Article 680

Swimming Pools, Spas, Hot Tubs, Fountains, and Similar Installations

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"AS FOR ME AND MY HOUSE WE WILL SERVE THE LORD" [JOSH. 24:2-15]

Mike Holt's Article 680

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Introduction

This index is a free resource from Mike Holt Enterprises, Inc. You requested it and we produced it! It's Article 680 from our Understanding the NEC, Volume 2 textbook. This free resource is for everyone that wants to focus on Pools, Spas, Hot Tubs, and Fountains.

It is always our pleasure to give back to the industry as much as we can, whenever we can and this is a perfect opportunity. If you're interested in this subject, have a look and please give us your feedback. As an extra bonus we also included Article 90 – Introduction to the NEC!

About the Author

Mike Holt worked his way up through the electrical trade from an apprentice electrician to become one of the most recognized experts in the world as it relates to electrical power installation. He was a Journeyman Electrician, Master Electrician, and Electrical Contractor. Mike came from the real world, and his dedication to electrical training is the result of his own struggles as an electrician looking for a program that would help him succeed in this challenging industry.

It is for reasons like this that Mike continues to help the industry by providing free resources such as this index. It is the goal of Mike Holt and everyone on the Mike Holt Team to do everything in our power to aid in your pursuit of excellence.

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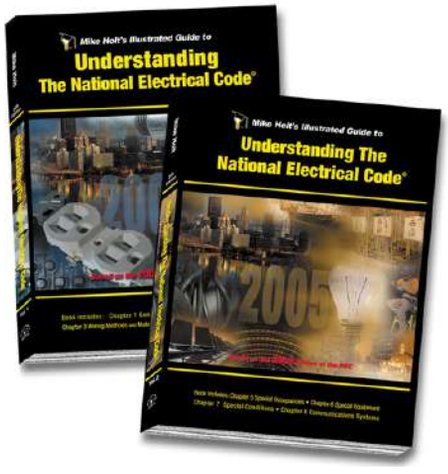


This article was extracted from Mike's Understanding the NEC, Volume 2 textbook. To understand the entire National Electrical Code, you need to study Mike's Understanding the NEC, Volume 1 & Volume 2 textbooks. Volume 1 covers general installation requirements, branch circuits, feeders, services and overcurrent protection, grounding versus bonding, conductors, cables and raceways, boxes, panels, motors and transformers, and more, in Articles 90 through 460 (NEC Chapters 1 through 4). Volume 2 covers requirements for wiring in special occupancies, special equipment, under special conditions, as well as communications systems requirements in Articles 500 through 830 (NEC Chapters 5-8).

How to Use This Textbook

This textbook is to be used with the *NEC*, not as a replacement for the *NEC,* so be sure to have a copy of the 2005 *National Electrical Code* handy. Compare what Mike has explained in the text to your *Code* book, and discuss those topics that you find difficult to understand with others. As you read through this textbook, be sure to take the time to review the text with the outstanding graphics and examples.

Cross-References

The textbook contains thousands of *NEC* cross-references to other related *Code* requirements to help you develop a better understanding of how the *NEC* rules relate to one another. These cross-references are identified by a *Code* Section number in brackets, such as "90.4," which would look like "[90.4]."

Author's Comments

This textbook contains hundreds of "Author's Comments." These sections were written by Mike to help you better understand the *NEC* material, and to bring to your attention things he believes you should be aware of. To help you find them more easily, they are printed differently than the rest of the material. Mike's first Author's Comment is contained in 90.1(B).

Textbook Format

This textbook follows the *NEC* format, but it doesn't cover every *Code* requirement. For example, it doesn't cover every *NEC* Article, Section, Subsection, Exception, or Fine Print Note. So don't be concerned if you see that the textbook contains Exception No. 1 and Exception No. 3, but not Exception No. 2. In addition, at times, the title of an Article, Section, or Subsection might be rephrased differently.

Difficult Concepts

As you progress through this textbook, you might find that you don't understand every explanation, example, calculation, or comment. Don't get frustrated, and don't get down on yourself. Remember, this is the *National Electrical Code* and sometimes the best attempt to explain a concept isn't enough to make it perfectly clear. When this happens to you, just make it a point to highlight the section that is causing you difficulty. If you can, take the textbook to someone you feel can provide additional insight, possibly your boss, the electrical inspector, a co-worker, your instructor, etc.

Not an *NEC* Replacement

This textbook is intended to explain the requirements of the *NEC*. It isn't intended to be a replacement for the *NEC*, so be sure you have a copy of the current *Code* book, and always compare Mike's explanation, comments, and graphics to the actual language contained in the *NEC*.

You'll sometimes notice that the titles of a few Articles and Sections are different than they appear in the actual *Code*. This only occurs when Mike feels it's easier to understand the content of the rule, so please keep this in mind when comparing the two documents. For example, 250.8 in the *NEC* is titled "Connection of Grounding and Bonding Equipment," but Mike used the title "Termination of Grounding (Earthing) and Bonding Conductors," because he felt his title better reflects the content of the rule.

Textbook Errors and Corrections

Humans develop the text, graphics, and layout of this textbook, and since currently none of us is perfect, there may be a few errors. This could occur because the *NEC* is dramatically changed each *Code* cycle; new Articles are added, some deleted, some relocated, and many renumbered. In addition, this textbook must be written within a very narrow window of opportunity; after the *NEC* has been published (September), yet before it's enforceable (January).

You can be sure we work a tremendous number of hours and use all of our available resources to produce the finest product with the fewest errors. We take great care in researching the *Code* requirements to ensure this textbook is correct. If you feel there's an error of any type in this textbook (typo, grammar, or technical), no matter how insignificant, please let us know.

Any errors found after printing are listed on our Website, so if you find an error, first check to see if it has already been corrected. Go to www.MikeHolt.com, click on the "Books" link, and then the "Corrections" link (www.MikeHolt.com/bookcorrections.htm).

If you do not find the error listed on the Website, contact us by E-mailing corrections@MikeHolt.com, calling 1.888.NEC.CODE (1.888.632.2633), or faxing 954.720.7944. Be sure to include the book title, page number, and any other pertinent information.

Internet

Today as never before, you can get your technical questions answered by posting them to Mike Holt's *Code* Forum. Just visit www.MikeHolt.com and click on the "*Code* Forum" link.

Different Interpretations

Some electricians, contractors, instructors, inspectors, engineers, and others enjoy the challenge of discussing the *Code* requirements, hopefully in a positive and a productive manner. This action of challenging each other is important to the process of better understanding the *NEC*'s requirements and its intended application. However, if you're going to get into an *NEC* discussion, please do not spout out what you think without having the actual *Code* in your hand. The professional way of discussing an *NEC* requirement is by referring to a specific section, rather than by talking in vague generalities.

The National Electrical Code

The *National Electrical Code (NEC)* is written for persons who understand electrical terms, theory, safety procedures, and electrical trade practices. These individuals include electricians, electrical contractors, electrical inspectors, electrical engineers, designers, and other qualified persons. The *Code* was not written to serve as an instructive or teaching manual for untrained individuals [90.1(C)].

Learning to use the *NEC* is somewhat like learning to play the game of chess; it's a great game if you enjoy mental warfare. You must first learn the names of the game pieces, how the pieces are placed on the board, and how each piece moves.

In the electrical world, this is equivalent to completing a comprehensive course on basic electrical theory, such as:

- What electricity is and how is it produced
- Dangers of electrical potential: fire, arc blast, arc fault, and electric shock
- Direct current
- Series and parallel circuits
- Electrical formulas
- Alternating current
- Induction, motors, generators, and transformers

Once you understand the fundamentals of the game of chess, you're ready to start playing the game. Unfortunately, at this point all you can do is make crude moves, because you really do not understand how all the information works together. To play chess well, you will need to learn how to use your knowledge by working on subtle strategies before you can work your way up to the more intriguing and complicated moves.

Again, back to the electrical world, this is equivalent to completing a course on the basics of electrical theory. You have the foundation upon which to build, but now you need to take it to the next level, which you can do by reading this textbook, watching the companion video or DVD, and answering the *NEC* practice questions in the *Workbook to Accompany Understanding the National Electric Code, Volume 1.*

Not a Game

Electrical work isn't a game, and it must be taken very seriously. Learning the basics of electricity, important terms and concepts, as well as the basic layout of the *NEC* gives you just enough knowledge to be dangerous. There are thousands of specific and unique applications of electrical installations, and the *Code* doesn't cover every one of them. To safely apply the *NEC*, you must understand the purpose of a rule and how it affects the safety aspects of the installation.

NEC Terms and Concepts

The *NEC* contains many technical terms, so it's crucial that *Code* users understand their meanings and their applications. If you do not understand a term used in a *Code* rule, it will be impossible to properly apply the *NEC* requirement. Be sure you understand that Article 100 defines the terms that apply to *two or more* Articles. For example, the term "Dwelling Unit" applies to many Articles. If you do not know what a Dwelling Unit is, how can you possibly apply the *Code* requirements for it?

In addition, many Articles have terms that are unique for that specific Article. This means that the definition of those terms is only applicable for that given Article. For example, Article 250 Grounding and Bonding has the definitions of a few terms that are only to be used within Article 250.

Small Words, Grammar, and Punctuation

It's not only the technical words that require close attention, because even the simplest of words can make a big difference to the intent of a rule. The word "or" can imply alternate choices for equipment wiring methods, while "and" can mean an additional requirement. Let's not forget about grammar and punctuation. The location of a comma "," can dramatically change the requirement of a rule.

Slang Terms or Technical Jargon

Electricians, engineers, and other trade-related professionals use slang terms or technical jargon that isn't shared by all. This makes it very difficult to communicate because not everybody

understands the intent or application of those slang terms. So where possible, be sure you use the proper word, and do not use a word if you do not understand its definition and application. For example, lots of electricians use the term "pigtail" when describing the short conductor for the connection of a receptacle, switch, luminaire, or equipment. Although they may understand it, not everyone does. Figure 1

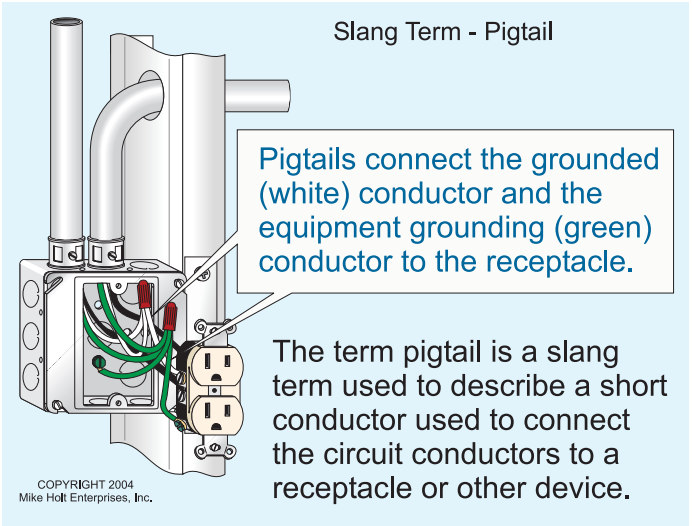


Figure 1

NEC Style and Layout

Before we get into the details of the *NEC*, we need to take a few moments to understand its style and layout. Understanding the structure and writing style of the *Code* is very important before it can be used effectively. If you think about it, how can you use something if you don't know how it works? Okay, let's get started. The *National Electrical Code* is organized into nine components.

- Table of Contents
- Chapters 1 through 9 (major categories)
- Articles 90 through 830 (individual subjects)
- Parts (divisions of an Article)
- Sections and Tables (*Code* requirements)
- Exceptions (*Code* permissions)
- Fine Print Notes (explanatory material)
- Index
- Annexes (information)

1. Table of Contents. The Table of Contents displays the layout of the Chapters, Articles, and Parts as well as the page numbers. It's an excellent resource and should be referred to periodically to observe the interrelationship of the various *NEC* components. When attempting to locate the rules for a particular situation, knowledgeable *Code* users often go first to the Table of Contents to quickly find the specific *NEC* section that applies.

2. Chapters. There are nine Chapters, each of which is divided into Articles. The Articles fall into one of four groupings: General Requirements (Chapters 1 through 4), Specific Requirements (Chapters 5 through 7), Communications Systems (Chapter 8), and Tables (Chapter 9).

- Chapter 1 General
- Chapter 2 Wiring and Protection
- Chapter 3 Wiring Methods and Materials
- Chapter 4 Equipment for General Use
- Chapter 5 Special Occupancies
- Chapter 6 Special Equipment
- Chapter 7 Special Conditions
- Chapter 8 Communications Systems (Telephone, Data, Satellite, and Cable TV)
- Chapter 9 Tables—Conductor and Raceway Specifications

3. Articles. The *NEC* contains approximately 140 Articles, each of which covers a specific subject. For example:

- Article 110 General Requirements
- Article 250 Grounding
- Article 300 Wiring Methods
- Article 430 Motors
- Article 500 Hazardous (Classified) Locations
- Article 680 Swimming Pools, Spas, Hot Tubs, and Fountains
- Article 725 Remote-Control, Signaling, and Power-Limited Circuits
- Article 800 Communications Systems

4. Parts. Larger Articles are subdivided into Parts. For example, Article 110 has been divided into multiple parts:

- Part I. General (Sections 110.1—110.23)
- Part II. 600 Volts, Nominal, or Less (110.26—110.27)
- Part III. Over 600 Volts, Nominal (110.30—110.59)

Note: Because the Parts of a *Code* Article aren't included in the Section numbers, we have a tendency to forget what "Part" the *NEC* rule is relating to. For example, Table 110.34(A) contains the working space clearances for electrical equipment. If we aren't careful, we might think this table applies to all electrical installations, but Table 110.34(A) is located in Part III, which contains the requirements for Over 600 Volts, Nominal installations. The rules for working clearances for electrical equipment for systems 600V or less are contained in Table 110.26(A)(1), which is located in Part II. 600 Volts, Nominal, or Less.

5. Sections and Tables.

Sections: Each *NEC* rule is called a *Code* Section. A *Code* Section may be broken down into subsections by letters in parentheses (A), (B), etc. Numbers in parentheses (1), (2), etc., may

further break down a subsection, and lower-case letters (a), (b), etc., further breaks the rule down to the third level. For example, the rule requiring all receptacles in a dwelling unit bathroom to be GFCI protected is contained in Section 210.8(A)(1). Section 210.8(A)(1) is located in Chapter 2, Article 210, Section 8, subsection (A), sub-subsection (1).

Many in the industry incorrectly use the term "Article" when referring to a *Code* Section. For example, they say "Article 210.8," when they should say "Section 210.8."

Tables: Many *Code* requirements are contained within Tables, which are lists of *NEC* requirements placed in a systematic arrangement. The titles of the Tables are extremely important; they must be carefully read in order to understand the contents, applications, limitations, etc., of each Table in the *Code*. Many times notes are provided in a table; be sure to read them as well, since they are also part of the requirement. For example, Note 1 for Table 300.5 explains how to measure the cover when burying cables and raceways, and Note 5 explains what to do if solid rock is encountered.

6. Exceptions. Exceptions are *Code* requirements that provide an alternative method to a specific requirement. There are two types of exceptions—mandatory and permissive. When a rule has several exceptions, those exceptions with mandatory requirements are listed before the permissive exceptions.

Mandatory Exception: A mandatory exception uses the words "shall" or "shall not." The word "shall" in an exception means that if you're using the exception, you're required to do it in a particular way. The term "shall not" means it isn't permitted.

Permissive Exception: A permissive exception uses words such as "is permitted," which means that it's acceptable to do it in this way.

7. Fine Print Note (FPN). A Fine Print Note contains explanatory material intended to clarify a rule or give assistance, but it isn't a *Code* requirement.

8. Index. The Index contained in the *NEC* is excellent and is helpful in locating a specific rule.

9. Annexes. Annexes aren't a part of the *NEC* requirements, and are included in the *Code* for informational purposes only.

- Annex A. Product Safety Standards
- Annex B. Application Information for Ampacity Calculation
- Annex C. Conduit and Tubing Fill Tables for Conductors and Fixture Wires of the Same Size
- Annex D. Examples
- Annex E. Types of Construction
- Annex F. Cross-Reference Tables (1999, 2002, and 2005 *NEC*)
- Annex G. Administration and Enforcement

Note: Changes to the *NEC*, since the previous edition(s) are identified in the margins by a vertical line (|), but rules that have been relocated aren't identified as a change. In addition, the location from which the *Code* rule was removed has no identifier.

How to Locate a Specific Requirement

How to go about finding what you're looking for in the *Code* depends, to some degree, on your experience with the *NEC*. *Code* experts typically know the requirements so well that they just go to the *NEC* rule without any outside assistance. The Table of Contents might be the only thing very experienced *Code* users need to locate their requirement. On the other hand, average *Code* users should use all of the tools at their disposal, and that includes the Table of Contents and the Index.

Table of Contents: Let's work out a simple example: What *NEC* rule specifies the maximum number of disconnects permitted for a service? If you're an experienced *Code* user, you'll know that Article 230 applies to "Services," and because this Article is so large, it's divided up into multiple parts (actually 8 parts). With this knowledge, you can quickly go to the Table of Contents (page 70-2) and see that it lists the Service Equipment Disconnecting Means requirements in Part VI, starting at page 70-77.

Note: The number 70 precedes all page numbers because the *NEC* is standard number 70 within the collection of *NFPA* standards.

Index: If you used the Index, which lists subjects in alphabetical order, to look up the term "service disconnect," you would see that there's no listing. If you tried "disconnecting means," then "services," you would find the Index specifies that the rule is located at 230, Part VI. Because the *NEC* doesn't give a page number in the Index, you'll need to use the Table of Contents to get the page number, or flip through the *Code* to Article 230, then continue to flip until you find Part VI.

As you can see, although the index is very comprehensive, it's not that easy to use if you do not understand how the index works. But if you answer the over 1,200 *NEC* practice questions or seven 50-question exams contained in the *Workbook to Accompany Understanding the National Electric Code, Volume 1,* you'll become a master at finding things in the *Code* quickly.

Many people complain that the *NEC* only confuses them by taking them in circles. As you gain experience in using the *Code* and deepen your understanding of words, terms, principles, and practices, you will find the *NEC* much easier to understand and use than you originally thought.

Customizing Your *Code* Book

One way to increase your comfort level with the *Code* is to customize it to meet your needs. You can do this by highlighting and underlining important *NEC* requirements, and by attaching tabs to important pages.

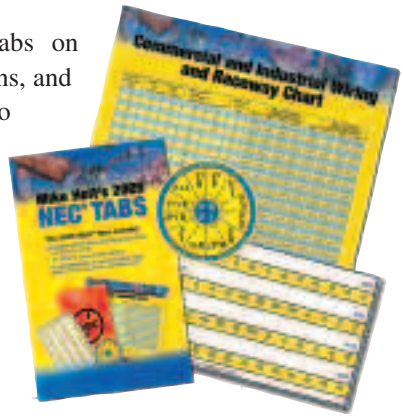
Highlighting: As you read through this textbook and answer the questions in the workbook, be sure you highlight those requirements in the *Code* that are most important to you. Use yellow for general interest and orange for important requirements you want to find quickly. Be sure to highlight terms in the Index and Table of Contents as you use them.

Because of the size of the 2005 *NEC*, I recommend you highlight in green the Parts of Articles that are important for your applications, particularly:

Article 230 Services
Article 250 Grounding
Article 430 Motors

Underlining: Underline or circle key words and phrases in the *NEC* with a red pen (not a lead pencil) and use a 6-in. ruler to keep lines straight and neat. This is a very handy way to make important requirements stand out. A small 6-in. ruler also comes in handy for locating specific information in the many *Code* tables.

Tabbing the *NEC*: Placing tabs on important *Code* Articles, Sections, and Tables will make it very easy to access important *NEC* requirements. However, too many tabs will defeat the purpose. You can order a custom set of *Code* tabs, designed by Mike Holt, online at www.MikeHolt.com, or by calling us at 1.888.NEC.Code (1.888.632.2633).



ARTICLE 90

Introduction to the National Electrical Code

Introduction

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, *NEC* requirements are the bare minimum for safety. This is exactly the stance electrical inspectors, insurance companies, and courts will 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. That is "the practical safeguarding of persons and property from hazards arising from the use of electricity."

Article 90 then describes the scope and arrangement of the *Code*. A person who says, "I can't find anything in the *Code,*" is really saying, "I never took the time to review Article 90." The balance of Article 90 provides the reader with information essential to understanding those items you do find in the *NEC*.

Typically, electrical work requires you to understand the first four Chapters of the *NEC*, plus have a working knowledge of the Chapter 9 tables. Chapters 5, 6, 7, and 8 make up a large portion of the *NEC*, but they apply to special situations. They build on, and extend, what you must know in the first four chapters. That knowledge begins with Chapter 1.

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.

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

The *NEC* requirements aren't intended to ensure that 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 *NEC*. Figure 90–1

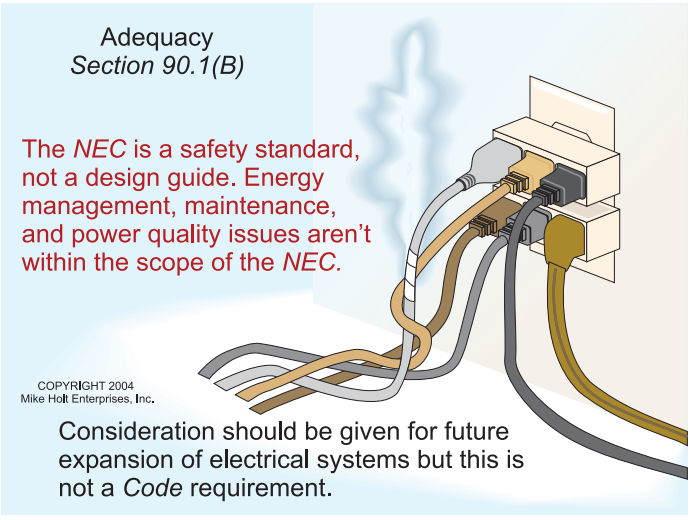


Figure 90–1

FPN: Hazards in electrical systems often occur because circuits are overloaded or not properly installed in accordance with the *NEC*. The initial wiring often did not provide reasonable provisions for system changes or for the increase in the use of electricity.

Author's Comments:

- See Article 100 for the definition of "Overload."
- 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 ensuring that the system meets the customers' needs, both of today and in the near future. To satisfy customers' needs, electrical systems must be designed and installed above the minimum requirements contained in the *NEC*.

(C) Intention. The *Code* is to be used by those skilled and knowledgeable in electrical theory, electrical systems, construction, and the installation and operation of electrical equipment. It isn't a design specification standard or instruction manual for the untrained and unqualified.

(D) Relation to International Standards. The requirements of the *NEC* address the fundamental safety principles contained in International Electrotechnical Commission standards, including protection against electric shock, adverse thermal effects, overcurrent, fault currents, and overvoltage. Figure 90–2

Author's Comments:

- See Article 100 for the definition of "Overcurrent."
- 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, the *NEC* is available in Spanish from the National Fire Protection Association, 1.617.770.3000.

Figure 90–2

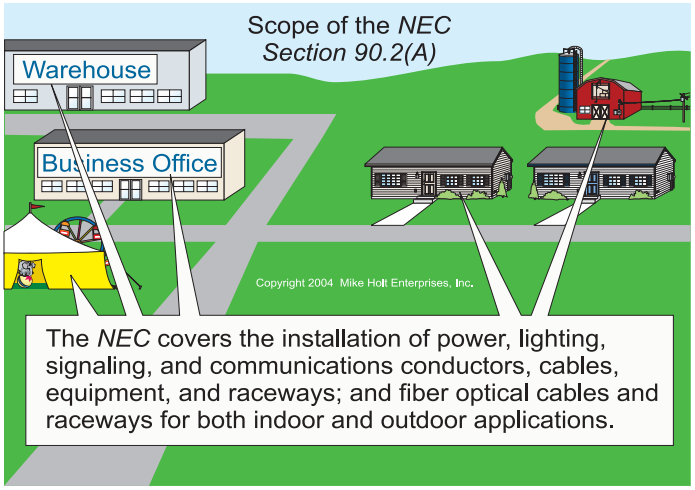


Figure 90–3

90.2 Scope of the *NEC*.

(A) What is Covered. The *NEC* contains requirements necessary for the proper electrical installation of electrical conductors, equipment, and raceways; signaling and communications conductors, equipment, and raceways; as well as fiber optic cables and raceways for the following locations: Figure 90–3

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

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

(3) Conductors and equipment that connect to the 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 are not an integral part of a utility's generating plant, substation, or control center. Figure 90–4

(B) What isn't Covered. The *National Electrical Code* doesn't apply to the following applications:

(1) Transportation Vehicles. Installations in cars, trucks, boats, ships and watercraft, planes, electric trains, or underground mines.

(2) Mining Equipment. Installations underground in mines and self-propelled mobile surface mining machinery and its attendant electrical trailing cables.

(3) Railways. Railway power, signaling, and communications wiring.

(4) Communications Utilities. The installation requirements of the *NEC* do not apply to communications (telephone), CATV, or network-powered broadband utility equipment located in

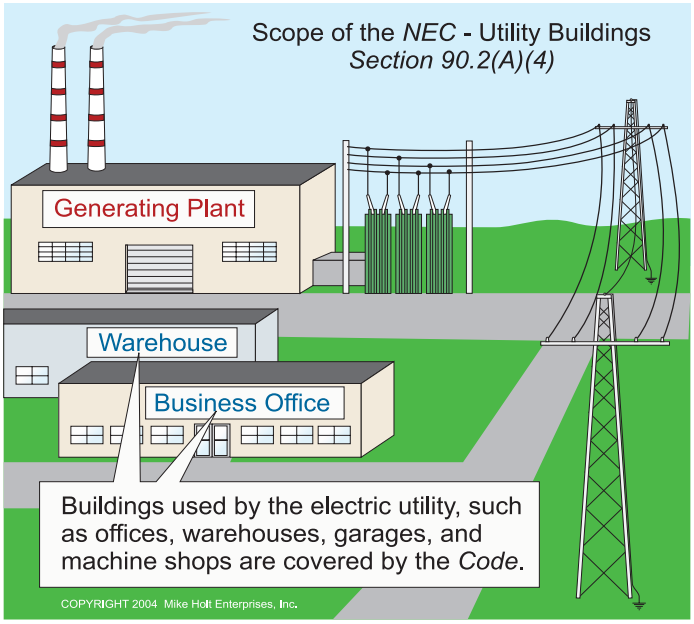


Figure 90–4

building spaces used exclusively for such use or outdoors, if the installation is under the exclusive control of the communications utility. Figure 90–5

Author's Comment: Interior wiring for communications systems, not in building spaces used exclusively for such use, must be installed in accordance with the following Chapter 8 requirements: Figure 90–6

- Phone and Data, Article 800
- CATV, Article 820
- Network-Powered Broadband, Article 830

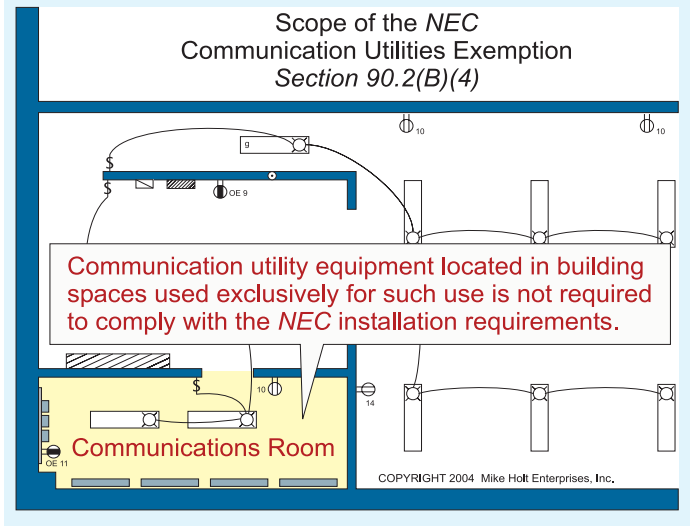


Figure 90–5

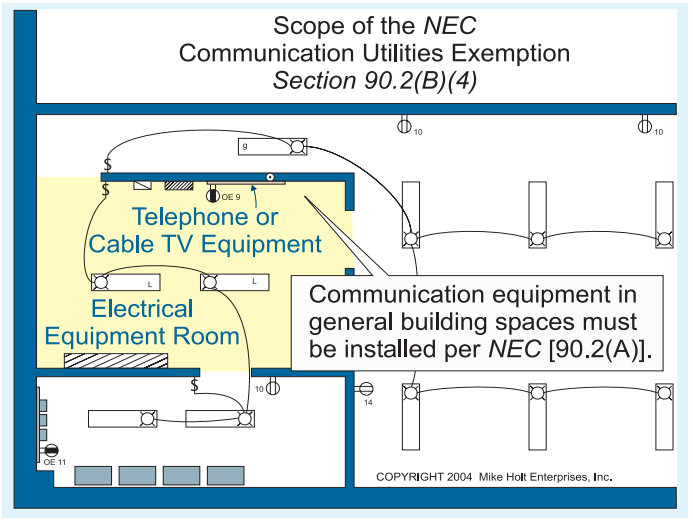


Figure 90–6

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

a. Consist of service drops or service laterals and associated metering. Figure 90–07

b. Are located on legally established easements, rights-of-way, or by other agreements recognized by public/utility regulatory agencies, or property owned or leased by the electric utility. Figure 90–8

c. Are on property owned or leased by the electric utility for the purpose of generation, transformation, transmission, distribution, or metering of electric energy. See Figure 90–8.

Author's Comment: Luminaires (lighting fixtures) located in legally established easements, or rights-of-way, such as at poles supporting transmission or distribution lines, are exempt from the requirements of the *NEC*. However, if the electric utility provides

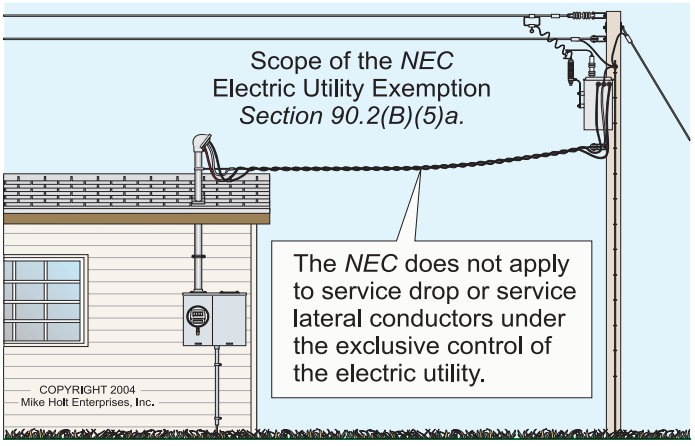


Figure 90–7

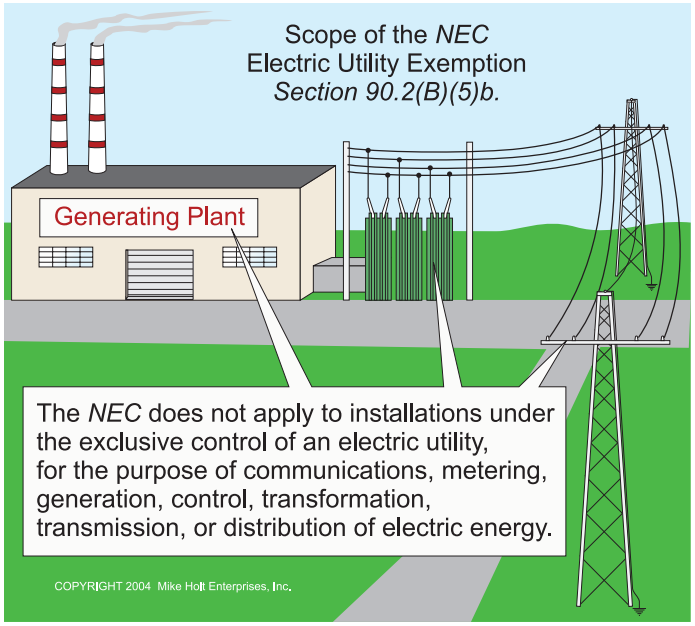


Figure 90–8

site and public lighting on private property, then the installation must comply with the *NEC* [90.2(A)(4)]. Figure 90–9

FPN to 90.2(B)(4) and (5): Utilities include entities that install, operate, and maintain communications systems (telephone, CATV, Internet, satellite, or data services) or electric supply systems (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.

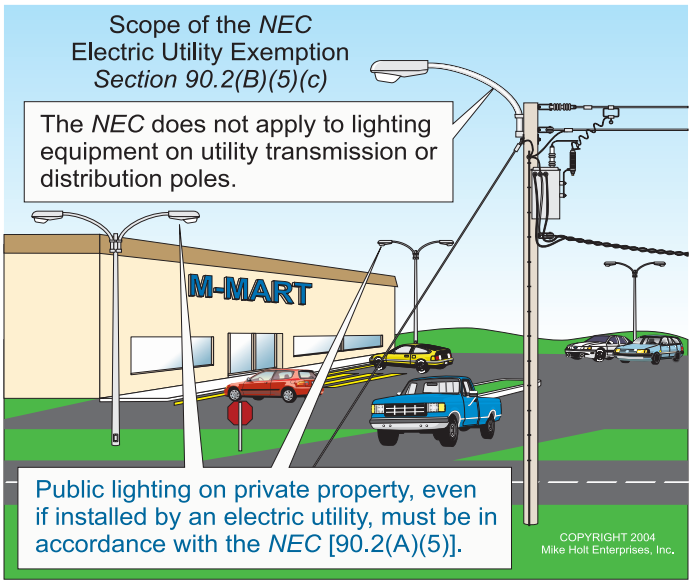


Figure 90–9

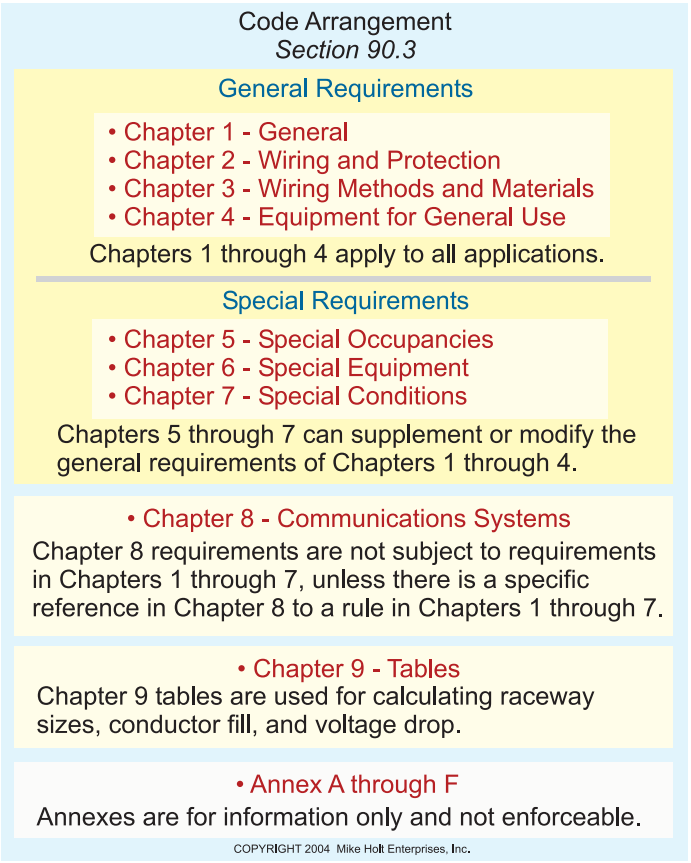


Figure 90–10

90.3 *Code* Arrangement. The *Code* is divided into an Introduction and nine chapters. Figure 90–10

General Requirements. The requirements contained in Chapters 1, 2, 3, and 4 apply to all installations.

Author's Comment: The scope of this textbook includes *NEC* Chapters 1 through 4.

Special Requirements. The requirements contained in Chapters 5, 6, and 7 apply to special occupancies, special equipment, or other special conditions. They can supplement or modify the requirements in Chapters 1 through 4.

For example, the general requirement contained in 250.118 of Article 250 Grounding and Bonding states that a metal raceway, such as Electrical Metallic Tubing, is considered suitable to provide a low-impedance path to the power supply for ground-fault current. However, 517.13(B) of Article 517 Health Care Facilities doesn't consider the raceway to be sufficient. It requires an insulated copper conductor to be installed in the raceway for this purpose.

Communications Systems. Chapter 8 contains the requirements for communications systems, such as telephone, antenna wiring, CATV, and network-powered broadband systems. Communications systems 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:** Mike Holt's *Understanding the NEC, Volume 2 [Articles 500 through 830]*, explains the wiring requirements of special occupancies, special equipment, and special conditions, as well as communications systems.

Table. Chapter 9 consists of tables necessary to calculate raceway sizing, conductor fill, and voltage drop.

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

- Annex A. Product Safety Standards
- Annex B. Conductor Ampacity Under Engineering Supervision
- Annex C. Raceway Size Tables
- Annex D. Examples
- Annex E. Types of Construction
- Annex F. Cross-Reference Tables

90.4 Enforcement. This *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 90–11

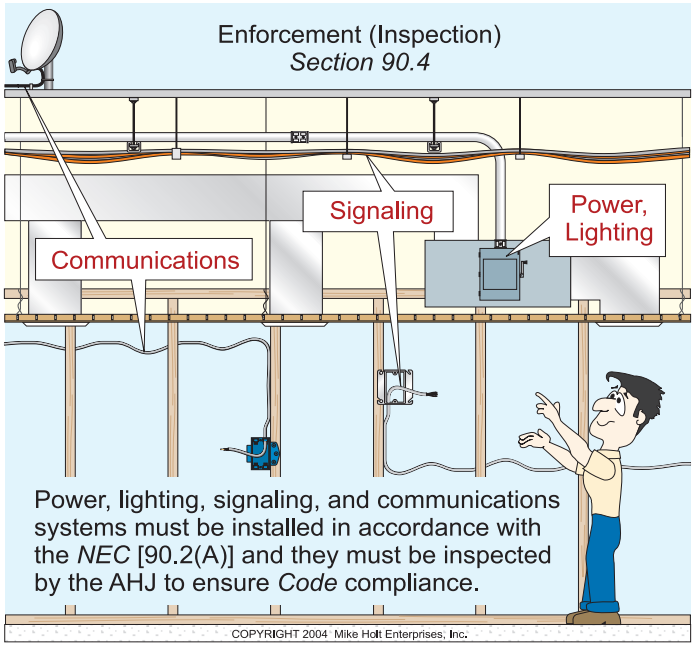


Figure 90–11

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 circuits, which include:

- Article 800 Communications Circuits (twisted-pair conductors)
- Article 810 Radio and Television Equipment (satellite dish and antenna)
- Article 820 Community Antenna Television and Radio Distribution Systems (coaxial cable)
- Article 830 Network-Powered Broadband Communications Systems

> **Author's Comment:** The installation requirements for signaling circuits and communications circuits are covered in Mike's *Understanding the NEC, 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 that equipment is installed in accordance with listing instructions.

> **Author's Comment:** See Article 100 for the definition of "Authority Having Jurisdiction."

Interpretation of the Requirements. The authority having jurisdiction is responsible for interpreting the *NEC*, but his or her 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 which specific *NEC* rule was violated.

> **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), but the *NEC* doesn't require all equipment to be listed. See 90.7, 110.2, 110.3, and the definitions in Article 100 for Approved, Identified, Labeled, and Listed. Figure 90–12

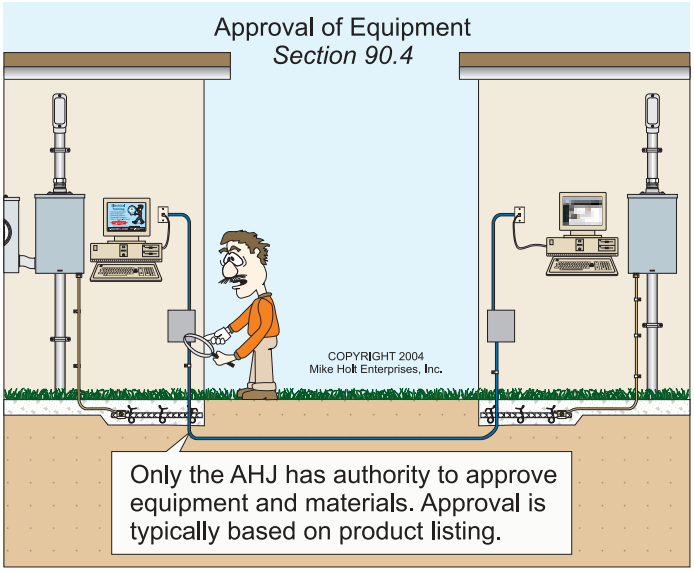


Figure 90–12

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

Waiver of Requirements. By special permission, the authority having jurisdiction can waive specific requirements in this *Code* or permit alternative methods where it's assured that 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 2005 *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* product requirements, and then it takes time before manufacturers can design, manufacture, and distribute these products to the marketplace.

Compliance with Listing Instructions. It's the authority having jurisdiction's responsibility to ensure that electrical equipment is installed in accordance with equipment listing and/or labeling instructions [110.3(B)]. In addition, the authority having jurisdiction can reject the installation of equipment modified in the field [90.7].

Author's Comment: The *NEC* doesn't address the maintenance of electrical equipment (NFPA 70B does), because the *Code* is an installation standard, not a maintenance standard.

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 the word "cannot."

(B) Permissive Requirements. When the *Code* uses "shall be permitted" it means the identified actions are allowed but not required, and the authority having jurisdiction is not to restrict an installation from being done 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 words "is 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 Fine Print Notes (FPN). Fine Print Notes are for information only and aren't intended to be enforceable.

For example, Fine Print Note No. 4 in 210.19(A)(1) recommends that the circuit voltage drop not exceed three percent. This isn't a requirement; it's just a recommendation.

90.6 Formal Interpretations. To promote uniformity of interpretation and application of the provisions of the *National Electrical Code,* 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* are not binding on the authority having jurisdiction!

90.7 Examination of Equipment for Product Safety.

Product evaluation for safety is typically performed by a testing laboratory, which publishes a list of equipment that meets a nationally recognized test standard. Products and materials listed, labeled, or identified by a testing laboratory are generally approved by the authority having jurisdiction.

Author's Comment: See Article 100 for the definition of "Approved."

Listed, factory-installed, internal wiring and construction of equipment need not be inspected at the time of installation, except to detect alterations or damage [300.1(B)]. Figure 90–13

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 a normal practice in all *NFPA* standards, even though the U.S. construction industry uses inch-pound units of measurement.

(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 compliance with either the metric or the inch-pound system of measurement constitutes compliance with the *NEC*, this textbook uses only inch-pound units.

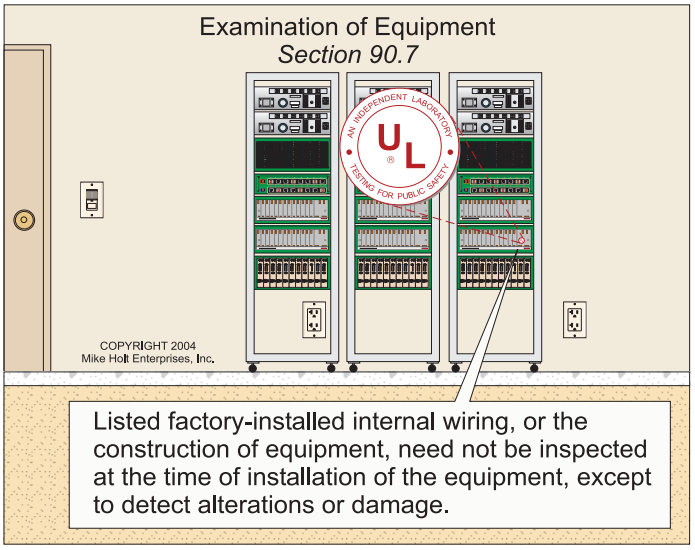


Figure 90–13

ARTICLE

680 Swimming Pools, Spas, Hot Tubs, Fountains, and Similar Installations

Introduction

The overriding concern of Article 680 is to keep people and electricity separated. Some ways in which Article 680 accomplishes this include:

- References to other articles.
- Equipment Requirements. Any equipment that goes into a pool, spa, hot tub, fountain, or similar installation must meet the appropriate requirements of Article 680.
- Equipotential Bonding. This prevents stray currents from taking a path through people.
- Conductor Control. For example, flexible cords cannot be 6 ft long—3 ft is the limit. Article 680 contains many other conductor-related requirements, such as minimum clearances from pool, spa, hot tub, and fountain structures.

PART I. GENERAL REQUIREMENTS FOR PERMANENTLY INSTALLED POOLS, STORABLE POOLS, OUTDOOR SPAS, OUTDOOR HOT TUBS, OR FOUNTAINS

Author's Comment: The requirements contained in Part I of Article 680 apply to permanently installed pools [680.20], storable pools [680.30], outdoor spas and hot tubs [680.42], and fountains [680.50].

680.1 Scope. The requirements contained in Article 680 apply to the installation of electric wiring and equipment for swimming pools, hot tubs, spas, fountains, and hydromassage bathtubs.

680.2 Definitions.

Forming Shell. A structure mounted in the wall of permanently installed pools, storable pools, outdoor spas, outdoor hot tubs, or fountains designed to support a wet-niche luminaire.

Hydromassage Bathtub. A permanently installed bathtub with a recirculating piping system designed to accept, circulate, and discharge water after each use.

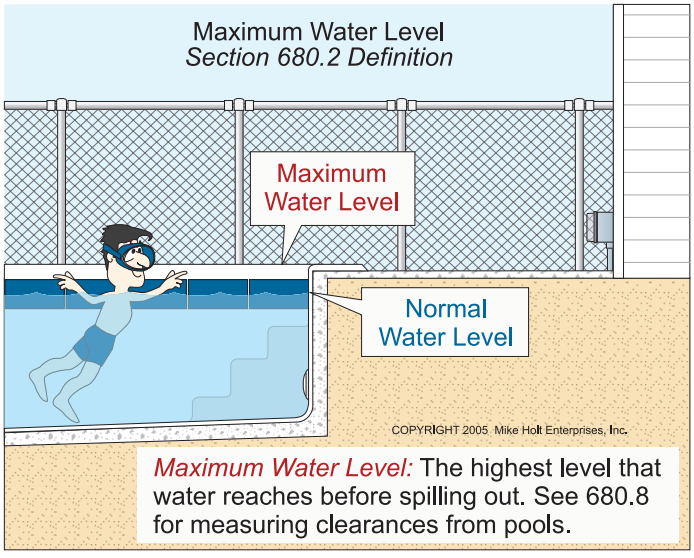


Figure 680–1

Maximum Water Level. The highest level that water reaches before it spills out. Figure 680-1

Spa or Hot Tub. A hydromassage pool or tub designed for recreational use that is typically not drained after each use.

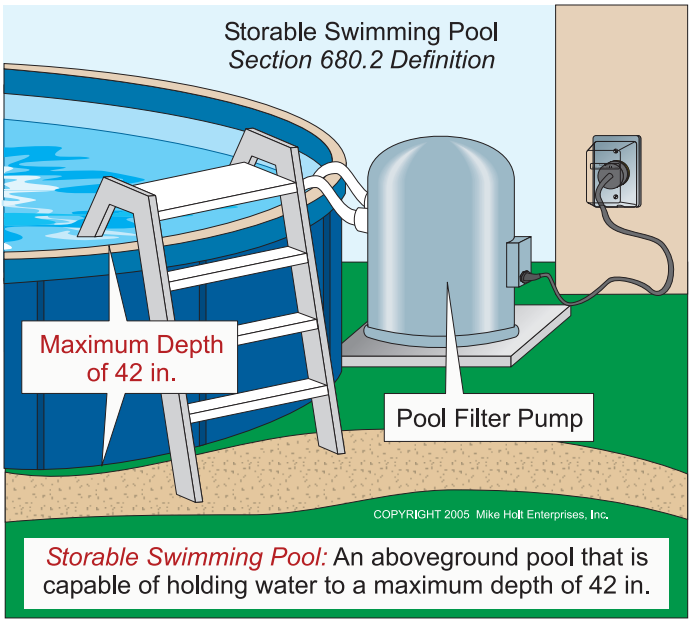


Figure 680–2

Storable Swimming Pool. An aboveground pool with a maximum water depth of 42 in. Figure 680-2

> **Author's Comment:** Storable pools are sold as a complete package that consists of the pool walls, vinyl liner, plumbing kit, and pump/filter device. Underwriters Laboratories Inc. (UL) requires the pump/filter units to have a minimum 25-ft cord to discourage the use of extension cords.

Wet-Niche Luminaire. A luminaire intended to be installed in a forming shell where the luminaire will be completely surrounded by water.

680.3 Other Articles. The wiring of permanently installed pools, storable pools, outdoor spas, outdoor hot tubs, or fountains must comply with Chapters 1 through 4, except as modified by this article. Figure 680-3

680.7 Cord-and-Plug Connected Equipment. Fixed or stationary equipment other than an underwater luminaire (lighting fixture) for permanently installed pools, storable pools, outdoor spas, outdoor hot tubs, or fountains can be cord-and-plug connected to facilitate the removal or disconnection for maintenance or repair.

(A) Length. Except for storable pools, the cord must not exceed 3 ft.

> **Author's Comment:** There is no maximum cord length specified in the *NEC* for a storable pool pump motor.

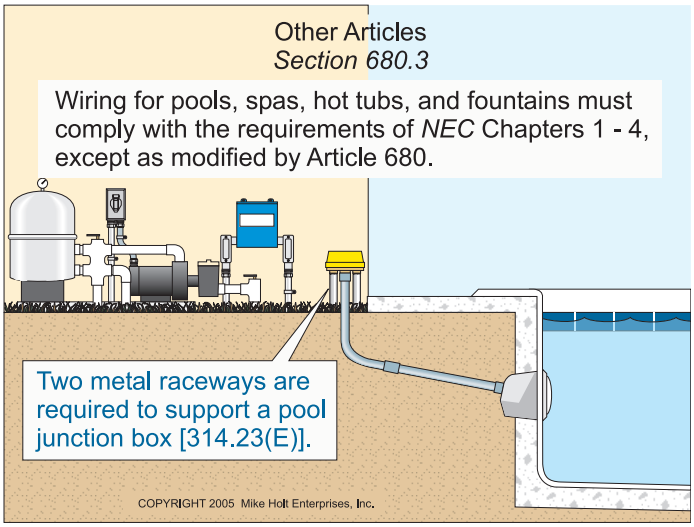


Figure 680–3

(B) Equipment Grounding (Bonding). The cord must have a copper equipment grounding (bonding) conductor not smaller than 12 AWG that terminates at a grounding-type attachment plug.

680.8 Overhead Conductor Clearance. Overhead conductors must meet the clearance requirements contained in Table 680.8. The clearance measurement is to be taken from the maximum water level.

(A) Overhead Power Conductors. Permanently installed pools, storable pools, outdoor spas, outdoor hot tubs, fountains, diving structures, observation stands, towers, or platforms must not be placed under or within 22½ ft of service-drop conductors or open overhead wiring.

> **Author's Comment:** This rule doesn't prohibit utility-owned overhead service-drop conductors from being installed over a permanently installed pool, storable pool, outdoor spa, outdoor hot tub, or fountain [90.2(B)(4)]. It does prohibit a permanently installed pool, storable pool, outdoor spa, outdoor hot tub, or fountain from being installed under an existing service drop.

(B) Communications Systems. Permanently installed pools, storable pools, outdoor spas, outdoor hot tubs, fountains, diving structures, observation stands, towers, or platforms must not be placed under, or within, 10 ft of communications cables. Figure 680-4

> **Author's Comment:** This rule doesn't prohibit a utility-owned communications overhead cable from being installed over a permanently installed pool, storable pool, outdoor spa, outdoor hot tub, or fountain [90.2(B)(4)]. It does prohibit a permanently installed pool, storable pool, outdoor spa, outdoor hot tub, or fountain from being installed under an existing communications utility overhead supply.

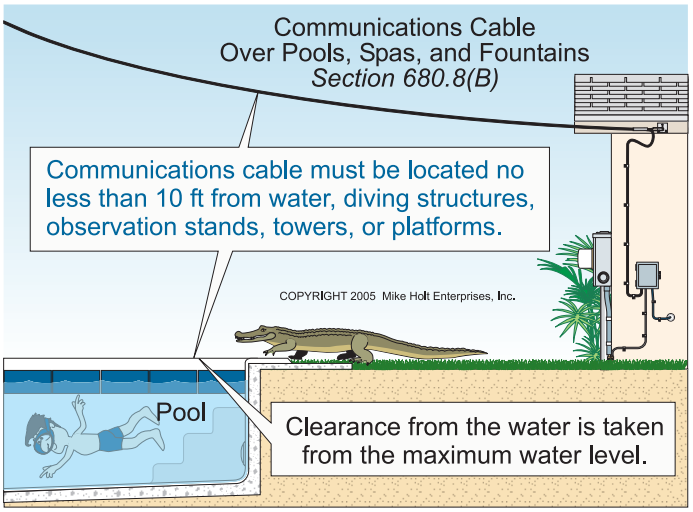


Figure 680–4

(C) Network-Powered Broadband Communications Systems. Permanently installed pools, storable pools, outdoor spas, outdoor hot tubs, or fountains must not be placed under, or within, 22½ ft of network-powered broadband communications cables. Observation stands, towers, or diving platforms must not be placed under, or within, 14½ ft of network-powered broadband communications cables. Figure 680-5

> **Author's Comment:** This rule doesn't prohibit a utility-owned broadband overhead cable from being installed over a permanently installed pool, storable pool, outdoor spa, outdoor hot tub, or fountain [90.2(B)(4)]. It does prohibit a permanently installed pool, storable pool, outdoor spa, outdoor hot tub, or fountain from being installed under an existing communications utility overhead supply.

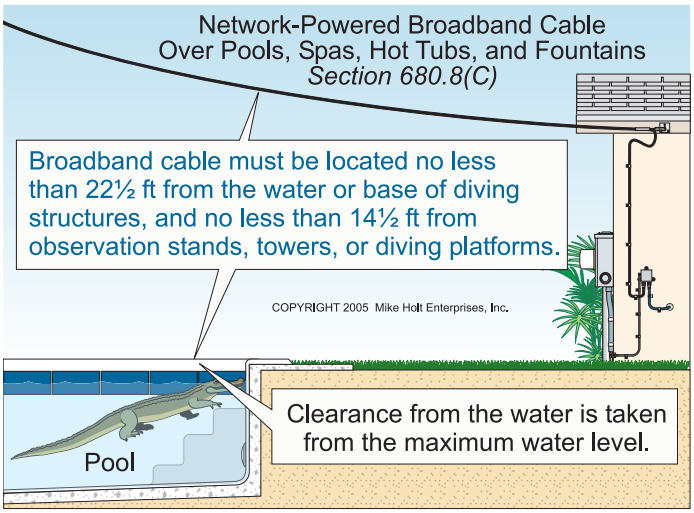


Figure 680–5

680.9 Electric Water Heater. The ampacity of branch-circuit conductors and overcurrent protective devices for pool or outdoor spa and hot tub water heaters cannot be less than 125 percent of the total nameplate rating.

680.10 Underground Wiring Location. Underground wiring isn't permitted under permanently installed pools, storable pools, outdoor spas, outdoor hot tubs, or fountains. Nor is it permitted within 5 ft horizontally from the inside wall of the pool, spa, hot tub, or fountain.

When necessary to supply permanently installed pools, storable pools, outdoor spas, outdoor hot tubs, or fountain equipment, or where space limitations prevent wiring from being at least 5 ft away, underground wiring must be installed in rigid metal conduit, intermediate metal conduit, or a nonmetallic raceway system that is listed for direct burial. The minimum burial depth is 6 in. for metal raceways and 18 in. for nonmetallic raceways.

680.11 Equipment Rooms and Pits. Permanently installed pools, storable pools, outdoor spas, outdoor hot tubs, or fountain equipment cannot be located in rooms or pits that do not have adequate drainage to prevent water accumulation during normal operation or filter maintenance.

680.12 Maintenance Disconnecting Means. A maintenance disconnecting means is required for a permanently installed pool, storable pool, outdoor spa, outdoor hot tub, or fountain equipment, other than lighting for these water bodies. The maintenance disconnecting means must be readily accessible and located within sight from the permanently installed pool, storable pool, outdoor spa, outdoor hot tub, or fountain equipment. Figure 680-6

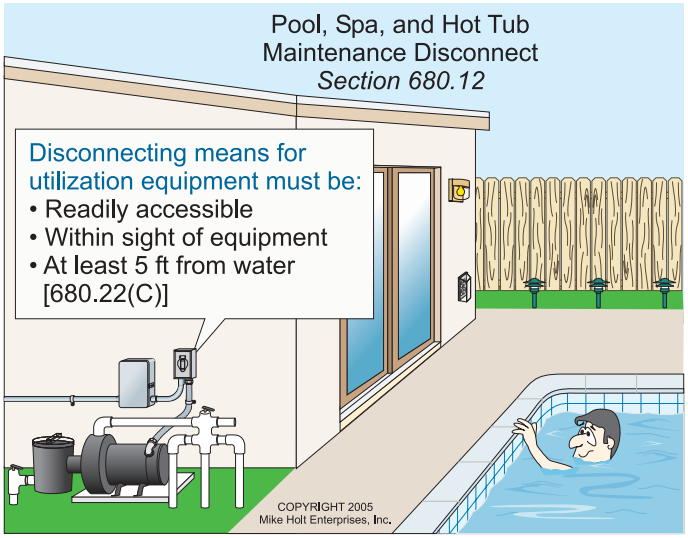


Figure 680–6

Author's Comment: Disconnects must be located not less than 5 ft horizontally from the inside walls of a permanently installed pool, storable pool, outdoor spa, outdoor hot tub, or fountain, unless separated by a solid fence, wall, or other permanent barrier [680.22(C)].

PART II. PERMANENTLY INSTALLED POOLS, OUTDOOR SPAS, AND OUTDOOR HOT TUBS

Author's Comment: The requirements contained in Part I of Article 680 also apply to permanently installed pools [680.20], outdoor spas, and outdoor hot tubs [680.42].

680.21 Motors.

(A) Wiring Methods.

(1) General. Branch-circuit conductors for permanently installed pool, outdoor spa, and outdoor hot tub motors must be installed in rigid metal conduit, intermediate metal conduit, rigid nonmetallic conduit, or Type MC cable listed for the location (sunlight-resistant or for direct burial). The wiring methods must contain an insulated copper equipment grounding (bonding) conductor sized in accordance with 250.122, but in no case can it be smaller than 12 AWG. Figure 680-7

Author's Comment: For interior wiring in one-family dwellings, Types UF, SE, and NM cable with an uninsulated equipment grounding (bonding) conductor are permitted [680.21(A)(4)].

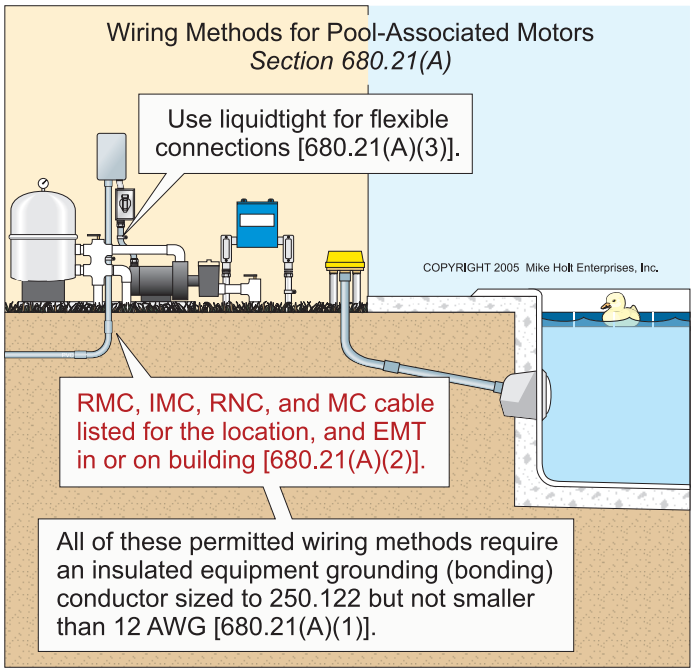


Figure 680–7

(2) On or Within Buildings. Where installed on or within buildings, electrical metallic tubing is permitted to supply permanently installed pool, outdoor spa, and outdoor hot tub motors.

Author's Comment: Electrical metallic tubing requires an insulated copper equipment grounding (bonding) conductor in accordance with 680.21(A)(1).

(3) Flexible Connections. Liquidtight flexible metal or nonmetallic conduit is permitted for permanently installed pool, outdoor spa, and outdoor hot tub motors.

Author's Comment: Liquidtight flexible metal or nonmetallic conduit requires an insulated copper equipment grounding (bonding) conductor in accordance with 680.21(A)(1).

(4) One-Family Dwellings Interior Wiring Method. Any Chapter 3 wiring method is permitted in the interior of one-family dwellings, or in the interior of accessory buildings associated with a one-family dwelling.

Where run in a raceway, the wiring method requires an insulated copper equipment grounding (bonding) conductor [680.21(A)(1)]. Figure 680-8

Where run in a cable, Types NM, SE, or UF cable with an uninsulated equipment grounding (bonding) conductor are permitted.

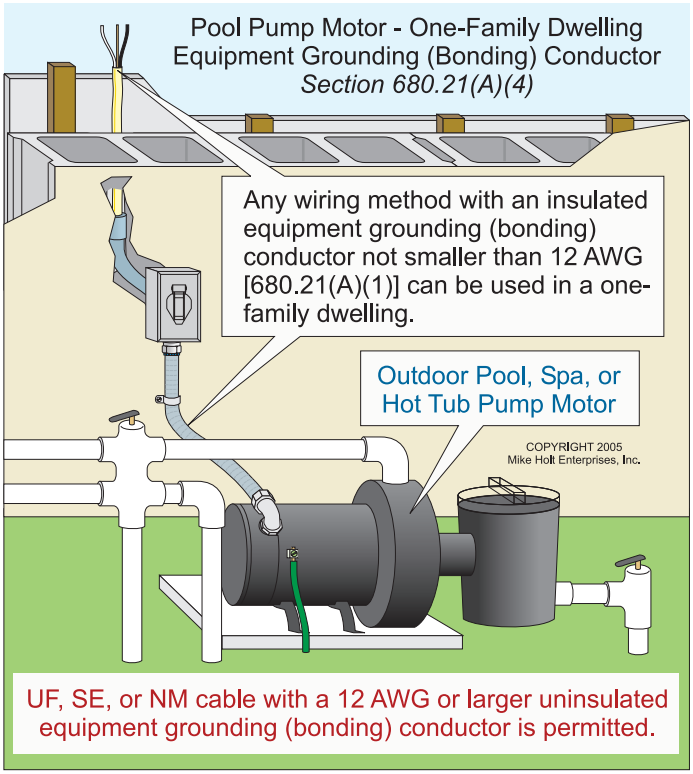


Figure 680–8

Author's Comment: Underground or exterior wiring of a one-family dwelling for permanently installed pool, outdoor spa, and outdoor hot tub motors must be installed in rigid metal conduit, intermediate metal conduit, or rigid nonmetallic conduit with an insulated copper equipment grounding (bonding) conductor in accordance with 680.21(A)(1).

(5) Cord-and-Plug Connections. A cord no longer than 3 ft, with an attachment plug and containing an equipment grounding (bonding) conductor, is permitted for permanently installed pool, outdoor spa, and outdoor hot tub motors.

Author's Comment: For outdoor spas and hot tubs, the cord must be GFCI protected and it can have a length of up to 15 ft [680.42(A)(2)].

680.22 Area Lighting, Receptacles, and Equipment.

(A) Receptacles.

(1) Circulation System. Receptacles for permanently installed pool, outdoor spa, and outdoor hot tub motors, or other loads directly related to the circulation system must be located not less than 10 ft from the inside walls, or not less than 5 ft from the water, if the receptacle is a single twist-locking type that is GFCI protected. Figure 680-9

(2) Other Receptacles. Receptacles not for motors or other loads directly related to the circulation system must be not less than 10 ft from the water. Figure 680-10

(3) Dwelling Unit. At a dwelling unit, one 15 or 20A, 125V receptacle must be located not less than 10 ft and not more than 20 ft from the water from a permanently installed pool, outdoor spa, or outdoor hot tub. This receptacle must be located not more than 6½ ft above the floor, platform, or grade level serving the permanently installed pool, outdoor spa, or outdoor hot tub. Figure 680-11

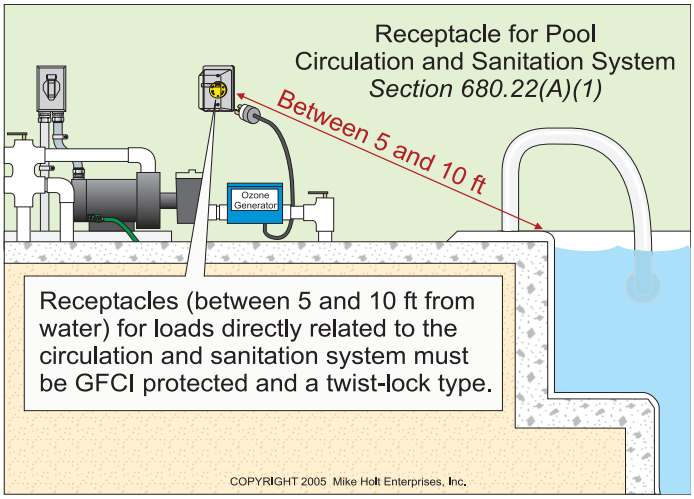


Figure 680–9

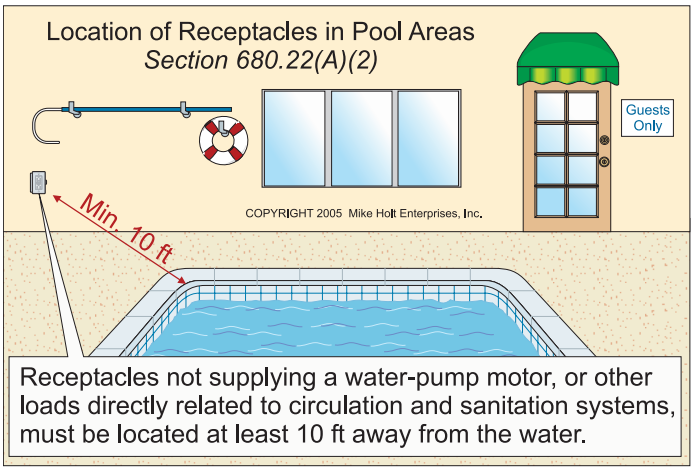


Figure 680–10

(4) Restricted Dwelling Space. Where a permanently installed pool, outdoor spa, or outdoor hot tub is within 10 ft of a dwelling, the receptacle required by 680.22(A)(3) can be located less than 10 ft, but not less than 5 ft measured horizontally from the water. Figure 680-12

(5) GFCI-Protected Receptacles. All 15 and 20A, 125V receptacles located within 20 ft of the inside walls of a permanently installed pool, outdoor spa, or outdoor hot tub must be GFCI protected. Figure 680-13

Author's Comment: All outdoor dwelling-unit receptacles must be GFCI protected, regardless of the distance from a permanently installed pool, outdoor spa, or outdoor hot tub [210.8(A)(3)]. In addition, all 15 and 20A, 125V receptacles for nondwelling units located outdoors with public access, or accessible to the public, require GFCI protection [210.8(B)(4)].

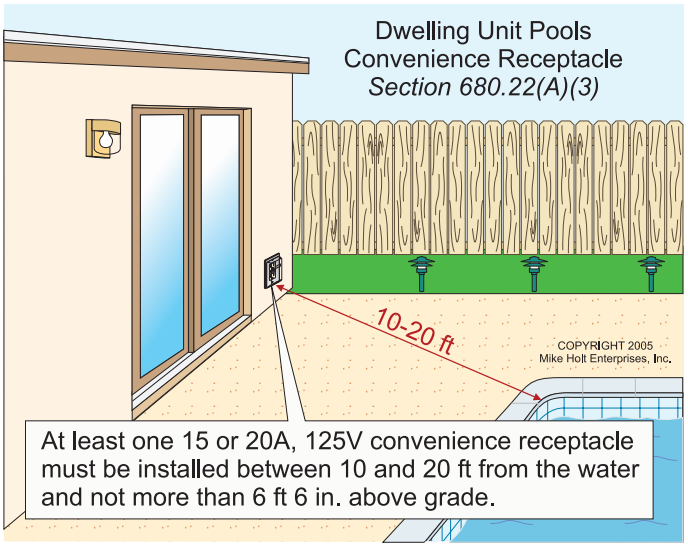


Figure 680–11

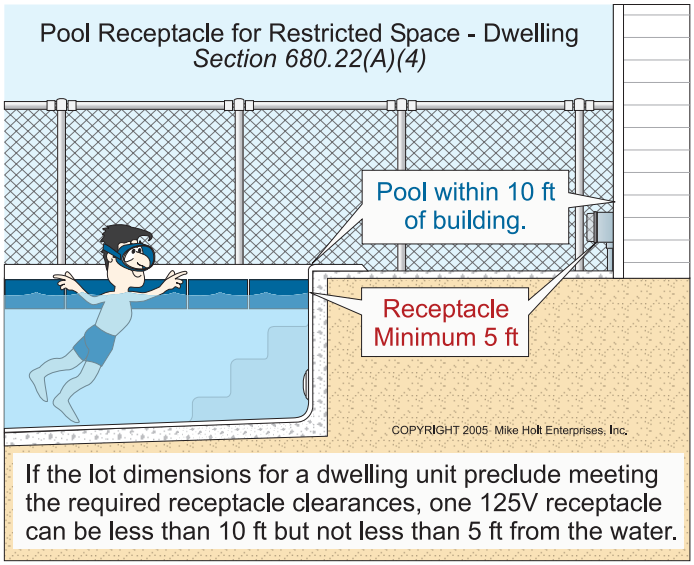


Figure 680–12

All receptacles rated 15 or 20A, 125V through 250V for a permanently installed pool, outdoor spa, or outdoor hot tub supplying cord-and-plug connected pump motors must be GFCI protected. Figure 680-14

(6) Measurements. In determining the above dimensions, the distance must be the shortest path a supply cord connected to the receptacle would follow without piercing a floor, wall, ceiling, doorway with hinged or sliding door, window opening, or other effective permanent barrier.

(B) Luminaires and Ceiling Fans.

(1) New Outdoor Installations. Luminaires and ceiling fans installed above the water, or the area extending within 5 ft horizontally from the water, must not be less than 12 ft above the maximum water level.

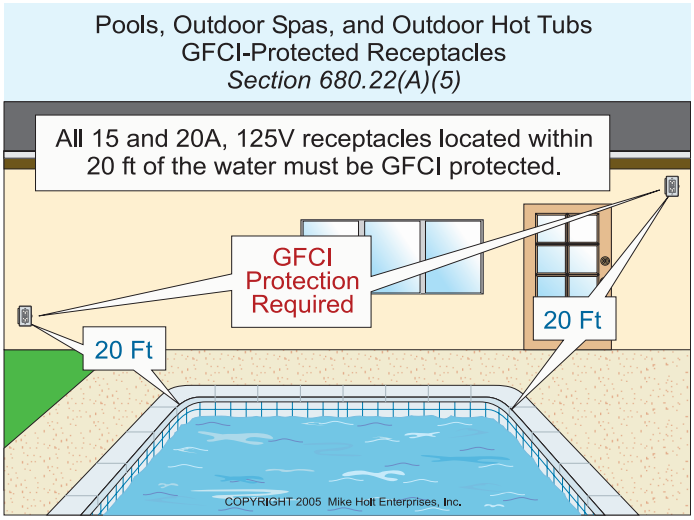


Figure 680–13

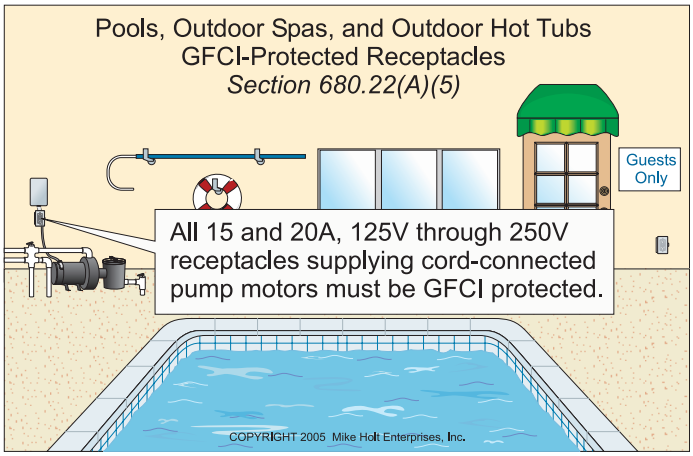


Figure 680–14

(3) Existing Installations. Existing luminaires located less than 5 ft horizontally from the water must be not less than 5 ft above the surface of the maximum water level and must be GFCI protected. Figure 680-15

(4) Adjacent Areas. New luminaires and ceiling fans installed between 5 ft and 10 ft horizontally, and not more that 5 ft above the maximum water level of a permanently installed pool, outdoor spa, or outdoor hot tub must be GFCI protected.

Author's Comment: Low-voltage lighting systems must not be located within 10 ft of a pool, spa, or hot tub, even if GFCI protected [411.4]. Figure 680-16

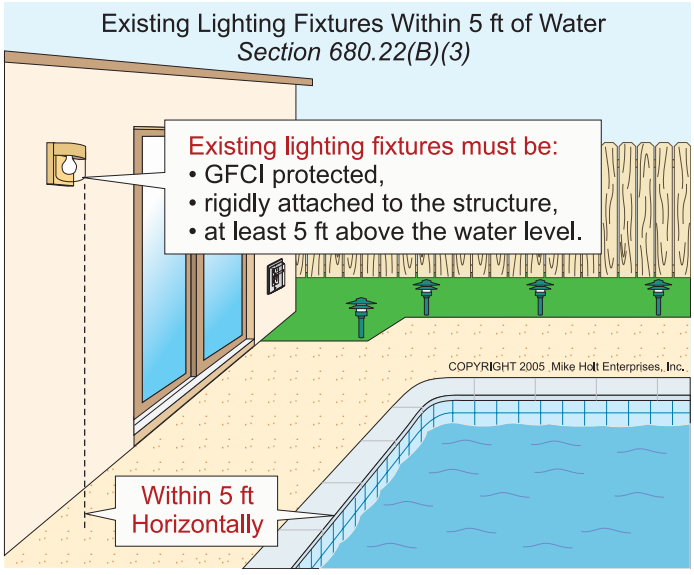


Figure 680–15

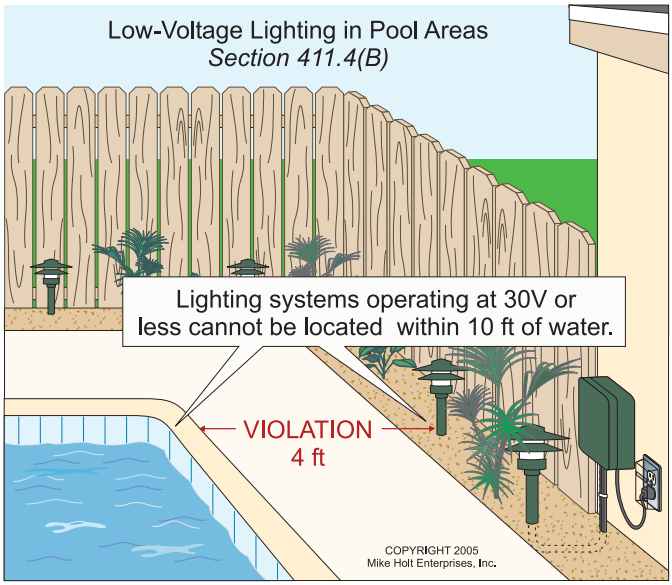


Figure 680–16

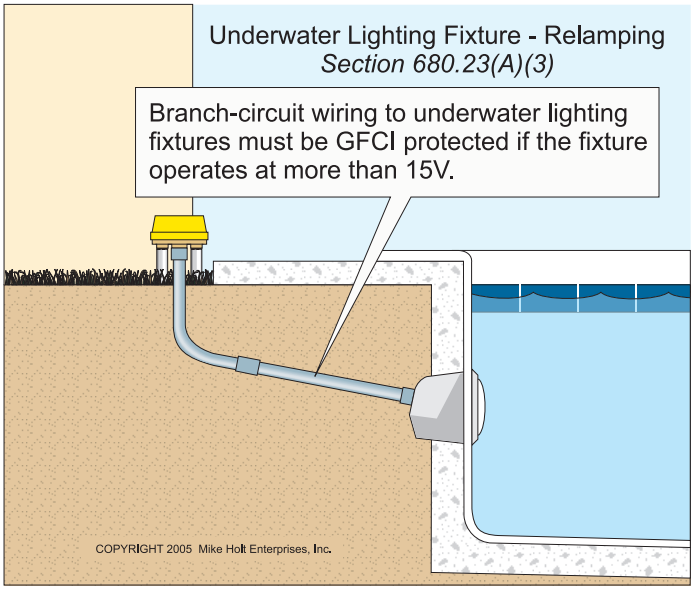


Figure 680–18

(C) Switching Devices. Circuit breakers, time clocks, pool light switches, and other switching devices must be located not less than 5 ft horizontally from the inside walls of a permanently installed pool, outdoor spa, or outdoor hot tub unless separated by a solid fence, wall, or other permanent barrier. Figure 680-17

680.23 Underwater Luminaires.

(A) General.

(2) Transformers. Transformers for underwater luminaires must be listed as a swimming pool transformer of the isolating winding type and have a grounded metal barrier between the primary and secondary windings.

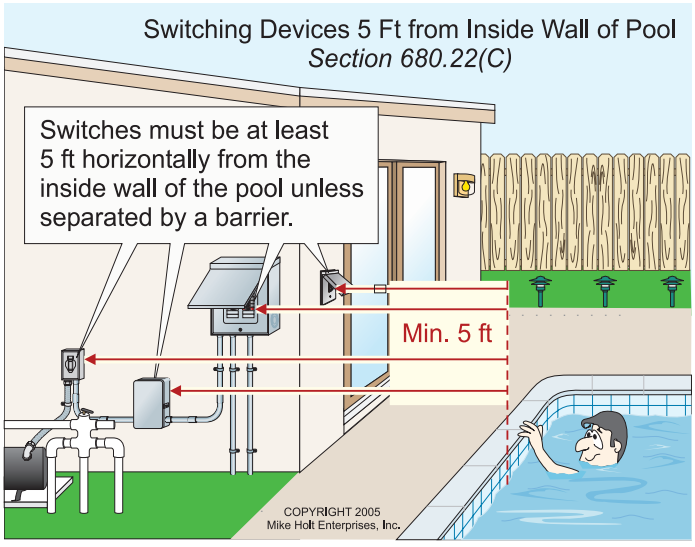


Figure 680–17

(3) GFCI Protection of Underwater Luminaires. Branch circuits that supply underwater luminaires operating at more than 15V must be GFCI protected. Figure 680-18

(5) Wall-Mounted Luminaires. Underwater luminaires must be installed so that the top of the luminaire lens isn't less than 18 in. below the normal water level.

> **Author's Comment:** The 18 in. requirement reduces the likelihood that persons hanging on the side of the pool will have their chest cavity in line with the underwater luminaire.

(B) Wet-Niche Underwater Luminaires.

(1) Forming Shells. Forming shells for wet-niche underwater luminaires must be equipped with provisions for conduit entries. All forming shells used with nonmetallic conduit systems must include provisions for terminating an 8 AWG copper conductor.

(2) Wiring to the Forming Shell. The conduit that extends directly to the underwater pool wet-niche forming shell must comply with (a) or (b).

(a) Metal Conduit. Brass or corrosion-resistant rigid metal approved by the authority having jurisdiction.

(b) Nonmetallic Conduit. Nonmetallic conduit containing an 8 AWG insulated (solid or stranded) copper bonding jumper, which must terminate in the forming shell and junction box. The termination of the 8 AWG bonding jumper in the forming shell must be covered with, or encapsulated in, a listed potting compound to protect the connection from the possible deteriorating effect of pool water.

(6) Servicing. Luminaires must be installed so that personnel can reach the luminaire for relamping, maintenance, or inspection while on the deck or in an equivalently dry location.

(F) Branch-Circuit Wiring.

(1) Wiring Methods. Branch-circuit wiring for underwater luminaires must be rigid metal conduit, intermediate metal conduit, liquidtight flexible nonmetallic conduit, or rigid nonmetallic conduit. See 680.23(B)(2).

Electrical metallic tubing can be installed on a building. Where installed within a building, electrical nonmetallic tubing, Type MC cable, or electrical metallic tubing is permitted.

Exception: Where connecting to transformers for pool lights, liquidtight flexible metal conduit or liquidtight flexible nonmetallic conduit is permitted in individual lengths not exceeding 6 ft.

(2) Equipment Grounding (Bonding). Branch-circuit conductors for an underwater luminaire must contain an insulated copper equipment grounding (bonding) conductor sized in accordance with Table 250.122, but not smaller than 12 AWG. Figure 680-19

The equipment grounding (bonding) conductor for the underwater luminaire must not be spliced, except as permitted in (a) or (b). Figure 680-20

(a) Where more than one underwater luminaire is supplied by the same branch circuit, the equipment grounding (bonding) conductor can terminate at a listed pool junction box that meets the requirements of 680.24(A).

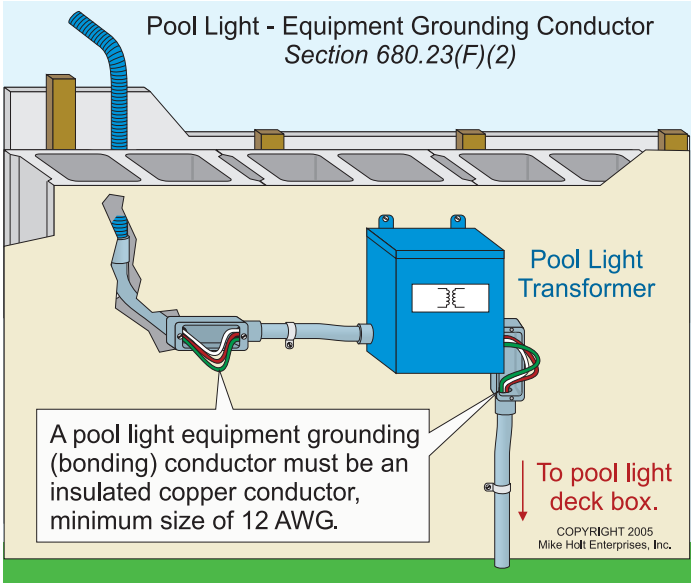


Figure 680–19

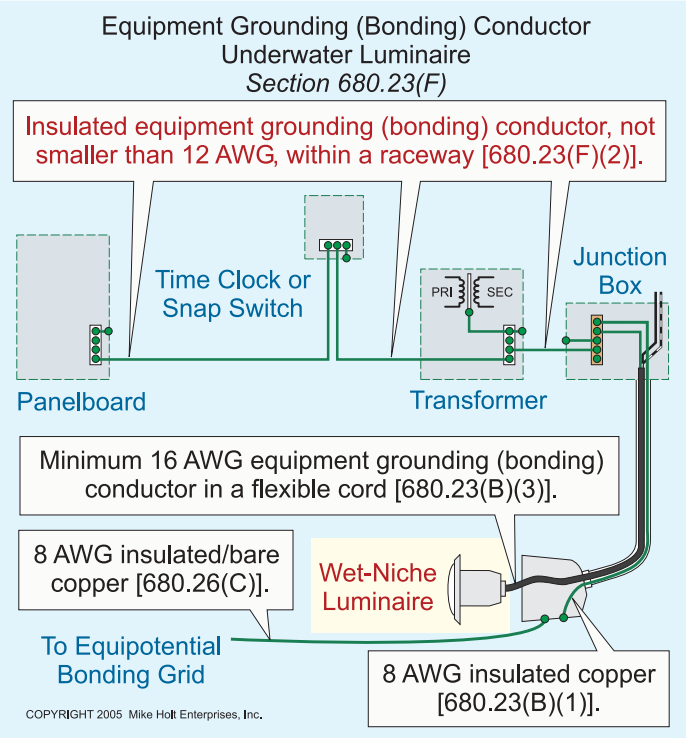


Figure 680–20

(b) The equipment grounding (bonding) conductor can terminate at the grounding terminal of a listed pool transformer that meets the requirements of 680.23(A)(2).

(3) Conductors. The branch-circuit conductors for the underwater luminaire must not occupy raceways, boxes, or enclosures containing other conductors on the load side of a GFCI or transformer, unless one of the following conditions applies:

(1) The other conductors are GFCI protected.

(2) The other conductors are grounding (bonding) conductors.

(3) The other conductors supply a feed-through type GFCI.

(4) The other conductors are in a panelboard.

680.24 Junction Boxes.

(A) Junction Boxes. The junction box (deck box) that connects directly to an underwater permanently installed pool, outdoor spa, or outdoor hot tub luminaire forming shell must comply with the following: Figure 680-21

(1) Construction. The junction box must be listed as a swimming pool junction box and must be:

(1) Equipped with threaded entries or a nonmetallic hub,

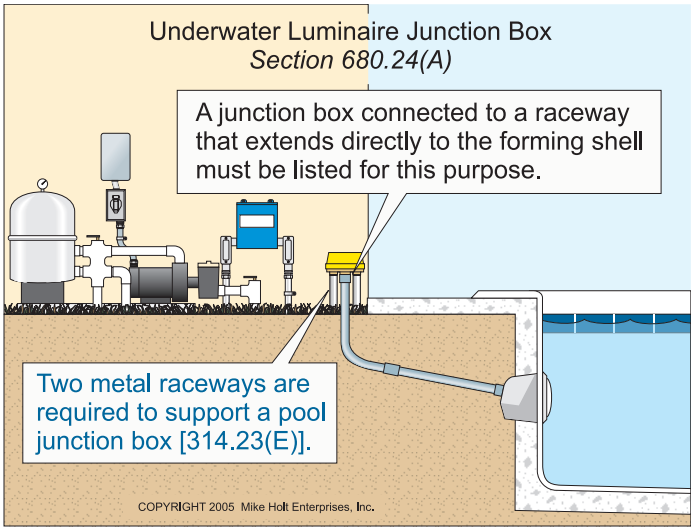


Figure 680–21

(2) Constructed of copper, brass, or corrosion-resistant material approved by the authority having jurisdiction, and

(3) Provided with electrical continuity between all metal conduit and the grounding (bonding) terminals within the junction box.

Author's Comment: In addition, the junction box must be provided with at least one more grounding (bonding) terminal than the number of conduit entries [680.24(D)], and it must be provided with a strain relief [680.24(E)].

(2) Installation. Where the luminaire operates at over 15 volts, the junction box location must comply with (a) and (b).

(a) Vertical Spacing. The junction box must be located not less than 4 in. above the ground or permanently installed pool, outdoor spa, or outdoor hot tub deck, or not less than 8 in. above the maximum water level.

(b) Horizontal Spacing. The junction box must be located not less than 4 ft from the inside wall of the permanently installed pool, outdoor spa, or outdoor hot tub, unless separated by a solid fence, wall, or other permanent barrier.

Author's Comment: The underwater luminaire junction box must be supported by two metal conduits threaded wrenchtight into the enclosure [314.23(E)].

(B) Transformer or Ground-Fault Circuit-Interrupter Enclosure. Where the enclosure for a transformer or GFCI is connected to a conduit that extends directly to an underwater permanently installed pool, outdoor spa, or outdoor hot tub luminaire forming shell, the enclosure must comply with the following:

(1) Construction. The enclosure must be listed and labeled for the purpose, and be:

(1) Equipped with threaded entries or a nonmetallic hub,

(2) Constructed of copper, brass, or corrosion-resistant material approved by the authority having jurisdiction, and

(4) Provide electrical continuity between all metal conduit and the grounding (bonding) terminals of the enclosure.

Author's Comment: See Article 100 for the definitions of "Labeled" and "Listed."

(C) Physical Protection. Junction boxes for underwater pool, spa, or hot tub luminaires must not be located in the walkway unless afforded protection by being located under diving boards or adjacent to fixed structures.

(D) Grounding (Bonding) Terminals. The junction box for an underwater permanently installed pool, outdoor spa, or outdoor hot tub luminaire must be provided with at least one more grounding (bonding) terminal than the number of conduit entries.

Author's Comment: Typically, there are four grounding (bonding) terminals in the junction box and three conduit entries.

(E) Strain Relief. The termination of a flexible cord that supplies an underwater permanently installed pool, outdoor spa, or outdoor hot tub luminaire must be provided with a strain relief.

680.25 Feeders

(A) Wiring Methods. Feeder conductors to panelboards containing permanently installed pool, outdoor spa, or outdoor hot tub equipment circuits must be installed in rigid metal conduit, intermediate metal conduit, liquidtight flexible nonmetallic conduit, or rigid nonmetallic conduit. Electrical metallic tubing is permitted where installed on or within a building, and electrical nonmetallic tubing is permitted where installed within a building.

Exception: Branch circuits for permanently installed pool, outdoor spa, or outdoor hot tub equipment can originate from an existing panelboard supplied by a cable assembly that includes an equipment grounding (bonding) conductor within its outer sheath.

(B) Grounding (Bonding). Except for existing feeders [680.25(A) Ex], an insulated equipment grounding (bonding) conductor must be installed with the feeder conductors between the grounding terminal of the permanently installed pool, outdoor spa, or outdoor hot tub equipment panelboard and the grounding terminal of the service equipment.

(1) Size. This feeder equipment grounding (bonding) conductor must be sized in accordance with 250.122, but not smaller than 12 AWG.

(2) Separate Buildings. Where a feeder is run to a separate building or structure to supply permanently installed swimming pool, outdoor spa, or outdoor hot tub equipment, an insulated equipment grounding (bonding) conductor must be installed with the feeder conductors to the disconnecting means in the separate building or structure [250.32(B)(1)].

680.26 Equipotential Bonding.

(A) Performance. Equipotential (stray voltage) bonding is intended to reduce voltage gradients in a permanently installed pool, outdoor spa, or outdoor hot tub area by forming a common bonding grid.

Author's Comment: Equipotential (stray voltage) bonding isn't intended to provide a low-impedance ground-fault current path to help assist in clearing a ground fault. The topic of stray voltage is beyond the scope of this textbook. For more information, visit www.MikeHolt.com, click on the Technical link, then the Stray Voltage link.

FPN: The 8 AWG or larger solid copper equipotential (stray voltage) bonding conductor [680.26(C)] isn't required to extend to or be attached to any panelboard, service equipment, or an electrode.

(B) Bonded Parts. The following parts of a permanently installed pool, outdoor spa, or outdoor hot tub must be bonded together.

Author's Comment: See 680.42(B) for the bonding methods permitted for outdoor spas and hot tubs.

(1) Metallic Parts of Structure. All metallic parts of the water structure, including the reinforcing metal of the permanently installed pool, outdoor spa, or outdoor hot tub shell and deck. The usual steel tie-wires are considered suitable for bonding the reinforcing steel together. Welding or special clamping is not required, but the tie-wires must be made tight. Figure 680-22

Where the reinforcing steel of the permanently installed pool, outdoor spa, or outdoor hot tub shell and deck is encapsulated with a nonconductive compound, or if it's not available, provisions must be made for an alternative means to eliminate voltage gradients that would otherwise be provided by unencapsulated, bonded reinforcing steel

Author's Comment: This means that an equipotential (stray voltage) grid constructed in accordance with 680.26(C) must be installed.

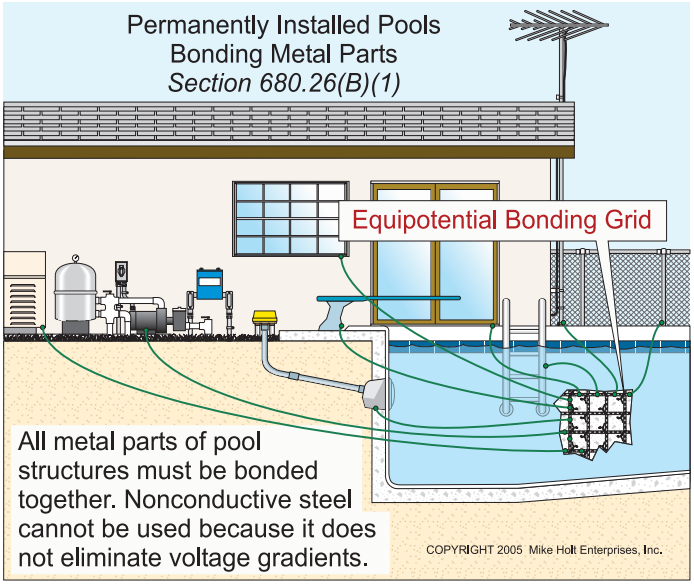


Figure 680–22

(2) Underwater Lighting. All metal forming shells for underwater permanently installed pool, outdoor spa, or outdoor hot tub luminaires and speakers.

(3) Metal Fittings. Metal fittings within or attached to the permanently installed pool, outdoor spa, or outdoor hot tub structure, such as ladders and handrails.

(4) Electrical Equipment. Metal parts of electrical equipment associated with the permanently installed pool, outdoor spa, or outdoor hot tub water circulating system, such as water heaters and pump motors.

Where a double-insulated water-pump motor is installed, a solid 8 AWG copper conductor from the bonding grid must be provided for a replacement motor.

(5) Metal Wiring Methods and Equipment. Metal-sheathed cables and raceways, metal piping, and all fixed metal parts, as well as metallic surfaces of electrical equipment if located:

(1) Within 5 ft horizontally of the inside walls of a permanently installed pool, outdoor spa, or outdoor hot tub, and

(2) Within 12 ft measured vertically above the maximum water level of a permanently installed pool, outdoor spa, or outdoor hot tub, or any observation stands, towers, platforms, or any diving structures.

(C) Equipotential Grid. A solid copper conductor not smaller than 8 AWG must be used to bond the metallic parts of a permanently installed pool, outdoor spa, or outdoor hot tub as specified in 680.26(B) to an equipotential (stray voltage) grid. The termination of the bonding conductor must be made by exothermic

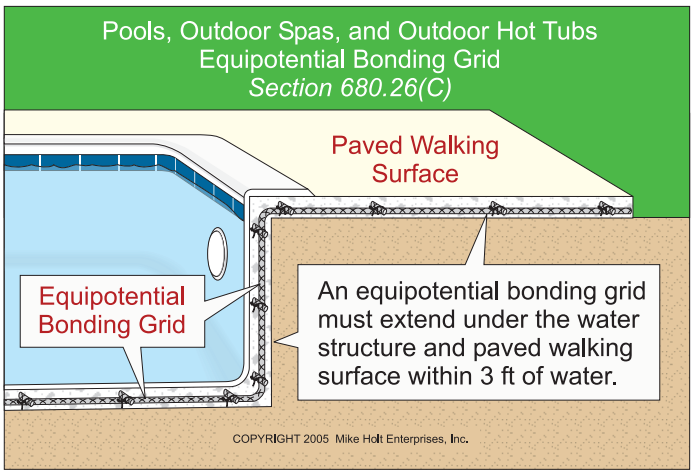


Figure 680–23

welding, listed pressure connectors, or listed clamps that are suitable for the purpose.

To properly mask stray voltage, an equipotential (stray voltage) grid must extend under walking surfaces for 3 ft horizontally from the water, Figure 680-23. The equipotential (stray voltage) grid must be formed from one or more of the following:

(1) Structural Reinforcing Steel. Structural reinforcing steel of the concrete permanently installed pool, outdoor spa, or outdoor hot tub.

(2) Bolted or Welded Metal Pools. The walls of a bolted or welded metal permanently installed pool, outdoor spa, or outdoor hot tub.

(3) Other Methods. The equipotential (stray voltage) grid can be constructed as specified in (a) through (c) below.

(a) Materials and Connections. The equipotential (stray voltage) grid can be constructed with 8 AWG bare solid copper conductors that are bonded to each other at all points of crossing.

(b) Grid. The equipotential (stray voltage) grid must cover the contour of the permanently installed pool, outdoor spa, or outdoor hot tub, and deck extending 3 ft horizontally from the water. The equipotential (stray voltage) grid must be arranged in a 1 ft x 1 ft network of conductors in a uniformly spaced perpendicular grid pattern with a tolerance of 4 in.

(c) Securing. The equipotential (stray voltage) grid must be secured.

(D) Connections. Where structural reinforcing steel or the walls of bolted or welded metal permanently installed pool, outdoor spa, or outdoor hot tub structures are used as an equipotential (stray voltage) grid for nonelectrical parts, the connections must be made in accordance with 250.8.

680.27 Specialized Equipment.

(B) Electrically Operated Covers.

(1) Motors and Controllers. The electric motors, controllers, and wiring for an electrically operated cover must be located not less than 5 ft from the inside wall of a permanently installed pool, outdoor spa, or outdoor hot tub, unless separated by a permanent barrier.

(2) Wiring Methods. The electric motor and controller circuit must be GFCI protected.

PART III. STORABLE SWIMMING POOL

680.30 General. Electrical installations for storable pools must also comply with Part I of Article 680.

> **Author's Comment:** The requirements contained in Part I of Article 680 include the location of switches, receptacles, and luminaires.

680.32 GFCI-Protected Receptacles. GFCI protection is required for all electrical equipment, including power-supply cords, used with storable pools.

GFCI protection is required for all 15 or 20A, 125V receptacles located within 20 ft of the inside walls of a storable pool or that supply storable pool pump motors. Figure 680-24

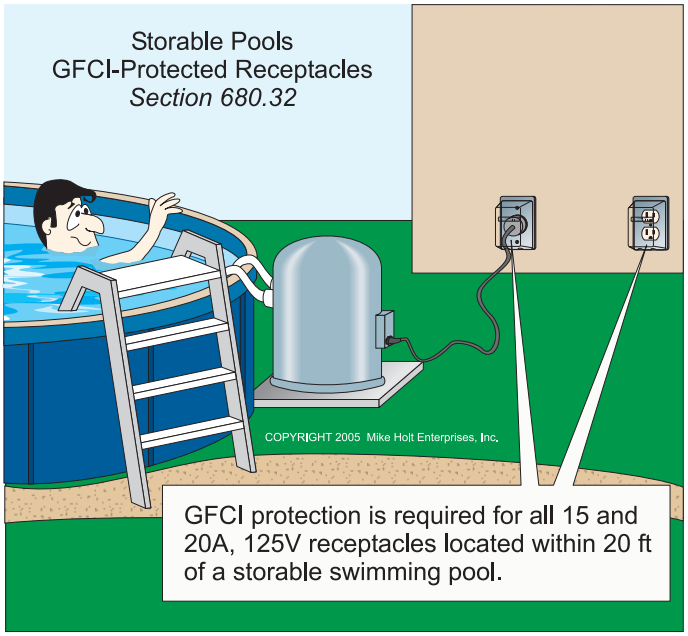


Figure 680–24

The measured distance is the shortest path a supply cord connected to the receptacle would follow without piercing a floor, wall, ceiling, doorway with hinged or sliding door, window opening, or other effective permanent barrier.

Author's Comment: This requirement mirrors the requirements contained in 680.25(A)(5) and (6) for permanently installed pools.

680.34 Receptacle Locations. Receptacles must not be located less than 10 ft from the inside walls of a storable pool. Figure 680-25

The measured distance is the shortest path a supply cord connected to the receptacle would follow without piercing a floor, wall, ceiling, doorway with hinged or sliding door, window opening, or other effective permanent barrier.

Author's Comment: This rule mirrors the requirements contained in 680.22(A)(1) for permanently installed pools.

PART IV. SPAS AND HOT TUBS

680.40 General. Electrical installations for spas and hot tubs must comply with Part I as well.

680.41 Emergency Switch for Spas and Hot Tubs. In other than a single-family dwelling, a clearly labeled emergency spa or hot tub water recirculation and jet system shutoff must be supplied. The emergency shutoff must be readily accessible to the users and located not less than 5 ft away, but adjacent to and within sight of the spa or hot tub. Figure 680-26

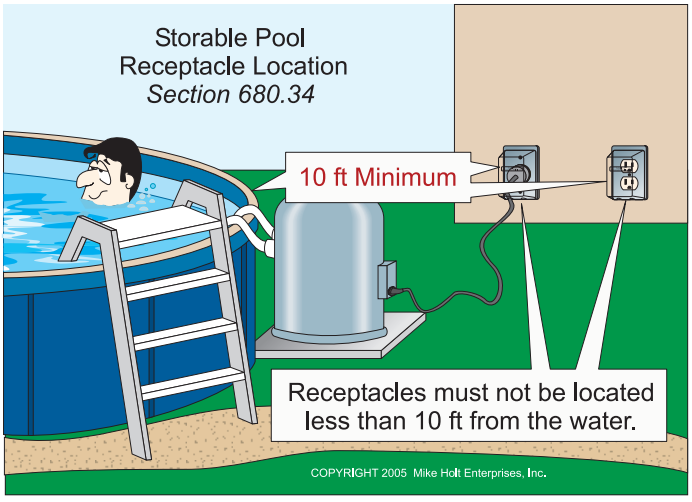


Figure 680–25

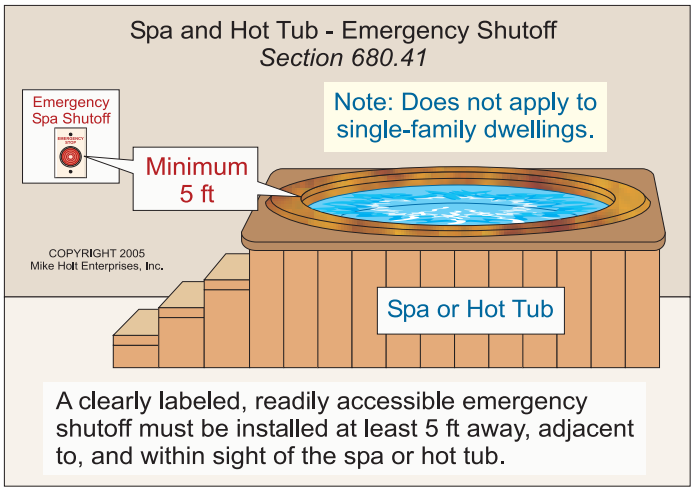


Figure 680–26

Author's Comments:

- Either the maintenance disconnecting means required by 680.12 or a pushbutton that controls a relay located in accordance with this section can be used to meet the emergency shutoff requirement.
- The purpose of the emergency shutoff is to protect users. Deaths and injuries have occurred in less than 3 ft of water because individuals became stuck to the water intake opening. This requirement applies to spas and hot tubs installed indoors as well as outdoors.

680.42 Outdoor Installations. Electrical installations for outdoor spas or hot tubs must comply with Parts I and II of this article, except as permitted in the following:

(A) Flexible Connections. Listed packaged spa or hot tub equipment assemblies or self-contained spas or hot tubs are permitted to use flexible connections as follows:

(1) Flexible Conduit. Liquidtight flexible metal conduit or liquidtight flexible nonmetallic conduit in lengths of not more than 6 ft.

(2) Cord-and-Plug Connections. Cord-and-plug connections with a GFCI-protected cord that is not longer than 15 ft.

(B) Bonding. Bonding is permitted by mounting equipment to a metal frame or base. Metal bands that secure wooden staves aren't required to be bonded.

(C) Interior Wiring for Outdoor Spas or Hot Tubs. Any Chapter 3 wiring method containing a copper equipment grounding (bonding) conductor that is insulated or enclosed within the outer sheath of the wiring method and not smaller than 12 AWG is permitted for the connection to motor, heating, and control loads that are part of a self-contained spa or hot tub, or a packaged spa or hot tub equipment assembly.

Wiring to an underwater light must comply with 680.23 or 680.33.

680.43 Indoor Installations. Electrical installations for an indoor spa or hot tub must comply with Parts I and II of Article 680, except as modified by this section. Indoor installations of spas or hot tubs can be connected by any of the wiring methods contained in Chapter 3.

Exception: Listed packaged units rated 20A or less can be cord-and-plug connected.

(A) Receptacles. At least one 15 or 20A, 125V receptacle must be located at least 5 ft, but not more than 10 ft, from the inside wall of the spa or hot tub.

(1) Location. Other receptacles must be located not less than 5 ft, measured horizontally, from the inside walls of the indoor spa or hot tub.

(2) GFCI-Protected Receptacles. Receptacles rated 30A or less at 125V, located within 10 ft of the inside walls of an indoor spa or hot tub, must be GFCI protected. Figure 680-27

(3) Spa or Hot Tub Receptacle. Receptacles that provide power for an indoor spa or hot tub must be GFCI protected.

(4) Measurements. In determining the above dimensions, the distance to be measured must be the shortest path that the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, doorway with hinged or sliding door, window opening, or other effective permanent barrier.

(B) Luminaires and Ceiling Fans.

(1) Elevation. Luminaires and ceiling fans within 5 ft, measured horizontally, from the inside walls of the indoor spa or hot tub must be:

(a) Not less than 12 ft above an indoor spa or hot tub where no GFCI protection is provided.

(b) Not less than 7½ ft above an indoor spa or hot tub where GFCI protection is provided.

(c) If GFCI protection is provided and the installation meets the following, luminaires and ceiling fans can be mounted less than 7½ ft above an indoor spa or hot tub:

(1) Recessed luminaires with a glass or plastic lens, nonmetallic or electrically isolated metal trim, and suitable for use in damp locations.

Author's Comment: See Article 100 for the definition of "Location, Damp."

(2) Surface-mounted luminaires with a glass or plastic globe, a nonmetallic body, or a metallic body isolated from contact, and suitable for use in damp locations.

(C) Switches. Switches must be located not less than 5 ft, measured horizontally, from the inside walls of the indoor spa or hot tub. Figure 680-28

(D) Bonding. The following parts of an indoor spa or hot tub must be bonded together:

(1) Metal fittings within or attached to the indoor spa or hot tub structure.

(2) Metal parts of electrical equipment associated with the indoor spa or hot tub water circulating system.

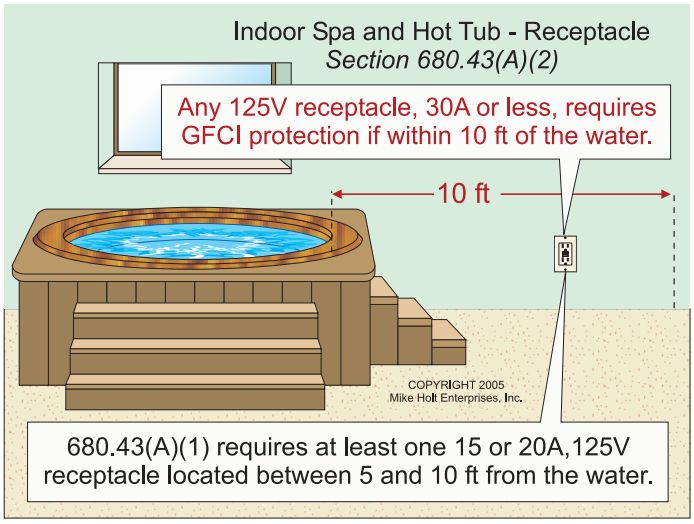


Figure 680–27

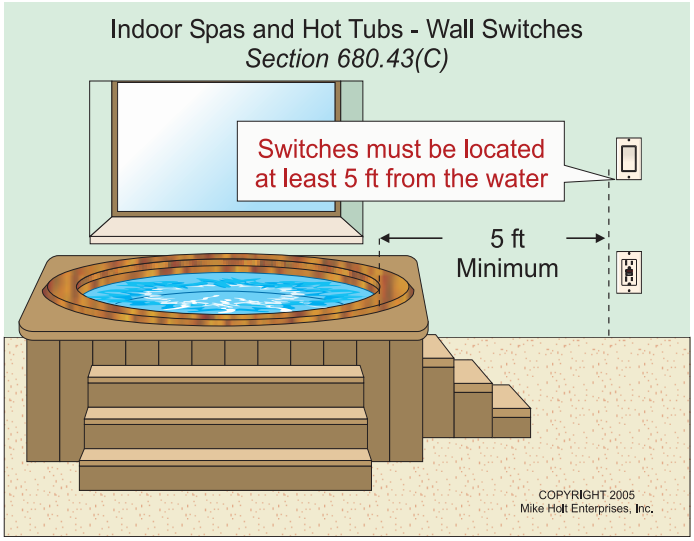


Figure 680–28

(3) Metal conduit, and metal piping within 5 ft of the inside walls of the indoor spa or hot tub, and not separated from the indoor spa or hot tub by a permanent barrier.

(4) Metal surfaces within 5 ft of the inside walls of an indoor spa or hot tub not separated from the indoor spa or hot tub area by a permanent barrier.

Exception: Small conductive surfaces, such as air and water jets, not likely to become energized, aren't required to be bonded. Other nonelectrical equipment, such as towel bars or mirror frames, which aren't connected to metallic piping, aren't required to be bonded.

(E) Methods of Bonding. All metal parts required by 680.43(D) to be bonded must be bonded together to create an equipotential (stray voltage) plane by any of the following methods:

(1) The interconnection of threaded metal piping and fittings.

(2) Metal-to-metal mounting on a common frame or base.

(3) A solid copper bonding jumper not smaller than 8 AWG.

680.44 GFCI Protection. The outlet that supplies a self-contained indoor spa or hot tub, a packaged spa or hot tub equipment assembly, or a field-assembled spa or hot tub must be GFCI protected. Figure 680-29

Author's Comment: A self-contained spa or hot tub is a factory-fabricated unit that consists of a spa or hot tub vessel with all water-circulating, heating, and control equipment integral to the unit. A packaged spa or hot tub equipment assembly is a factory-fabricated unit that consists of water circulating, heating, and control equipment mounted on a common base intended to operate a spa or hot tub [680.2].

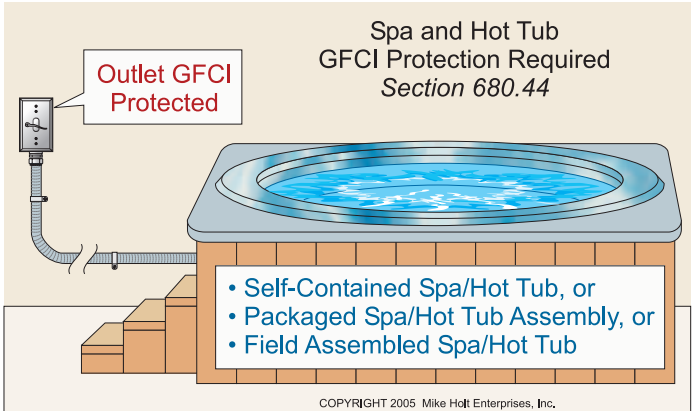


Figure 680–29

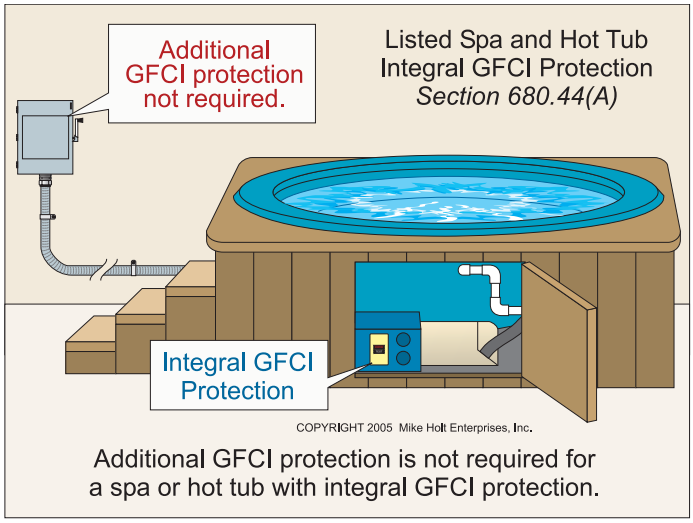


Figure 680–30

(A) Listed Units. Additional GFCI protection isn't required for a listed self-contained spa or hot tub unit or listed packaged spa or hot tub assembly marked to indicate that integral GFCI protection has been provided for all electrical parts within the unit or assembly. Figure 680-30

(B) Other Units. GFCI protection isn't required for a field-assembled spa or hot tub that is three-phase or that has a voltage rating over 250V, or has a heater load above 50A.

(C) Combination Pool and Spa or Hot Tub. GFCI protection isn't required for equipment that supplies a combination pool/hot tub or spa assembly.

PART V. FOUNTAINS

680.50 General. Fountains that have water common to a pool must comply with the pool requirements of Parts I and II.

680.51 Luminaires, Submersible Pumps, and Other Submersible Equipment.

(A) GFCI Protection for Fountain Equipment. The branch circuit that supplies luminaires, submersible pumps, and other submersible equipment must be GFCI protected, unless the equipment is listed for not more than 15V and is supplied by a listed pool transformer that complies with 680.23(A)(2).

(C) Luminaire Lenses. Luminaires must be installed so the top of the luminaire lens is below the normal water level unless listed for above-water use.

(E) Cords. The maximum length of exposed cord in the fountain is 10 ft. Power supply cords that extend beyond the fountain

perimeter must be enclosed in a wiring enclosure approved by the authority having jurisdiction.

(F) Servicing. Equipment must be capable of being removed from the water for relamping or for normal maintenance.

(G) Stability. Equipment must be inherently stable or securely fastened in place.

680.53 Bonding. All metal piping systems associated with the fountain must be bonded to the equipment grounding (bonding) conductor of the branch circuit that supplies the fountain.

680.55 Methods of Grounding (Bonding).

(B) Supplied by a Flexible Cord. Equipment supplied by a flexible cord must have all exposed metal parts grounded (bonded) to an effective ground-fault current path by an insulated copper equipment grounding (bonding) conductor that is an integral part of the cord.

680.56 Cord-and-Plug Connected Equipment.

(A) GFCI Protection of Cord-and-Plug Equipment. All cord-and-plug connected fountain equipment must be GFCI protected.

(B) Cord Type. Flexible cords immersed in or exposed to water must be of the hard-service type, as designated in Table 400.4, and must be marked "Water-Resistant."

680.57 Signs in or Adjacent to Fountains.

(B) GFCI Protection of Sign Equipment. Each circuit that supplies a sign installed within a fountain, or within 10 ft of the fountain edge, must be GFCI protected [680.57(A)]. Figure 680-31

(C) Sign Location.

(1) Fixed or Stationary. A fixed or stationary electric sign installed within a fountain must be not less than 5 ft from the outside edge of the fountain.

(2) Portable. A portable electric sign must not be placed in or within 5 ft from the inside walls of a fountain.

> **Author's Comment:** Because portable electric signs pose a greater hazard from electric shock than a fixed or stationary sign, they cannot be installed within 5 ft of the inside walls of the fountain.

(D) Disconnect. Either the sign disconnect must be within sight of the sign or the disconnecting means must be capable of being locked in the open position, in accordance with 600.6 and 680.12.

680.58 GFCI-Protected Receptacles. GFCI protection is required for all 15 and 20A, 125V through 250V, receptacles located within 20 ft of the inside walls of a fountain. Figure 680-32

PART VII. HYDROMASSAGE BATHTUBS

680.70 Protection. A hydromassage bathtub, which is a permanently installed bathtub equipped with a recirculating piping system designed to accept, circulate, and discharge water upon each use, isn't required to comply with the other parts of this article.

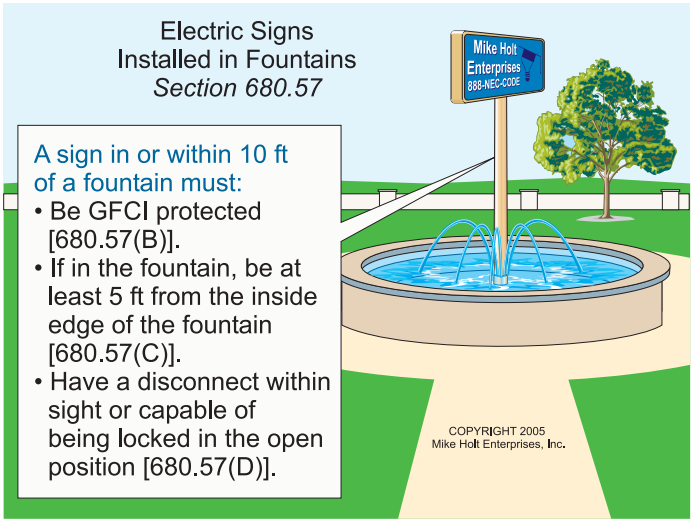


Figure 680–31

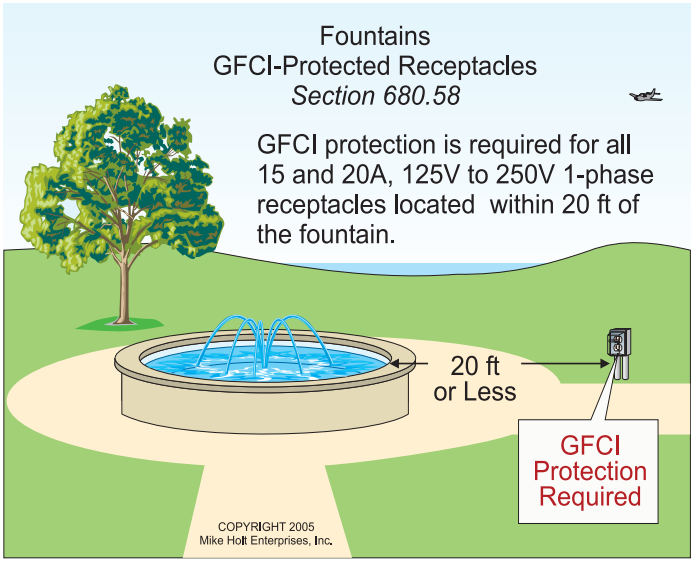
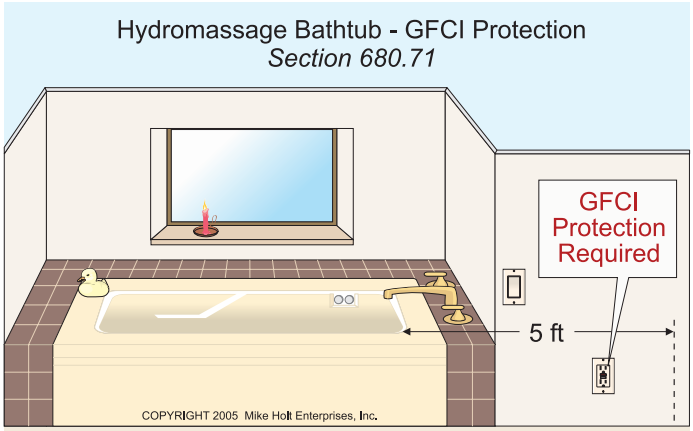


Figure 680–32



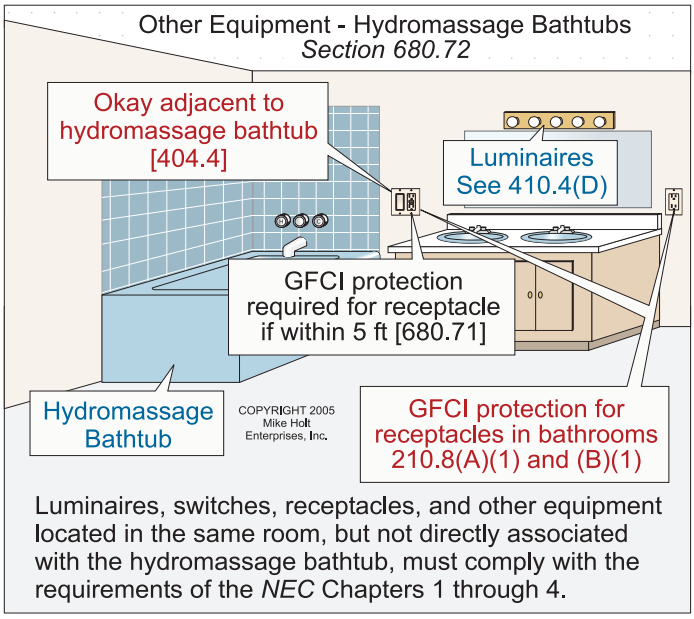
The electrical components of a hydromassage bathtub and all 125V receptacles within 5 ft must be GFCI protected.

Figure 680–33

680.71 Other Electric Equipment. Hydromassage bathtubs and their associated electrical components must be GFCI protected. In addition, GFCI protection is required for all receptacles rated 30A or less at 125V located within 5 ft of the inside walls of a hydromassage tub. Figure 680-33

680.72 Other Electrical Equipment. Luminaires, switches, receptacles, and other electrical equipment located in the same room and not directly associated with a hydromassage bathtub must be installed in accordance with Chapters 1 through 4.

Author's Comment: A hydromassage bathtub is treated like a regular bathtub. For example, a 5 ft clearance isn't required for switches or receptacles, and the fixtures must be installed in accordance with 410.4(D). Figure 680-34



Luminaires, switches, receptacles, and other equipment located in the same room, but not directly associated with the hydromassage bathtub, must comply with the requirements of the *NEC* Chapters 1 through 4.

Figure 680–34

680.73 Accessibility. Electrical equipment for hydromassage bathtubs must be capable of being removed or exposed without damaging the building structure or finish.

680.74 Bonding. All metal piping systems and grounded metal parts in contact with the circulating water must be bonded together using a solid copper bonding jumper not smaller than 8 AWG.