ARTICLE

90

INTRODUCTION TO THE *NATIONAL ELECTRICAL CODE*

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

Article 90 opens by saying the *National Electrical Code* (*NEC*/*Code*) is not intended as a design specification or instruction manual. It has one purpose only, and that is the "practical safeguarding of persons and property from hazards arising from the use of electricity." That does not necessarily mean the installation will be efficient, convenient, or able to accommodate future expansion; just safe. The necessity of carefully studying the *Code* rules cannot be overemphasized, and the step-by-step explanatory design of a textbook such as this is to help in that undertaking. Understanding where to find the requirements in the *NEC* that apply to the installation is invaluable. Rules in several different articles often apply to even a simple installation. You are not going to remember every section of every article of the *Code* but, hopefully, you will come away with knowing where to look after studying this textbook.

Article 90 then goes on to describe the scope and arrangement of the *NEC*. The balance of it provides the reader with information essential to understanding the *Code* rules.

Most electrical installations require you to understand the first four chapters of the *NEC* (which apply generally) and have a working knowledge of the Chapter 9 tables. That understanding begins with this article. Chapters 5, 6, and 7 make up a large portion of the *Code* book, but they apply to special occupancies, special equipment, or 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 radio and television equipment, satellite receivers, antenna systems, twisted pair conductors, and coaxial cable wiring. Communications systems are not subject to the general requirements of Chapters 1 through 4, or the special requirements of Chapters 5 through 7, unless there is a specific reference to a rule in the previous chapters.

90.1 Purpose of the *NEC*

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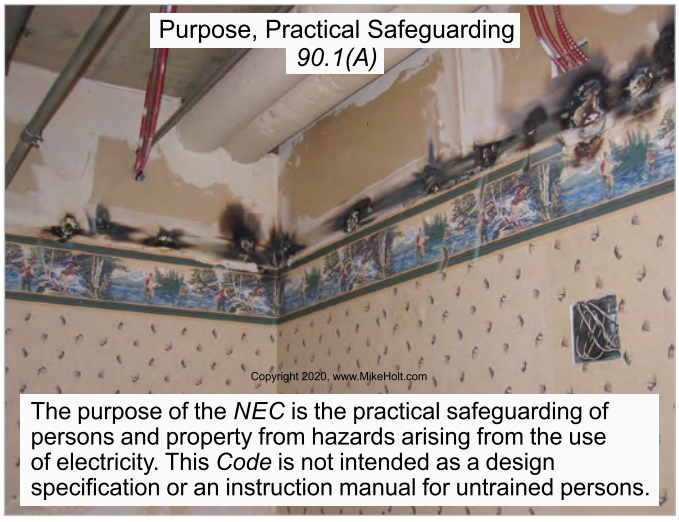
(A) Practical Safeguarding. The purpose of the *National Electrical Code* is to ensure electrical systems are installed in a manner that protects people and property by minimizing the risks associated with the use of electricity. The *NEC* is not a design specification standard nor is it an instruction manual for the untrained and unqualified. ▸Figure 90–1



The purpose of the *NEC* is the practical safeguarding of persons and property from hazards arising from the use of electricity. This *Code* is not intended as a design specification or an instruction manual for untrained persons.

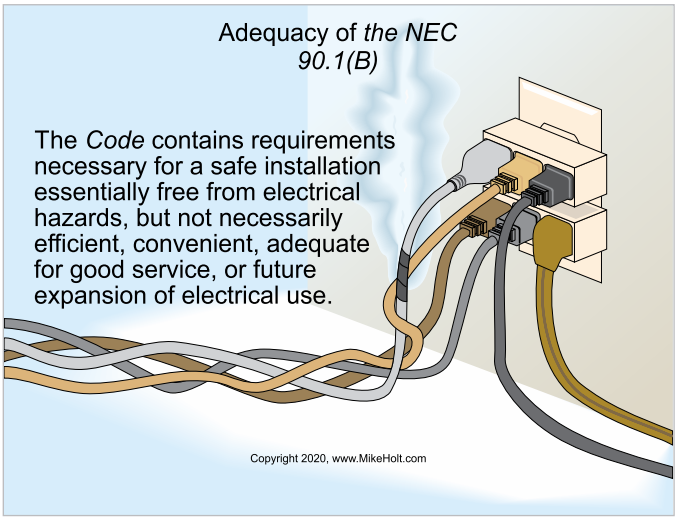
▸Figure 90–1

Author's Comment:

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

(B) Adequacy. The *NEC* contains the requirements considered necessary for a safe electrical installation. If one is installed in compliance with the *Code*, it is considered essentially free from electrical hazards.

The requirements contained in the *NEC* are not intended to ensure an electrical installation will be efficient, convenient, adequate for good service, or suitable for future expansion. ▶Figure 90–2

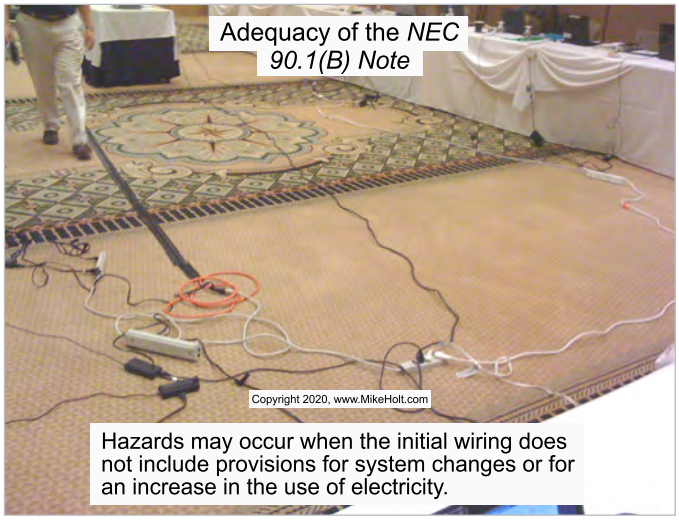


▶Figure 90–2

Author's Comment:

- Electrical energy management, equipment maintenance, power quality, or suitability for future loads are not issues within the scope of the *Code*.

Note: Hazards often occur because the initial wiring did not provide for increases in the use of electricity and therefore wiring systems become overloaded. ▶Figure 90–3



▶Figure 90–3

Author's Comment:

- The *NEC* does not 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 that the electrical system meets the customers' needs, both for today and in the coming years. To satisfy their needs, electrical systems are often designed and installed above the minimum requirements contained in the *NEC*.

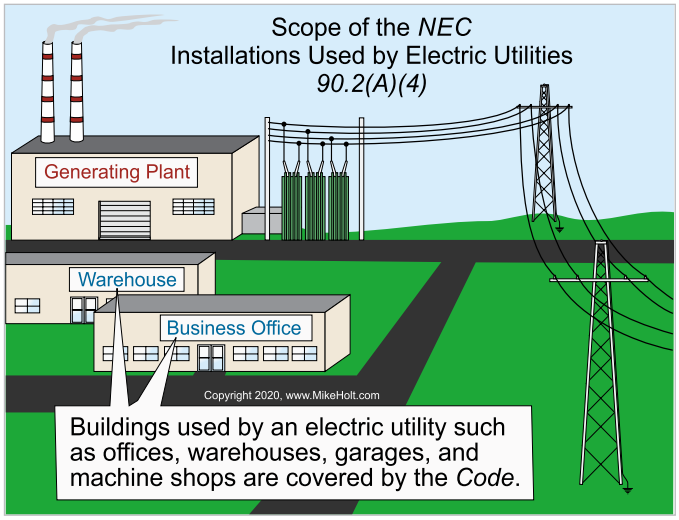
(C) Relation to International Standards. The requirements of the *Code* address the fundamental safety principles contained in the International Electrotechnical Commission (IEC) Standard.

Note: IEC 60364-1, Section 131, contains fundamental principles of protection for safety that encompass protection against electric shock, protection against thermal effects, protection against overcurrent, protection against fault currents, and protection against overvoltage. All of these potential hazards are addressed by the requirements in this *Code*. ▶Figure 90–4

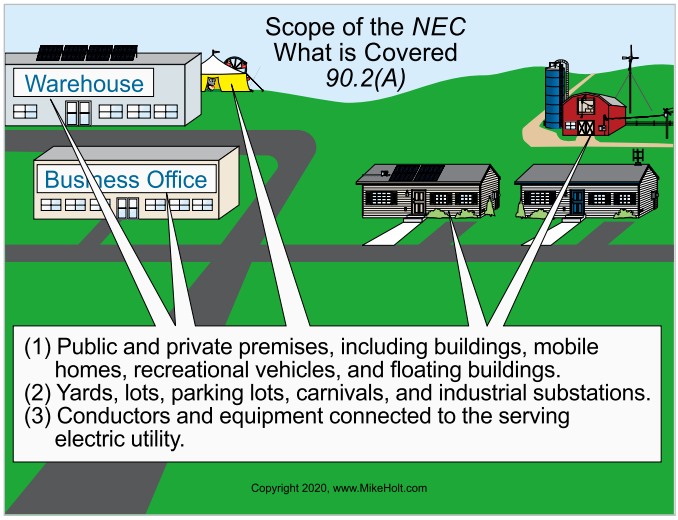
90.2 Scope of the *NEC*

(A) What is Covered by the *NEC*. The *NEC* covers the installation and removal of electrical conductors, equipment, and raceways; signaling and communications conductors, equipment, and raceways; and optical fiber cables and raceways for the following: ▶Figure 90–5

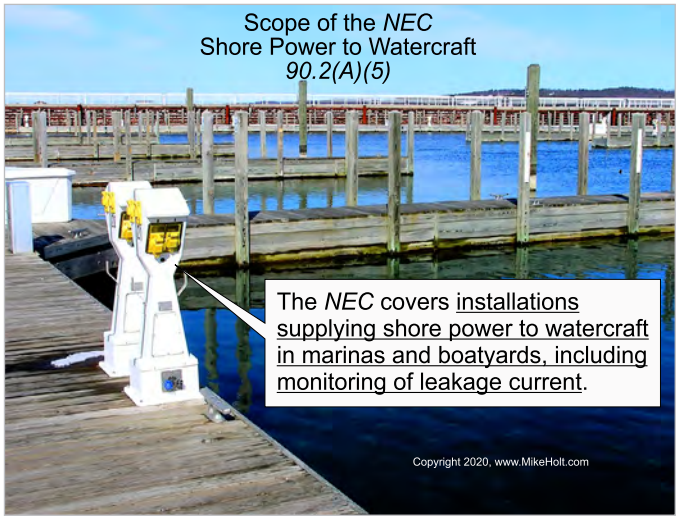
▶Figure 90–4



▶Figure 90–6



▶Figure 90–5



▶Figure 90–7

(1) Public and private premises including buildings, mobile homes, recreational vehicles, and floating buildings.

(2) Yards, lots, parking lots, carnivals, and industrial substations.

(3) Conductors and equipment connected to the serving electric utility.

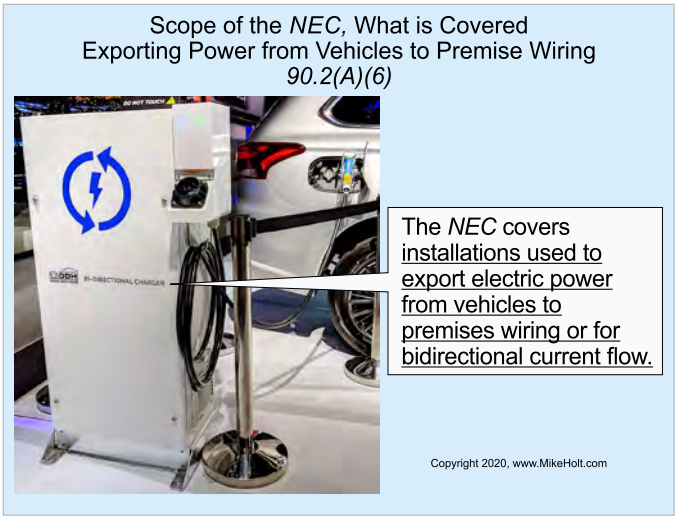
(4) Installations used by a serving electric utility such as office buildings, warehouses, garages, machine shops, recreational buildings, and other electric utility buildings that are not an integral part of a utility's generating plant, substation, or control center. ▶Figure 90–6

(5) Installations supplying shore power to watercraft in marinas and boatyards, including monitoring of leakage current. ▶Figure 90–7

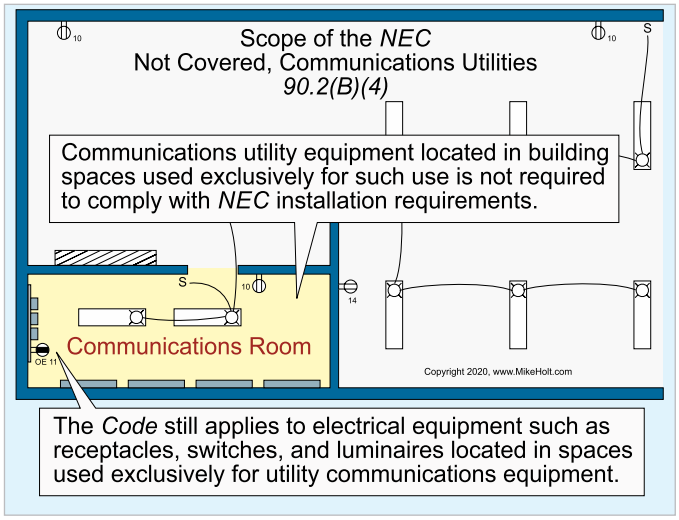
Author's Comment:

- The new item in Article 90's scope, 90.2(A)(5), appears to include the power cable between the pedestal and the boat in the scope of the *NEC*, but there are no specific rules in Article 555 covering that power-supply cord.
- The text in 555.35(B) requires leakage detection equipment to detect leakage current from boats and applies to the load side of the supplying receptacle.

(6) Installations used to export electric power from vehicles to premises wiring or for bidirectional current flow ▶Figure 90–8



▶Figure 90–8



▶Figure 90–9

Author's Comment:

- The battery power supply of an electrical vehicle can be used "bidirectionally" which means it can be used as a backup or alternate power source to supply premises wiring circuits in the event of a power failure. The rules for this application can be found in Article 625.

(B) What is not Covered by the *NEC*. The *Code* does not apply to the installation of electrical or communications systems for:

(1) Transportation Vehicles. The *NEC* does not apply to installations in ships and watercraft other than floating buildings, and automotive vehicles other than mobile homes and recreational vehicles.

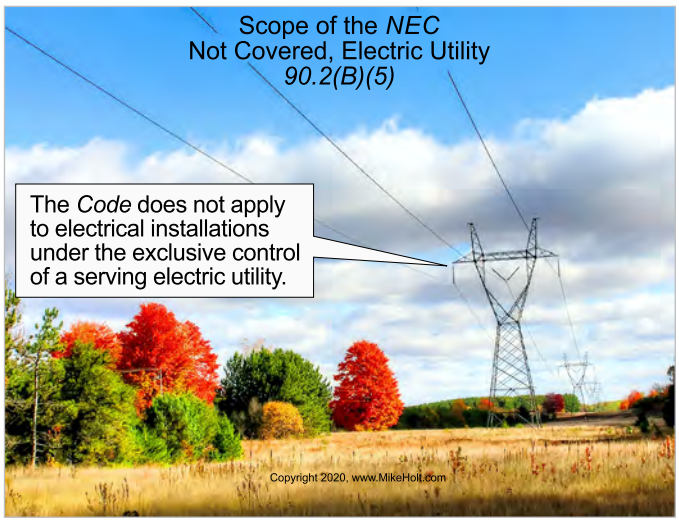
(2) Mining Equipment. The *Code* does not apply to installations underground in mines, and in self-propelled mobile surface mining machinery and its attendant electrical trailing cables.

(3) Railways. The *NEC* does not apply to railway power, signaling, energy storage, and communications wiring.

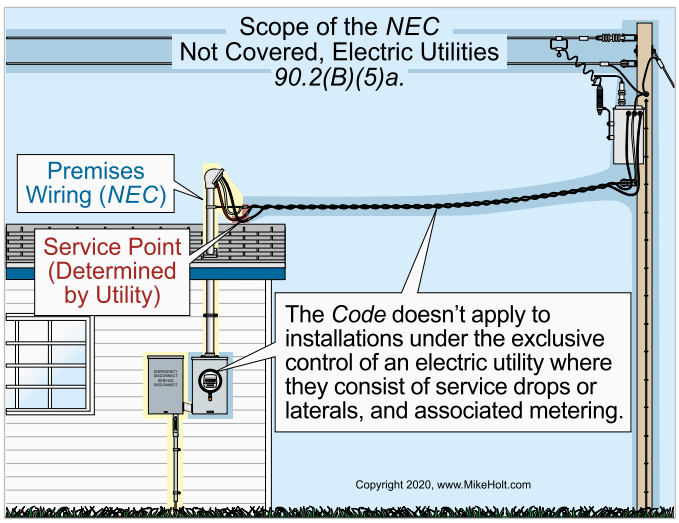
(4) Communications Utilities. The *Code* does not apply to installations under the exclusive control of the communications utility located in building spaces used exclusively for these purposes or located outdoors. ▶Figure 90–9

(5) Electric Utilities. The *NEC* does not apply to electrical installations under the exclusive control of a serving electric utility where such installations: ▶Figure 90–10

a. Consist of service drops or service laterals and associated metering, or ▶Figure 90–11

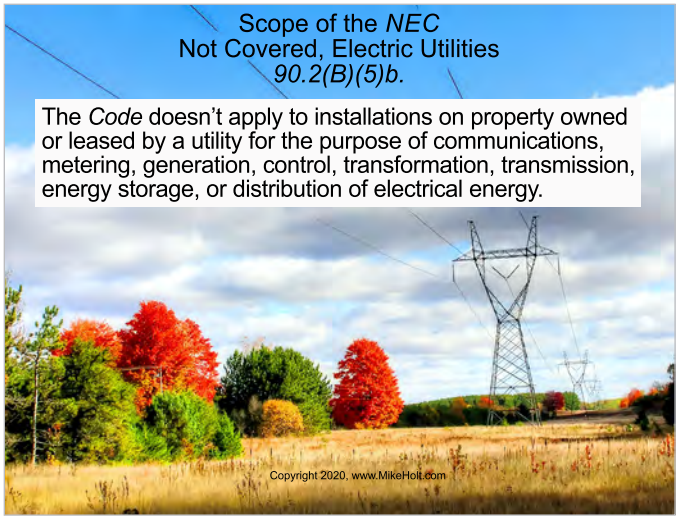


▶Figure 90–10



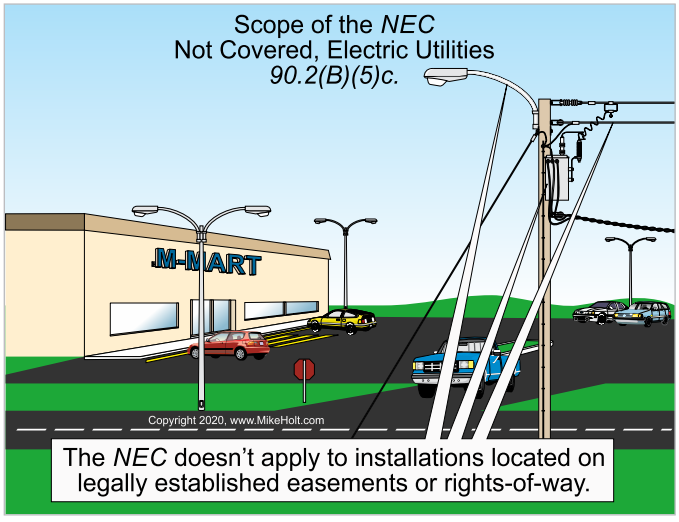
▶Figure 90–11

b. Are on property owned or leased by the utility for the purpose of communications, metering, generation, control, transformation, transmission, energy storage, or distribution of electrical energy, or ▸Figure 90–12



▸Figure 90–12

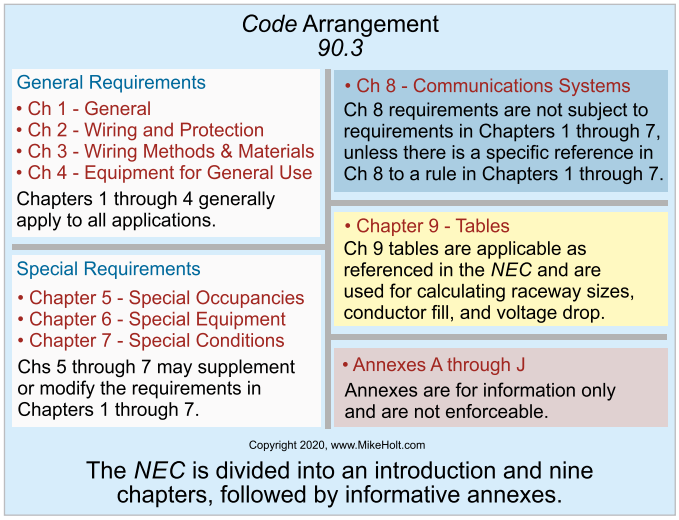
c. Are located in legally established easements or rights-of-way ▸Figure 90–13



▸Figure 90–13

90.3 *Code* Arrangement

General Requirements. The *Code* is divided into an introduction and nine chapters followed by informative annexes. Chapters 1, 2, 3, and 4 are general conditions. ▸Figure 90–14



▸Figure 90–14

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.

Chapter 8 contains the requirements for communications systems (twisted wire, antennas, and coaxial cable) which are not subject to the general requirements of Chapters 1 through 4, or the special requirements of Chapters 5 through 7, unless a specific reference in Chapter 8 is made to a rule in Chapters 1 through 7.

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 are not part of the requirements 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

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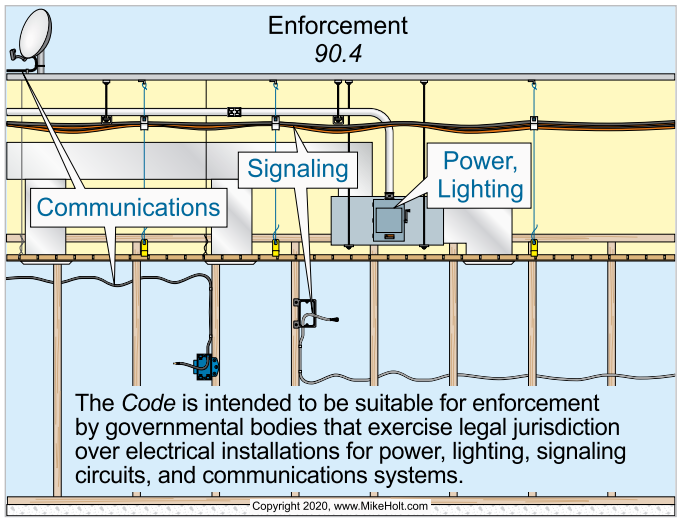
The *NEC* is intended to be suitable for enforcement by governmental bodies that exercise legal jurisdiction over electrical installations for power, lighting, signaling circuits, and communications systems such as: ▸Figure 90–15



▸Figure 90–15

Signaling circuits include:

- Article 725. Remote-Control, Signaling, and Power-Limited Circuits
- Article 760. Fire Alarm Systems
- Article 770. Optical Fiber Cables

Communications systems which include:

- Article 810. Radio and Television Equipment (Satellite Antenna)
- Article 820. Community Antenna Television and Radio Distribution Systems (Coaxial Cable)

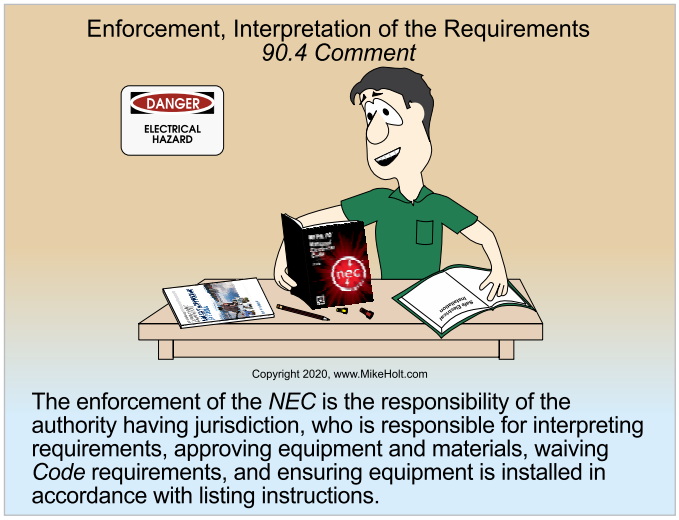
Author's Comment:

- Once adopted (in part, wholly, or amended), the *National Electrical Code* becomes statutory law for the adopting jurisdiction and is thereby considered a legal document.

Enforcement. The enforcement of the *NEC* is the responsibility of the authority having jurisdiction, who is responsible for interpreting requirements, approving equipment and materials, waiving *Code* requirements, and ensuring equipment is installed in accordance with listing instructions. ▸Figure 90–16

Author's Comment:

- "Authority Having Jurisdiction" is defined in Article 100 as the organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure. See 90.4 and 90.7 for more information.



▸Figure 90–16

Author's Comment:

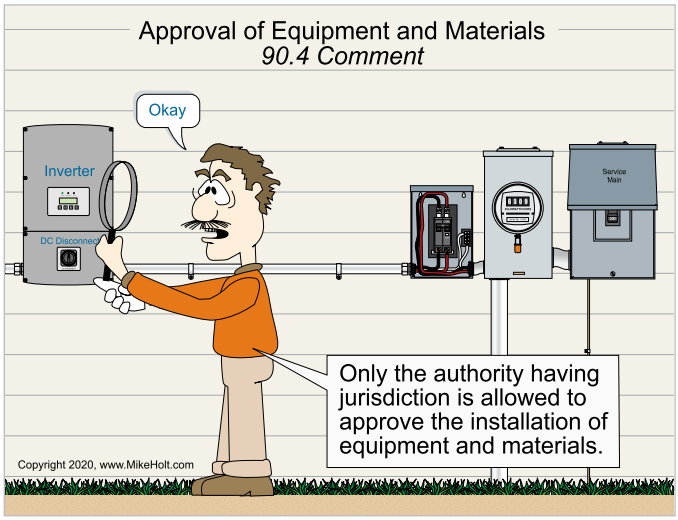
- "Approved" is defined in Article 100 as acceptable to the authority having jurisdiction; usually the electrical inspector.

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

Author's Comment:

- The authority having jurisdiction's decisions must be based on a specific *Code* requirement. If an installation is rejected, the AHJ is legally responsible for informing the installer of the specific *NEC* rule that was violated.
- The art of getting along with the AHJ consists of doing good work and knowing what the *Code* says (as opposed to what you think it says). It is 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 the authority to approve the installation of equipment and materials. ▸Figure 90–17



▸Figure 90–17

Author's Comment:

- Typically, the AHJ will approve equipment listed by a product testing organization such as Underwriters Laboratories, Inc. (UL). The *NEC* does not require all equipment to be listed, but many state and local authorities having jurisdictions do. See 90.7, 110.2, and 110.3 and the definitions for "Approved," "Identified," "Labeled," and "Listed" in Article 100.
- According to the *Code*, 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 is assured equivalent safety can be achieved and maintained.

Author's Comment:

- "Special Permission" is defined in Article 100 as the written consent of the AHJ.

Waiver of Product Requirements. If the *Code* requires products, constructions, or materials that are not yet available at the time the *NEC* 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 for testing laboratories to establish product standards for new *NEC* product requirements; 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. The words "shall" or "shall not" indicate a mandatory requirement.

Author's Comment:

- For greater ease in reading this textbook, we will use the word "must" instead of "shall," and "must not" will be used instead of "shall not."

(B) Permissive Requirements. When the *Code* uses "shall be permitted" it means the action is permitted, but not required. Permissive rules are often contained in exceptions to the general requirement.

Author's Comment:

- For greater ease in reading, the phrase "shall be permitted" (as used in the *NEC)* has been replaced in this textbook with "is permitted" or "are permitted."

(C) Explanatory Material. References to other standards or information related to a *Code* rule are included in the form of "Informational Notes." Such notes are for informational purposes only and are not enforceable as an *NEC* requirement.

For example, Informational Note No. 3 in 210.19(A)(1) recommends that the voltage drop of a circuit not exceed 3 percent; this is a recommendation—not a *Code* requirement.

Author's Comment:

- For convenience and ease in reading this textbook, "Informational Notes" will simply be identified as "Note."

Caution

Informational notes are not enforceable but notes to tables are. Within this textbook, we will call notes contained in a table a "Table Note."

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

90.7 Examination of Equipment for Product Safety

Product evaluation for *Code* compliance, approval, and safety is typically performed by a nationally recognized testing laboratory in accordance with the listing standards.

Except to detect alterations or damage, listed factory-installed internal wiring of equipment that has been processed by a qualified testing laboratory does not need to be inspected for *NEC* compliance at the time of installation. ▸Figure 90–18

Note 1: The requirements contained in Article 300 do not apply to the integral parts of electrical equipment. See 110.3(B).

Note 2: "Listed" is defined in Article 100 as equipment or materials included in a list published by a testing laboratory acceptable to the authority having jurisdiction. The listing organization must periodically inspect the production of listed equipment or material to ensure it meets appropriate designated standards and is suitable for a specified purpose.

▸Figure 90–18