

# ARTICLE 90

# INTRODUCTION TO THE *NATIONAL ELECTRICAL CODE*

## Introduction to Article 90—Introduction to the *National Electrical Code*

Many *NEC* violations and misunderstandings wouldn't occur if people doing the work simply understood Article 90. For example, many people see *Code* requirements as performance standards. In fact, the *NEC* requirements are bare minimums for safety. This is exactly the stance electrical inspectors, insurance companies, and courts take when making a decision regarding electrical design or installation.

Article 90 opens by saying the *NEC* isn't intended as a design specification or instruction manual. The *National Electrical Code* has one purpose only, and that's the "practical safeguarding of persons and property from hazards arising from the use of electricity." The necessity of carefully studying the *NEC* rules can't be overemphasized, and the role of textbooks such as this one are to help in that undertaking. Understanding where to find the rules in the *Code* that apply to the installation is invaluable. Rules in several different articles often apply to even a simple installation.

Article 90 then describes the scope and arrangement of the *NEC*. The balance of this article provides the reader with information essential to understanding the *Code* rules.

Typically, electrical work requires you to understand the first four chapters of the *NEC* which apply generally, plus have a working knowledge of the Chapter 9 tables. That understanding begins with Article 90. Chapters 5, 6, and 7 make up a large portion of the *Code*, but they apply to special occupancies, special equipment, or other special conditions. They build on, modify, or amend the rules in the first four chapters. Chapter 8 contains the requirements for communications systems, such as twisted pair conductors for telephone and data systems, satellite receivers, antenna systems, and coaxial cable wiring. Communications systems (twisted wire, antennas, and coaxial cable) aren't subject to the general requirements of Chapters 1 through 4, or the special requirements of Chapters 5 through 7, unless there's a specific reference in Chapter 8 to a rule in Chapters 1 through 7.

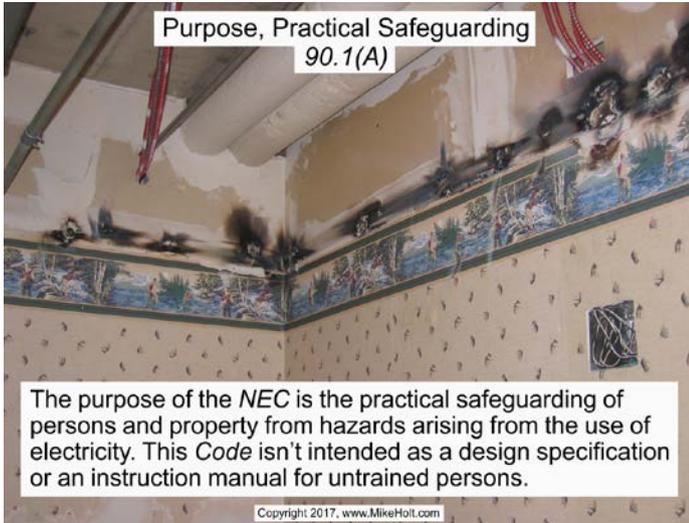
## 90.1 Purpose of the *NEC*

**(A) Practical Safeguarding.** The purpose of the *NEC* is to ensure that electrical systems are installed in a manner that protects people and property by minimizing the risks associated with the use of electricity. It isn't a design specification standard or instruction manual for the untrained and unqualified. ▶ [Figure 90-1](#)

### Author's Comment:

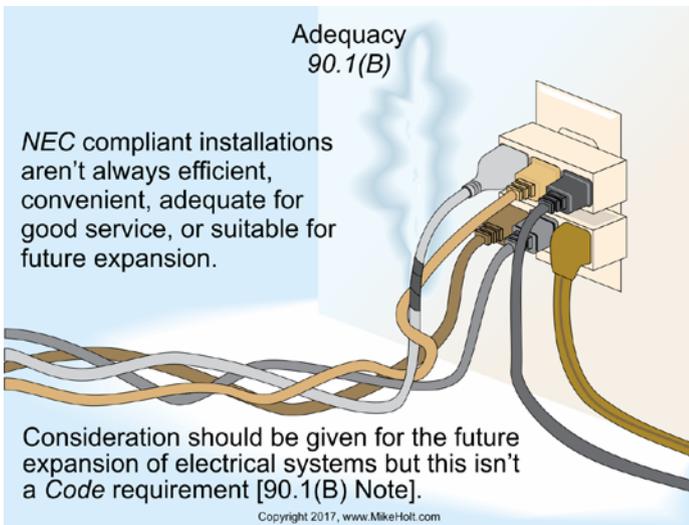
- The *Code* is intended to be used by those skilled and knowledgeable in electrical theory, electrical systems, construction, and the installation and operation of electrical equipment.

**(B) Adequacy.** The *Code* contains requirements considered necessary for a safe electrical installation. If an electrical system is installed in compliance with the *NEC*, it will be essentially free from electrical hazards. The *Code* is a safety standard, not a design guide.



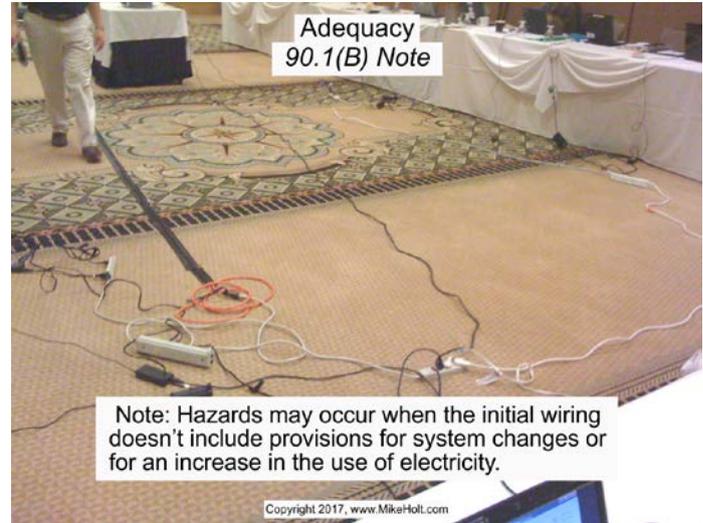
▶Figure 90-1

*NEC* requirements aren't intended to ensure the electrical installation will be efficient, convenient, adequate for good service, or suitable for future expansion. Specific items of concern, such as electrical energy management, maintenance, and power quality issues aren't within the scope of the *Code*. ▶Figure 90-2



▶Figure 90-2

**Note:** Hazards in electrical systems often occur because circuits are overloaded or not properly installed in accordance with the *NEC*. These often occur if the initial wiring didn't provide reasonable provisions for system changes or for the increase in the use of electricity. ▶Figure 90-3



▶Figure 90-3

**Author's Comment:**

- See the definition of "Overload" in Article 100.
- The *NEC* doesn't require electrical systems to be designed or installed to accommodate future loads. However, the electrical designer (typically an electrical engineer) is concerned with not only ensuring electrical safety (*Code* compliance), but also with ensuring the system meets the customers' needs, both of today and in the near future. To satisfy customers' needs, electrical systems are often designed and installed above the minimum requirements contained in the *NEC*. But just remember, if you're taking an exam, licensing exams are based on your understanding of the minimum *Code* requirements.

**(C) Relation to International Standards.** The requirements of the *NEC* address the fundamental safety principles contained in the International Electrotechnical Commission (IEC) Standard, including protection against electric shock, adverse thermal effects, overcurrent, fault currents, and overvoltage. ▶Figure 90-4

**Author's Comment:**

- The *NEC* is used in Chile, Ecuador, Peru, and the Philippines. It's also the *Electrical Code* for Colombia, Costa Rica, Mexico, Panama, Puerto Rico, and Venezuela. Because of these adoptions, it's available in Spanish from the National Fire Protection Association, 617.770.3000, or [www.NFPA.org](http://www.NFPA.org).

### NEC Relation to International Standards 90.1(C) and Note

The *NEC* addresses the safety principles contained in the IEC Standard such as:

- Protection against electric shock
- Adverse thermal effects
- Overcurrent
- Fault currents
- Overvoltage

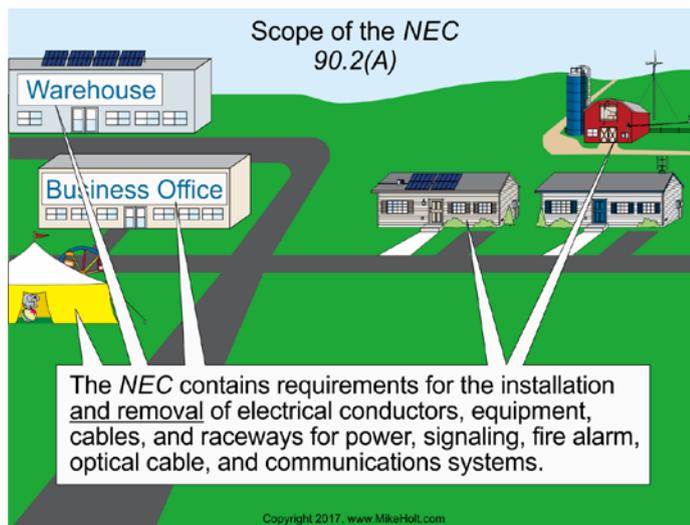


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▶ Figure 90-4

## 90.2 Scope of the *NEC*

**(A) What Is Covered by the *NEC*.** The *NEC* contains requirements necessary for the proper installation and removal of electrical conductors, equipment, cables, and raceways for power, signaling, fire alarm, optical cable, and communications systems (twisted wire, antennas, and coaxial cable) for: ▶ Figure 90-5



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▶ Figure 90-5

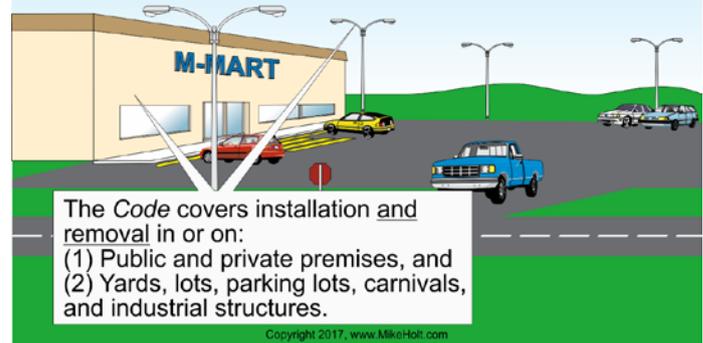
### Author's Comment:

- The *NEC* contains the following requirements on the removal of equipment and cables; temporary wiring 590.3 and abandoned cables for Audio [640.6(B)], Signaling [725.25], Fire Alarm [760.25], Optical Fiber [770.25], Twisted Pair [800.25], and Coaxial [820.25].

- (1) Public and private premises, including buildings, mobile homes, recreational vehicles, and floating buildings. ▶ Figure 90-6

### Scope of the *NEC*, Public and Private Premises 90.2(A)(1) and (2)

Public lighting on private property must be installed in accordance with the *NEC* even if installed by an electric utility.



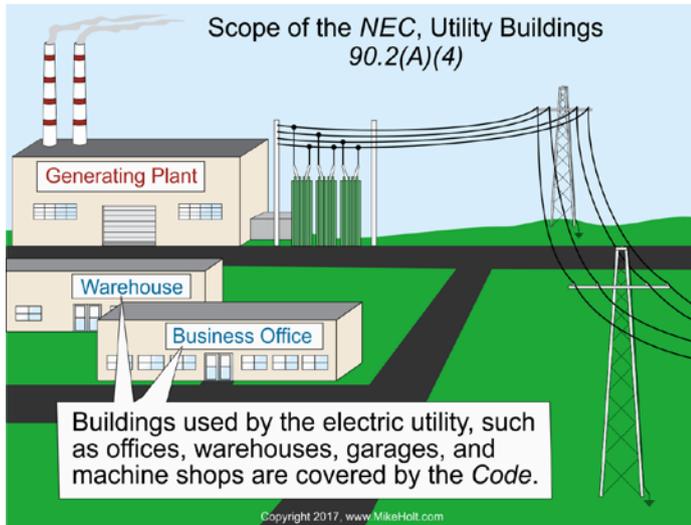
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▶ Figure 90-6

- (2) Yards, lots, parking lots, carnivals, and industrial substations.
- (3) Conductors and equipment connected to the electric utility supply.
- (4) Installations used by an electric utility, such as office buildings, warehouses, garages, machine shops, recreational buildings, and other electric utility buildings that aren't an integral part of a utility's generating plant, substation, or control center. ▶ Figure 90-7

**(B) What Isn't Covered by the *NEC*.** The *NEC* doesn't apply to the installation of electrical or communications systems (twisted wire, antennas, and coaxial cable) for:

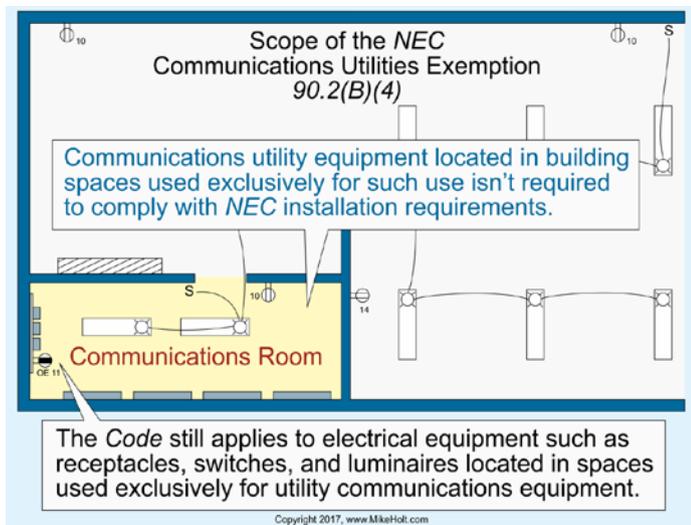
- (1) Transportation Vehicles.** The *NEC* doesn't apply to installations in cars, trucks, boats, ships and watercraft, planes, or electric trains.
- (2) Mining Equipment.** The *NEC* doesn't apply to installations underground in mines and self-propelled mobile surface mining machinery and its attendant electrical trailing cables.



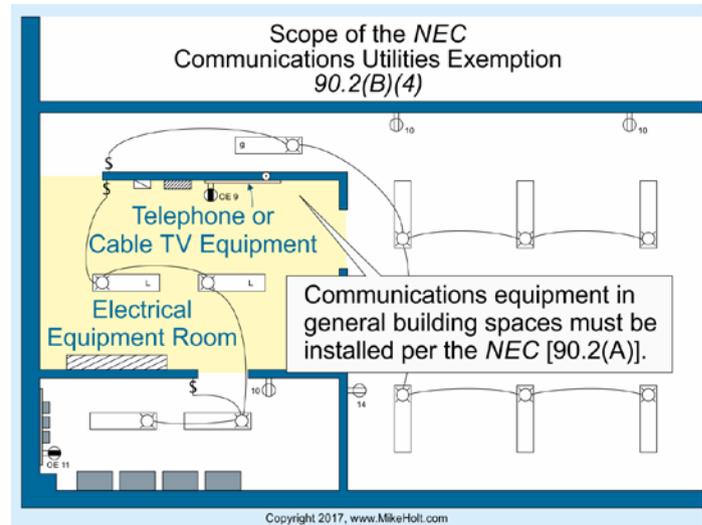
▶Figure 90-7

**(3) Railways.** The *NEC* doesn't apply to railway power, signaling, energy storage, and communications wiring.

**(4) Communications Utilities.** If the installation is under the exclusive control of the communications utility, the installation requirements of the *NEC* don't apply to the communications (telephone) or network-powered broadband utility equipment located in building spaces used exclusively for these purposes, or located outdoors if the installation is under the exclusive control of the communications utility. ▶Figure 90-8 and ▶Figure 90-9



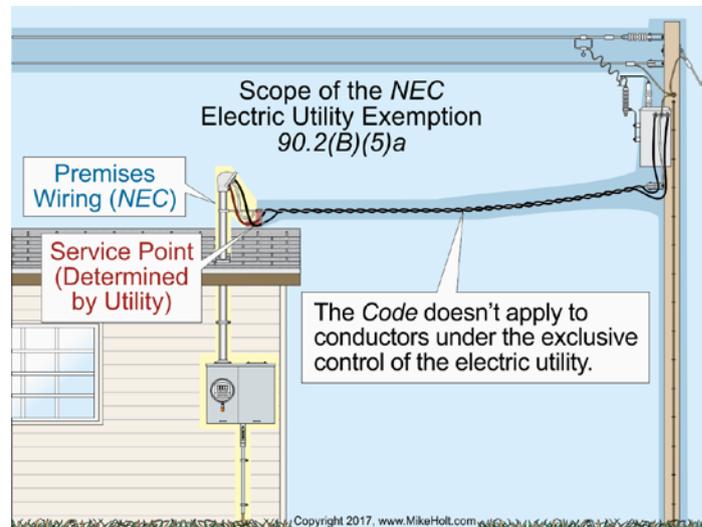
▶Figure 90-8



▶Figure 90-9

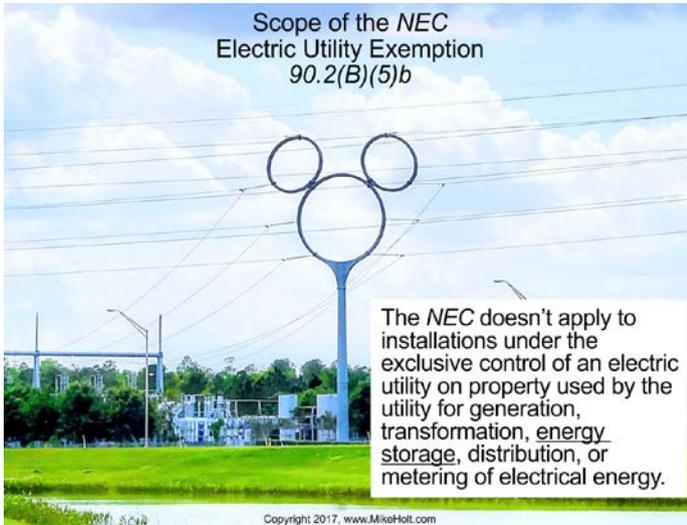
**(5) Electric Utilities.** The *NEC* doesn't apply to electrical installations under the exclusive control of an electric utility, where such installations:

- a. Consist of electric utility installed service drops or service laterals under their exclusive control. ▶Figure 90-10



▶Figure 90-10

- b. Are on property owned or leased by the electric utility for the purpose of generation, transformation, transmission, energy storage, distribution, or metering of electric energy. ▶Figure 90-11



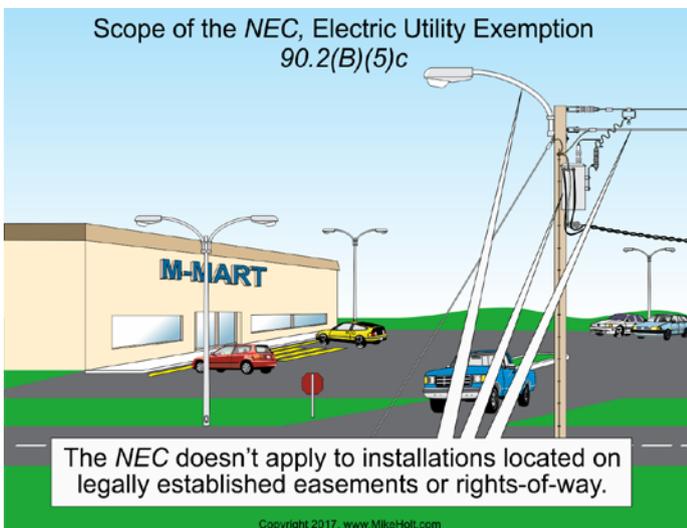
▶Figure 90–11

**Author's Comment:**

- Luminaires located in legally established easements, or rights-of-way, such as at poles supporting transmission or distribution lines, are exempt from the *NEC*. However, if the electric utility provides site and public lighting on private property, then the installation must comply with the *Code* [90.2(A)(4)].

- c. Are located on legally established easements or rights-of-way.

▶Figure 90–12



▶Figure 90–12

- d. Are located by other written agreements either designated by or recognized by public service commissions, electric utility commissions, or other regulatory agencies having jurisdiction for such installations; limited to installations for the purpose of communications, metering, generation, control, transformation, transmission, energy storage, or distribution of electric energy where legally established easements or rights-of-way can't be obtained. These installations are limited to federal lands, Native American reservations through the U.S. Department of the Interior Bureau of Indian Affairs, military bases, lands controlled by port authorities and state agencies and departments, and lands owned by railroads.

**Note to 90.2(B)(4) and (5):** Utilities include entities that install, operate, and maintain communications systems (twisted wire, antennas, and coaxial cable) or electric supply (generation, transmission, or distribution systems) and are designated or recognized by governmental law or regulation by public service/utility commissions. Utilities may be subject to compliance with codes and standards covering their regulated activities as adopted under governmental law or regulation.

## 90.3 Code Arrangement

**General Requirements.** The *Code* is divided into an introduction and nine chapters followed by informational annexes. Chapters 1, 2, 3, and 4 are general conditions. ▶Figure 90–13

Code Arrangement 90.3	
<b>General Requirements</b> <ul style="list-style-type: none"> <li>• Ch 1 - General</li> <li>• Ch 2 - Wiring and Protection</li> <li>• Ch 3 - Wiring Methods &amp; Materials</li> <li>• Ch 4 - Equipment for General Use</li> </ul> Chapters 1 through 4 generally apply to all applications.	<ul style="list-style-type: none"> <li>• <b>Ch 8 - Communications Systems</b> Ch 8 requirements aren't subject to requirements in Chapters 1 through 7, unless there's a specific reference in Ch 8 to a rule in Chapters 1 through 7.</li> </ul>
<b>Special Requirements</b> <ul style="list-style-type: none"> <li>• Chapter 5 - Special Occupancies</li> <li>• Chapter 6 - Special Equipment</li> <li>• Chapter 7 - Special Conditions</li> </ul> Chs 5 through 7 may supplement or modify the <u>requirements</u> in Chapters 1 through 7.	<ul style="list-style-type: none"> <li>• <b>Chapter 9 - Tables</b> Ch 9 tables are applicable as referenced in the <i>NEC</i> and are used for calculating raceway sizes, conductor fill, and voltage drop.</li> </ul>
The <i>NEC</i> is divided into an introduction and nine chapters, followed by informative annexes.	

▶Figure 90–13

**Author's Comment:**

- These first four chapters may be thought of as the foundation for the rest of the *Code*.

**Special Requirements.** The requirements contained in Chapters 5, 6, and 7 apply to special occupancies, special equipment, or other special conditions, which may supplement or modify the requirements contained in Chapters 1 through 7, but not Chapter 8.

**Communications Systems.** Chapter 8 contains the requirements for communications systems (twisted wire, antennas, and coaxial cable) which aren't subject to the general requirements of Chapters 1 through 4, or the special requirements of Chapters 5 through 7, unless there's a specific reference in Chapter 8 to a rule in Chapters 1 through 7.

**Author's Comment:**

- An example of how Chapter 8 works is in the rules for working space about equipment. The typical 3-ft working space isn't required in front of communications equipment, because Table 110.26(A)(1) isn't referenced in Chapter 8.

**Tables.** Chapter 9 consists of tables applicable as referenced in the *NEC*. The tables are used to calculate raceway sizing, conductor fill, the radius of raceway bends, and conductor voltage drop.

**Annexes.** Annexes aren't part of the *Code*, but are included for informational purposes. There are ten annexes:

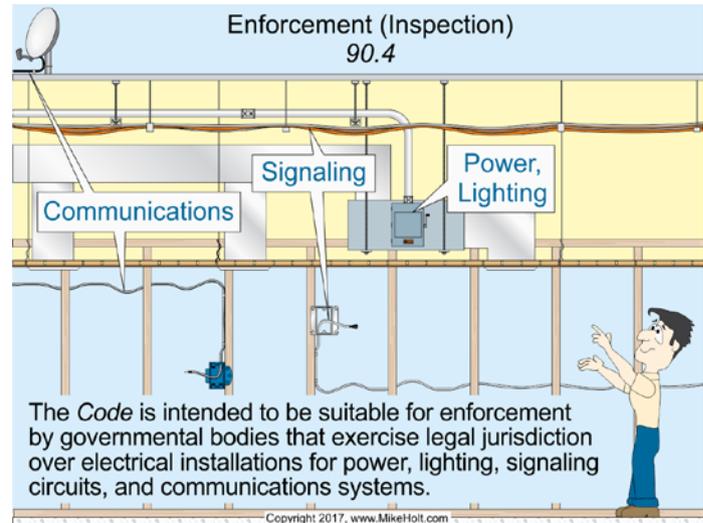
- Annex A. Product Safety Standards
- Annex B. Application Information for Ampacity Calculation
- Annex C. Raceway Fill Tables for Conductors and Fixture Wires of the Same Size
- Annex D. Examples
- Annex E. Types of Construction
- Annex F. Critical Operations Power Systems (COPS)
- Annex G. Supervisory Control and Data Acquisition (SCADA)
- Annex H. Administration and Enforcement
- Annex I. Recommended Tightening Torques
- Annex J. ADA Standards for Accessible Design

## 90.4 Enforcement



Scan this QR code for a video of Mike explaining this topic; it's a sample from the DVDs that accompany this textbook.

The *Code* is intended to be suitable for enforcement by governmental bodies that exercise legal jurisdiction over electrical installations for power, lighting, signaling circuits, and communications systems, such as: ▶ **Figure 90–14**



▶ **Figure 90–14**

Signaling circuits which include:

- Article 725 Class 1, Class 2, and Class 3 Remote-Control, Signaling, and Power-Limited Circuits
- Article 760 Fire Alarm Systems
- Article 770 Optical Fiber Cables and Raceways

Communications systems which include:

- Article 810 Radio and Television Equipment (satellite dish and antenna)
- Article 820 Community Antenna Television and Radio Distribution Systems (coaxial cable)

**Author's Comment:**

- The installation requirements for signaling circuits and communications circuits are covered in Mike Holt's *Understanding the National Electrical Code, Volume 2* textbook.

The enforcement of the *NEC* is the responsibility of the authority having jurisdiction (AHJ), who is responsible for interpreting requirements, approving equipment and materials, waiving *Code* requirements, and ensuring equipment is installed in accordance with listing instructions.

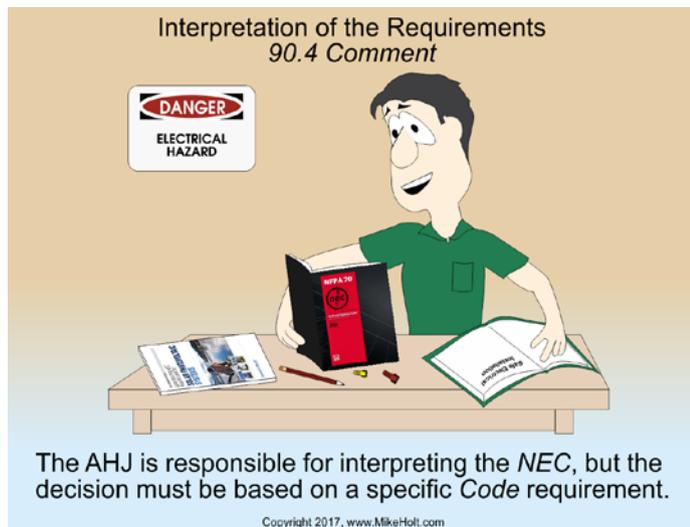
**Author's Comment:**

- See the definition of “Authority Having Jurisdiction” in Article 100.

**Interpretation of the Requirements.** The authority having jurisdiction is responsible for interpreting the *NEC*.

**Author's Comment:**

- The AHJ's decisions must be based on a specific *Code* requirement. If an installation is rejected, the authority having jurisdiction is legally responsible for informing the installer of the specific *NEC* rule that was violated. ▶Figure 90–15

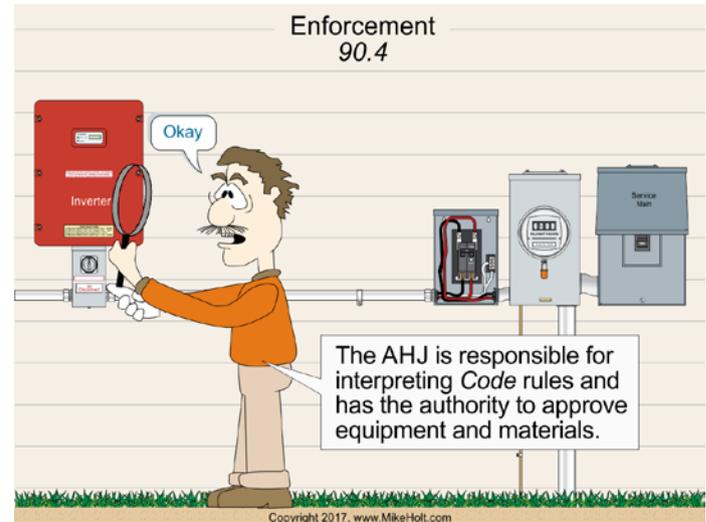


▶Figure 90–15

**Author's Comment:**

- The art of getting along with the authority having jurisdiction consists of doing good work and knowing what the *Code* actually says (as opposed to what you only think it says). It's also useful to know how to choose your battles when the inevitable disagreement does occur.

**Approval of Equipment and Materials.** Only the authority having jurisdiction has authority to approve the installation of equipment and materials. Typically, the authority having jurisdiction will approve equipment listed by a product testing organization, such as Underwriters Laboratories, Inc. (UL). The *NEC* doesn't require all equipment to be listed, but many state and local AHJs do. See 90.7, 110.2, 110.3, and the definitions for “Approved,” “Identified,” “Labeled,” and “Listed” in Article 100. ▶Figure 90–16



▶Figure 90–16

**Author's Comment:**

- According to the *NEC*, the authority having jurisdiction determines the approval of equipment. This means he or she can reject an installation of listed equipment and can approve the use of unlisted equipment. Given our highly litigious society, approval of unlisted equipment is becoming increasingly difficult to obtain.

**Approval of Alternate Means.** By special permission, the authority having jurisdiction may approve alternate methods where it's assured equivalent safety can be achieved and maintained.

**Author's Comment:**

- Special permission is defined in Article 100 as the written consent of the authority having jurisdiction.

**Waiver of New Product Requirements.** If the current *NEC* requires products that aren't yet available at the time the *Code* is adopted, the authority having jurisdiction can allow products that were acceptable in the previous *Code* to continue to be used.

**Author's Comment:**

- Sometimes it takes years before testing laboratories establish product standards for new *NEC* requirements, and then it takes time before manufacturers can design, manufacture, and distribute those products to the marketplace.

## 90.5 Mandatory Requirements and Explanatory Material

**(A) Mandatory Requirements.** In the *NEC* the words “shall” or “shall not,” indicate a mandatory requirement.

### Author’s Comment:

- For the ease of reading this textbook, the word “shall” has been replaced with the word “must,” and the words “shall not” have been replaced with “must not.” Remember that in many places, we’ll paraphrase the *Code* instead of providing exact quotes, to make it easier to read and understand.

**(B) Permissive Requirements.** When the *Code* uses “shall be permitted” it means the identified actions are permitted but not required, and the authority having jurisdiction isn’t permitted to restrict an installation from being completed in that manner. A permissive rule is often an exception to the general requirement.

### Author’s Comment:

- For ease of reading, the phrase “shall be permitted,” as used in the *Code*, has been replaced in this textbook with the phrase “is permitted” or “are permitted.”

**(C) Explanatory Material.** References to other standards or sections of the *NEC*, or information related to a *Code* rule, are included in the form of Informational Notes. Such notes are for information only and aren’t enforceable as requirements of the *NEC*.

For example, Informational Note 4 in 210.19(A)(1) recommends that the voltage drop of a circuit not exceed 3 percent. This isn’t a requirement; it’s just a recommendation.

### Author’s Comment:

- For convenience and ease of reading in this textbook, Informational Notes will simply be identified as “Note.”
- Informational Notes aren’t enforceable, but Table Notes are. This textbook will call notes found in a table “Table Notes.”

**(D) Informative Annexes.** Nonmandatory information annexes contained in the back of the *Code* book are for information only and aren’t enforceable as requirements of the *NEC*.

## 90.6 Formal Interpretations

To promote uniformity of interpretation and application of the provisions of the *NEC*, formal interpretation procedures have been established and are found in the NFPA Regulations Governing Committee Projects.

### Author’s Comment:

- This is rarely done because it’s a very time-consuming process, and formal interpretations from the NFPA aren’t binding on the authority having jurisdiction.

## 90.7 Examination of Equipment for Product Safety

Product evaluation for safety is typically performed by a nationally recognized testing laboratory that’s approved by the authority having jurisdiction. The suitability of equipment use is determined by the application of product safety listing standards that are compatible with the *NEC*.

### Author’s Comment:

- See Article 100 for the definition of “Approved.”

Except to detect alterations or damage, listed factory-installed internal wiring and construction of equipment need not be inspected at the time of installation [300.1(B)]. ▶ [Figure 90–17](#)



▶ [Figure 90–17](#)

**Note 1:** See 110.3 on the required use of listed products.

**Note 2:** “Listed” is defined in Article 100.

**Note 3:** Annex A contains a list of product safety standards that comply with the NEC.

## 90.9 Units of Measurement

**(B) Dual Systems of Units.** Both the metric and inch-pound measurement systems are shown in the *NEC*, with the metric units appearing first and the inch-pound system immediately following in parentheses.

### Author’s Comment:

- This is the standard practice in all NFPA standards, even though the U.S. construction industry uses inch-pound units of measurement. You’ll need to be cautious when using the tables in the *Code* because the additional units can make the tables more complex and more difficult to read.

**(D) Compliance.** Installing electrical systems in accordance with the metric system or the inch-pound system is considered to comply with the *Code*.

### Author’s Comment:

- Since the use of either the metric or the inch-pound system of measurement constitutes compliance with the *NEC*, this text-book uses only inch-pound units.