

ADVANCING ELECTRICAL SAFETY THROUGH THE NATIONAL ELECTRICAL CODE

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OVERVIEW

The National Electrical Code® (NEC), developed by the National Fire Protection Association (NFPA), has been the foundation of the country's electrical safety system since 1897. The NEC is created through an exhaustive stakeholder consensus process that considers input from a balance of interests and reflects the collective knowledge of qualified electricians, electrical inspectors, manufacturers, testing lab personnel, and other professionals. Updated triennially to include technological advancements, adopting the latest version of NEC is the best way to ensure uniform implementation of installation requirements and consistency throughout the built environment.

As electrical product and delivery technology evolves, so do the challenges of safely integrating the technology into our electrical systems. Each three-year updated version of the NEC ensures that electrical installations continually meet minimum safety requirements so that electrical systems perform as expected while preventing harm to life and property. Revised codes address technological advancements such as wind, solar, energy storage and electric vehicles, thus enabling safety regulations to support, rather than obstruct installations that accommodate these innovations.

The current Indiana electrical code is based on the 2008 edition of the NEC, which has been revised **four times** in the interim. The latest update issued by the NFPA Standards Council is the 2020 edition. Each new version of the NEC builds upon the legacy established by preceding editions and contains new and revised requirements that enable the industry to meet consumers' expectation of a safe electrical system.

Just a few examples of updates to the past four editions of the NEC include requirements for leading edge technology such as that associated with electric vehicles and alternative energy systems like solar and wind power that must be installed and used safely in order for the public to derive their full benefit.

Additionally, new requirements have been added for utility-scale PV systems, direct-current microgrids and energy storage systems; all examples of the regulatory world striving to keep up with innovation.

Significant changes to rules governing calculations to modernize and reflect improvements in energy efficiency, which may provide relief on the overall cost of electrical systems, is another example of how an outdated code is out of alignment with industry trends. We also see advancements with each new edition to increase safety for electricians and maintenance personnel, as well as improved and expanded electrical safety requirements throughout all occupancies and uses in the built environment.

These are just a few ways in which adopting the latest edition of the NEC enables communities to continue providing an acceptable level of public safety while supporting the latest technological advances. States neighboring Indiana as well as states across the country have adopted more up-to-date versions of the NEC and citizens in Indiana certainly deserve the same protection.

This document presents a chronology of significant changes to the NEC over the last four code revision cycles that enhance the safety mission of the code and provide opportunity for more cost-effective installations.

2020 NEC Updates

Keeping the regulatory document current with industry trends in new technology and delivery and generation of electric power.

- 230.67. A new requirement covering surge protection for dwelling units aligns with the everchanging electrical industry landscape to protect against surges that can damage sensitive electronics found in most modern appliances, safety devices and other equipment used in dwellings. The expanded use of distributed energy resources can also contribute introduction of surges into the system.
- Several new sections throughout the Code address whether equipment is permitted to be reconditioned.
- Article 242 Overvoltage Protection – A new article addresses installation requirements for Surge-Protective Devices and Surge Arrestors used to achieve this protection.
- Article 625 Electric Vehicle Power Transfer System – Sets requirements for electric vehicles and supply equipment to encompass bidirectional current exchange.
- Updates to Articles 690 Solar Photovoltaic (PV) Systems, 691 Large-Scale Photovoltaic (PV) Electric Supply Stations, 706 Energy Storage Systems, Article 710 Standalone Systems and Article 712 Direct-Current Micro-grids continue to support new and expanding technologies, which has immeasurable societal benefits at both the micro- and macro-economic levels.

Examples of new and revised requirements that may lower the overall cost of electrical systems.

- 210.11(C)(3) & (4). This revision specifies which receptacle outlets are required to be on the required 20 ampere circuit for bathrooms and garages, thus providing more flexibility with circuiting in those areas.
- Article 220 Branch-Circuit, Feeder, and Service Load Calculations – Several revisions to this article, including the modernization of the tables currently in use for calculations, which has been extensively revised to reflect improvements in energy efficiency and may grant substantial relief for sizing of service and feeder distribution systems.
- 225.30(B). This has been revised to permit multiple smaller feeders, with smaller conductors and lower rated overcurrent protective devices to allow more flexibility with the design.
- 250.104(A)(1). Revised to provide relief with the maximum sized bonding jumper for bonding metal water piping systems.

Protecting electrical workers who maintain or service electrical or electrically powered equipment.

- 110.26(C)(3). Changes to revise working space requirements for non-dwelling unit large electrical equipment installations.
- 230.62(C). A new requirement that provides additional shock protection with barriers to be placed in service equipment to prevent inadvertent contact.
- 230.71(B). Current requirements for service disconnecting means is revised by eliminating risk from the inability to establish electrically safe conditions for energized work that must be performed within service equipment enclosures with more than one service disconnect.

- 240.67 & 240.87. Revised requirements for arc energy reduction to ensure it is set to operate at less than the available arcing current and prohibits temporary adjustment of the instantaneous trip setting as the method for meeting the requirement for circuit breakers.
- 408.18(C). A new requirement for manufacturers to provide a label on the front of equipment when working space is required for rear or side access to the equipment.

Protecting patient sleeping rooms in nursing homes and limited-care facilities from fires of electrical origin

- 210.12. Arc-fault circuit interrupters (AFCIs) are the most advanced technology currently recognized by the NEC for protecting premises against fires resulting from damaged wiring. Revisions to AFCI requirements expand this protection to these occupancies.

Protecting people from electric shock in homes, workplaces, and places of recreation.

- 210.8. New requirements applicable to ground-fault circuit interrupter (GFCIs) expand the protection across additional uses and occupancies not addressed in previous editions of the NEC. First introduced in the early 1970s, their continued expansion to areas in homes and workplaces where occupants are particularly susceptible to electric shock accidents is directly related to reductions in electrocutions and electric shock accidents.
- Revision to add “floating buildings” to the scope of Article 555 and revised to provide greater flexibility regarding the application of ground-fault protection requirements.

2017 NEC Updates

Keeping the regulatory document current with industry trends in new technology and delivery and generation of electric power.

- Article 425 Fixed Resistance and Electrode Industrial Process Heating Equipment – new article addresses installation requirements for fixed industrial process heating employing electric resistance or electrode heating technology.
- Article 691 Large-Scale Photovoltaic (PV) Electric Supply Stations - new article addresses requirements for large scale PV systems of no less than 5000 kW that are used to deliver power back to the utility grid.
- Article 706 Energy Storage Systems - Another new article to cover installation requirements for energy storage systems. The current state of energy storage technology, which includes batteries, and the anticipated evolution of energy storage supports the need for a singular set of requirements in the NEC covering such systems.
- Article 710 Standalone Systems - New article to address requirements for electric power production sources operating in a stand-alone mode independent of an electrical production and distribution network.
- Article 712 Direct-Current Micro-grids - New requirements to address micro-grids as they are becoming popular as a means to increase energy efficiency, reduce costs, and maintain critical business continuity. Powering utilization equipment directly from dc sources without intervening dc-ac and ac-dc conversion steps leads to higher efficiencies and potentially smaller, lower-cost equipment than ac-coupled methods.
- Article 690 - Revised requirements covering the expanding use of solar photovoltaic power. This will enhance first responder safety when performing operations on a roof by establishing a boundary creating two areas of rapid shutdown protection, providing separate requirements for protection inside and outside of the boundary, and specifying performance requirements for the rapid shutdown equipment inside and outside the boundary.

- Article 625 - Amended requirements for including wireless charging technology installation requirements for electrical vehicles.

Examples of new and revised requirements that may reduce the overall cost of the electrical system.

- 220.12. New exception for banks and office occupancies to permit reduced lighting load based on allowable load density prescribed by adopted energy codes. This may grant substantial relief for sizing of service and feeder distribution systems.
- Deletion of Table 310.15(B)(3)(c). This removes the required temperature adder for ambient temperature adjustment correction when calculating size of conductors installed on rooftops exposed to sunlight unless conductors are installed 7/8" or closer to the roof.
- 310.15(B)(7). Expands the use of 83% reduction for 3-conductor feeders (2 ungrounded and a neutral) derived from either single or three phase supplies.
- 338.10(B)(4) Revised to only require cables with 10 AWG and smaller conductors to default to the 60 degree C ampacity when installed in insulation.
- 210.8. New language covering all GFCI requirements that involve a measurement to determine receptacle proximity.
- 210.52(B)(1). Revision to expand permitted appliances in rooms or areas required to be supplied by a 20-ampere small appliance branch circuit to be supplied from an individual branch circuit rated 15 amperes or greater.
- 210.64. An amendment to only require a receptacle for service equipment located indoors and a new exception for services rated more than 120 volts to ground that supply certain types of equipment.

Protecting electrical workers who maintain and service electrical or electrically powered equipment.

- 110.16. Revision to require additional marking requirements for non-dwelling unit service equipment rated 1200 amperes or more.
- 110.26. New requirements that include working space for equipment located in a space that has limited access.
- 240.87. Revised requirements for arc energy reduction provide additional methods for acceptable arc flash mitigation and provide arc energy reduction requirements for fuses rated 1200 amperes or greater.
- 409.22, 620.51 & 670.5. New requirements for marking equipment with the short circuit current and maximum available fault current for elevators, industrial machinery, and industrial control panels.
- 404.22. New requirements for electronic lighting control switches to prohibit the introduction of current on the equipment grounding conductor during normal operation.
- 408.3. New provision that requires barriers for panelboards to provide a measure of safety against inadvertent contact with line-energized parts during maintenance and installation of new feeders or branch circuits.
- 670.6 & 695.15. New requirement for surge protection for industrial machinery and fire pump controllers.

Protecting hotels and motels from fires of electrical origin

210.12. Provides expanded coverage from arc-fault circuit interrupters, the most advanced technology recognized by the NEC for protection against fires resulting from damaged wiring - to hotel and motels.

Protecting people from electric shock in homes, workplaces, and places of recreation.

- 210.8. New requirements for use of GFCIs to expand protection from these devices across a range of uses and occupancies.
- Revision to add boatyards and commercial and noncommercial docking facilities to the scope of Article 555 and to lower the ground-fault protection threshold to a maximum 30 mA.
- Article 680, Part VIII. New series of requirements covering the certification, marking, protection, and field installation of “electrically powered pool lifts.”

2014 NEC Updates

Keeping the regulatory document current with industry trends in new technology and delivery and generation of electric power.

- Revisions that change the voltage thresholds from 600 to 1000 volts in recognition of commonly used alternative energy systems that operate at more than 600 volts. This will lead to revised equipment voltage ratings within product standards to accommodate higher operating voltages of systems such as PV and wind power.
- Article 694 - A new article introduced in the 2011 NEC addressed requirements for small wind electrical systems of 100 KW and smaller. This article has been revised to apply to all wind systems, ensuring that regardless of size, minimum electrical safety requirements are in place.
- Article 646 - A new article for Modular Data Centers. These new systems are becoming prominent in the demand for business systems to meet a 100% up-time-for-business continuity.
- Article 690 - Revised requirements covering the expanding use of solar photovoltaic power, including a new requirement for a rapid shutdown of PV systems on buildings to lower the power to a level intended to prevent a shock hazard to first responders performing firefighting operations on a roof.
- Article 393 - New article and installation requirements for Low Voltage Suspended Ceiling Power Distribution Systems
- Articles 410 and 600 - Extensive upgrades are underway to achieve greater energy efficiency in signs and luminaires by replacing in-place illumination systems with LEDs. New requirements ensure that “retro fit kits” employed meet minimum product safety standards through listing requirements.
- Article 625 - New and revised requirements covering electric vehicle charging equipment that keeps the regulatory document in step with the increase in consumer demand for all-electric and hybrid- electric vehicles. New provisions that allow an automatic load management system that may grant relief on sizing of service and feeders.

Energy management is common in modern electrical infrastructure through the control of utilization equipment, energy storage and power production. Several new requirements in 2014 addressed safe interaction with these energy management systems, while others provide substantial relief on the overall cost of the electrical system.

- Article 750 - A new article that provides requirements to cover loads where continuity of power cannot be compromised or where automatic disconnection creates a hazard for the public such as shutting off emergency circuits.
- 220.12. New exception to permit calculation of the general lighting load to be performed as per locally adopted energy codes. This may grant substantial relief for sizing of service and feeder distribution systems.
- 404.2(C). The 2011 NEC included requirements for a grounded conductor to be provided at switch location to address switching devices, such as occupancy sensors and their safe connection to the electrical system. The 2014 edition grants relief by providing alternative methods of compliance.
- 406.3(E). New marking symbol requirement for receptacle outlets controlled by an automatic control device or by an automatic energy management system to ensure safe interaction and ensure business continuity.

Protecting electrical workers who maintain or service electrical or electrically powered equipment.

- 110.25. New requirement that provides uniform conditions for locking off switches that control power to equipment to ensure that electrical workers can service and maintain equipment safely. This correlates with federal occupational health and safety regulations covering safe work practices on and about electrical equipment.
- 110.26. Revisions to egress door requirements to address worker safety in the event of an arc flash or arc blast incident.
- 110.21. Revised to provide uniform hazard marking where caution, warning, or danger signs or labels are required by this referenced standard.
- 240.87. Revised requirements for Arc Energy Reduction to expand methods for acceptable arc flash mitigation methods.

Protecting homes and dormitories from fires of electrical origin.

- 210.12. Revisions to AFCI requirements expand this protection and provide additional methods for compliance.

Protecting people from electric shock in homes and workplaces.

- 210.8. New requirements for GFCI application.

Changes impacting safety in Healthcare Facilities

- Several changes throughout Article 517, which addresses safety installation requirements for electrical systems installed in healthcare facilities.

2011 NEC Updates

Keeping the regulatory document current with industry trends in new technology and delivery and generation of electric power.

- New Article 840 includes requirements for equipment associated with broadband communication systems.
- New Article 399 adds requirements for outdoor overhead conductors over 600 volts.
- New Article 694 adds requirements for small wind electrical systems of 100 KW and smaller.
- Article 625 revised to include hybrid- electric vehicles under the scope of the article.

- Article 645 - Extensive revisions to provide greater flexibility with design for information technology equipment installations.

Protecting electrical workers who maintain or service electrical or electrically powered equipment.

- 240.87. New requirement to provide a method for reducing incident energy for non-instantaneous trip circuit breakers.
- 410.130. Requirement to install disconnecting means when ballasts are replaced in existing luminaires.
- 110.24. New labeling requirement for service equipment to identify the maximum available fault current.

Protecting people from electric shock in homes and workplaces.

- 210.8. Additional requirements for ground-fault circuit interrupter protection (GFCI).
- 555.3. New requirement to provide ground fault protection for the main overcurrent device supplying marinas and boatyards to help prevent electric shock drowning.
- 404.2(C). New requirement for installation of a grounded conductor at switch locations where lighting loads are controlled.
- 406.12. Expands tamper-resistant receptacle requirements to guest rooms, guest suites, and childcare facilities.

The regulatory community has relied on the NEC for over 100 years to meet society's demand for safe electrical installations. Adopting the most current edition of the NEC is a vitally important, proactive step for consumer protection and for the safe advancement of new electrical system technology. By taking that step, commission members will ensure greater electrical safety for the citizens of Indiana.

If you have questions or would like additional information, contact Mr. Tim McClintock, Midwest Field Representative for the National Electrical Manufacturers Association, at 330- 749-9782 or tim.mcclintock@nema.org.