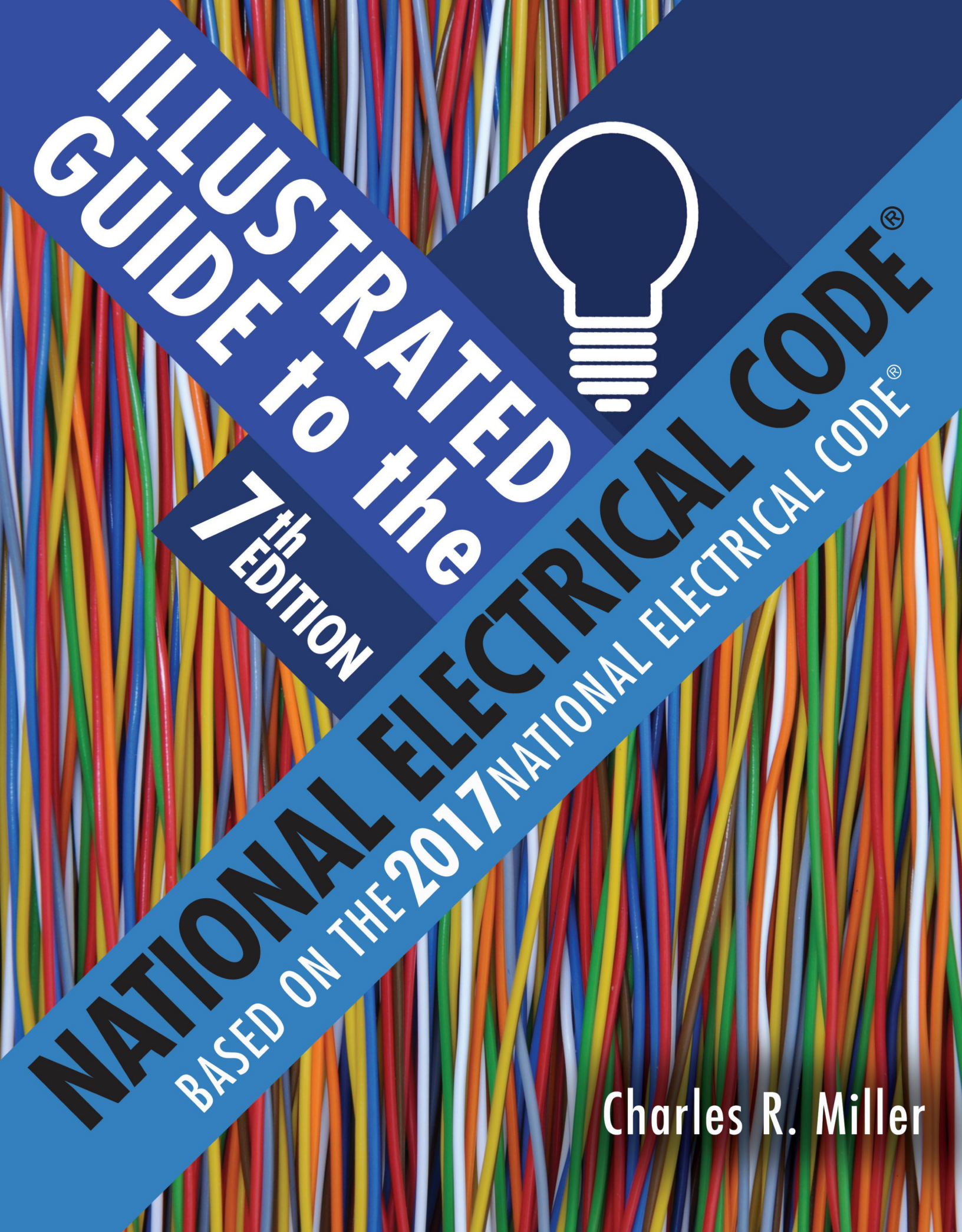




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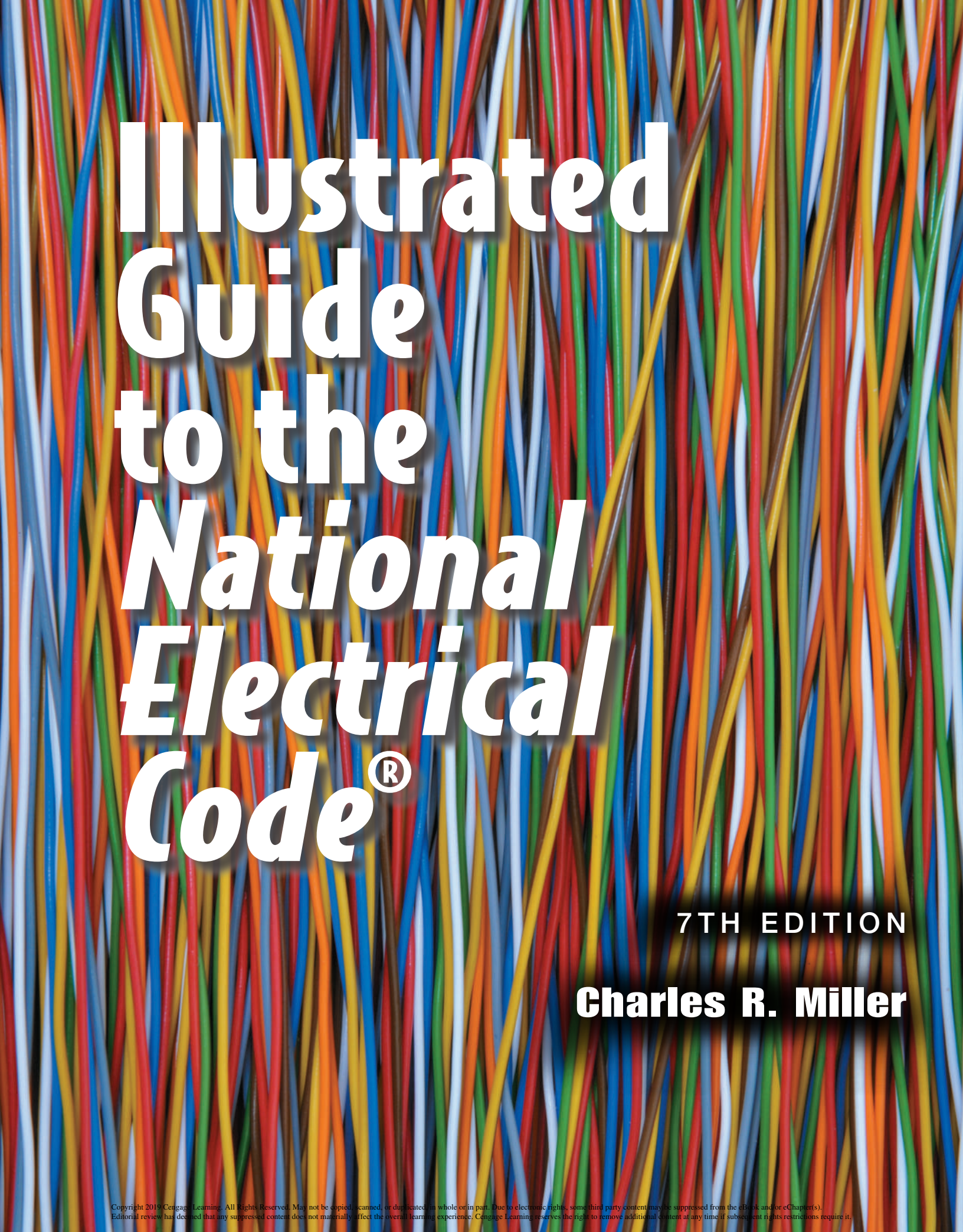
7th
EDITION



NATIONAL ELECTRICAL CODE[®]

BASED ON THE 2017 NATIONAL ELECTRICAL CODE[®]

Charles R. Miller



Illustrated Guide to the *National Electrical Code*[®]

7TH EDITION

Charles R. Miller

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Illustrated Guide to the National Electrical Code offers an exciting new approach to understanding and applying the provisions of the *National Electrical Code*.^{*} Unlike the *Code*, this text gathers and presents detailed information in a format, such as one-family or multifamily dwellings, based on “type of occupancy.” *Code* specifications applicable to a given type of occupancy are logically organized in easy-to-read units and graphically enhanced by numerous technical illustrations. Going an extra step, the occupancy-specific material is subdivided into specific rooms and areas. Information relevant to more than one type of occupancy is organized into independent units for easier reference. For instance, items such as raceways and conductors are covered in Unit 5 but are related to every type of occupancy.

Students who wish to acquire a comprehensive grasp of all electrical codes will want to study this text section by section and unit by unit. Practicing electricians who have specialized in one type of occupancy and who wish to understand an unfamiliar segment may want to focus on those new areas. For example, an electrician who has been wiring commercial facilities for a number of years wants to wire a new house. Being unfamiliar with the codes concerning residential wiring, this individual can turn to Section 2, “One-Family Dwellings.” Here, everything from receptacle placement to the placement of the service point is explained. Section 2 is made up of four units: Units 6 through 9. Unit 6, “General Provisions,” contains general requirements for one-family dwellings, both interior and exterior. Unit 7, “Specific Provisions,” addresses more complex issues, requiring additional provisions for specific areas such as kitchens, hallways, clothes closets, bathrooms, garages, basements, etc. Unit 8, “Load Calculations,” simplifies the standard as well as optional load calculation methods for one-family dwellings. Unit 9, “Services and Electrical Equipment,” is divided into five subheadings: Service-Entrance Wiring Methods; Service and Outside Wiring Clearances; Working Space around Equipment; Service Equipment and Panelboards; and Grounding.

The “what,” “when,” “where” adoption of the provisions of the *NEC* is under the discretionary control of state and local jurisdictions. State and local jurisdictions also have the liberty of appending additional codes, which in many cases may be more stringent than those outlined by the *NEC*. The *Code* may be adopted in whole or in part. For example, while some local codes do not allow the use of nonmetallic-sheathed cable for residential or commercial wiring, others allow its use in residential but not in commercial wiring applications. To ensure compliance, obtain a copy of any additional rules and regulations for your area.

This guide’s objective is to provide the information needed to complete your project—without the necessity of learning the *NEC* from cover to cover. *Illustrated Guide to the National Electrical Code* will bring your project to life as quickly and as accurately as any text on the market today. In the electrical field, as in any career, the learning experience never ends. Whether you are an electrician’s apprentice, a master electrician, or an electrical inspector, *Illustrated Guide to the National Electrical Code* has something for you. We believe you will find it to be a valuable addition to your reference library. In fact, you may want to include it in your toolbox or briefcase!

Take note that this guidebook was completed after all the normal steps in the National Fire Protection Association (NFPA) 70 review cycle—Public Input, First Draft Report, Public Comment, Second Draft Report, reviews by Technical Correlating Committee, NFPA Annual

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Meeting, and ANSI Standards Council—and before the actual publication of the 2017 edition of the *NEC*. Every effort has been made to be technically correct, but there is always the possibility of typographical errors or appeals made to the NFPA Board of Directors after the normal review cycle that could change the appearance or substance of the *Code*.

If changes do occur after the printing of this book, they will be included in the Instructor's Guide and will be incorporated into the guidebook in its next printing.

Note also that the *Code* has a standard method to introduce changes between review cycles, called “Tentative Interim Amendment,” or TIA. These TIAs and correction of typographical errors can be downloaded from the NFPA Web site, www.nfpa.org, to make your copy of the *Code* current.

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ABOUT THE AUTHOR

For eighteen years, Charles R. Miller owned and operated a successful commercial electrical contracting company (Lighthouse Electric Co., Inc.) in Nashville, Tennessee. Throughout those years, he prided himself on solving problems abandoned by less-skilled or less-dedicated technicians. In 1988, he began operating a second company, dedicated to electrical-related training and known as Lighthouse Educational Services. Mr. Miller teaches custom-tailored

classes and seminars covering various aspects of the *National Electrical Code* and NFPA 70E. Countless numbers of students have taken advantage of his extensive experience in electrical contracting; regulatory exams (current electrical codes); electrical-related business and law; and electrical safety-related work practices. Class and seminar attendees have included individuals employed by companies such as Ford, Textron, the Aerostructures Corporation, Aladdin Industries, Lorillard Tobacco Company, Smith & Wesson, McKee Foods, Lockheed Martin, and Goodyear; by academic institutions such as Tennessee State University, Vanderbilt University, and Purdue University; and governmental agencies including the National Aeronautics and Space Administration (NASA).

In 1999, Charles started writing and illustrating the “Code In Focus” column in *Electrical Contractor* magazine. His attention-to-detail illustrations and writing style make this one of the top, if not the top, read columns in the monthly magazine. Charles Miller started writing for NFPA in 2003. Titles include *Pocket Guide to Residential Electrical Installations*, *Pocket Guide to Commercial and Industrial Electrical Installations*, *NFPA’s Electrical References*, *NFPA’s Pocket Electrical References*, *Electrician’s Exam Prep Manual*, and *Ugly’s Electrical Safety and NFPA 70E*. Besides teaching, writing, and illustrating, Charles cohosted a home improvement radio talk show in Nashville, Tennessee, for more than three years.

Charles Miller has dedicated over 5000 hours to making *Illustrated Guide to the National Electrical Code* a reality. His unsurpassed attention to detail is evident on every page. Since this book’s inception, every day’s waking hours have been consumed with careful planning and execution of content and design. His unwavering commitment to quality, from the first page in Unit 1 to the last page in Unit 19, has produced a technically superior, quintessentially user-friendly guide.

Acknowledgments

I would like to say “thank you” to my children, Christin and Adam, for being patient and understanding during the extremely long hours and endless days working on this text. My mother, Evelyn Miller, gets a special “thank you” and “I love you” for a lifetime of support and encouragement. She called every day to check on me and quite often sent encouraging greeting cards that always came at just the right time. “Thank you” to my wife, Linda, for all your love and support as I spend long hours writing and illustrating.

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FOUNDATIONAL PROVISIONS

section 1

UNIT

1

Introduction to the *National Electrical Code*®

Objectives

After studying this unit, the student should:

- ▶ be able to give a brief account of electricity in its infancy.
- ▶ be able to identify the catalyst that brought about the *National Electric Code (NEC)*.
- ▶ understand how the *NEC* began and its purpose.
- ▶ understand how changes to the *Code* evolve.
- ▶ be familiar with the terminology, presentation, and format of the *NEC*.
- ▶ know what type of information is found in the *NEC* (its layout).
- ▶ understand the *NEC*'s concern with equipment and material standards.
- ▶ be able to recognize various trademark logos that denote listed and labeled products.
- ▶ comprehend the role of nationally recognized testing laboratories (NRTL) and the National Electrical Manufacturers Association (NEMA) as well as the expanded role of the National Fire Protection Association (NFPA).
- ▶ be familiar with this book's layout, text conventions, and illustration methods.
- ▶ be advised on how to study the *Illustrated Guide to the NEC*.
- ▶ be aware that electrical requirements in addition to the *NEC* may exist, and if so, that compliance is required.

THE NATIONAL ELECTRICAL CODE

Just as an extensive education is required for doctors to perform the duties of their chosen field, a working knowledge of the *NEC* is a necessity for anyone practicing a profession in the electrical industry. The *NEC* provides the standards by which all electrical installations are judged. Although other requirements, such as local ordinances and manufacturer instructions, must be applied, the *NEC* is the foundation on which successful installations are built. It is the most widely recognized and used compilation of technical rules for the installation and operation of electrical systems in the world today. Because of its widespread effect on the industry, it is important to understand the history of the *NEC*.

The Beginning

In 1882, New York City was home to the first central-station electric generating plant developed by Thomas A. Edison. The Pearl Street Station began operation at 3:00 P.M. on Monday, September 4. Fifty-nine customers had reluctantly consented to have their houses wired on the promise of three free months of electric light. They were given the option of discarding the service if it proved to be unsatisfactory. But this new way of lighting was more than satisfactory . . . it was a sensation. The number of customers tripled in only four months. And, as they say, the rest is history. The new industry swept the nation: New construction included the installation of electricity, and property owners demanded that existing structures be updated as well. New materials and equipment were developed and manufactured, and methods for installing and connecting these items to the electrical source were devised. For more than a decade, manufacturers, architects, engineers, inventors, electricians, and others worked independently to develop their contributions to the new technology. By 1895, there were as many as five different electric installation codes in use, and no single set of codes was accepted by all. To further complicate matters, there was an unexpected hazard darkening the prospects of this new industry.

Purpose and History of the *NEC*

Electrically caused fires were becoming commonplace and, by 1897, the problem was reaching epidemic proportions. A diverse group of knowledgeable, concerned individuals assembled to address this critical issue. The need for standardization was apparent. The consensus of more than 1200 individuals produced the first set of nationally adopted rules to govern electrical installations and operations—the *National Electrical Code*.

The *NEC* states its purpose as . . . *the practical safeguarding of persons and property from hazards arising from the use of electricity*. This objective has remained constant throughout the *NEC*'s existence, and the principles it contains continue to grow and change with the dynamic electrical industry.

Code Changes

The *NEC* is regularly revised to reflect the evolution of products, materials, and installation techniques. Since 1911, the National Fire Protection Association (NFPA) of Quincy, Massachusetts, has been responsible for the maintenance and publication of the *NEC*. The 2017 edition, which contains hundreds of reworded, as well as new, regulations, represents the diligent work of nineteen code-making panels and the technical correlating committee, composed strictly of volunteers from all professions within the electrical industry.

These panels are complemented by a host of private individuals who submit proposals or comment on proposals already submitted for changes to the *NEC*. Anyone who wishes to participate can contact the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471, and request a free booklet, "The NFPA Standards-Making System." The current edition of the *NEC* provides information in the back of the book for submitting public inputs and public comments for changes to the next edition, a copy of which is reproduced on the next page for your reference.

Now let us examine what is inside the *NEC* and how we can go about understanding it.

Submitting Public Input/Public Comment Through the Online Submission System

Soon after the current edition is published, a Standard is open for Public Input.

Before accessing the Online Submission System, you must first sign in at www.nfpa.org. *Note: You will be asked to sign-in or create a free online account with NFPA before using this system:*

- Click on Sign In at the upper right side of the page.
- Under the Codes and Standards heading, click on the “List of NFPA Codes & Standards,” and then select your document from the list or use one of the search features.

OR

- Go directly to your specific document information page by typing the convenient shortcut link of www.nfpa.org/document# (Example: NFPA 921 would be www.nfpa.org/921). Sign in at the upper right side of the page.

To begin your Public Input, select the link “The next edition of this standard is now open for Public Input” located on the About tab, Current & Prior Editions tab, and the Next Edition tab. Alternatively, the Next Edition tab includes a link to Submit Public Input online.

At this point, the NFPA Standards Development Site will open showing details for the document you have selected. This “Document Home” page site includes an explanatory introduction, information on the current document phase and closing date, a left-hand navigation panel that includes useful links, a document Table of Contents, and icons at the top you can click for Help when using the site. The Help icons and navigation panel will be visible except when you are actually in the process of creating a Public Input.

Once the First Draft Report becomes available there is a Public Comment period during which anyone may submit a Public Comment on the First Draft. Any objections or further related changes to the content of the First Draft must be submitted at the Comment stage.

To submit a Public Comment you may access the online submission system utilizing the same steps as previously explained for the submission of Public Input.

For further information on submitting public input and public comments, go to: <http://www.nfpa.org/publicinput>.

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NEC Terminology, Presentation, and Format

Tables present a requirement's multiple application possibilities.

Table 210.21(B)(3) Receptacle Ratings for Various Size Circuits	
Circuit Rating (Amperes)	Receptacle Rating (Amperes)
15	Not over 15
20	15 or 20
30	30
40	40 or 50
50	50

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Diagrams, or figures, are used to further clarify NEC applications.

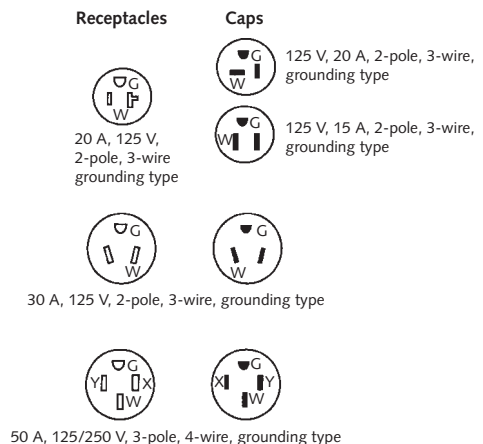


Figure 551.46(C)(1) Configurations for grounding-type receptacles and attachment plug caps used for recreational vehicle supply cords and recreational vehicle lots.

CAUTION

Be advised that the local authority having jurisdiction has the ability to amend the *Code* requirements. Consult the proper authority to obtain applicable guidelines.

Informational Notes contain explanatory material such as references to other standards, references to related sections of the *Code*, or information related to a *Code* rule. These are informational only and do not require compliance >>90.5(C)<<.

Parts (subheadings) are used to break down articles into simpler topics. (Not all articles have subheadings.)

• **Bullets** (solid black circles) indicate areas where one or more complete paragraphs have been deleted or moved since the last edition.

Sections are numerical listings where the *Code* requirements are located.

Exceptions appear in *italics* and explain when and where a specific rule does not apply.

Not Shown

■ This icon indicates new sections or new articles. These sections could be new or just moved from other sections.

— SWITCHES

404.28

(E) **Dimmer Switches.** General-use dimmer switches shall be used only to control permanently installed incandescent luminaires unless listed for the control of other loads and installed accordingly.

(F) **Cord- and Plug-Connected Loads.** Where a snap switch or control device is used to control cord- and plug-connected equipment on a general-purpose branch circuit, each snap switch or control device controlling receptacle outlets or cord connectors that are supplied by permanently connected cord pendants shall be rated at not less than the rating of the maximum permitted ampere rating or setting of the overcurrent device protecting the receptacles or cord connectors, as provided in 210.21(B).

Informational Note: See 210.50(A) and 400.10(A)(1) for equivalency to a receptacle outlet of a cord connector that is supplied by a permanently connected cord pendant.

Exception: Where a snap switch or control device is used to control not more than one receptacle on a branch circuit, the switch or control device shall be permitted to be rated at not less than the rating of the receptacle.

Part II. Construction Specifications**404.20 Marking.**

(A) **Ratings.** Switches shall be marked with the current, voltage, and, if horsepower rated, the maximum rating for which they are designed.

(B) **Off Indication.** Where in the off position, a switching device with a marked OFF position shall completely disconnect all ungrounded conductors to the load it controls.

404.22 Electronic Lighting Control Switches. Electronic lighting control switches shall be listed. Electronic lighting control switches shall not introduce current on the equipment grounding conductor during normal operation. The requirement to not introduce current on the equipment grounding conductor shall take effect on January 1, 2020.

Exception: Electronic lighting control switches that introduce current on the equipment grounding conductor shall be permitted for applications covered by 404.2(C), Exception. Electronic lighting control switches that introduce current on the equipment grounding conductor shall be listed and marked for use in replacement or retrofit applications only.

404.26 Knife Switches Rated 600 to 1000 Volts. Auxiliary contacts of a renewable or quick-break type or the equivalent shall be provided on all knife switches rated 600 to 1000 volts and designed for use in breaking current over 200 amperes.

404.27 Fused Switches. A fused switch shall not have fuses in parallel except as permitted in 240.8.

404.28 Wire-Bending Space. The wire-bending space required by 404.3 shall meet Table 312.6(B) spacings to the enclosure wall opposite the line and load terminals.

70-257

Dictionary-style header—The left header shows the first section referenced, and the right header shows the last section referenced.

Normal black letters are used for basic *Code* definitions and explanations.

Mandatory rules use the terms “shall” or “shall not” and require compliance >>90.5(A)<<.

Highlighted text within sections indicates changes, other than editorial, since the last *NEC* edition. The letter N with gray shading is placed in outside margins to identify new sections and for new articles.

Permissive rules contain the phrases “shall be permitted” or “shall not be required.” These phrases normally describe options or alternative methods. Compliance is discretionary >>90.5(B)<<.

NFPA document number followed by a page number.

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Formal Interpretations

Section 90.6 states: *To promote uniformity of interpretation and application of the provisions of this Code, formal interpretation procedures have been established and are found in the NFPA Regulations Governing Committee Projects.* (The NFPA Regulations Governing Committee Projects are in the NFPA Directory. Contact NFPA for a copy of this annual publication.)

The NEC Layout

The table of contents in the *NEC* provides a breakdown of the information found in the book. Chapters 1 through 4 contain the most-often used articles in the *Code*, because they include general, or basic, provisions. Chapter 1, while relatively brief, includes definitions essential to the proper application of the *NEC*. It also includes an introduction and a variety of general requirements for electrical installations. More general requirements are found in Chapters 2, 3, and 4, addressing Wiring and Protection, Wiring Methods and Materials, and Equipment for General Use. Special issues are covered in Chapters 5 through 7. Chapter 5 contains information on Special Occupancies; Chapter 6, Special Equipment; and Chapter 7, Special Conditions. The contents of these chapters are applied in addition to the general rules given in earlier chapters. Chapter 8 covers Communications Systems and is basically independent of other chapters, except where cross-references are given. The final chapter, Chapter 9, contains Tables and Examples. Each chapter contains one or more articles, and each article contains sections. Sections may be further subdivided by the use of lettered or numbered paragraphs. The *Code* is completed by Annexes A through J, an index, and a proposal form.

WIRING SYSTEM PRODUCT STANDARDS

In addition to installation rules, the *NEC* is concerned with the type and quality of electrical wiring system materials. Two terms are synonymous with acceptability in this area: **labeled** and **listed**. Their definitions, found in Article 100, are very similar. Similarities within these definitions include: (1) an organization that is responsible for providing the listing or labeling, (2) that these organizations must be acceptable to the authority having jurisdiction, (3) that both are concerned with the evaluation of products, and (4) that both maintain periodic inspection of the production (or manufacturing) of the equipment or materials which have been listed or labeled. A manufacturer of labeled equipment (or material) must continue to comply with the appropriate standards (or performance) under which the labeling was granted. “Listed” also means that the equipment, materials, or services meet appropriate designated standards or have been tested and found suitable for a specified purpose. This information is compiled and published by the organization. The Informational Note under “Listed” states that each organization may have different means for identifying listed equipment. In fact, some do not recognize equipment as listed unless it is also labeled. Listed or labeled equipment must be installed and used as instructed » 110.3(B)«.

The organizations described in the following directly affect the *Code* as it relates to equipment and material acceptability and play a role in developing and maintaining the standards set forth in the *NEC*.

Nationally Recognized Testing Laboratories

Prior to 1989, there were only two organizations perceived as capable of providing safety certification of products that would be used nationwide. Because there were only two, innovative technology was slow to be tested and approved. When Congress created the Occupational Safety and Health Administration (OSHA) in the early 1970s, OSHA was directed to establish safety regulations for the workplace and for the monitoring of those regulations. OSHA adopted an explanation from the *NEC* and included it in the *Code of Federal Regulations*. In part, it reads: “an installation or equipment is acceptable to the Assistant Secretary of Labor . . . if it is acceptable or certified, or listed, or labeled, or otherwise determined to be safe by a nationally recognized testing laboratory. . .”

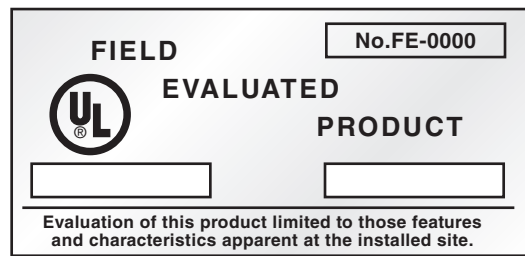
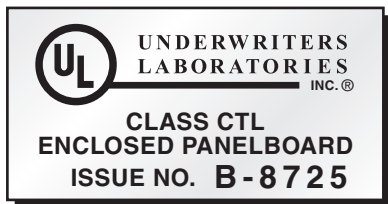
Testing by a nationally recognized testing laboratory (NRTL) was specified in the Code of Federal Regulations, but requirements for becoming an NRTL had not yet been identified. Although OSHA introduced “Accreditation of Testing Laboratories” in 1973, the process through which a laboratory would receive accreditation was still missing. Cooperative efforts produced the OSHA regulation finalized in 1988, and called “OSHA Recognition Process for Nationally Recognized Testing Laboratories.”

OSHA’s NRTL program greatly benefits manufacturers by providing a system that certifies that a product meets national safety standards. Just as important, the door was opened for a greater number of laboratories to provide certification, and manufacturers are now better able to meet the demands of today’s highly competitive market.

The aim of NRTLs is to ensure that electrical products properly safeguard against reasonable, identifiable risks. An extensive network of field personnel conduct unannounced inspections at manufacturing facilities that use the laboratory’s “seal of approval.” Some of the better-known trademarks of testing laboratories are shown below:



Some of the labels that appear on evaluated and certified electrical products, such as the ones that follow, carry the trademarks of the testing laboratory or the laboratory’s standards being used for comparison.



MET Laboratories

MET Laboratories, Inc., working with the Department of Labor as well as other agencies, served as a working example for the accreditation process for independent testing laboratories. In fact, MET became the first U.S. laboratory to successfully complete the process (1989), and thus became the first NRTL licensed by OSHA.

MET field inspectors interact with local electrical inspectors throughout the country to ensure product acceptance by all federal and state regulatory officials. The MET label is accepted by all fifty states, the federal government, and major retailers.

Underwriters Laboratories, Inc.

Prior to the formalization of NRTLs in 1989, electrical product standards were primarily written by Underwriters Laboratories, Inc. (UL), who also performed certification testing. Standards written by UL are still widely used. The appearance of the UL logo on a label indicates that the product complies with the UL standard. It does not mean, necessarily, that UL did the product testing. Although one of many NRTLs, Underwriters Laboratories is perhaps the most widely recognized and respected testing laboratory in operation today. Founded in 1894, UL is a not-for-profit corporation whose mission is to bring safer products to the marketplace and to serve the public through rigorous product safety testing. This organization offers a wide range of services, which include, but are not limited to, product listing, classification, component recognition, field certification, field engineering, facility registration, inspection, fact-finding, and research. As one can see from this list, UL plays a major role in guiding the safety of the electrical industry.

Intertek Testing Services

Select laboratories of Intertek Testing Services (ITS) have passed OSHA's stringent NRTL accreditation procedures and thereby have earned the right to issue product approvals and list products using the familiar ETL listed and CE marks. ITS has been conducting performance and reliability tests to nearly 200 safety standards applicable to workplace-related products since 1896. Intertek's comprehensive program includes testing, listing, labeling, and quarterly follow-up inspections. While recognized internationally by its many listed marks, the ETL listed mark is accepted throughout the United States, by all jurisdictions for electrical products, when denoting compliance with nationally recognized standards such as Wyle Laboratories (WL), International Electrotechnical Commission (IEC), UL, Canadian Standards Association (CSA), and FM Approvals (FM).

National Electrical Manufacturers Association

Founded in 1926, National Electrical Manufacturers Association (NEMA) comprises companies that manufacture equipment for all facets of electrical application, from generation through utilization. Its expansive objectives include product quality maintenance and improvement, safety standards for product manufacture and usage, and a variety of product standards, such as ratings and performance. NEMA contributes to the development of the *National Electrical Safety Code* as well as the *NEC*.

National Fire Protection Association

The NFPA, more than a century old, dedicates itself to safety standards, gathering statistical data, conducting research, providing crucial information on fire protection, prevention, and suppression methods, and much more. Boasting an internationally diverse membership of more than 75,000, this leading nonprofit organization publishes over 300 widely recognized consensus codes and standards, including the *NEC*. Its primary pursuit is to protect lives and property from the often catastrophic hazards of fire.

THIS BOOK

The *Illustrated Guide to the NEC* is designed to teach through visualization. If a picture is truly worth a thousand words, this book should provide a more in-depth look at the *National Electrical Code* than can be found in any other single publication. Its highly detailed illustrations are complemented with concise, easy-to-understand written information. Not intended as a how-to book, the *Illustrated Guide to the NEC* instead strives to translate difficult material into simpler, straightforward principles. Once the reader understands how the *Code* translates in a specific area, the same techniques can be applied throughout.

Its Layout

Not only is the presentation of material in this text different from others on the market, but the organization of information also offers a new approach. After covering the fundamental provisions in the balance of Unit 1, this text proceeds to address code requirements by type of occupancy. Comprehensive information is given for one-family dwellings, multifamily dwellings, commercial locations, and special occupancies. To accomplish this task, information has been gathered logically from throughout the *Code* book and concentrated in one section, under the appropriate occupancy. Each occupancy type is broken down into its finite components, and each component is thoroughly discussed and illustrated (see table of contents).

Text Conventions

General text is grouped in small areas surrounding an illustration. **Notes** provide additional information considered relevant to the point being discussed. **Cautions** indicate that particular care is needed during application. **Warnings** indicate potential danger and are intended to prevent misunderstanding of a given rule.

Terms *Luminaire* and *Lighting Fixture*

The word *luminaire* is the international term for *lighting fixture*. As defined in Article 100, a luminaire is a complete lighting unit consisting of a light source such as a lamp or lamps, together with the parts designed to position the light source and to connect it to the power supply. It may also include parts to protect the light source, ballast, or distribute the light. A lampholder itself is not a luminaire. Starting with the 2002 edition, *luminaire* became the main term and *fixture* or *lighting fixture* followed in parentheses. In the 2008 edition, *fixture* and *lighting fixture* were removed and do not follow the term *luminaire*. Throughout this text, *fixture* and *lighting fixture* have also been omitted.

Studying This Text

As the title implies, frequent references are made to the *National Electrical Code*. Keep a copy of the latest edition of the *Code* close at hand. Any confusion about terminology not cleared up by the “Definitions” section of this text may be explained by consulting the *Code’s Article 100—Definitions* section. Whenever direct references are made to the *Code*, benefits will be gained by taking the time to read the suggested article or section. The *Illustrated Guide to the NEC* is not intended, in any way, to replace the *Code*. Each unit’s “Competency Test” requires a thorough understanding of related *NEC* subject matter. Use of this text alone is insufficient to successfully complete the test. It is, however, intended as an indispensable supplement to the *NEC*.

Note that when comparing calculations made by both the English and metric systems, slight differences will occur due to the conversion method used. These differences are not significant, and calculations for both systems are, therefore, valid.

ADDITIONAL ELECTRICAL REQUIREMENTS

Local Ordinances

The importance of local (state, city, etc.) electrical codes cannot be overemphasized. Local agencies can adopt the *NEC* exactly as written or can amend the *Code* by incorporating more or less stringent regulations. While the *NEC* represents the minimum standards for safety, some jurisdictions have additional restrictions. Obtain a copy of additional requirements (if any) for your area.

Engineers or architects who design electrical systems may also set requirements beyond the provisions of the *NEC*. For example, an engineer might require the installation of 20-ampere circuits in areas where the *NEC* allows 15-ampere circuits. Requirements from engineers or architects are found in additional documents, such as the following.

Plans and Specifications

If plans and specifications are provided for a project by knowledgeable engineers or architects, this information must be considered and, if need be, compared to the requirements set forth by the *NEC*. It is unlikely that the plans or specifications provided by competent professionals will conflict with or contradict the *Code*. Nonetheless, it is best to be diligent in applying the governing principals of the *NEC*.

Manufacturer Instructions

Equipment or material may include instructions from the manufacturer. In accordance with 110.3(B), these instructions must be followed. For example, baseboard heaters generally include installation instructions. The *NEC* does not prohibit the installation of receptacle outlets above baseboard heaters, but the manufacturer's instructions may prohibit the installation of its heater below receptacles.

CONCLUSION

While this unit briefly discusses the history of the *National Electrical Code*, it is not possible to do justice to the importance of the *Code* in a few short pages. With only a glimpse into its history and present-day supporting structure, this text moves on to the task of understanding the contents of the *Code*. The *Illustrated Guide to the NEC* presents visually stimulating information in an occupancy-organized, concise format. To begin the journey through the 2017 edition of the *National Electrical Code*, simply turn the page, read, look, and understand.

Definitions

Objectives

After studying this unit, the student should:

- ▶ understand the meaning of the term **accessible** (1) when applied to wiring methods and (2) when applied to equipment.
- ▶ be able to identify accessible equipment that is not readily accessible.
- ▶ be able to accurately evaluate a location as accessible, readily accessible, or not readily accessible.
- ▶ be able to identify equipment classified as appliances.
- ▶ be familiar with the four categories of branch circuits and be able to list their differences.
- ▶ be able to distinguish the difference between the terms **enclosed** and **guarded**.
- ▶ be able to determine whether a load is continuous or noncontinuous.
- ▶ know the difference between branch-circuit conductors and feeder conductors.
- ▶ understand the terminology associated with grounded and grounding.
- ▶ know the maximum distance permitted for **within sight** situations.
- ▶ be able to give examples of damp, dry, and wet locations.
- ▶ be able to determine which conductors are neutral conductors.
- ▶ comprehend the electrical vocabulary associated with the word **service**.
- ▶ be familiar with what constitutes a separately derived system.
- ▶ understand that the authority having jurisdiction (AHJ) could provide special permission, which is defined as **written consent**.

Introduction

What is the difference between accessible and readily accessible? Which is appropriate in a given application? When sizing a branch circuit or feeder, is the electrical load considered continuous or noncontinuous? What is the difference between a damp location and a wet location?

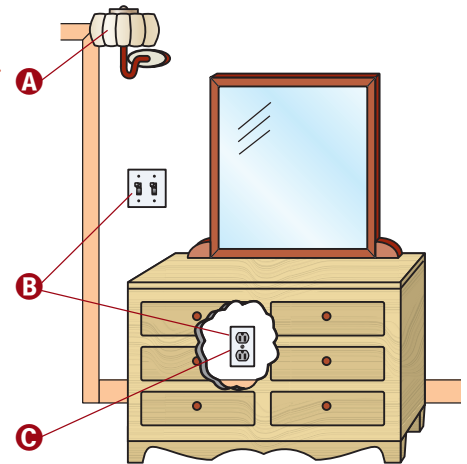
These and many other questions can be accurately answered only through a thorough understanding of *National Electrical Code (NEC)* terminology. Knowing the correct definition of words and phrases as found in Article 100 is crucial to installing a hazard-free electrical system. Article 100 does not include commonly defined general or technical terms from related codes and standards. Normally, only terms used in two or more articles are defined in Article 100. Other terms are defined within the article in which they appear but may be referenced in Article 100. Part 1 of Article 100 contains definitions to be applied wherever the terms are used throughout the *NEC*. Part 2 contains definitions applicable only to the parts of articles specifically covering installations and equipment operating at over 1000 volts, nominal.

DEFINITIONS

Accessible (As Applied to Wiring Methods)

Wiring components are considered accessible when (1) access can be gained without damaging the structure or finish of the building or (2) they are not permanently closed in by the structure or finish of the building » [Article 100](#)«.

- A** Conductors in junction boxes behind luminaires are considered accessible if, by removing the luminaire, access to the conductors is available.
- B** Conductors connected to switches and receptacles are accessible by removing the cover-plate and device.
- C** Receptacles behind furniture are accessible because the furniture can be moved.

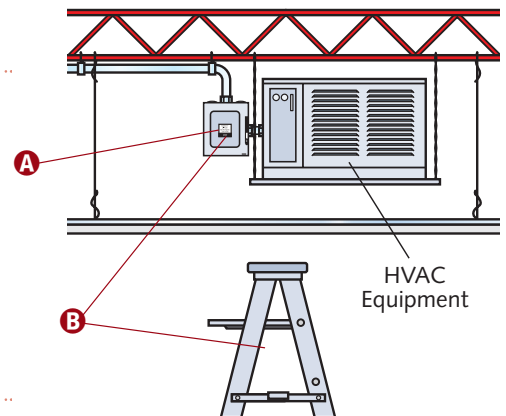


NOTE

Unlike readily accessible, wiring methods meet the definition of being accessible if access to the wiring method can be gained by using tools to remove covers or by climbing on ladders.

Accessible (As Applied to Equipment)

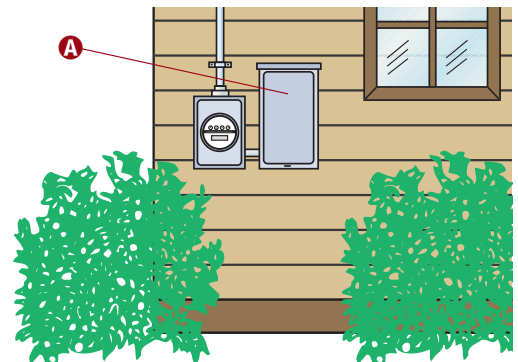
- A** Accessible equipment is equipment not guarded by locked doors, elevation, or other effective means » [Article 100](#)«. Equipment installed in locations requiring the use of portable means, such as a ladder, is considered accessible, but not *readily* accessible.
- B** Overcurrent devices do not have to be **readily accessible** if located adjacent to the equipment where access is achieved by the use of portable means » [240.24\(A\)\(4\)](#)«.



Accessible, Readily (Readily Accessible)

Readily accessible means capable of being reached quickly (for operation, renewal, or inspections) without having to take actions such as to use tools (other than keys), to climb over or under, to remove obstacles, or resort to portable ladders, etc. » [Article 100](#)«.

- A** The service disconnecting means must be readily accessible. It may be located either outside or inside, near the entry point of the service conductors » [230.70\(A\)\(1\)](#)«.



NOTE

Use of keys is a common practice under controlled or supervised conditions and a common alternative to the ready access requirements under such supervised conditions as provided elsewhere in the NEC. » *Informational Note under Readily Accessible*«

Accessible

- A** Ready accessibility to wiring in luminaires is not required. In most cases, access can be gained through the use of a ladder, scaffolding, etc.
- B** Conductors within junction boxes of recessed luminaires can be accessed by removing part of the luminaire, such as trims, lamps, internal shells, etc.

