changes could affect the installation and maintenance of stationary battery systems.

The NEC has undergone some significant organization changes. New articles on energy storage and microgrids have been added and tentatively approved for the 2017 version of the document. Since article 480 remains in the document as well, there are certain to be interpretation issues between the various articles.

NFPA 70E® is also in the midst of a revision (2018 version). The IEEE Stationary Battery Committee – Codes Task Group (CTG) had submitted numerous public inputs related to stationary battery safety and some of the recommendations have been tentatively accepted.

This paper will outline all of the changes and the rationale behind them. The future direction of both of these documents will be discussed as well.

Background

The National Electrical Code® (NFPA 70®)¹, published by the National Fire Protection Association (NFPA®), is focused on “the practical safeguarding of persons and property from hazards arising from the use of electricity”. A version of the NEC® is enforced in most jurisdictions in all 50 states in the USA and in several other countries. To fully understand how batteries are addressed, understanding the structure of the NEC® is required. The core of the NEC® is in the first four chapters which apply generally. Chapters 5-7 supplement or amend the first four chapters. Chapter 8, which covers communications circuits, is unique. Chapter 8 is not subject to the requirements of Chapters 1 through 7 except where specifically referenced by Chapter 8. Chapter 8 applies to communication equipment which, by definition, includes related power equipment including batteries.

Within each chapter are “Articles” for specific topics. See Table 1 for examples.

Topic	Where addressed in the NEC	
Working space around battery systems	Article 110	
Uses not permitted in battery rooms	Chapter 3	Chapters 1-4 apply generally to all electrical installations
- Nonmetallic sheathed cable	- 334.1	
- Underground feeder & branch circuit cable	- 340.12	
- Flexible metal conduit	- 348.12	
- Flexible metal tubing	- 360.12	
- LV suspended ceiling power distribution	- 393.12	
- Lighting track	- 410.151	
Storage batteries	Article 480	
Hazardous locations, use of chargers	Articles 503, 511, and 513.	Chapters 5-7 supplement or modify Chapters 1-4
Health care facilities, use of batteries	Article 517.	
Modular data centers, work space around batteries	Article 646.	
Photovoltaic battery systems	Article 690	
Wind system batteries	Article 694	
Emergency system, use of batteries	Article 700	
Legally Required standby systems, use of batteries	Article 701	
Energy storage systems	Article 706 [new]	
Critical operations power systems, use of batteries	Article 708	
Direct Current Microgrids	Article 712 [new]	
Communication circuits and equipment which includes related dc systems and batteries	Article 800	Chapter 8

Table 1, batteries in the NEC

The current edition of the NEC® is 2014, although earlier editions may be enforced in some jurisdictions. The NEC® is on a 3-year revision cycle, so the next edition will be 2017 (released in fall 2016). Public inputs have been reviewed twice by 19 different code-making panels (CMPs). CMPs are responsible for writing specific sections of the Code. For example, CMP-13 is responsible for battery systems in Article 480 and Article 706.

NEC® Article 480 –Changes

This section summarizes the proposals that have been approved by the CMP (second revision). While last minute changes are possible, they are unlikely:

- **Corrosion prevention** – Reference to mating of dissimilar metals will be removed. Antioxidant material suitable for the battery connection must be used when recommended by the battery manufacturer.
- **Battery terminal conductors** – An informational note will clarify that pre-formed conductors are acceptable to prevent stress on battery terminals, as are fine-stranded cables (e.g., “welding cable”). Manufacturer guidance is recommended.
- **New Section after 480.2 (480.3 Equipment)** - This section is to require all batteries and battery management equipment to be listed. Lead-acid batteries are excluded. There was a great deal of discussion on this topic and it had been proposed that all batteries should be listed for the intended application. While some type of listing is required, typically UL, no specifics are given.
- **Overcurrent Protection for Prime Movers.** – The exclusion for overcurrent protection for prime movers was increased from *50 volts nominal* to *60 volts*.
- **Disconnecting Means** – The voltage was increased from *50 volts nominal* to *60 volts*.

- **Remote disconnect activation** - There was some confusion in the wording in this section and there were other proposals that would allow disconnects to not be in sight of the battery. The existing wording was improved to clearly state that the battery disconnect must be in sight of the battery.
- **Disconnect labeling** – The intention was to make the labeling consistent with the requirement of 70E. To that end, a new information note directs the user to NFPA® 70E for guidance on how to calculate fault current. Wording was also added to require an arc-flash warning label (Section 110.16). Also, “short circuit current” wording was restored to the original (the first revision had changed it to fault current).
- **Insulation of batteries** - This section was essentially deleted. The following sentence was added: “Batteries constructed of an electrically conductive container shall have insulating support if a voltage is present between the container and ground”. This sentence was added just in case there was a battery produced that had a voltage to ground.
- **Battery support systems** – The term “racks and trays” will be replaced with the more inclusive term “battery support systems.” This section was lead-acid centric and was modified to be more generic. For battery chemistries with corrosive electrolyte, the structure that supports the battery must be resistant to deteriorating action by the electrolyte. Metallic structures must be provided with non-conducting support members for the cells, or else they must be constructed with a continuous insulating material. Paint alone is not considered to be an insulating material.
- **Ventilation** – A new informational note will direct readers to IEEE 1635/ASHRAE 21 for guidance on ventilation of various types of batteries in a variety of enclosures and operating conditions. The intent is to maximize battery reliability as well as the safety of personnel and equipment.
- **Top terminal batteries** – The working space requirement for batteries on open racks will be expanded to include top terminal batteries in cabinets. While the wording that refers to the manufacturer’s instructions for guidance was retained, a note was added to refer to IEEE 1187 which does have very specific guidance for required clearance for cabinetized batteries.
- **Egress** – The listed panic hardware of doors in a battery room will be required to display the listing label.
- **Vented cell flame arresters** – Vented cells are required to have a flame arrestor. Text about the purpose of the flame arrestor will be moved to an informational note because the authority having jurisdiction (AHJ) cannot determine if the flame arrestor is properly designed.
- **Pressure-release valves** – This paragraph was referring to VRLA cells, although it was written generically. The wording was changed to make having a pressure relief valve only mandatory for battery designs where a battery is constructed such that an excessive accumulation of pressure could occur within the cell during operation.

New Articles in the NEC impacting battery systems

Two new Articles have been proposed for NEC®-2017. Both of these articles were approved.

Article 706: Electrical Energy Storage Systems (ESS)

The original purpose of article 706 was to consolidate all code requirements for all energy storage systems, including batteries. Initially there was some question as to whether article 480 would continue to exist after this article. The final determination was to keep both this article and article 480. As previously stated, chapters 1-4 are the core part of the code, and chapters 5-7 supplement or amend the first four chapters. However, article 706 currently states that “Whenever the requirements of other articles of the Code and Article 706 differ, the requirements of Article 706 shall apply”. There are some inconsistencies and gray areas between articles 480 and 706 and it remains to be seen if this will cause confusion once the code is published.

This article is not restricted to electrochemical storage systems. Flywheels, compressed air energy storage (CAES) or other energy storage technologies are included.

An example of a discrepancy between articles 480 and 706 is the references to the IEEE documents. In article 480, all dates were removed yet they remain in article 706.

The scope of article 706 is specifically limited to systems over 50 volts AC or 60 volts DC. Therefore, only article 480 (excluding disconnects) will be applicable to 48 volt systems.

Article 706 does require that all ESS components, including batteries, must be listed and labeled. Lead-acid batteries are excluded from this requirement.

While both articles 480 and 706 require that short-circuit information be included on a label on the disconnect, article 480 stipulates that an arc flash assessment be included on the label as well. However, both articles refer to article 110.16, which also has arc flash assessment marking requirements. It is not completely clear if the wording differences will cause any confusion.

Article 706 requires that an ESS for dwellings shall not exceed 100 volts between conductors or to ground, unless live parts are not accessible during routine maintenance.

Article 706 also requires that battery strings must be able to be broken down into segments not exceeding 240 volts nominal for field servicing. Battery disconnects are required for systems exceeding 100 volts in article 706, which is different than the 60 volt requirement in article 480. Also in article 706, systems exceeding 100 volts shall be permitted to operate with ungrounded conductors, but a ground fault detector must be utilized.

NEC® Other Articles - Proposed changes for storage batteries

Proposed changes pertaining to battery systems in other parts of the NEC® include:

- **Top clearance** - An exception will be added to Section 110.26 regarding the height of working space directing the reader to go to Article 480 for batteries
- **Insulating covers** - Per Section 110.27, only “qualified persons” will be permitted to remove insulating covers over exposed conducting parts. Only one polarity is permitted to be exposed at one time.
- **Emergency system battery maintenance** – The term “battery” will disappear in all-inclusive statements in Articles 700 (Emergency systems) and 701 (Legally required standby systems). Emergency system equipment must be maintained in accordance with manufacturer instructions and industry standards.
- **Emergency system minimum voltage** - The existing requirement for the battery to hold up the load for 1.5 hours above a minimum voltage of 87.5% of the nominal voltage *was restored*.

Article 712: DC Microgrids - A direct current microgrid is a power distribution system consisting of one or more interconnected dc power sources, dc-dc converters, dc loads, and ac loads powered by dc-ac inverters. A dc microgrid could be permitted to be directly connected to a primary source of 60 Hz electricity through a bidirectional multimode inverter or bidirectional utility interactive inverter. As presently drafted, Article 712 would defer to the previously described Article 706 for specifications on battery systems.

Batteries in NFPA 70E – Impact on Operation and Maintenance

NFPA® 70E is the *Standard for Electrical Safety in the Workplace*.® This document is in the “70” series of NFPA documents but, unlike the National Electrical Code® (which is mandatory in most jurisdictions of all 50 states in the USA), NFPA® 70E is a standard, which means that it is theoretically an option. In reality, because this document is a recognized best practice, failure to comply with its safety guidelines can result in penalties from organizations such as the U.S. Occupational Safety and Health Administration (OSHA). Whereas the NEC® is focused on safe electrical design and layout, NFPA 70E is focused on the safety of the worker.

Battery implications – Prior to the 2012 edition, requirements for direct current (dc) were almost nonexistent in NFPA® 70E. Thanks largely to efforts by the IEEE Stationary Battery Committee, requirements for dc in general and for batteries in particular show up in various places throughout the document. Further guidelines were added in the 2015 edition of NFPA® 70E.

The first round of public comments has been processed by the 70E technical committee and a first revision of the document has been released and additional public comments are currently being solicited.

While a number of public inputs were submitted by the stationary battery committee codes task group, most of the suggestions were not accepted. The majority of the proposals were to clarify existing wording. While there is one additional opportunity to make the case for the battery related proposals, it is unlikely that they will be accepted and incorporated in the final document this revision cycle. The fact that the proposals were not accepted will not add to the difficulty of determining PPE for battery installation and maintenance activities, but it will not improve them either.

Significant changes have been made to the arc flash risk assessment section. In the current version of NFPA 70E, tables were provided that identified if an arc flash hazard exists for certain tasks. This table has been replaced by one that identifies the likelihood of occurrence of an arc flash event for various tasks. Risk assessment and risk control are considered keys to determining if PPE is required.

Opportunities for change

The 2017 version of NFPA®-70 is essentially completed and there is a very limited opportunity for a change at this point. This document will be released towards the end of 2016. However, a new revision cycle will begin next year.

The next edition of NFPA® 70E (2018) is at the public comment stage of the first revision. However, the deadline for public inputs is approaching quickly. The CTG will be submitting public inputs.

While any individual can provide public inputs to any NFPA document, battery practitioners interested in providing input are advised to contact the IEEE Stationary Battery Committee – Codes Task Group (CTG). The CTG is open to anyone interested in improving any codes related to stationary batteries. Please contact the author of this paper for information concerning CTG membership and participation guidelines.

References

1. NFPA, NFPA 70 National Electrical Code, 2014: Quincy, MA.
2. NFPA, NFPA 70E Standard for Electrical Safety in the Workplace, 2015: Quincy, MA.