Session: IAEI Swimming Pool Requirements Based on Chapter 42, 2018 IRC

Swimming Pools and Similar Installations for Dwelling Units

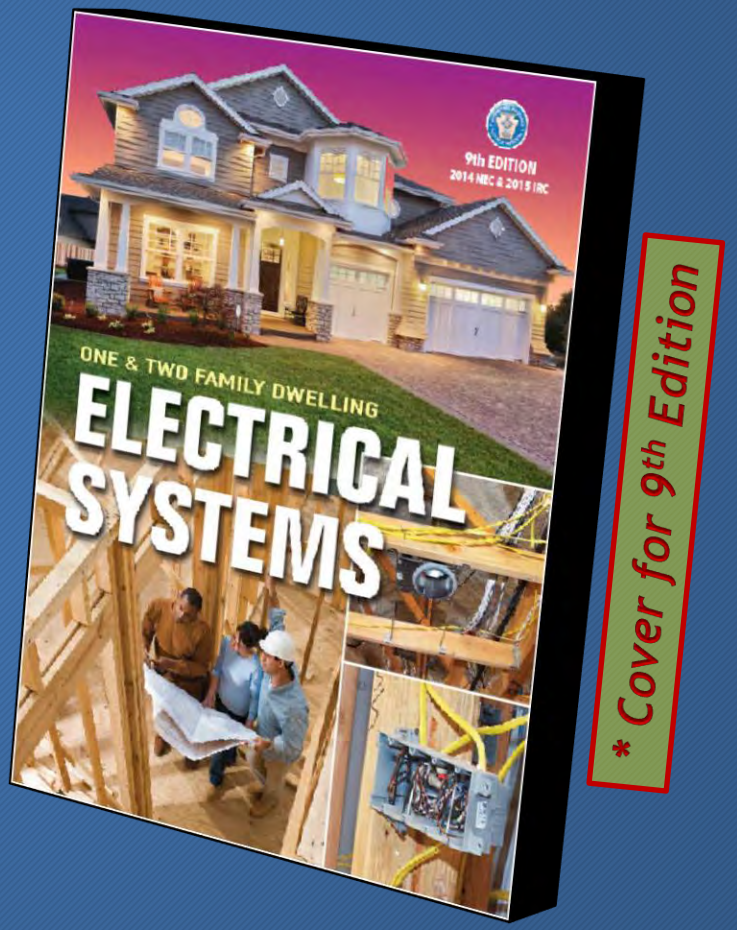
2018 IRC

Training Presentation by:

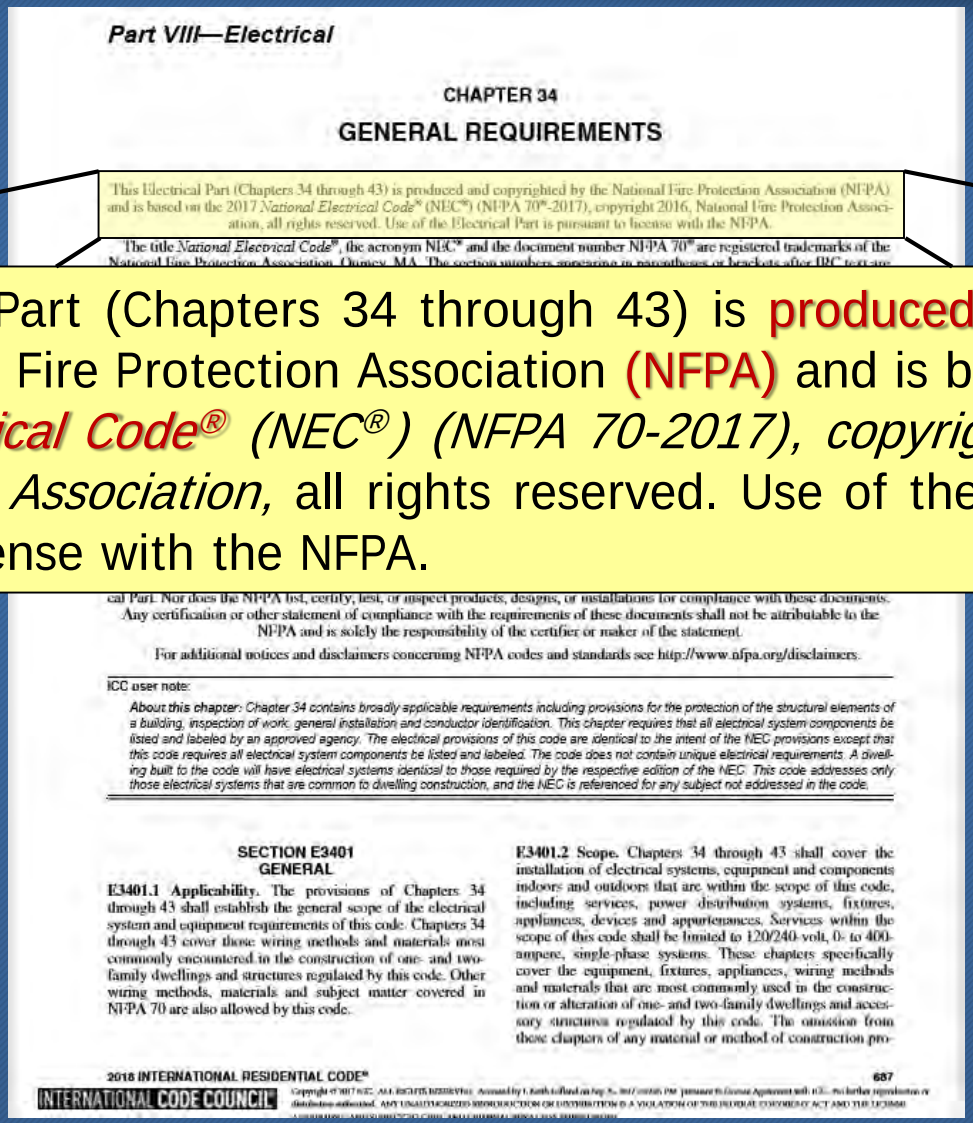
International Association of Electrical Inspectors

One- and Two Family Dwelling Electrical Systems – 2017 *NEC*

- Presentation based on IAEI's *One- and Two-Family Dwelling Electrical Systems* , 10th edition textbook
- This textbook is based on the requirements contained the **2017 *NEC*** and the **2018 *IRC***



2018 IRC Part VIII - Electrical



Part VIII—Electrical

CHAPTER 34

GENERAL REQUIREMENTS

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ICC user note:

About this chapter: Chapter 34 contains broadly applicable requirements including provisions for the protection of the structural elements of a building, inspection of work, general installation and conductor identification. This chapter requires that all electrical system components be listed and labeled by an approved agency. The electrical provisions of this code are identical to the intent of the NEC provisions except that this code requires all electrical system components be listed and labeled. The code does not contain unique electrical requirements. A dwelling built to the code will have electrical systems identical to those required by the respective edition of the NEC. This code addresses only those electrical systems that are common to dwelling construction, and the NEC is referenced for any subject not addressed in the code.

SECTION E3401
GENERAL

E3401.1 Applicability. The provisions of Chapters 34 through 43 shall establish the general scope of the electrical system and equipment requirements of this code. Chapters 34 through 43 cover those wiring methods and materials most commonly encountered in the construction of one- and two-family dwellings and structures regulated by this code. Other wiring methods, materials and subject matter covered in NFPA 70 are also allowed by this code.

E3401.2 Scope. Chapters 34 through 43 shall cover the installation of electrical systems, equipment and components indoors and outdoors that are within the scope of this code, including services, power distribution systems, fixtures, appliances, devices and appurtenances. Services within the scope of this code shall be limited to 120/240-volt, 0- to 400-ampere, single-phase systems. These chapters specifically cover the equipment, fixtures, appliances, wiring methods and materials that are most commonly used in the construction or alteration of one- and two-family dwellings and accessory structures regulated by this code. The omission from these chapters of any material or method of construction pro-

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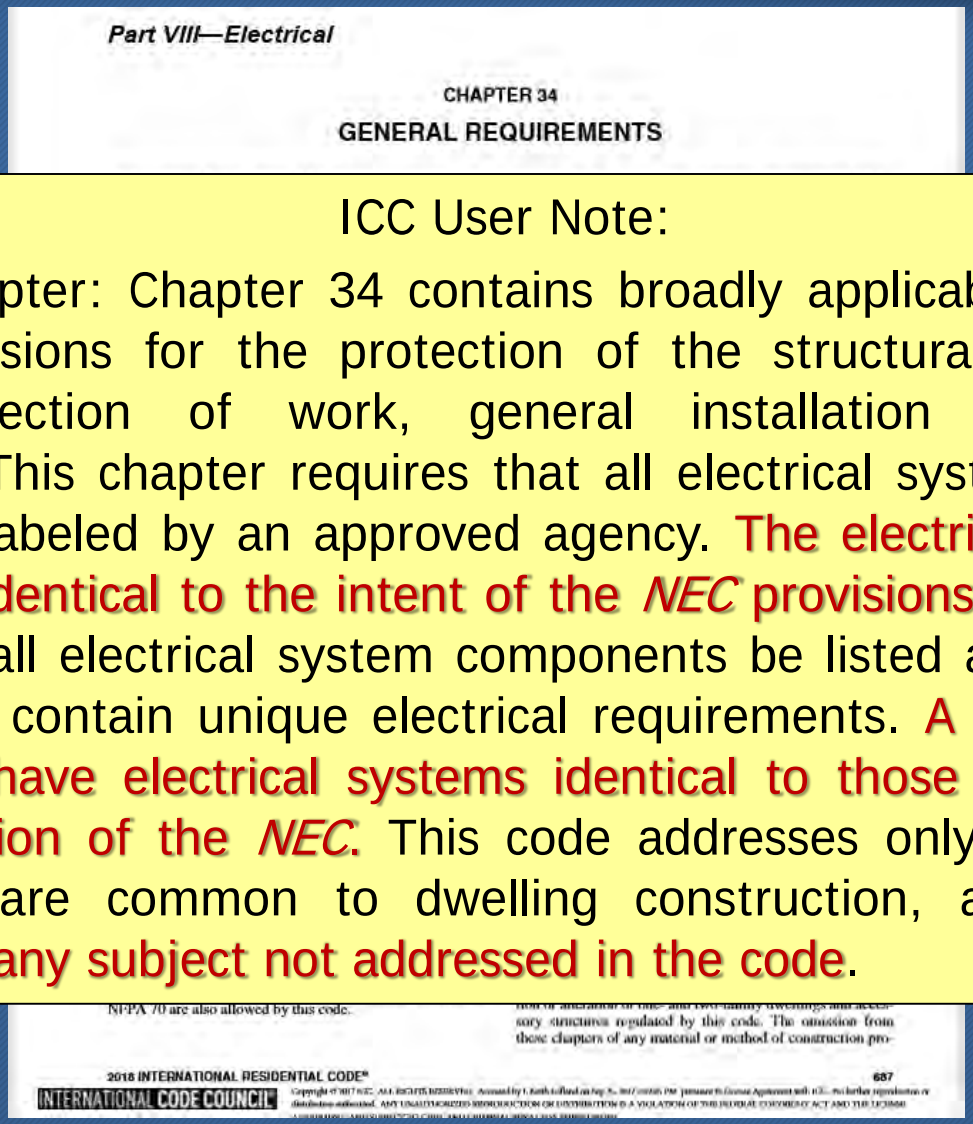
Part VIII—Electrical

CHAPTER 34

GENERAL REQUIREMENTS

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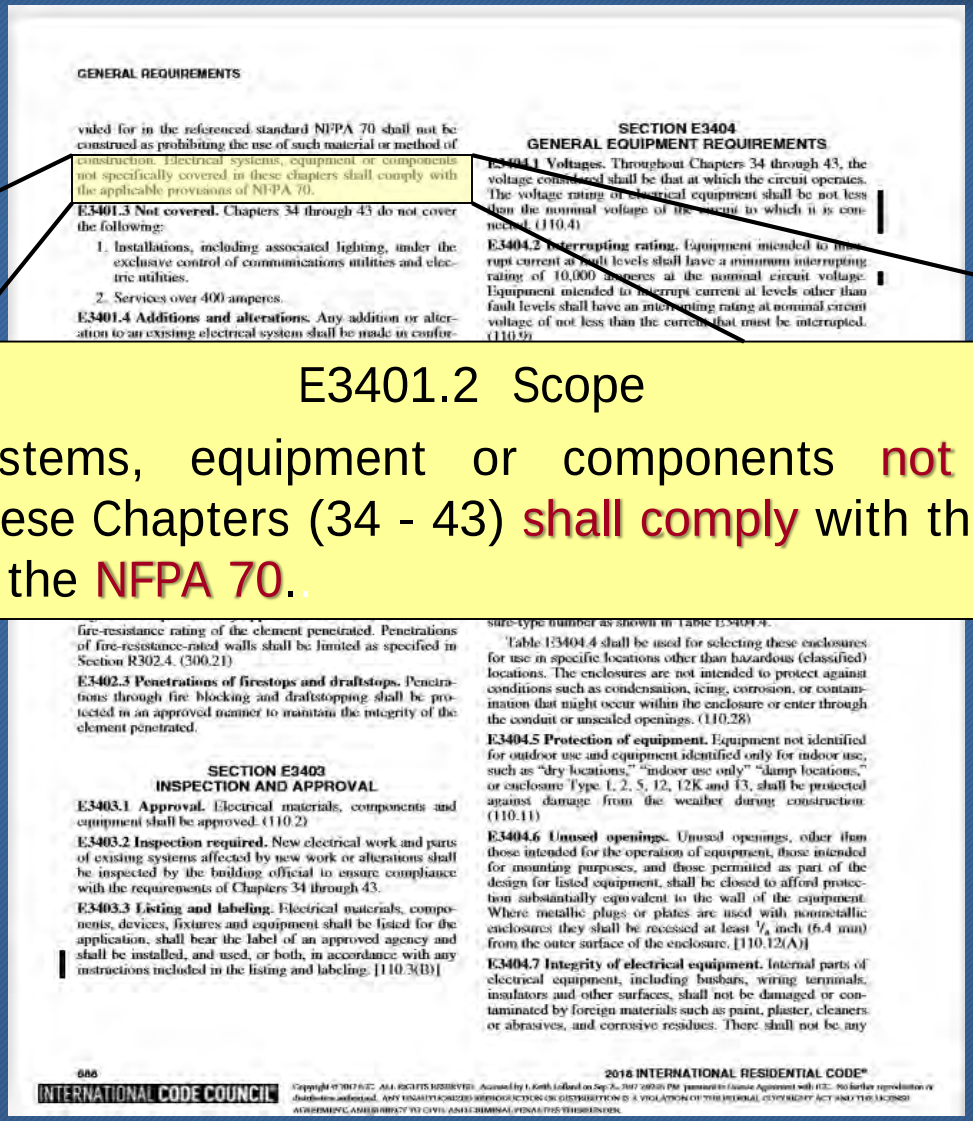
2018 IRC Part VIII - Electrical



GENERAL REQUIREMENTS

vided for in the referenced standard NFPA 70 shall not be construed as prohibiting the use of such material or method of construction. Electrical systems, equipment or components not specifically covered in these chapters shall comply with the applicable provisions of NFPA 70.

E3401.3 Not covered. Chapters 34 through 43 do not cover the following:

1. Installations, including associated lighting, under the exclusive control of communications utilities and electric utilities.
2. Services over 400 amperes.

E3401.4 Additions and alterations. Any addition or alteration to an existing electrical system shall be made in confor-

SECTION E3404
GENERAL EQUIPMENT REQUIREMENTS

E3404.1 Voltages. Throughout Chapters 34 through 43, the voltage considered shall be that at which the circuit operates. The voltage rating of electrical equipment shall be not less than the nominal voltage of the circuit to which it is connected. (110.4)

E3404.2 Interrupting rating. Equipment intended to interrupt current at fault levels shall have a minimum interrupting rating of 10,000 amperes at the nominal circuit voltage. Equipment intended to interrupt current at levels other than fault levels shall have an interrupting rating at nominal circuit voltage of not less than the current that must be interrupted. (110.9)

fire-resistance rating of the element penetrated. Penetrations of fire-resistance-rated walls shall be limited as specified in Section R302.4. (300.21)

E3402.3 Penetrations of firestops and draftstops. Penetrations through fire blocking and draftstopping shall be protected in an approved manner to maintain the integrity of the element penetrated.

SECTION E3403
INSPECTION AND APPROVAL

E3403.1 Approval. Electrical materials, components and equipment shall be approved. (110.2)

E3403.2 Inspection required. New electrical work and parts of existing systems affected by new work or alterations shall be inspected by the building official to ensure compliance with the requirements of Chapters 34 through 43.

E3403.3 Listing and labeling. Electrical materials, components, devices, fixtures and equipment shall be listed for the application, shall bear the label of an approved agency and shall be installed, and used, or both, in accordance with any instructions included in the listing and labeling. [110.3(B)]

sure-type number as shown in Table E3404.4.

Table E3404.4 shall be used for selecting these enclosures for use in specific locations other than hazardous (classified) locations. The enclosures are not intended to protect against conditions such as condensation, icing, corrosion, or contamination that might occur within the enclosure or enter through the conduit or unsealed openings. (110.28)

E3404.5 Protection of equipment. Equipment not identified for outdoor use and equipment identified only for indoor use, such as "dry locations," "indoor use only" "damp locations," or enclosure Type 1, 2, 5, 12, 12K and 13, shall be protected against damage from the weather during construction. (110.11)

E3404.6 Unused openings. Unused openings, other than those intended for the operation of equipment, those intended for mounting purposes, and those permitted as part of the design for listed equipment, shall be closed to afford protection substantially equivalent to the wall of the equipment. Where metallic plugs or plates are used with nonmetallic enclosures they shall be recessed at least $^{1}/_{4}$ inch (6.4 mm) from the outer surface of the enclosure. [110.12(A)]

E3404.7 Integrity of electrical equipment. Internal parts of electrical equipment, including busbars, wiring terminals, insulators and other surfaces, shall not be damaged or contaminated by foreign materials such as paint, plaster, cleaners or abrasives, and corrosive residues. There shall not be any

E3401.2 Scope

Electrical systems, equipment or components not specifically covered in these Chapters (34 - 43) shall comply with the applicable provisions of the NFPA 70.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Volume IV
Chapter Fourteen

Swimming Pools and Other Similar Installations

IRC Chapter 42 Arrangement

E4201	General
E4202	Wiring Methods for Pools, Spas, Hot Tubs, and Hydromassage Bathtubs
E4203	Equipment Location and Clearances
E4204	Bonding
E4205	Grounding
E4206	Equipment Installation
E4207	Storable Swimming Pools, Storable Spas, and Storable Hot Tubs
E4208	Spas and Hot Tubs
E4209	Hydromassage Bathtubs

NEC Article 680

NEC Article 680 Arrangement

Part I	General
Part II	Permanently Installed Pools
Part III	Storable Pools Storable Spas, and Storable Hot Tubs
Part IV	Spas and Hot Tubs
Part V	Fountains
Part VI	Pools for Therapeutic Use
Part VII	Hydromassage Bathtubs
Part VIII	Electrically Powered Pool Lifts

Note: NEC Article 680 is written in a style where, for the most part, these Parts are stand-alone Parts

Applicable Definitions

- Several definitions unique to swimming pools, spas, hot tubs and other equipment are found in IRC Chapter 42 and *NEC* Article 680
- There are seventeen (17) definitions located at IRC E4201.2 and twenty-four (24) definitions found at *NEC* 680.2 used exclusively to these aquatic environments
- The definitions contained in the *Code* that precede the actual *Code* requirements can assist users with proper application of the appropriate rule to these types of installations and equipment

E4201.2 Definitions

- Cord- and Plug-Connected Lighting Assembly
- Dry-Niche Luminaire
- Electrically Powered Pool Lift *(see NEC 680.2)*
- Fixed *(as applied to equipment) (see NEC 680.2)*
- Forming Shell
- Fountain
- Hydromassage Bathtub
- Low Voltage Contact Limit
- Maximum Water Level
- No-Niche Luminaire
- Packaged Spa or Hot Tub Equipment Assembly

E4201.2 Definitions *(cont.)*

- Packaged Therapeutic Tub or Hydrotherapeutic Tank Equipment Assembly *(see NEC 680.2)*
- Permanently Installed Decorative Fountains and Reflection Pools
- Permanently Installed Swimming, Wading, Immersion, and Therapeutic Pools
- Pool
- Pool Cover, Electrically Operated
- Portable *(as applied to equipment) (see NEC 680.2)*
- Self-Contained Spa or Hot Tub
- Self-Contained Therapeutic Tubs or Hydrotherapeutic Tanks *(see NEC 680.2)*

E4201.2 Definitions *(cont.)*

- Spa or Hot Tubs
- Stationary *(as applied to equipment) (see NEC 680.2)*
- Storable Swimming, Wading, or Immersion Pools; or Storable/Portable Spas and Hot Tubs
- Through-Wall Lighting Assembly
- Wet-Niche Luminaire

E4201.2 Definitions

- **Dry-niche Luminaire.** "A luminaire intended for installation in the wall of a pool or fountain in a niche that is sealed against the entry of pool water."
- **No-niche Luminaire.** "A luminaire intended for installation above or below the water without a niche."
- **Wet-Niche Luminaire.** "A luminaire intended for installation in a forming shell mounted in a pool or fountain structure where the luminaire will be completely surrounded by water."

E4201.2 Definitions *(cont.)*

- **Fixed *(as applied to equipment)*.** "Equipment that is fastened or otherwise secured at a specific location." *(NEC 680.2)*
- **Portable *(as applied to equipment)*.** "Equipment that is actually moved or can easily be moved from one place to another in normal use." *(NEC 680.2)*
- **Stationary *(as applied to equipment)*.** "Equipment that is not easily moved from one place to another in normal use." *(NEC 680.2)*
- **Cord-and-Plug-Connected Lighting Assembly.** "A lighting assembly consisting of a luminaire (lighting fixture) intended for installation in the wall of a spa, hot tub, or storable pool, and a cord-and-plug-connected transformer."

E4201.2 Definitions *(cont.)*

- **Electrically Powered Pool Lift.** "An electrically powered lift that provides accessibility to and from a pool or spa for people with disabilities." *(NEC 680.2)*
- **Forming Shell.** "A structure designed to support a wet-niche luminaire assembly and intended for mounting in a pool or fountain structure."
- **Hydromassage Bathtub.** "A permanently installed bathtub equipped with a recirculation piping system, pump, and associated equipment. It is designed so it can accept, circulate, and discharge water upon each use."

E4201.2 Definitions *(cont.)*

- **Low Voltage Contact Limit.** "A voltage not exceeding the following values:
  - (1) 15 volts (RMS) for sinusoidal ac
  - (2) 21.2 volts peak for nonsinusoidal ac
  - (3) 30 volts for continuous dc
  - (4) 12.4 volts peak for dc that is interrupted at a rate of 10 to 200 Hz"

E4201.2 Definitions *(cont.)*

- **Maximum Water Level.** "The highest level that water can reach before it spills out."
- **Permanently Installed Swimming, Wading, Immersion, and Therapeutic Pools.** "Those that are constructed in the ground or partially in the ground, and all others capable of holding water in a depth greater than 1.0 m (42 in.), and all pools installed inside of a building, regardless of water depth, whether or not served by electrical circuits of any nature."
- **Pool.** "Manufactured or field-constructed equipment designed to contain water on a permanent or semipermanent basis and used for swimming, wading, immersion, or therapeutic purposes."

NEC 680.2 Definitions

E4201.2 Definitions *(cont.)*

- **Self-Contained Spa or Hot Tub.** "Factory-fabricated unit consisting of a spa or hot tub vessel with all water-circulating, heating, and control equipment integral to the unit. Equipment may (can) include pumps, air blowers, heaters, lights, controls, sanitizer generators, and so forth."
- **Packaged Spa or Hot Tub Equipment Assembly.** "A factory-fabricated unit consisting of water-circulating, heating, and control equipment mounted on a common base, intended to operate a spa or hot tub. Equipment may include pumps, air blowers, heaters, lights, controls, sanitizer generators, and so forth."

E4201.2 Definitions *(cont.)*

- **Spa or Hot Tub.** "A hydromassage pool, or tub for recreational or therapeutic use, not located in health care facilities, designed for immersion of users, and usually having a filter, heater, and motor-driven blower.
- It may be installed indoors or outdoors, on the ground or supporting structure, or in the ground or supporting structure.
- Generally, a spa or hot tub is not designed or intended to have its contents drained or discharged after each use."

E4201.2 Definitions *(cont.)*

- **Storable Swimming, Wading, or Immersion Pool; or Storable/Portable Spas and Hot Tubs.** "Swimming, wading, or immersion pools that are intended to be stored when not in use, constructed on or above the ground and are capable of holding water to a maximum depth of 42 inches (1067 mm), or a pool, spa, or hot tub constructed on or above the ground, with nonmetallic, molded polymeric walls or inflatable fabric walls regardless of dimension."

- **Through-Wall Lighting Assembly.** "A lighting assembly intended for installation above grade, on or through the wall of a pool, consisting of two interconnected groups of components separated by the pool wall."

NEC 680.2 Definitions

E4201.1 Scope

- Chapter 42 shall apply to the construction and installation of electric wiring for, and equipment in or adjacent to, all **swimming pools, wading pools, therapeutic and decorative pools, fountains, hot tubs and spas, and hydromassage bathtubs**, whether permanently installed or storable
- Chapter 42 shall also apply to metallic auxiliary equipment, such as **pumps, filters, and similar equipment**
- The term **"body of water"** *(used in the NEC)* applies to all bodies of water covered in this scope unless otherwise amended

NEC 680.1

Sections of Chapter 42

- Sections E4202 through E4206 provide general rules for permanently installed pools, spas and hot tubs
- Section E4207 provides specific rules for storable pools, and storable/portable spas and hot tubs
- Section E4208 provides specific rules for spas and hot tubs
- Section E4209 provides specific rules for hydromassage bathtubs
- *NEC* provisions will need to be addressed for permanently installed fountains *(NEC Article 680, Part V)* and electrically powered pool lifts *(NEC Article 680, Part VIII)*

Ground-Fault Circuit Interrupters

- Chapter 42 contains numerous specific requirements for **ground-fault circuit interrupters (GFCI)** for swimming pools, etc.
- Required for equipment such as:
  - Receptacles
  - Luminaires
  - Motors
- GFCIs can be:
  - Self-contained units
  - Circuit breaker type
  - Receptacle type
- Note: *See Chapter 35 for definition of* Ground-Fault Circuit Interrupter *(Class A device – 4 to 6 mA)*

IRC Chapter 42 – GFCI Requirements

• Pool Pump Motors	E4203.1.4 680.21(C)
• Receptacles-Circulation and Sanitation System	E4203.1.1 680.22(A)(2)
• Receptacles-Outdoor Pools, Spas & Hot Tubs	E4203.1.4 680.22(A)(4)
• Luminaires, Ceiling Fans - Indoor Clearances	E4203.4.2 680.22(B)(2)
• Luminaires, Ceiling Fans - Existing Installations	E4203.4.4 680.22(B)(3)
• Luminaires, Ceiling Fans - Pools	E4203.4.6 680.22(B)(4)
• Lamping, Relamping, and Servicing	E4206.4 680.23(A)(3)

IRC Chapter 42 – GFCI Requirements

• Underwater Luminaires *(First GFCI Requirement in NEC)*	E4206.4 680.23(A)(8)
• Conductors on Load Side of GFCI for Underwater Luminaire Conductors	E4206.3 680.23(F)(3)
• Enclosures for Underwater Forming Shell	E4206.9.2 680.24(B)
• Pool Cover Equipment	E4206.11 680.27(B)(2)
• Gas-Fired Water Heater	*(NEC Default)* 680.28
• Storable Pool, Spa, or Hot Tub Pump Motor	E4207.1 680.31
• Storable Pool , Spa, or Hot Tub Receptacles/Equipment	E4207.2 680.32

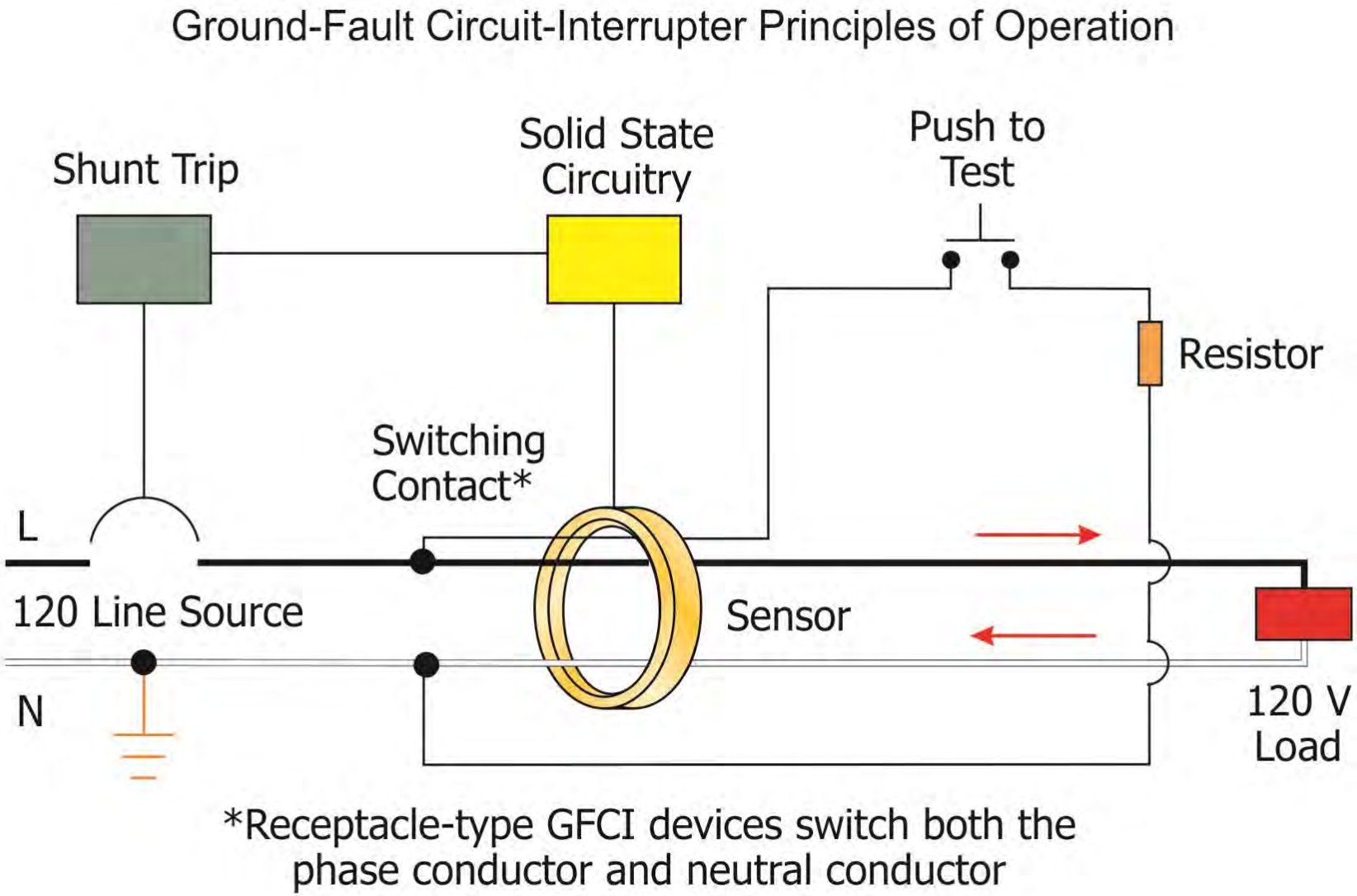
IRC Chapter 42 – GFCI Requirements

• Luminaires - Storable Pools , Spa, or Hot Tub	E4207.3.2 680.33(B)
• Outdoor Spas & Hot Tubs (Cord-n-Plug)	E4202.3.3 680.42(A)(2)
• Receptacles - Indoor Spas & Hot Tubs	E4203.1.6 680.43(A)(2)
• Outlets that Supply Indoor Spas or Hot Tubs	E4208.1 680.43(A)(3)
• Luminaires, Ceiling Fans - Spa And Hot Tubs	E4203.4.2 680.43(B)(1)
• Self-Contained or Packaged Spa or Hot Tubs	E4208.1 680.44
• Field-Assembled Spas and Hot Tubs	E4208.1 680.44(B)

IRC Chapter 42 – GFCI Requirements

• Fountains (Luminaires)	*(NEC Default)* 680.51(A)
• Fountains (Cord-n-Plug Connected Equipment)	*(NEC Default)* 680.56(A)
• Signs (in or Adjacent to Fountains)	*(NEC Default)* 680.57(B)
• Fountains - Adjacent Receptacles	*(NEC Default)* 680.58
• Therapeutic Pools and Tubs (Outlet Supplied)	*(NEC Default)* 680.62(A)
• Receptacles - Therapeutic Pools and Tubs	*(NEC Default)* 680.62(E)
• Hydromassage Bathtubs	E4209.2 680.71
• Electrically Powered Pool Lifts	*(NEC Default)* 680.82

GFCI Principles of Operation



PUSH
TO
TEST
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Quality In
Name:
Phone #

Class A GFCI Receptacle Outlet Device

GFCI Requirements for Swimming Pools

- IRC Chapter 42 contains numerous specific requirements for **ground-fault circuit interrupters** for swimming pools
- Conductors that supply pool equipment, such as heaters, that do not have GFCI-protection generally cannot be installed in the same conduits, boxes or other enclosures that contain conductors having GFCI protection that supply underwater luminaires unless…
  - Specific conditions of E4206.3 apply

NEC 680.23(F)(3)

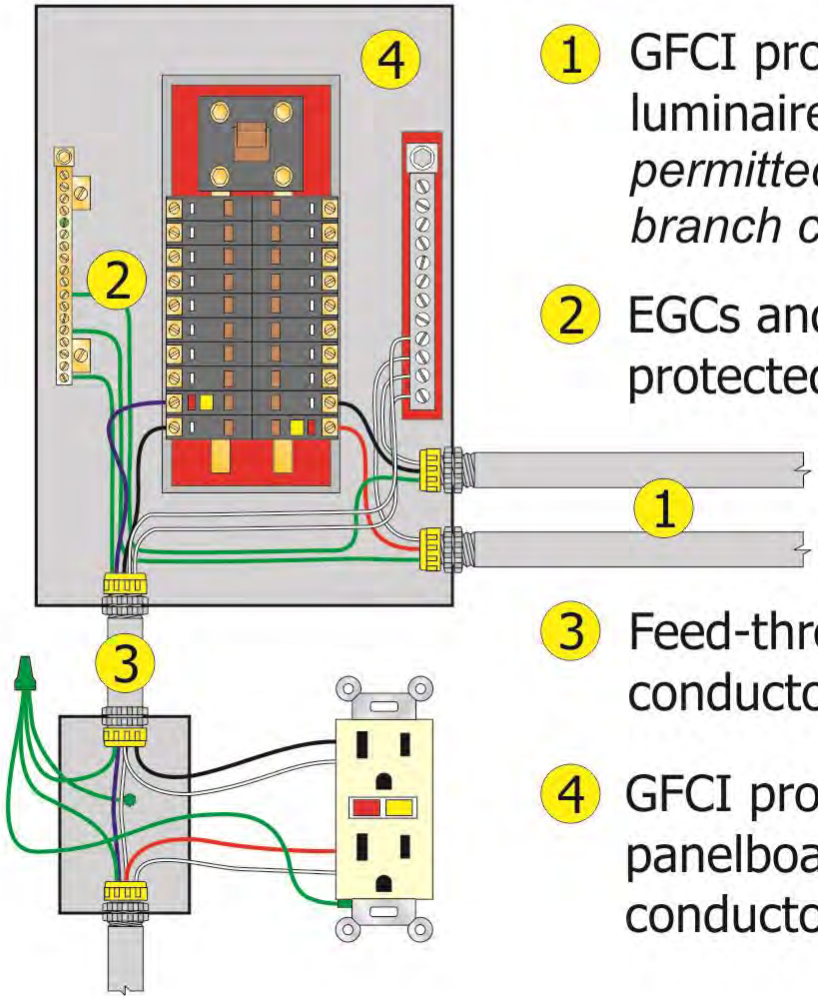
GFCI Requirements for Swimming Pools *(cont.)*

- E4206.3 permits non-GFCI protected conductors to occupy raceway, boxes, or enclosures containing underwater luminaire GFCI protected conductors if one of the following applies:
  - GFCI protected conductors permitted in panelboard containing circuits protected by other than GFCI
  - Feed-through-type supply conductors to a GFCI device
  - GFCI protected conductors on load side of GFCI devices
  - Equipment grounding conductors and bonding jumpers are permitted to occupy the same raceway, box or enclosure
- Note: *The prohibition only applies to load-side GFCI or transformer conductors feeding an underwater luminaire*

NEC 680.23(F)(3)

E4206.3 GFCI-Protected Conductors

Non-GFCI protected conductors generally not permitted to occupy same raceways, boxes, or enclosure as GFCI protected conductors supply under-water luminaires unless one of the conditions below applies:



1. GFCI protected conductors to underwater luminaires *(other GFCI protected conductors permitted) (non-GFCI protected such as heater branch circuit conductors not permitted)*
2. EGCs and bonding jumpers permitted with GFCI protected conductors
   - *(To heater)*
   - *(To underwater luminaire)*
3. Feed-through-type non-GFCI protected supply conductors to GFCI device permitted
4. GFCI protected conductors permitted in panelboard with other non-GFCI protected conductors

NEC 680.23(F)(3)

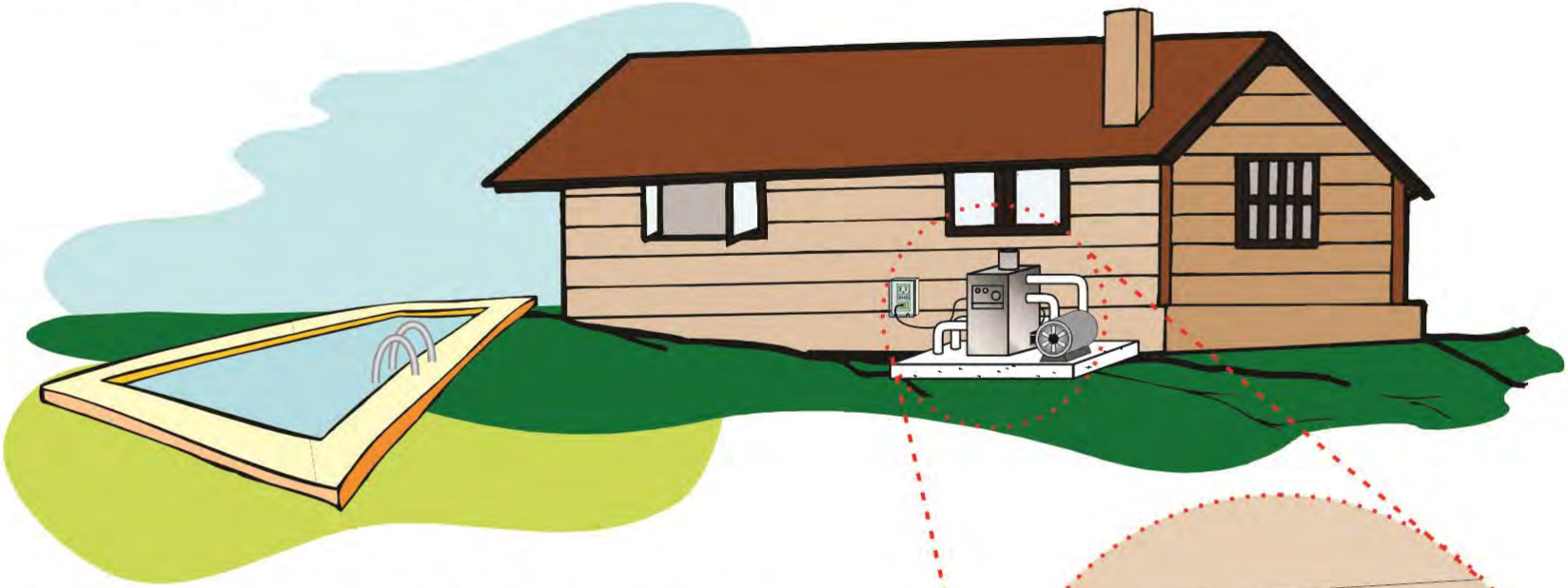
GFCI Requirements for Swimming Pool Pump Motors

- GFCI requirements for permanently installed pool pump motors have changed quite a lot over the last few *Code* cycles
- Today, all **outlets** supplying pool pump motors require ground-fault circuit-interrupter protection for motors:
  - Rated 120-volt through 240-volt
  - Single-phase, whether by **receptacle or direct connection**
- No minimum or maximum ampere rating associated with this GFCI requirement
- See IRC E4203.1.4

NEC 680.21(C)

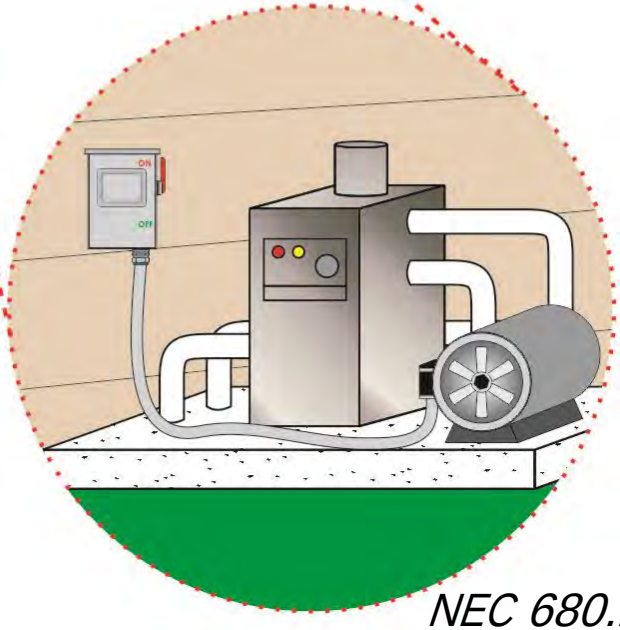
E4203.1.4 GFCI Protection for Pool Pump Motors

All single-phase, 120 volt through 240 volt outlets supplying pool pump motors require GFCI protection



Outlets supplying pool pump motors require GFCI protection under the following conditions:

- 120 volt through 240 volt
- Single phase
- Receptacle or direct connection
- Regardless of location
- Regardless of ampacity



NEC 680.21(C)

E4205.1 Grounding of Electrical Equipment

- Electrical equipment associated with bodies of water such pools, spas, hot tubs and hydromassage bathtubs must be grounded as well as bonded
- Grounding and bonding serve two different functions
- Equipment grounding conductor(s) are used to ground equipment and serves the following functions:
  - Provides a reference to ground for metal parts and equipment
  - Provides a low-impedance path for fault current to return to the source and facilitate overcurrent device operation in clearing a fault

NEC 680.6

E4205.1 Grounding of Electrical Equipment *(cont.)*

- The following equipment is required to be specifically grounded:
  - Through-wall lighting assemblies and underwater luminaries (*Some listed low-voltage lighting products not required to be grounded*)
  - Electrical equipment within 1.5 m (5 ft.) of water
  - Recirculating system electrical equipment
  - Junction boxes
  - Transformer and power supply enclosures
  - GFCIs
  - Panelboards *(pool equipment)*

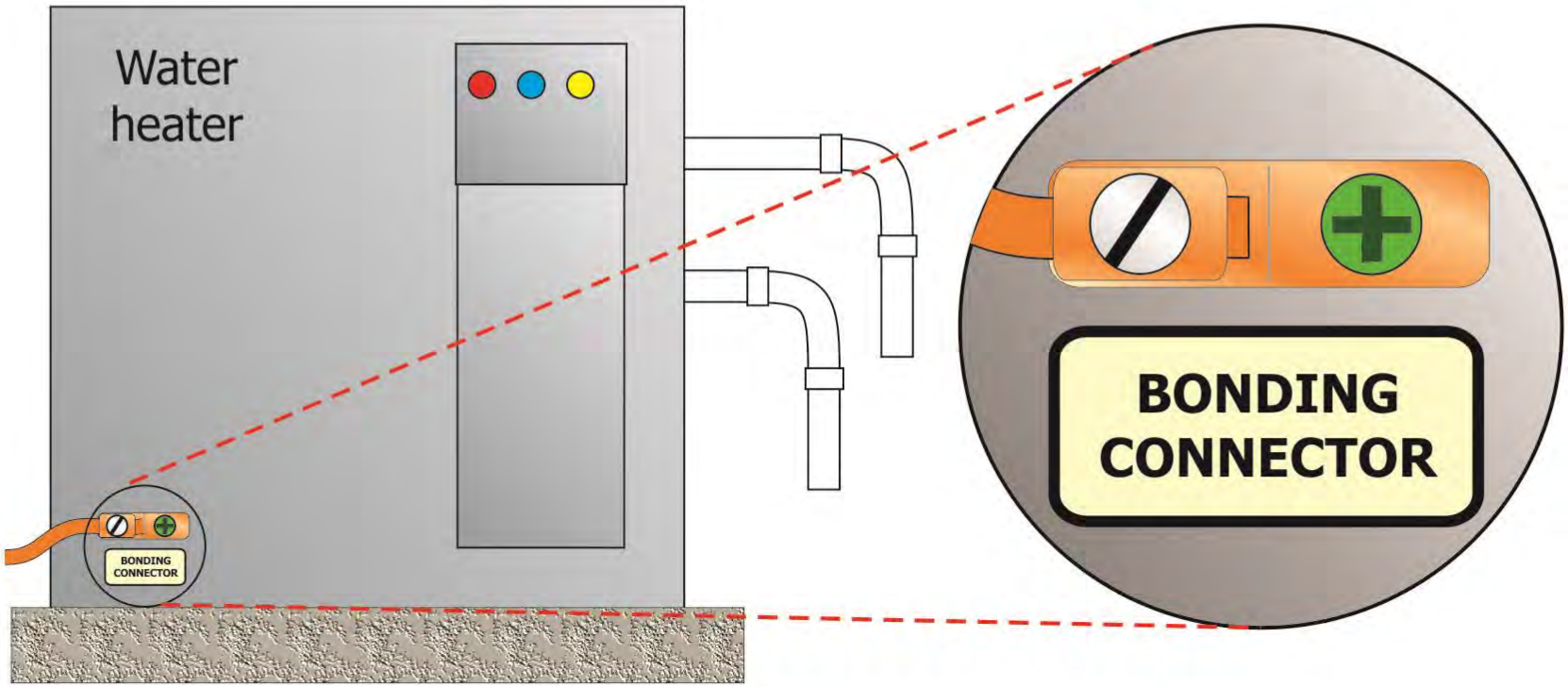
NEC 680.6

E4205.1 Grounding and Bonding Terminals

Grounding and bonding terminals shall be identified for use in wet and corrosive environments

Field-installed grounding and bonding connections in a damp, wet, or corrosive environment shall be composed of copper, copper alloy, or stainless steel

Grounding and bonding terminals shall be listed for direct burial use



NEC 680.7


Bonding Connector.
Connecteur de Raccordement.
Conector de Enlace.
472277

E4202.3 Cord-and-Plug-Connected Equipment

- **Fixed or stationary equipment** *(other than underwater luminaires)* for permanently installed pools permitted to be connected to the electrical supply by **flexible cord- and plug-connection**
- This allows for removal or disconnection during maintenance or repair operations
- **Underwater luminaires** for permanently installed pools are permitted to be supplied by a flexible cord, but **cannot be cord- and plug-connected**
- Length of a flexible cord in this application is limited to **900 mm (3 ft)** *(other than storable pools)*

NEC 680.8(A)

E4202.3 Cord-and-Plug-Connected Equipment *(cont.)*

- Flexible cords used with equipment are required to contain a **copper** equipment grounding conductor sized based on the rating of the overcurrent device but not smaller than a **12 AWG**
- EGC must terminate in a **grounding-type attachment plug**
- Only copper EGC permitted in this application
- These EGCs to be connected to a **fixed metal part** of the assembly
- If connected to a removable part, these removable parts must be mounted on or bonded to a fixed metal part

NEC 680.8(B) and (C)

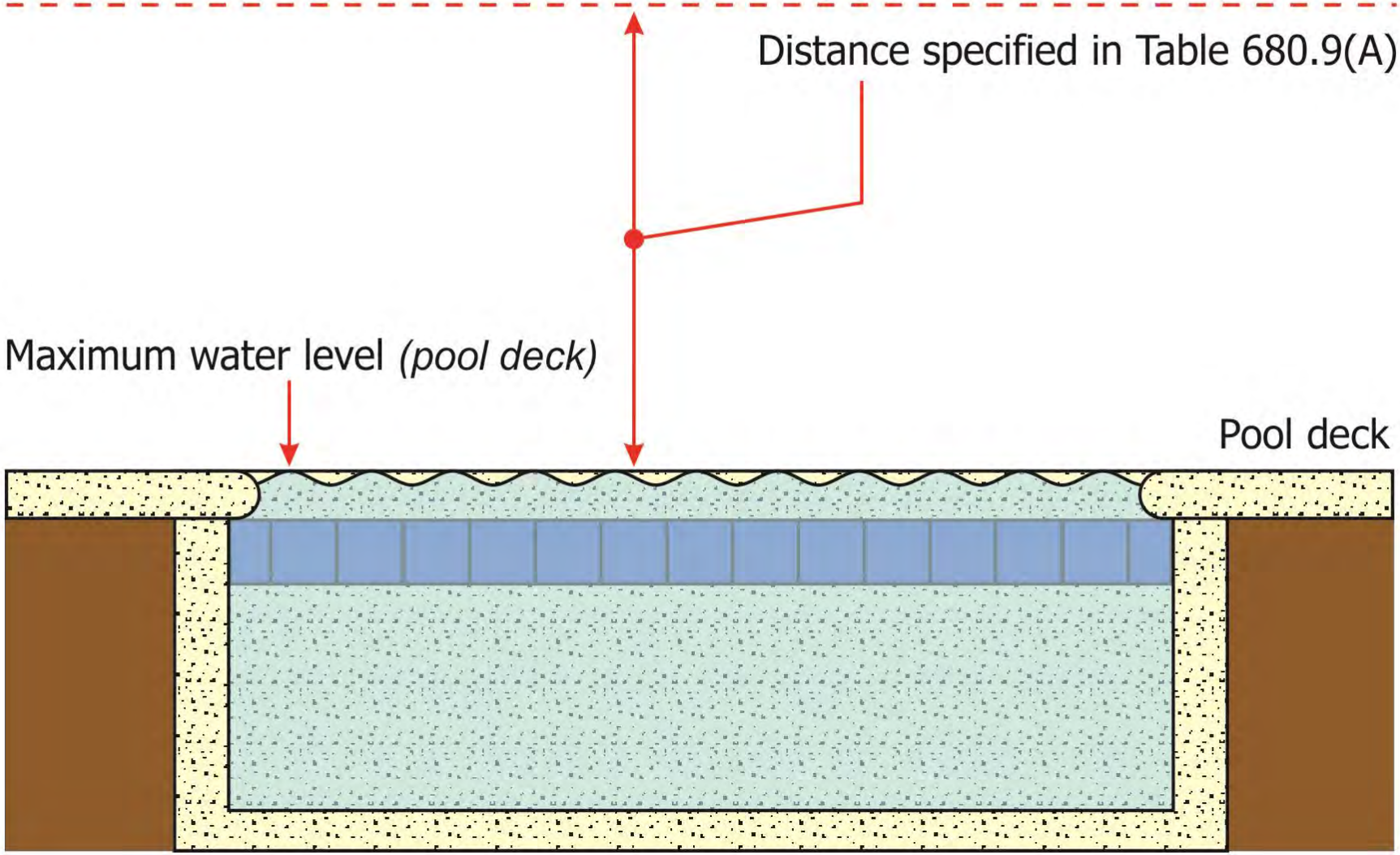
E4203.6 Overhead Conductor Clearances

- Overhead conductors installed over outdoor bodies of water (pools, spas, and hot tubs, etc.) must meet **minimum clearances** specified in IRC **Table E4203.6** and ***NEC* Figure 680.9(A)**
- Where a minimum clearance from the water level is specified, the measurement is taken from the **maximum water level** of the specified body of water
- Maximum water level is typically the deck *(not normal water level)*
- Clearances apply to existing service-drop conductors or any other open overhead wiring

NEC 680.9(A) and Table 680.9(A)

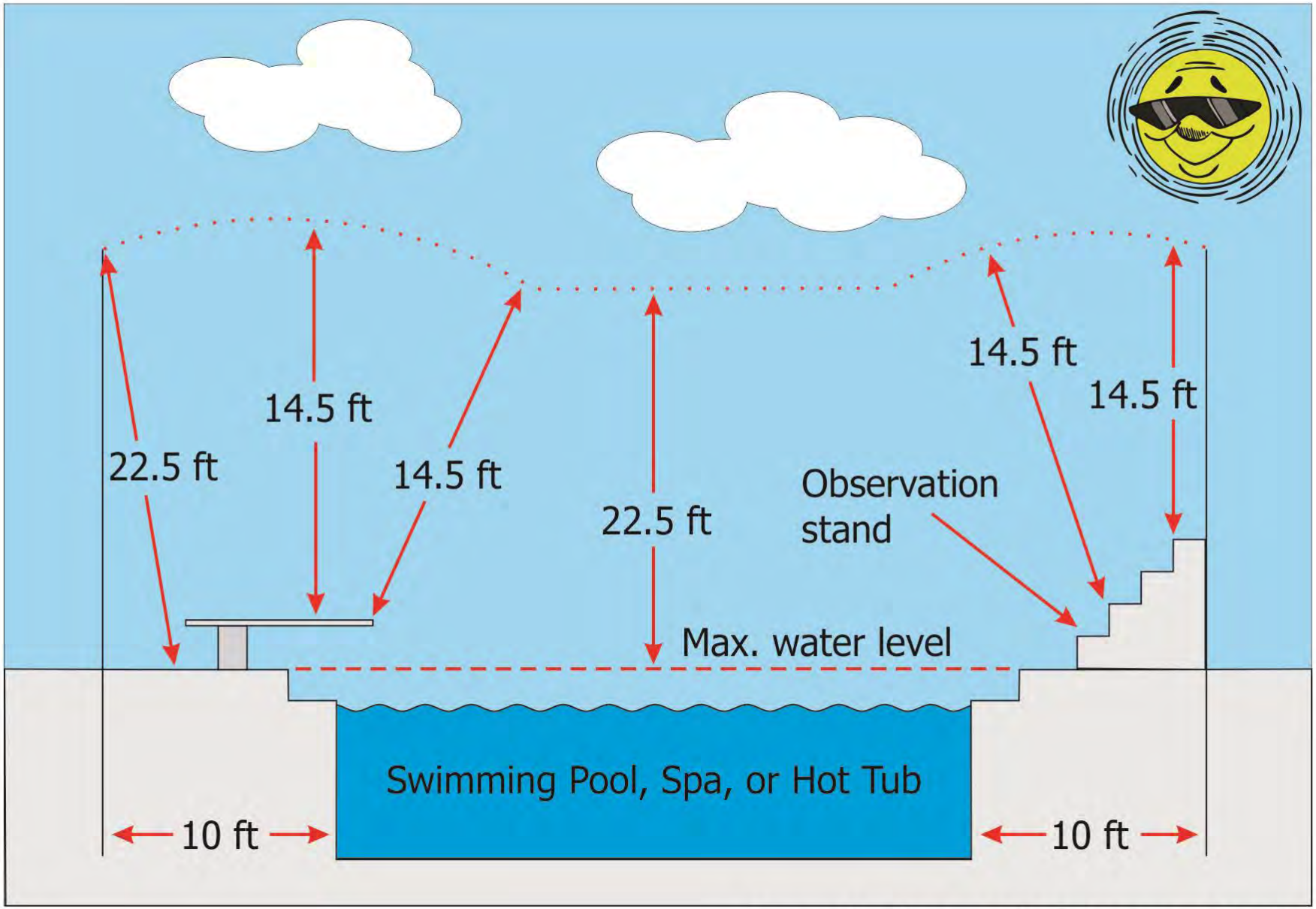
E4203.6 Overhead Conductor Clearances

Minimum clearances required by 680.9 shall be taken from the maximum water level of the specified body of water



NEC 680.9(A)

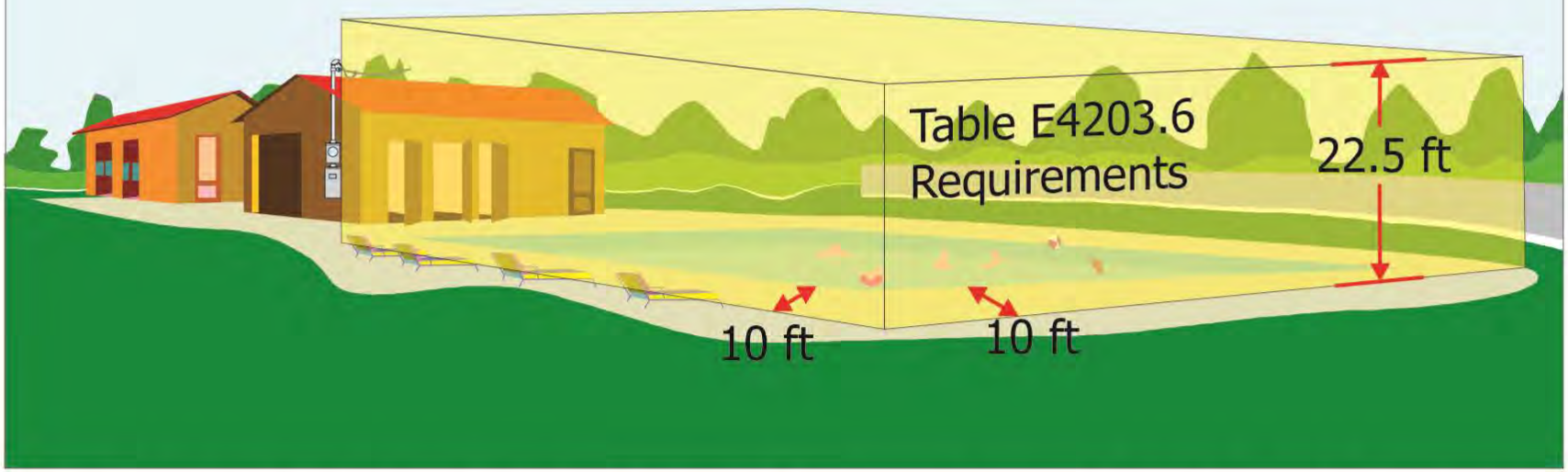
Overhead Clearances From Pool Structures



Reproduction of NEC Figure 680.9(A)

Table E4203.6 Overhead Conductor Clearances

Overhead wiring outside of the yellow shaded area must comply with IRC Chapter 36 *(NEC Chapter 2)* clearance requirements such as E3604.2.2 *[NEC 230.24(B)]*



Overhead service drops, overhead service conductors, open overhead wiring, etc. must comply with the clearance parameters of Table E4203.6 when this overhead wiring encroaches upon the space depicted in the yellow shading

NEC 680.8 and Table 680.8(A)

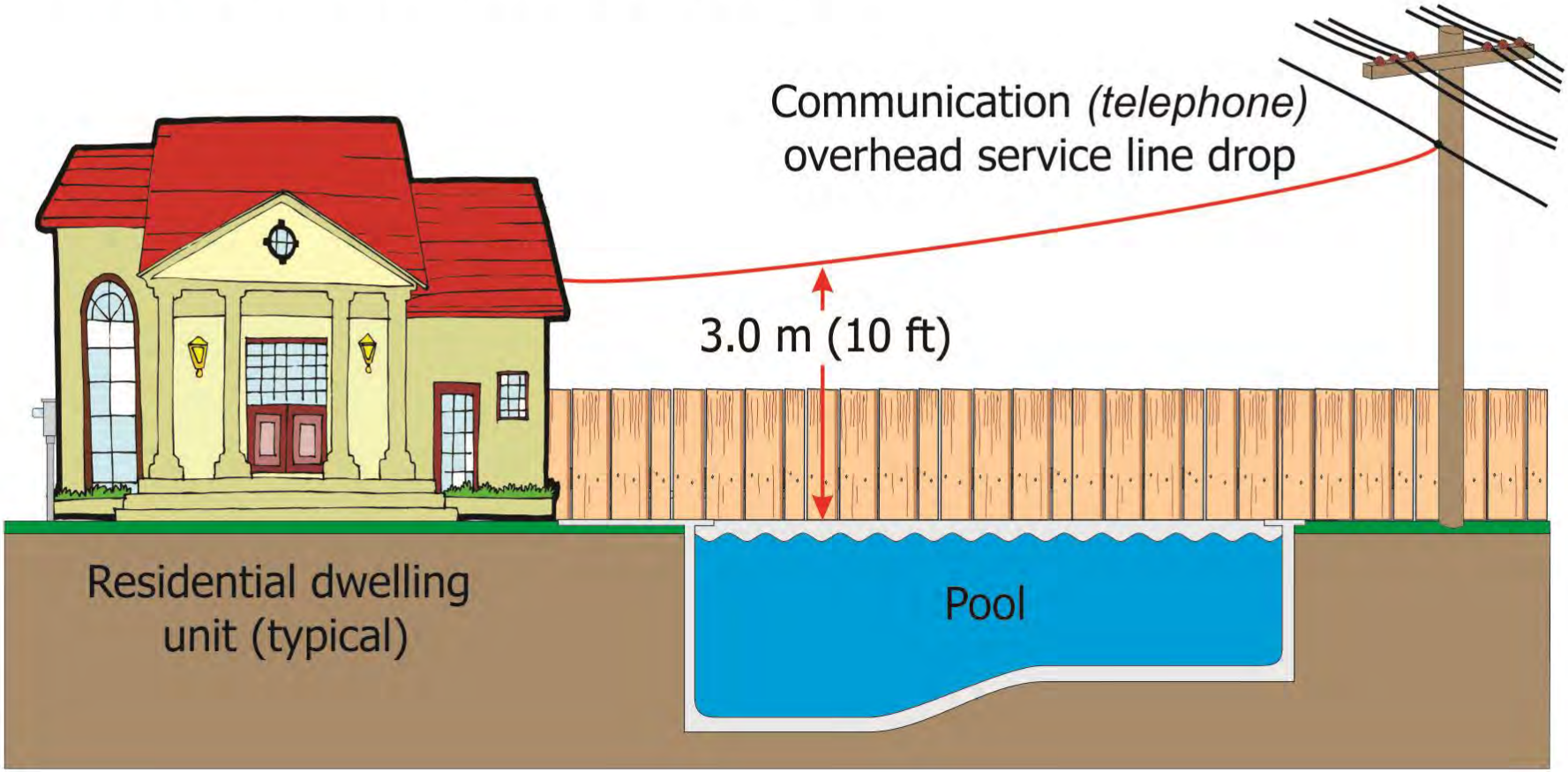
E4203.6 Overhead Conductor Clearances *(cont.)*

- **Communication conductors** *(community antenna systems, and radio and television coaxial cables)* and their supporting messengers must be installed at a height of at least **3.0 m (10 ft)** or more above swimming and wading pools, diving structures and observation stands, towers or platforms *[NEC 680.9(B)]*
- **Network-powered broadband communication cables** are treated as a power cable as far as overhead clearances are concerned
- NPBC cables are **current-carrying conductors** and must comply with applicable table heights under the **0–750 volts column** of *NEC* **Table E4203.6**

NEC 680.9(B) and (C) and Table 680.9(A)

E4203.6 Overhead Conductor Clearances for Communications Systems

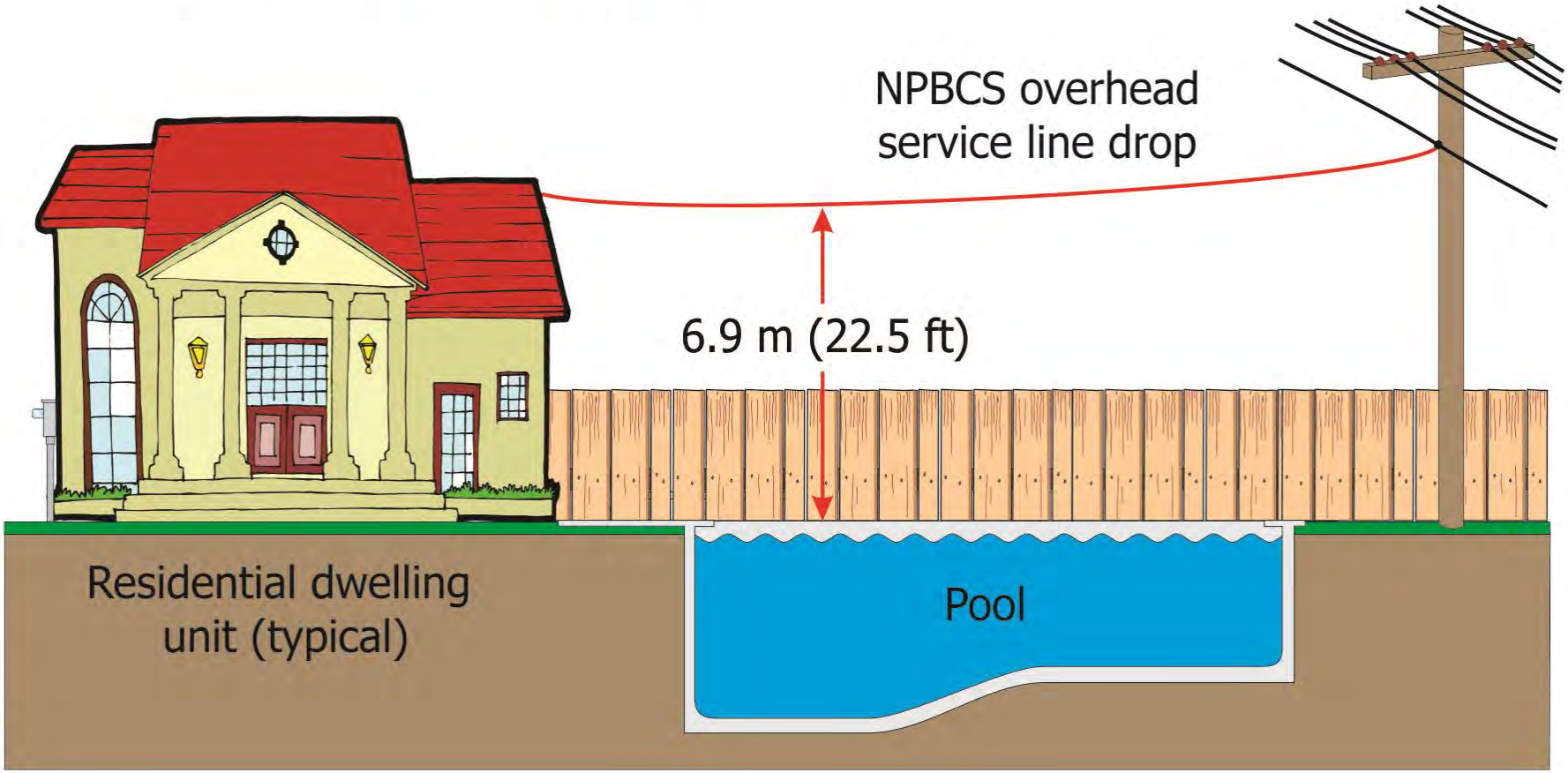
Communications, radio, and television coaxial cables within the scope of Articles 800 through 820 shall be permitted at a height of not less than 3.0 m (10 ft) above swimming and wading pools, diving structures, and observation stands, towers, or platforms



NEC 680.9(B)

E4203.6 Overhead Conductor Clearances for NPBC Systems

The minimum clearances for overhead network-powered broadband communications systems conductors from pools or fountains shall comply with the provisions in Table E4203.6 for conductors operating at 0 to 750 volts to ground [6.9 m (22.5 ft)]



NEC 680.9(C) and Table 680.9(A)

E4203.7
Underground Wiring Locations

- Requirements for wiring installed underground around swimming pools was **revised for the 2018 IRC**
- Revisions clarify that the wiring methods underground near pools must be installed in a manner to **withstand the conditions unique to the pool environment**
- Identified wiring methods in these underground areas around pools are:
  - Rigid metal conduit
  - Intermediate metal conduit
  - Rigid polyvinyl chloride (PVC) conduit
  - Reinforced thermosetting resin conduit
  - Type MC cable *(suitable for the environment)*

NEC 680.11

E4203.7
Underground Wiring Locations *(cont.)*

- Underground wiring now permitted to be installed in close proximity of the pool regardless of its location to the pool
  - No consideration needs to be given as to whether this wiring is "necessary to supply pool equipment" *(as previous Code text required)*
- Minimum burial depth cover requirements around pools must now comply with IRC **Table E3803.1** *(NEC Table 300.5)*
- Previous IRC **Table E4203.7** *(NEC Table 680.10)* for minimum cover depths around pools has been **deleted**
- Underground wiring is generally not permitted to be installed under a pool unless this wiring is necessary to supply pool equipment permitted by IRC Chapter 42 *(NEC Article 680)*

NEC 680.11

Pool Water Heaters

- **Electric pool water heating elements** are required to be subdivided into loads not exceeding **48 amperes**
- Overcurrent protection for these units must not be rated at more than **60 amperes**
- The branch-circuit conductor ampacity and the rating or setting of the overcurrent protective devices cannot be less than **125 percent** of the total load that is included on the water heater nameplate *(see IRC E4206.12)*
- Ground-fault circuit-interrupter **(GFCI)** protection is **not required** for **electric water heaters** as the risk of electric shock is considered adequately mitigated through the use of:
  - Proper grounding provisions *[see IRC E4205.1.3 or NEC 680.6(3)]*
  - Listing installation requirement for the use of **current collectors** on the input and output side of electric heaters

NEC 680.10

Pool Water Heaters *(cont.)*

- **Current collectors** prevent unacceptable levels of current in the pool in the event of corrosion of the immersed heating elements
- Circuits supplying **gas-fired swimming pool and spa water heaters** operating at voltages above the low-voltage contact limit are required to be provided with **GFCI protection** for personnel *(see NEC 680.28, not included in IRC)*
- Current collectors are not used with a gas-fired swimming pool heater
- 125-volt branch circuit to a gas-fired water heater is susceptible to a loss of current and a ground-fault condition as much as any other piece of electrical equipment

NEC 680.28


Pentair
MasterTemp 400

E4202.2 Corrosive Environment

- Swimming pool and spa equipment are often subject to **deteriorating chemicals** such as chlorine, especially in indoor electrical equipment rooms or pits
- Equipment and wiring methods in these locations are **subject to failure** due to this exposure to these corrosive chemicals
- Chlorine and other pool chemicals severely deteriorate electrical connections of conductors and **accelerate rust and deterioration** of metal parts of electrical pool equipment
- Chemicals are often **stored, mixed and dispensed** in the same room or area as the electrical equipment

NEC 680.14

E4202.2 Corrosive Environment *(cont.)*

- Areas where pool sanitation chemicals are stored, as well as areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations are areas identified as being considered to be a **corrosive environment**
- The **air** in such areas is also considered to be **laden with acid, chlorine, and bromine vapors**, or any combination of acid, chlorine, or bromine vapors
- Wiring methods in these corrosive areas are required to be listed and identified for use in such areas

NEC 680.14

E4202.2 Corrosive Environment *(cont.)*

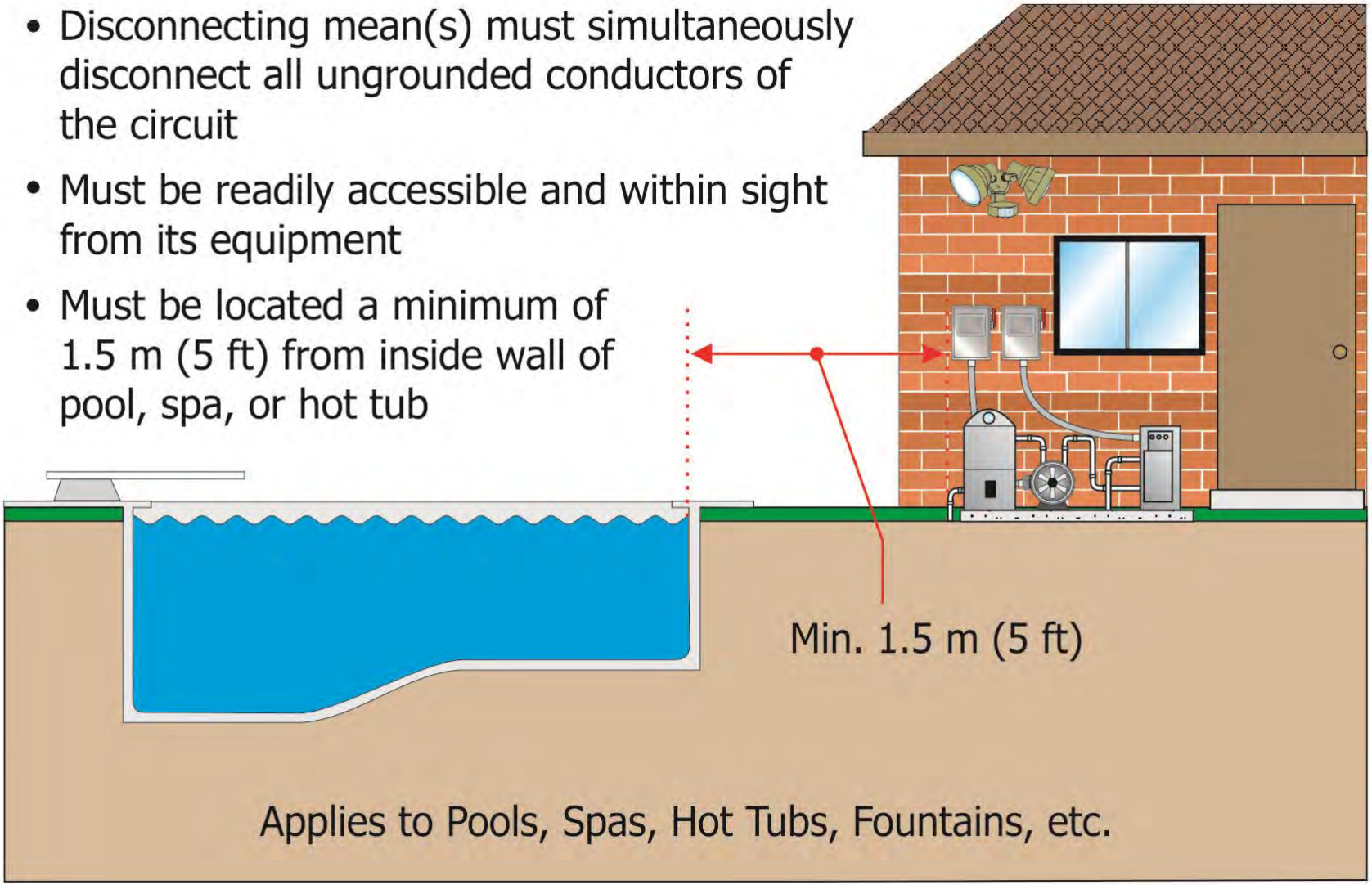
- Wiring methods considered to be resistant to these corrosive environments around pools and spas are:
  - Rigid metal conduit
  - Intermediate metal conduit
  - Rigid polyvinyl chloride (PVC) conduit
  - Reinforced thermosetting resin conduit
- IRC Table E4202.1 contains permitted wiring methods for corrosive environments along with locations and purposes for said wiring methods.

NEC 680.14

Photo courtesy of
David Williams, Michigan

E4203.3 Equipment Maintenance Disconnect(s)

- Disconnecting mean(s) must simultaneously disconnect all ungrounded conductors of the circuit
- Must be readily accessible and within sight from its equipment
- Must be located a minimum of 1.5 m (5 ft) from inside wall of pool, spa, or hot tub



NEC 680.13


Adequate Working
Space Provided?

Receptacle Locations for Permanently Installed Swimming Pools

- Receptacles that provide power for **circulation water-pump motors** are required to be:
  - Located at least **1.83 m (6 ft)** away from inside walls of pool
  - **Grounding type** receptacle
  - Ground-fault circuit interrupter **(GFCI)** protected
- See IRC E4203.1.1 [*NEC* 680.22(A)(2)]
- Where a flexible cord-and-attachment plug is used to connect a pump motor, the cord must meet the following:
  - Cord length is not permitted to exceed **900 mm (3 ft)**
  - Must include a **copper EGC** not smaller than **12 AWG**
  - Provided with a **grounding-type** attachment plug
- See IRC E4202.3.1

Receptacle Locations for Permanently Installed Swimming Pools *(cont.)*

- Receptacles *(or outlets)* that provide power for **circulation water-pump motors** rated **120-volt through 240-volt**, single-phase required to be:
  - GFCI protected
    - Regardless of the ampere rating
    - GFCI applies to cord- and plug-connected or hard-wired
- See IRC E4203.1.4

NEC 680.21(C)

Receptacle Locations for Permanently Installed Swimming Pools *(cont.)*

- For permanently installed pools, at least one 125-volt, 15- or 20-ampere receptacle must be installed in the vicinity of the pool
- This receptacle must be:
  - GFCI protected
  - On a general purpose branch circuit
  - Located not closer than **1.83 m (6 ft)** and not farther than **6.0 m (20 ft)** from the inside wall of the pool
  - Located not more than **2.0 m (6½ ft)** above the same floor, platform or grade on which the pool is installed
- Required receptacle applies whether the permanently installed pool is constructed at either a new or existing structures or dwelling unit(s)
- All 15- and 20-ampere, 125-volt receptacles located within **6.0 m (20 ft)** of the inside walls of a pool must be GFCI protected
- See IRC E4203.1, E4203.1.3, and E4203.1.4

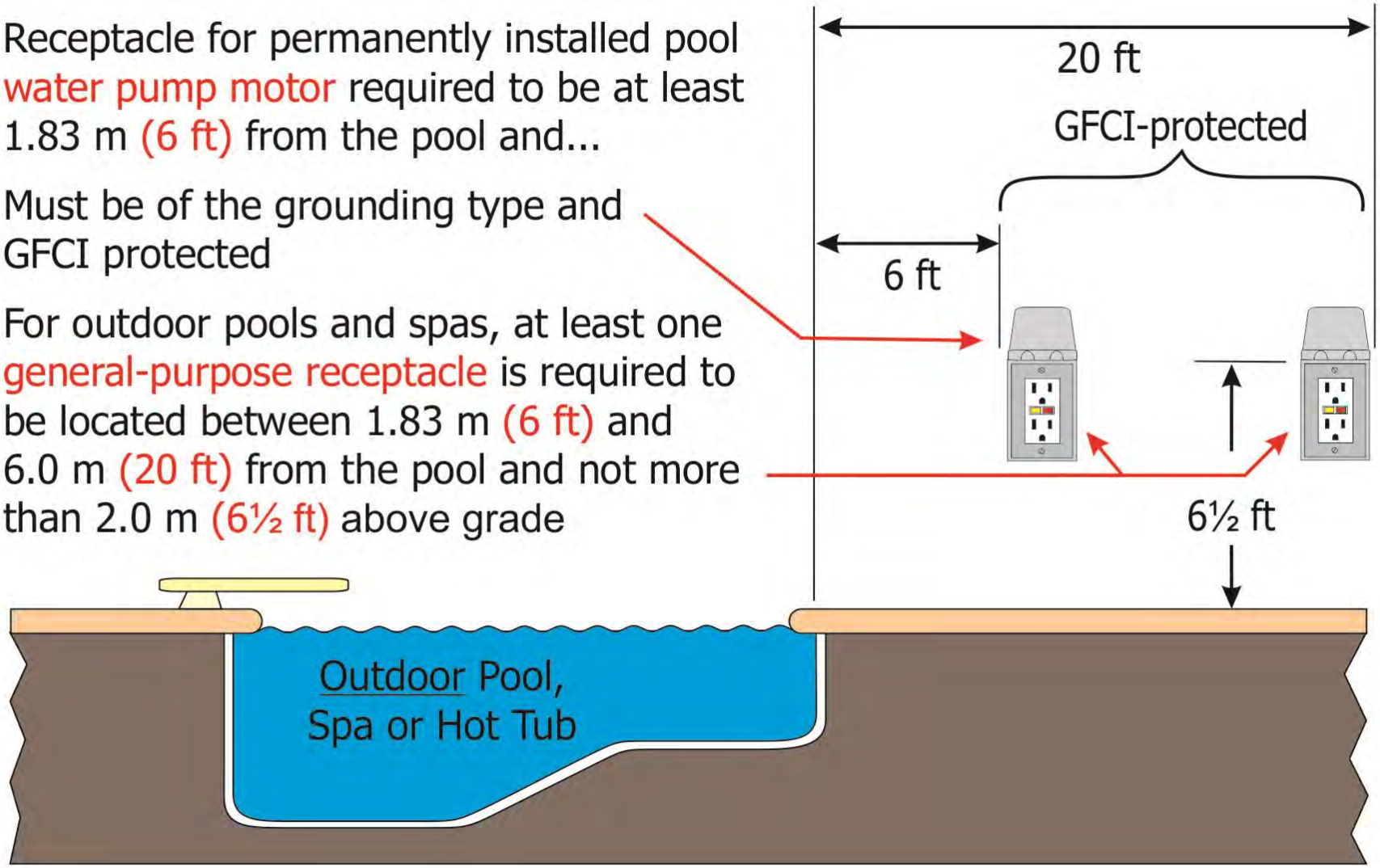
NEC 680.22(A)(1) and (A)(4)

E4203.1 Receptacle Locations for Permanently Installed Pools

Receptacle for permanently installed pool water pump motor required to be at least 1.83 m (6 ft) from the pool and...

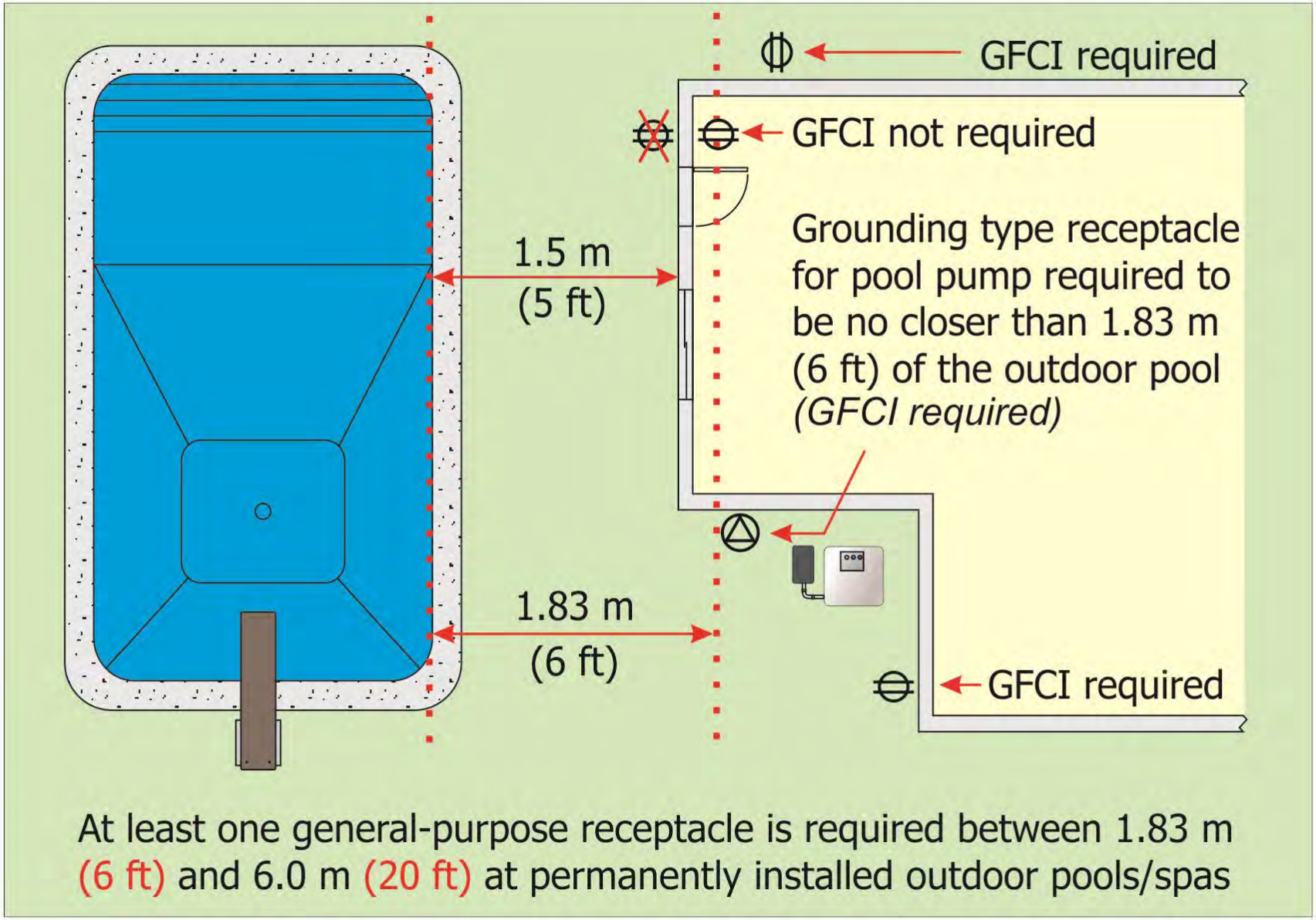
Must be of the grounding type and GFCI protected

For outdoor pools and spas, at least one general-purpose receptacle is required to be located between 1.83 m (6 ft) and 6.0 m (20 ft) from the pool and not more than 2.0 m (6½ ft) above grade



NEC 680.22(A)

E4203.1 Receptacle Locations



At least one general-purpose receptacle is required between 1.83 m (6 ft) and 6.0 m (20 ft) at permanently installed outdoor pools/spas

NEC 680.22(A)

"…not less than 1.83 m (6 ft) from, and not more than 6.0 m (20 ft) from, the inside wall of the pool"

Luminaires, Lighting Outlets and Ceiling Fans

- **New Outdoor Installations**
  - Generally, luminaires, lighting outlets and ceiling-suspended (paddle) fans cannot be installed over outdoor pools or over any area extending **1.5 m (5 ft) horizontally** from the inside walls of a pool unless…
  - Located **3.7 m (12 ft)** or more above the maximum water level
- See IRC E4203.4.1

NEC 680.22(B)(1)

Luminaires, Lighting Outlets and Ceiling Fans

- **GFCI Protection in Adjacent Areas**
  - Luminaires and lighting outlets installed in the area extending between **1.5 m (5 ft) and 3.0 m (10 ft) horizontally** from the inside walls of a pool must be GFCI protected
  - GFCI protection not required where installed:
    - At least **1.5 m (5 ft) away and 1.5 m (5 ft) above** the maximum water level
    - **Rigidly attached** to structure adjacent to or enclosing the pool
- See IRC E4203.4.6

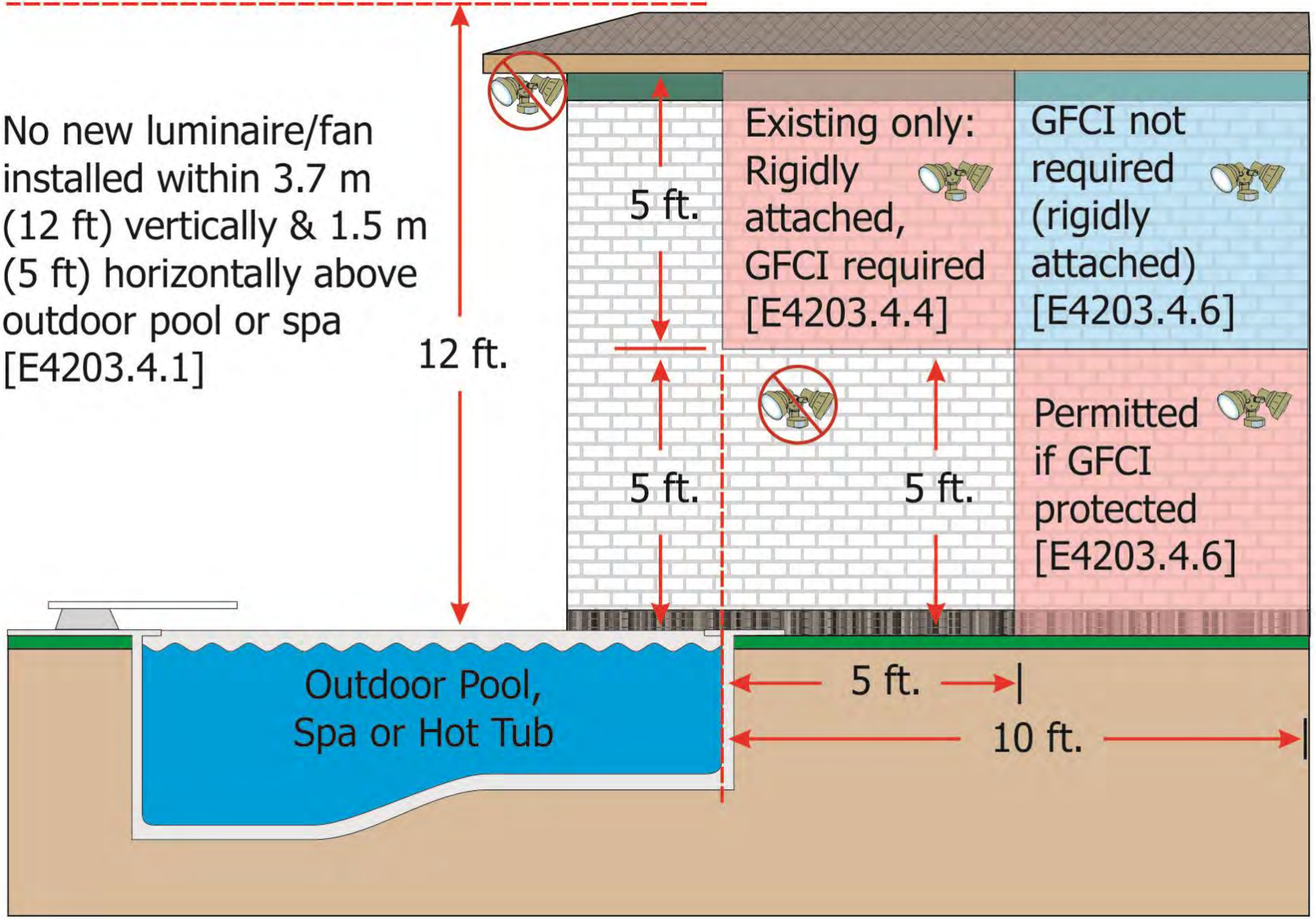
NEC 680.22(B)(4)

Luminaires, Lighting Outlets and Ceiling Fans *(cont.)*

- **Existing Installations**
  - Existing luminaires and lighting outlets that are located **less than 1.5 m (5 ft) measured horizontally** from the inside walls of a pool must be installed so they are:
    - At least **1.5 m (5 ft) above** the surface of the maximum water level
    - **Rigidly attached** to the existing structure
    - **GFCI** protected
- See IRC E4203.4.4

NEC 680.22(B)(3)

E4203.4 Outdoor Luminaires, Ceiling Fans, etc.



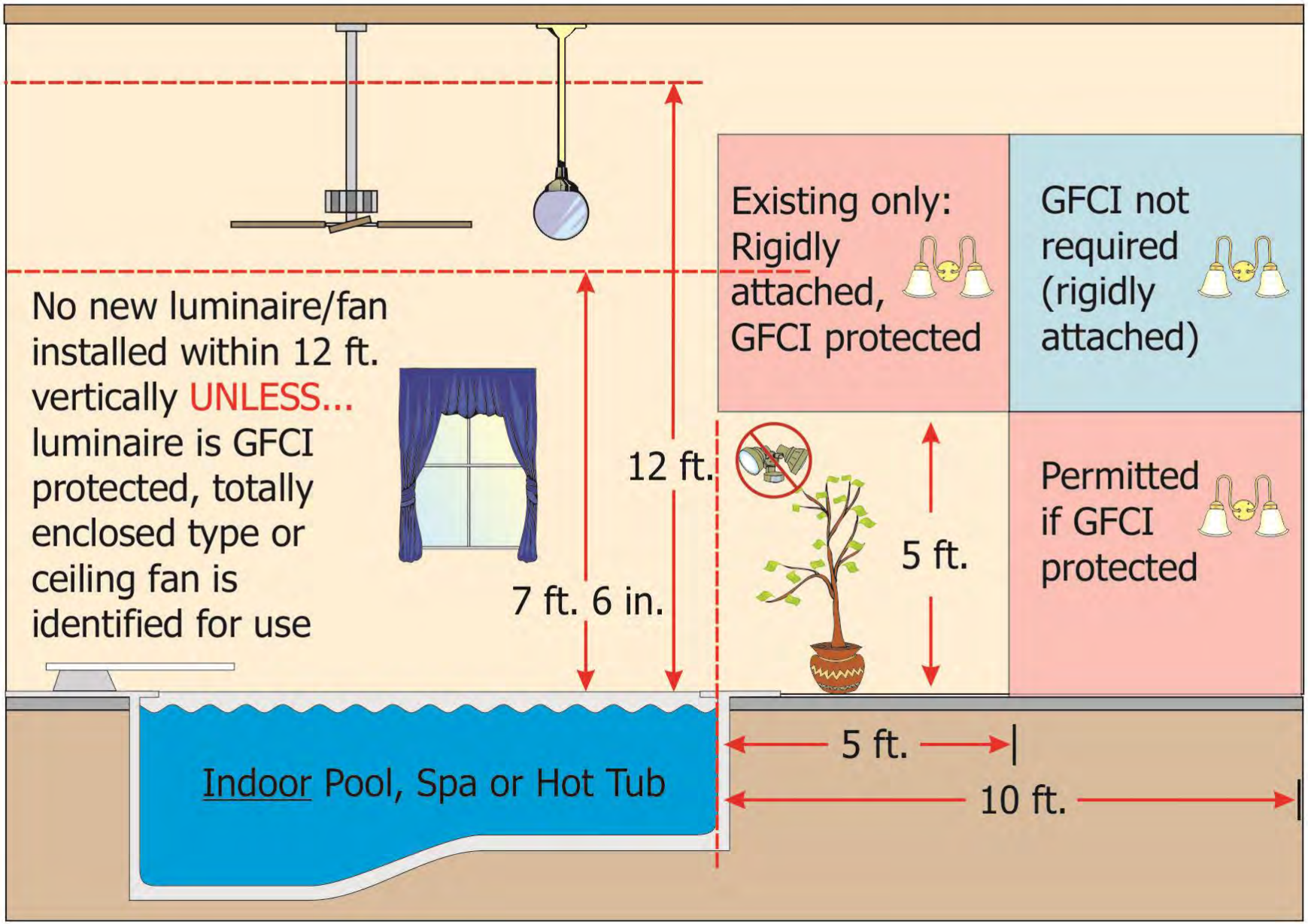
NEC 680.22(B)

Luminaires, Lighting Outlets and Ceiling Fans *(cont.)*

- **Indoor Installations**
  - New luminaires or ceiling-suspended paddle fan(s) permitted to be installed closer to an indoor pool/spa than to an outdoor pool/spa but specific conditions must be met:
    - Luminaires have to be of **totally enclosed type**
    - Ceiling-suspended (paddle) fans are required to **be identified for use** *(possible damp or wet locations)*
    - Distance from the bottom of the luminaire or ceiling-suspended (paddle) fan to the maximum water level cannot be less than **2.3 m (7 ft 6 in.)**
    - **GFCI protection** required to be installed in the branch circuit supplying the luminaire(s) or ceiling-suspended (paddle) fan(s)
- See IRC E4203.4.2

NEC 680.22(B)(2)

E4203.4.2 Indoor Luminaires, Ceiling Fans, etc.



NEC 680.22(B)(2)

Low-Voltage Lighting Systems for Swimming Pools

- Under certain conditions, some low-voltage luminaires are permitted to be located **less than 1.5 m (5 ft)** from the inside walls of a permanently installed pool
- Low-voltage luminaires must meet the following conditions:
  - Must be of the type that does not require connection to an equipment grounding conductor
  - Cannot exceed the voltage limitations defined in the definition of "Low Voltage Contact Limit"
  - Supplied by transformers or power supplies **listed, labeled, and identified** for swimming pool and spa use
- See IRC E4203.4.3

NEC 680.22(B)(6)

Low-Voltage Lighting Systems for Swimming Pools *(cont.)*

- ***NEC* Article 411** for "Low-Voltage Lighting," also allows low voltage lighting systems to be installed in close proximity to swimming pools if "permitted by *NEC* Article 680"
- See *NEC* 411.4(B)

Supply to Underwater Luminaires

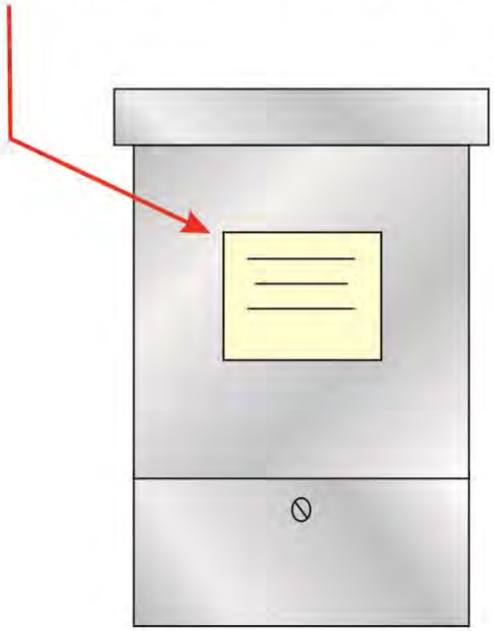
- Underwater lighting is permitted to be supplied either directly by a branch circuit or through a suitable, listed isolated-winding transformer or power supply
- Transformers and power supplies *(and enclosures)* used for the supply of underwater luminaires are required to be **listed, labeled, and identified** for swimming pool and spa use
- Transformer or power supply must be either a isolated-winding type having a ungrounded secondary and grounded metal barrier between the primary and secondary windings or a transformer that incorporates an approved system of double insulation between the primary and secondary windings
- See E4206.1 and E4206.4

NEC 680.23(A)(1), (A)(2), and (A)(8)

E4206.1 Underwater Luminaire Transformers and Power Supplies

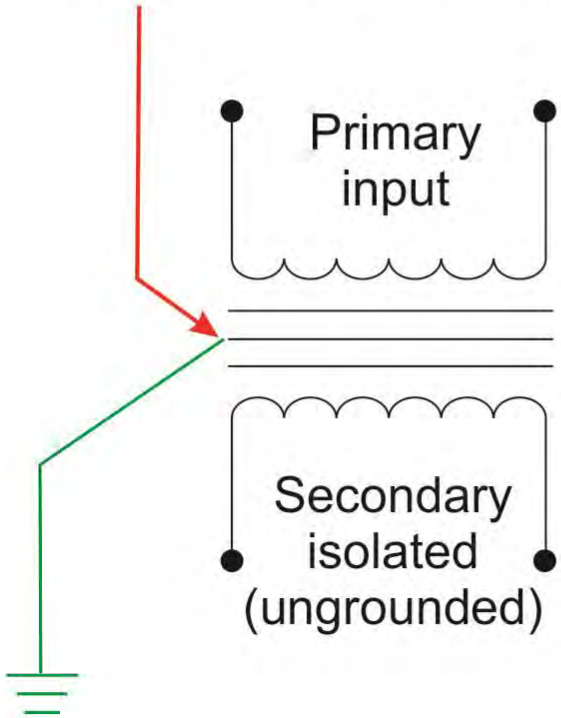
Transformers or power supplies for underwater luminaires shall incorporate either a transformer of the isolated winding type or one that incorporates an approved system of double insulation between the primary and secondary windings

Listed, labeled, and identified as a swimming pool and spa transformer



Transformer and enclosure (assembly)

Grounded metal barrier or approved system of double insulation



NEC 680.23(A)(2)

E4206.1 Underwater Luminaire Transformers and Power Supplies

Courtesy of Intermatic, Inc.

NEC 680.23(A)(2)

Branch Circuit Supplying Underwater Luminaires

- Where supplying underwater luminaires operating at voltages greater than the low voltage contact limit, **GFCI protection must be installed in the branch circuit**
- Ensures no shock hazard during lamping, relamping, or servicing
- GFCI will protect against a shock hazard with any likely fault-condition combination that involves a person in a conductive path from any ungrounded part of the branch circuit or the luminaire to ground
- Compliance requires the use of a listed underwater luminaire with a listed GFCI in the branch circuit or a listed transformer or power supply for luminaires operating at not more than the low voltage contact limit
- See IRC E4206.4

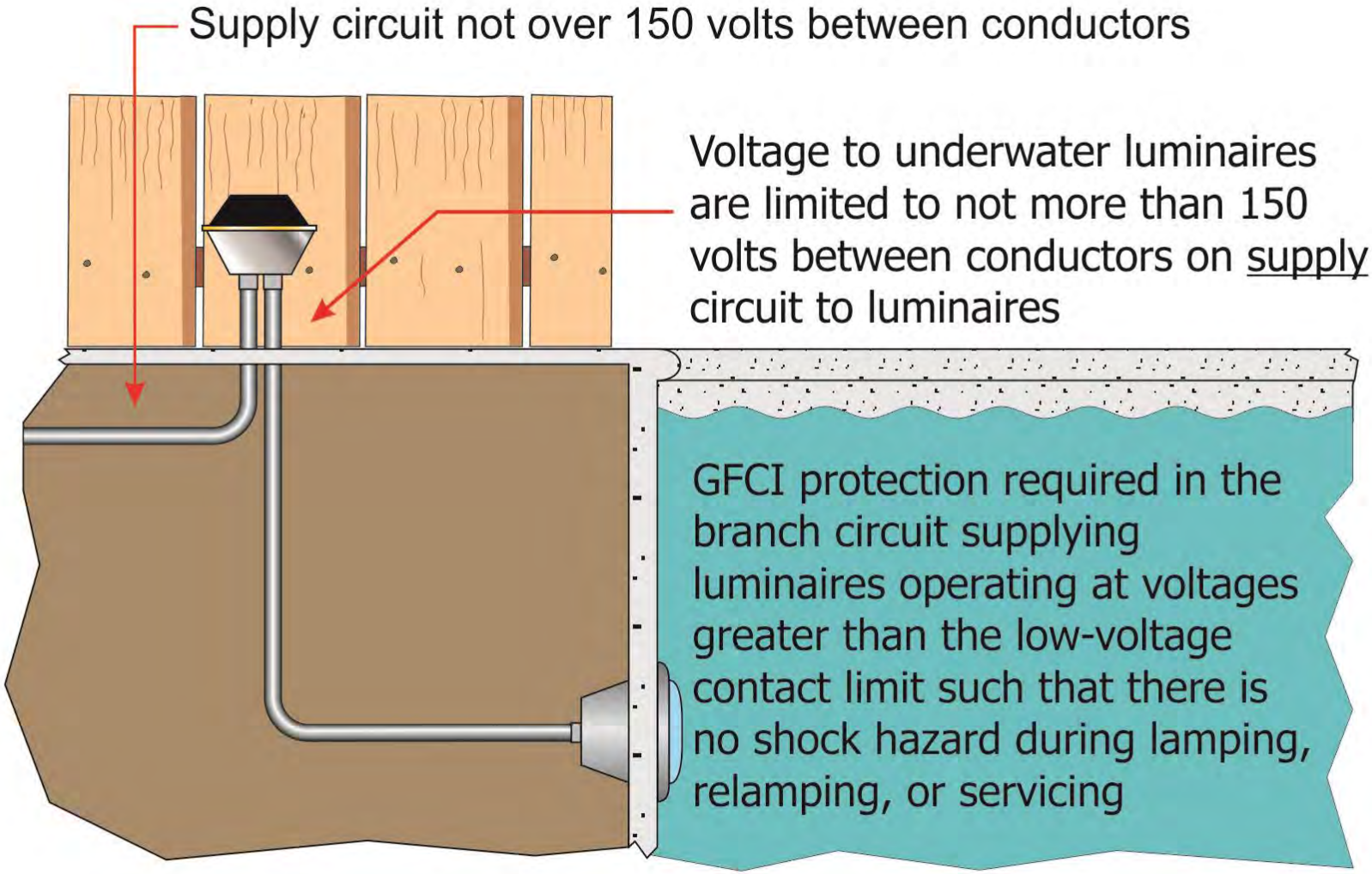
NEC 680.23(A)(1), (A)(3), and (A)(8)

E4206.4.1 Voltage Limitation

- No underwater luminaires are permitted to be installed where they operate on supply circuits **over 150 volts between conductors**
- The use of luminaires such as electric-discharge luminaires where the supply circuit voltage does not exceed 150 volts between conductors on the supply side, but the luminaire operating voltage is higher than 150 volts on the output side is not prohibited by this voltage limitation

NEC 680.23(A)(4)

E4206.4.1 Voltage Limitation



* Operating voltage on the output side of electric-discharge luminaires may be higher

NEC 680.23(A)(4)

Underwater Luminaire Mounting Requirements

- Wall-mounted underwater luminaires generally required to be installed with the top of luminaire lens at least **450 mm (18 in.)** below the normal water level of the pool
- Lesser depths permitted for luminaires specifically **listed and identified** for use at a depth of not less than **100 mm (4 in.)** below the normal water level of the pool
- Luminaires installed facing in an **upward position** must:
  - Have lens **adequately guarded** to prevent contact by any person or…
  - Be listed for use without a guard
- Guarding may be by some identified wire grill or mesh
- See IRC E4206.4

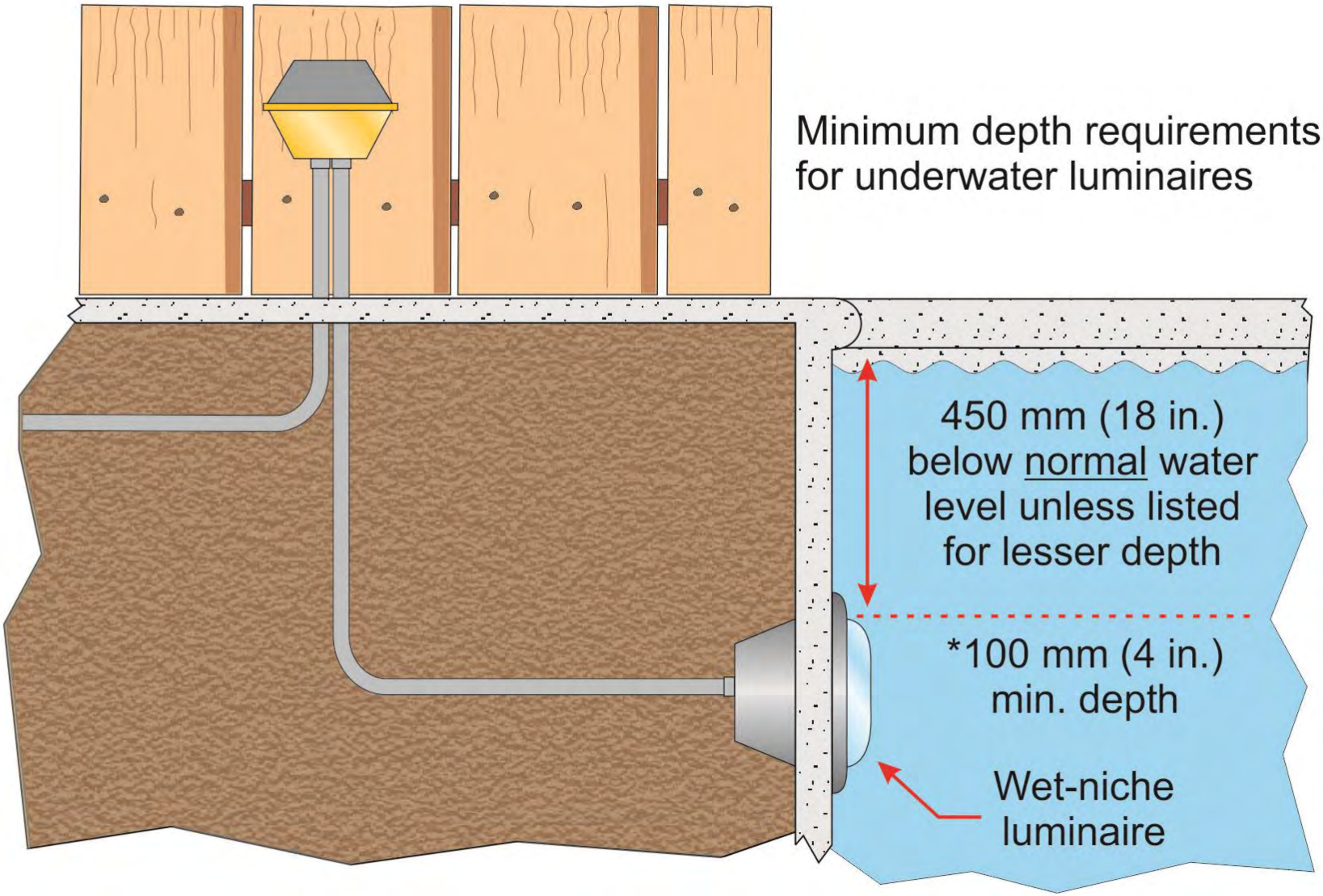
NEC 680.23(A)(5) and (A)(6)

Underwater Luminaire Mounting Requirements *(cont.)*

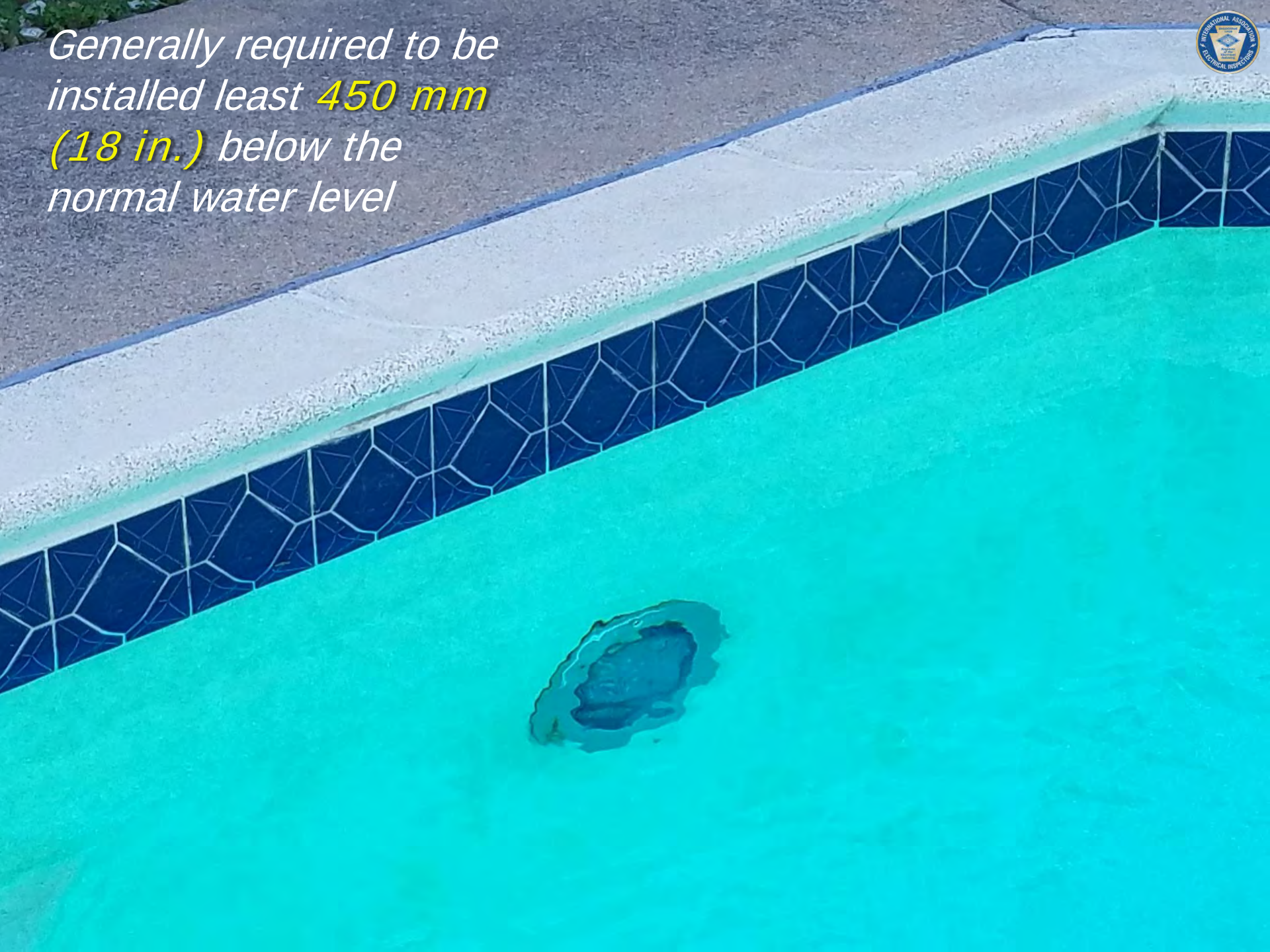
- Underwater luminaires that depend on **submersion** for their safe operation must have **protection against overheating** built into the luminaire
- Compliance with the preceding requirements is obtained by:
  - Using listed underwater luminaires
  - Following the installation instructions
  - Installation of a GFCI protective device in the branch circuit or a listed swimming pool and spa transformer or power supply that limits the operating voltage to the low-voltage contact limits
- See IRC E4206.4

NEC 680.23(A)(7) and (A)(8)

E4206.4.2 Location of Underwater Luminaires



Permanently Installed Pools

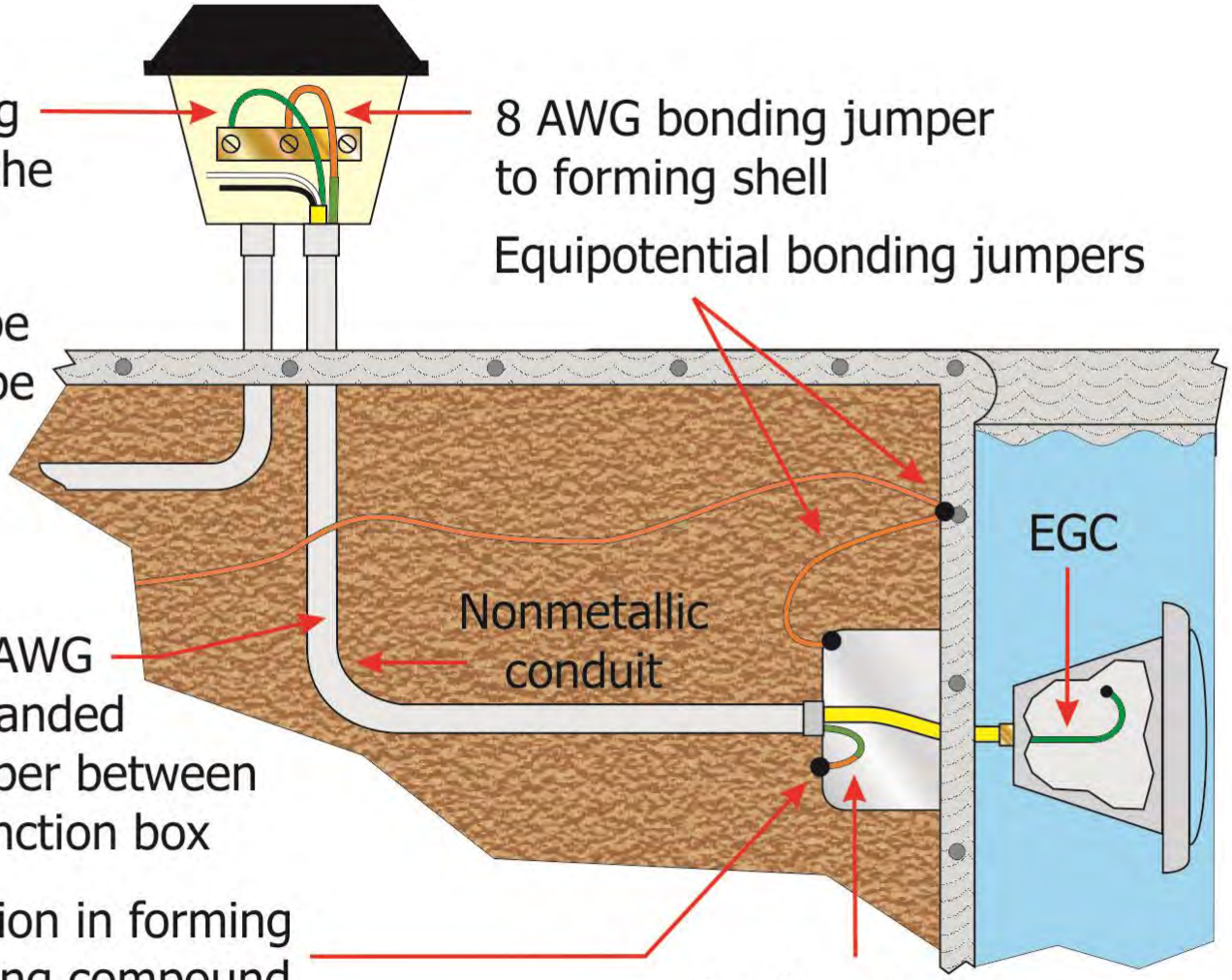

Generally required to be installed least 450 mm (18 in.) below the normal water level

E4206.5 Wet-Niche Luminaires

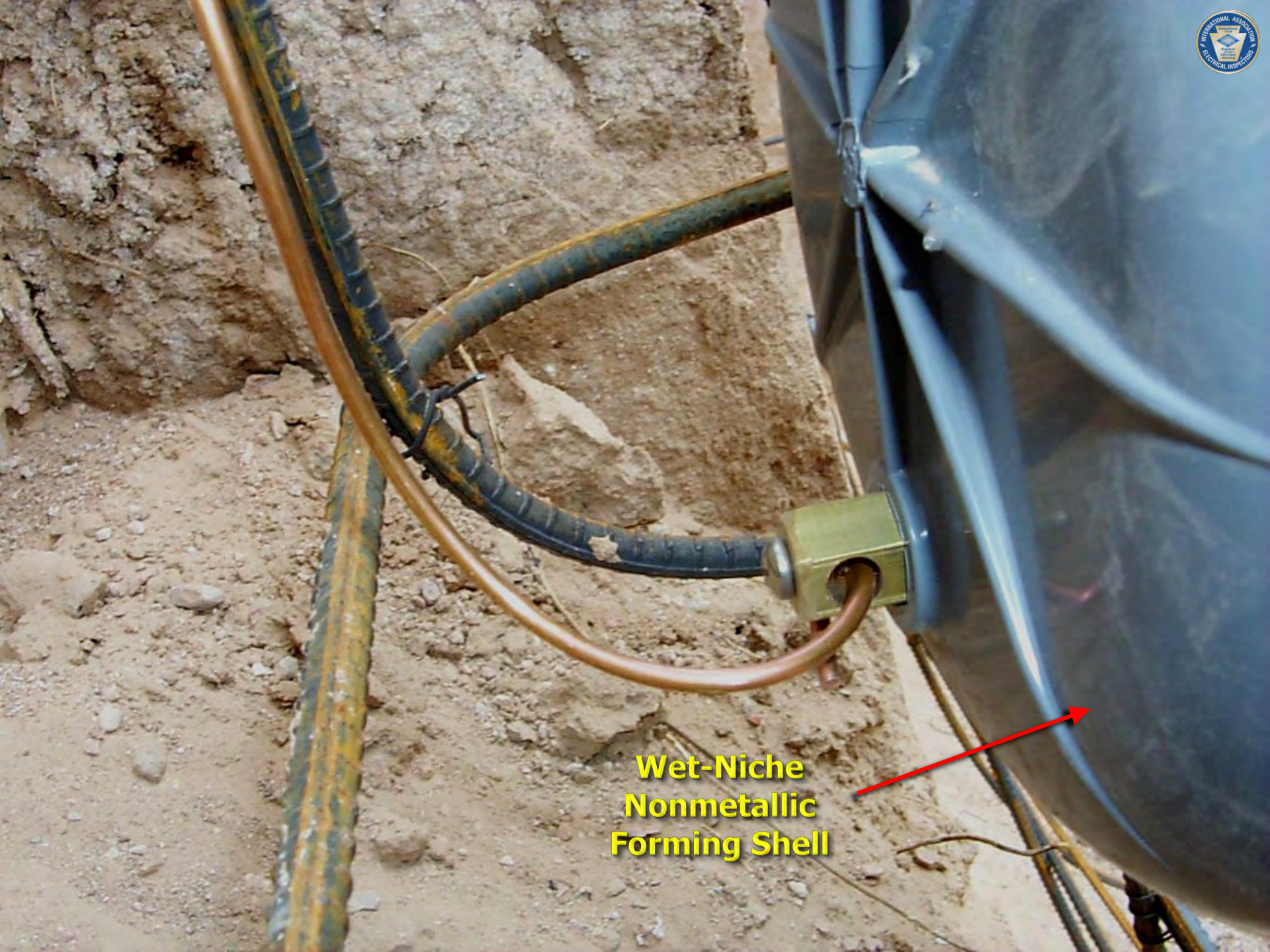
- By far, the most common underwater luminaire employed at dwelling unit swimming pools is the **wet-niche luminaire**
- Wet-niche luminaires required to be installed in a **forming shell**
- Where mounted in permanently installed pool or fountain, must be installed in the forming shell such that the luminaire will be **surrounded by water**
- Forming shell must be equipped with provisions for **conduit entries**
- Where in contact with the pool water, metal parts of the luminaire and forming shell must also be of **brass or other approved corrosion-resistant metal**
- Forming shell used with nonmetallic conduit systems must have provisions for terminating an **8 AWG copper bonding jumper** *(not applicable to non-grounding listed low-voltage systems)*

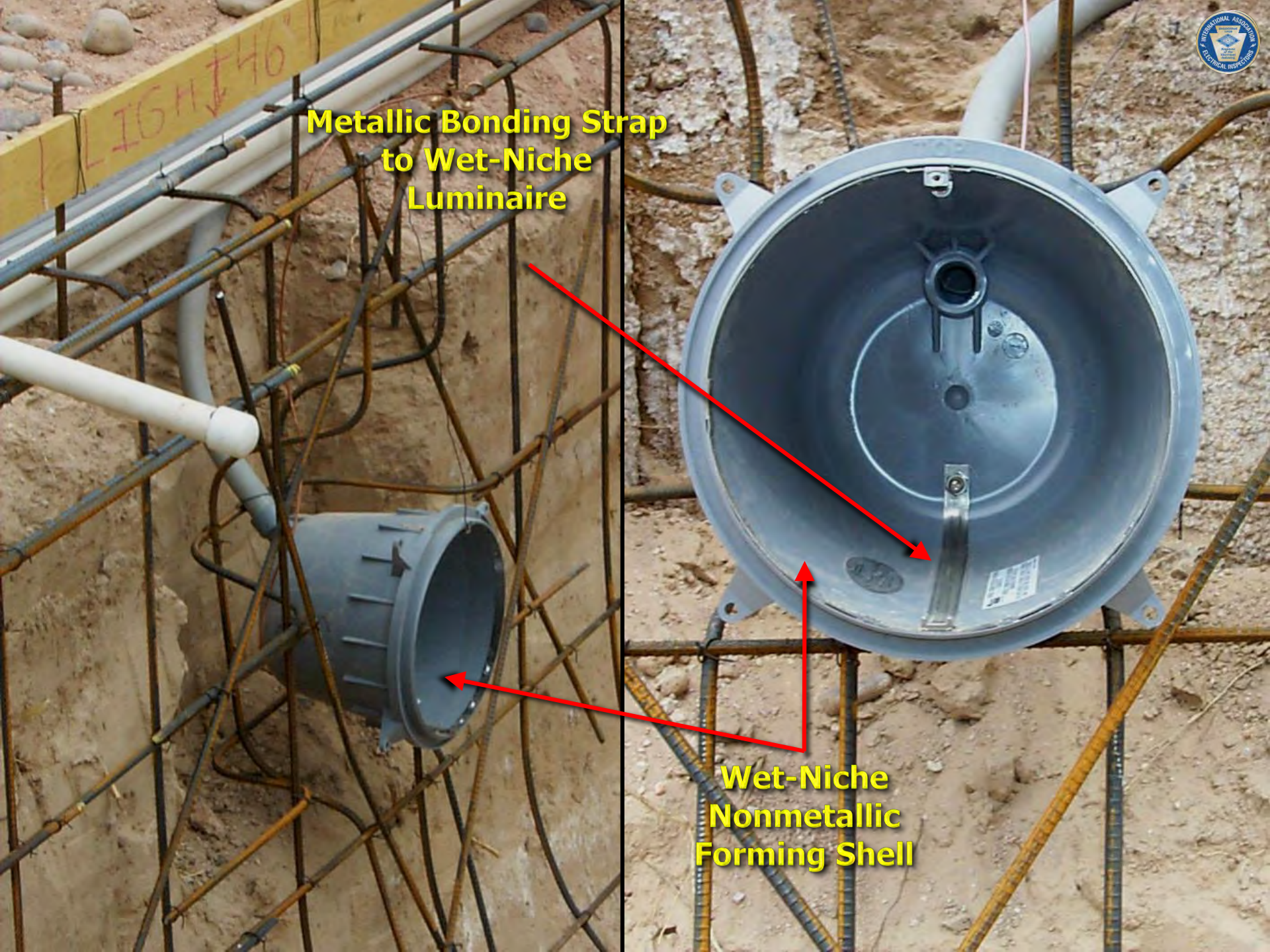
NEC 680.23(B)(1)

Wiring Methods to Wet-Niche Luminaires

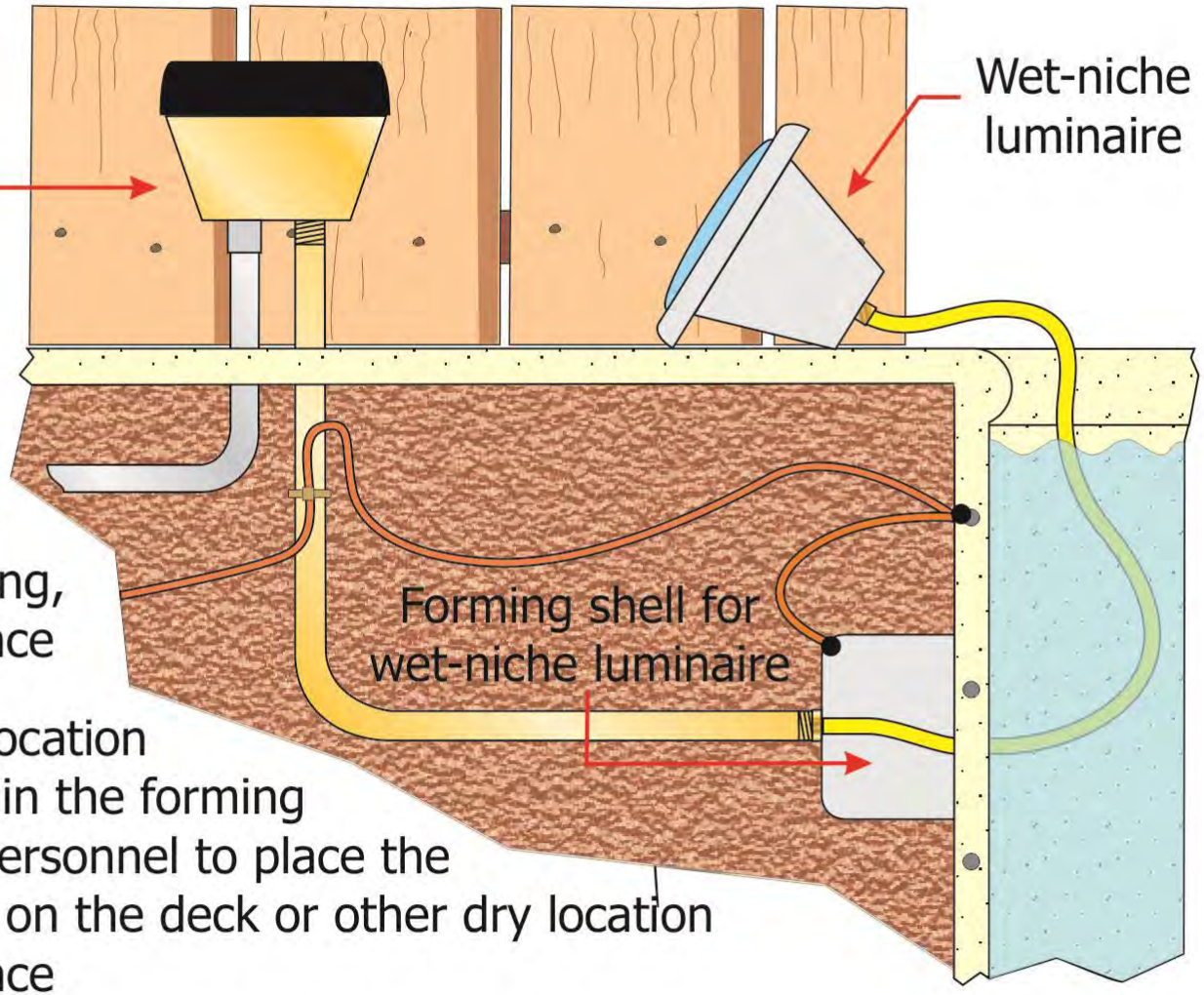


NEC 680.23(B)(2)


Wet-Niche
Nonmetallic
Forming Shell


Metallic Bonding Strap
to Wet-Niche
Luminaire
Wet-Niche
Nonmetallic
Forming Shell

E4206.5.1 Servicing and Relamping



- All wet-niche luminaires shall be removable from the water for inspection, relamping, or other maintenance
- The forming shell location and length of cord in the forming shell shall permit personnel to place the removed luminaire on the deck or other dry location for such maintenance
- The luminaire maintenance location shall be accessible without entering or going in the pool water

NEC 680.23(B)(6)

Branch-Circuit Wiring Methods for Underwater Luminaires

- Branch-circuit wiring on the supply side of deck or junction boxes and enclosures and connected to conduits run to underwater wet-niche, dry-niche, or no-niche luminaires installed in corrosive environments shall be listed and identified for use in such areas
- Corrosive environments are described at IRC E4202.2 *(NEC 680.14)*
- Wiring methods identified for such corrosive environments are:
  - Rigid metal conduit
  - Intermediate metal conduit
  - Reinforced thermosetting resin conduit
  - Rigid polyvinyl chloride conduit (PVC)
  - Liquidtight flexible nonmetallic conduit
- See IRC Table E4202.1

NEC 680.23(F) and 680.14

Branch-Circuit Wiring Methods for Underwater Luminaires *(cont.)*

- Where installed in a **noncorrosive environment**, such as on or within an attic of a dwelling unit, **any or IRC Chapter 38 *(NEC Chapter 3)* wiring method** identified for such use can be used
- In noncorrosive environments, such wiring methods as **electrical metallic tubing** is permitted to be used to protect conductors where it is installed on or within a building
- Branch circuits or feeders ran **inside a dwelling unit** in a noncorrosive location could include:
  - Nonmetallic-sheathed cable
  - Electrical nonmetallic tubing (ENT)
  - Type MC cable
  - Type AC cable
- See IRC Table E4202.1

NEC 680.23(F)

Branch-Circuit Wiring Methods for Underwater Luminaires *(cont.)*

- Liquidtight flexible metal conduit or liquidtight flexible nonmetallic conduit permitted to connect to **transformers or power supplies** for pool luminaires
- Total length limited to **3.0 m (10 ft)** with any one length limited to **1.8 m (6 ft)**
- Liquidtight flexible nonmetallic conduit, Type B **(LFNC-B)** permitted in lengths longer than 1.8 m (6 ft)
- See IRC Table E4202.1

NEC 680.23(F), Exception

E4205.2 Equipment Grounding for Underwater Luminaires

- Through-wall lighting assemblies, wet-niche, dry-niche or no-niche luminaires must be connected to an **insulated copper equipment grounding conductor** (EGC)
- Does not apply to listed low-voltage luminaires *(no grounding provisions)*
- EGC to be run with the branch-circuit conductors and sized based on the rating of the circuit overcurrent protective device
  - Exception applies to EGC between secondary side of a transformer and junction box to be sized in accordance with the overcurrent device in this circuit
- Not smaller than **12 AWG**
- See IRC **Table E3908.12** *(NEC Table 250.122)* for the minimum size EGC

NEC 680.23(F)(2)

E4205.2 Equipment Grounding for Underwater Luminaires *(cont.)*

- Equipment grounding conductors (EGC) used in conjunction with underwater luminaire circuits are generally to be installed **without splice or joint**
- Two conditions exist to permit such splice or joint on grounding terminals:
  - Where more than one luminaire is supplied by the same branch circuit
  - Located on equipment in the same circuit as the underwater luminaire
- **Example:** Underwater luminaire protected by a GFCI and controlled by a clock-operated switch

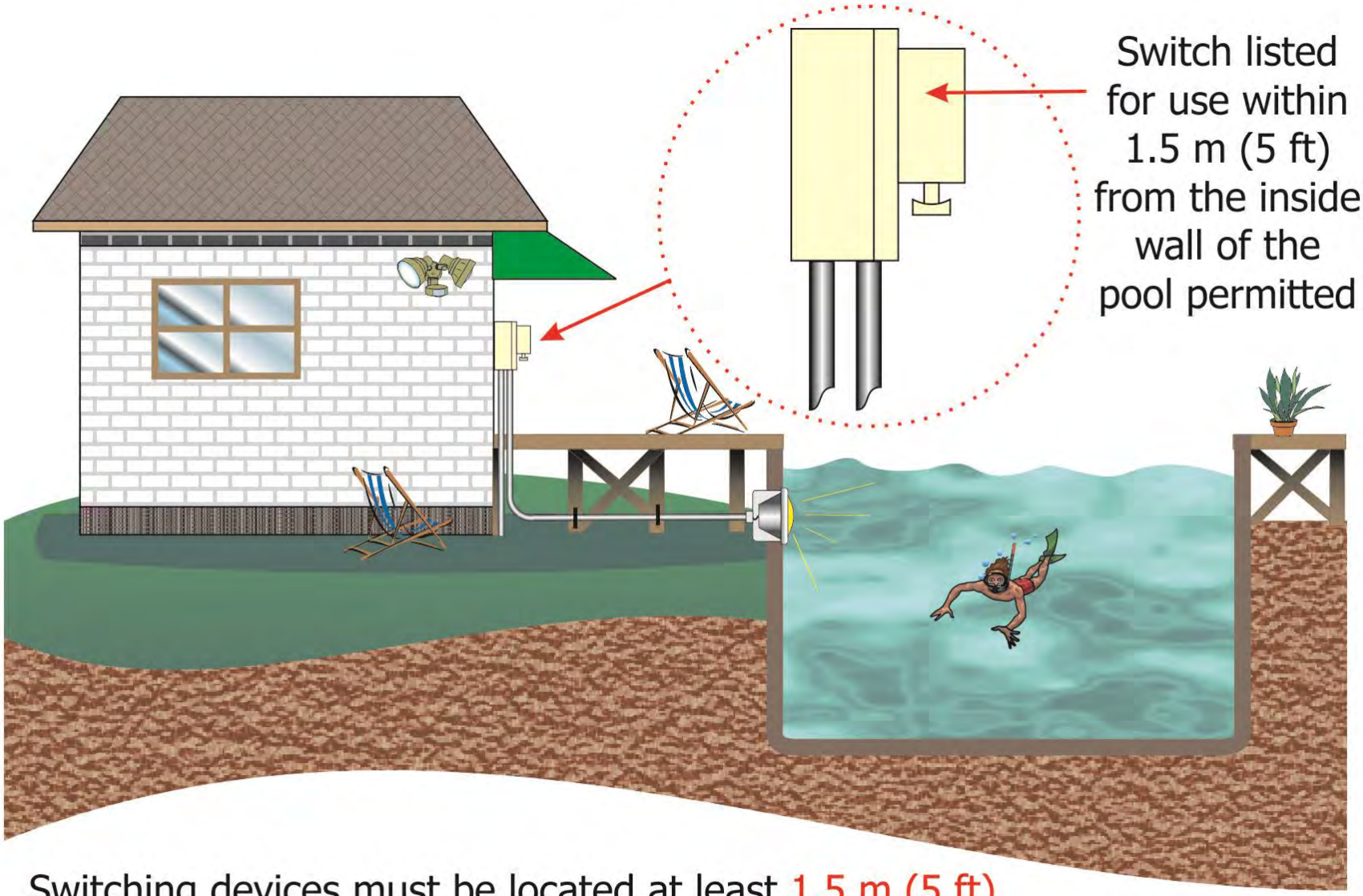
NEC 680.23(F)(2)(a) and (b)

E4203.2 Switching Devices

- Switching devices of any type *(including maintenance disconnects)* required to be located at least **1.5 m (5 ft)** from the inside walls of a pool
- Lesser distances permitted where switching devices are separated from the pool by a **permanent barrier** *(such as a solid fence or wall)*
- Applies to equipment disconnects, circuit breakers and fusible switches, as well as to switches installed for other purposes such as controlling a luminaire
- Switches **listed for use within 1.5 m (5 ft)** limitation permitted
  - **Example:** Factory-installed switch part of a listed spa assembly

NEC 680.22(C)

E4203.2 Switching Devices



Switching devices must be located at least 1.5 m (5 ft) horizontally from the inside walls of a pool unless separated from the pool by a solid fence, wall, or other permanent barrier

NEC 680.22(C)

E4206.9.1
Junction Boxes and Enclosures

- Where a conduit is connected to a junction box that extends directly to an underwater forming shell, the box is required to meet the following requirements:
  - **Listed , labeled, and identified** as swimming pool junction boxes
  - Equipped with **threaded entries** or **nonmetallic hubs**
  - Made of copper, brass, suitable plastic, or other approved **corrosion-resistant material**

NEC 680.24(A)(1)

E4206.9.1
Junction Boxes and Enclosures *(cont.)*

- Where a conduit is connected to a junction box that extends directly to an underwater forming shell, the box is required to meet the following requirements:
  - **Electrical continuity** between every connected metal conduit and the grounding terminals
  - Shall **not be located in finished walkways** unless afforded additional protection (*under diving boards, etc.*)
  - Provided with no fewer than one more **grounding terminal** than the number of conduit entries

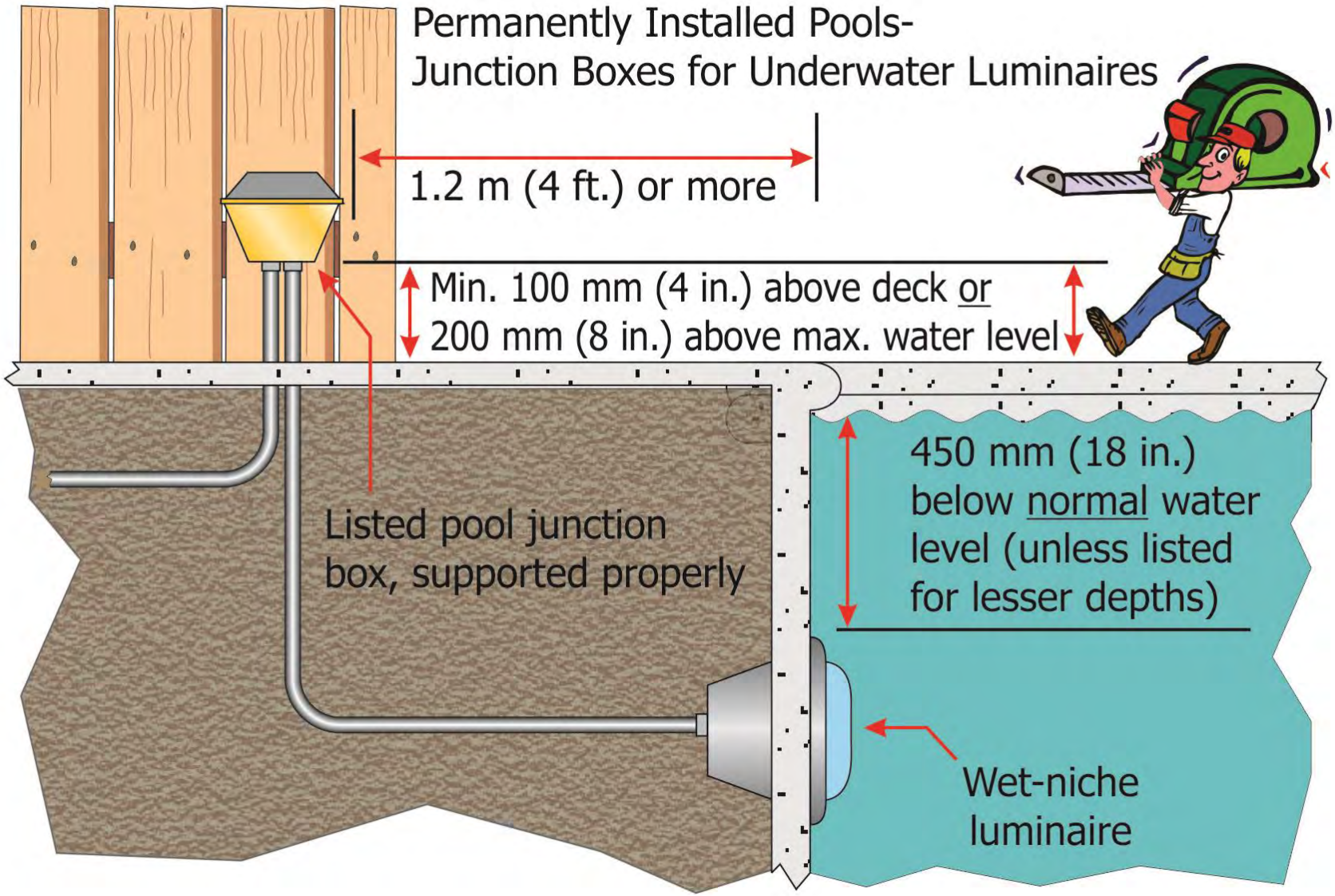
NEC 680.24(A)(1), 680.24(C) and (D)

E4206.9.1
Junction Boxes and Enclosures *(cont.)*

- **Vertical Spacing:** Located not less than **100 mm (4 in.)** measured from the bottom of the box or enclosure to the ground level or deck level or…
  - not less that **200 mm (8 in.)** above the maximum water level, whichever provides the greatest elevation
- **Horizontal Spacing:** Locate not less than **1.2 m (4 ft)** from the inside walls of the pool

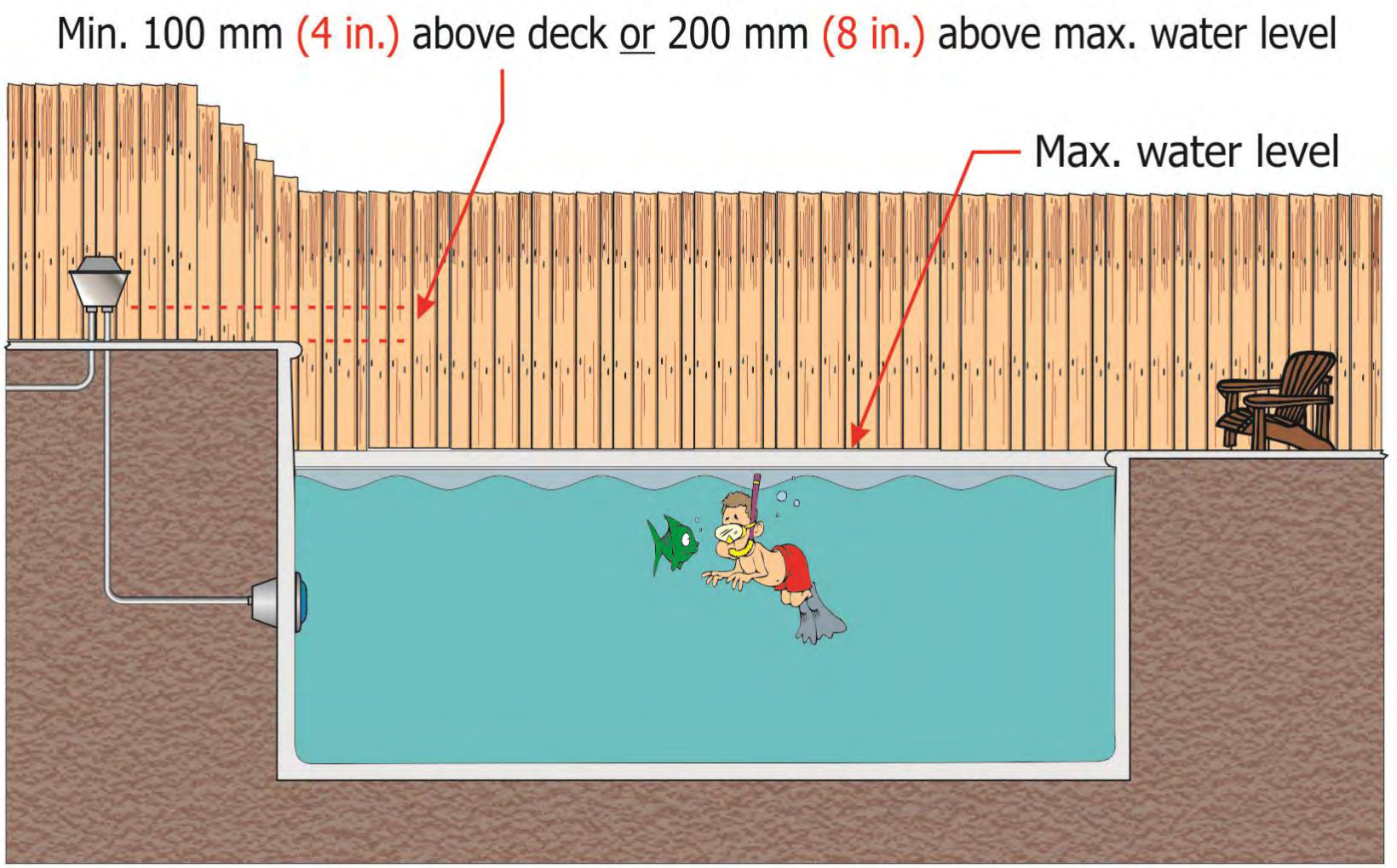
NEC 680.24(A)(2)

E4206.9.1 Junction Boxes and Enclosures



NEC 680.24(A)

E4206.9.1 Junction Boxes & Enclosures



Permanently Installed Pools - Junction Boxes for Underwater Luminaires

NEC 680.24(A)

Permanently Installed Pools

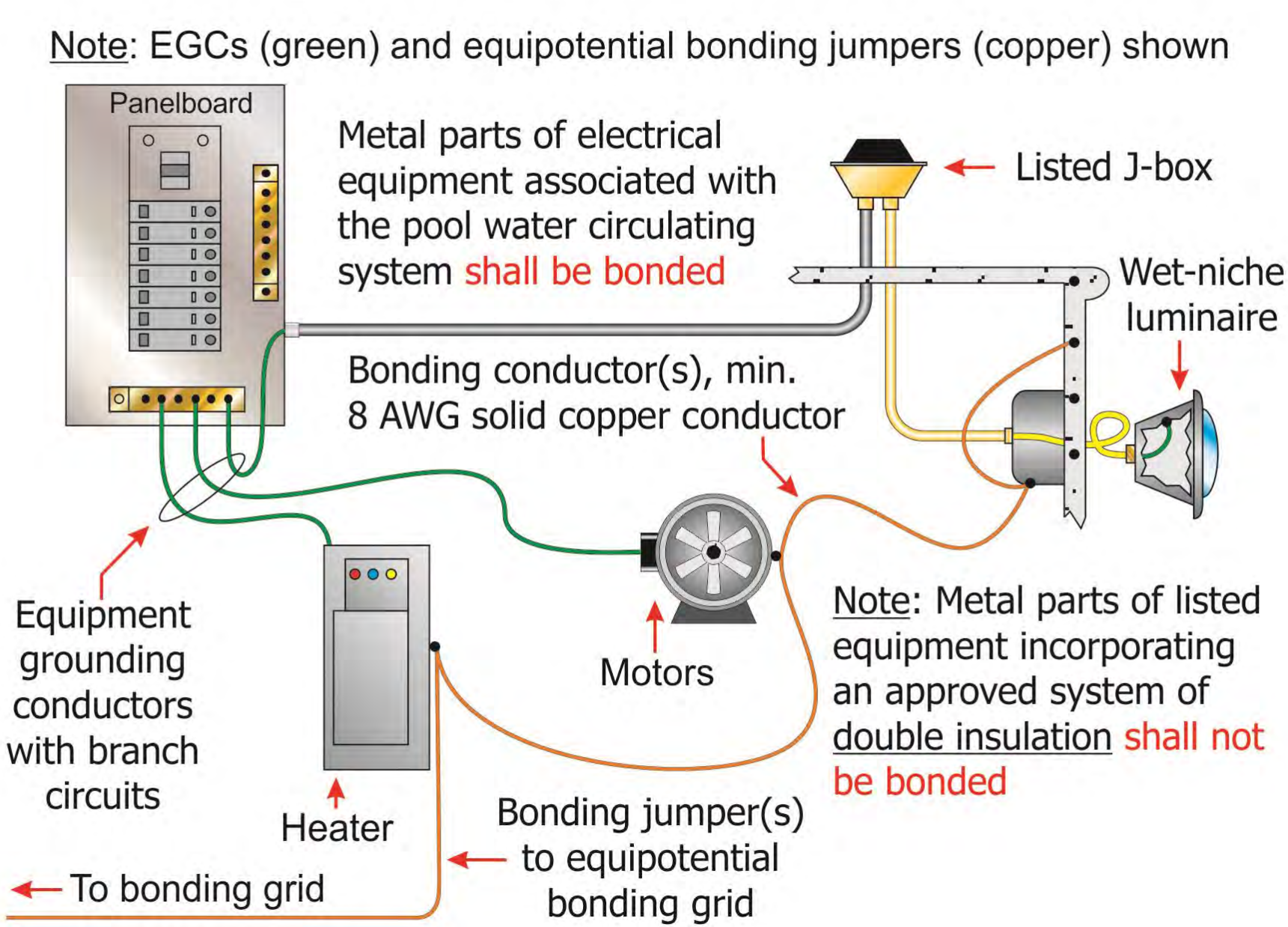
Listed Junction Boxes

E4204 Equipotential Bonding

- The **equipotential bonding** is required to **reduce voltage gradients** in the pool area
- This action essentially puts all metallic parts around and associated with the pool at the **same voltage potential**
- It is important to understand the difference between the terms *bonding* and *grounding* as they apply to IRC Chapter 42 or *NEC* Article 680
- Providing a path for ground-fault current is not the function of the equipotential bonding grid and associated bonding conductors

NEC 680.26

E4204 Bonding and Equipment Grounding



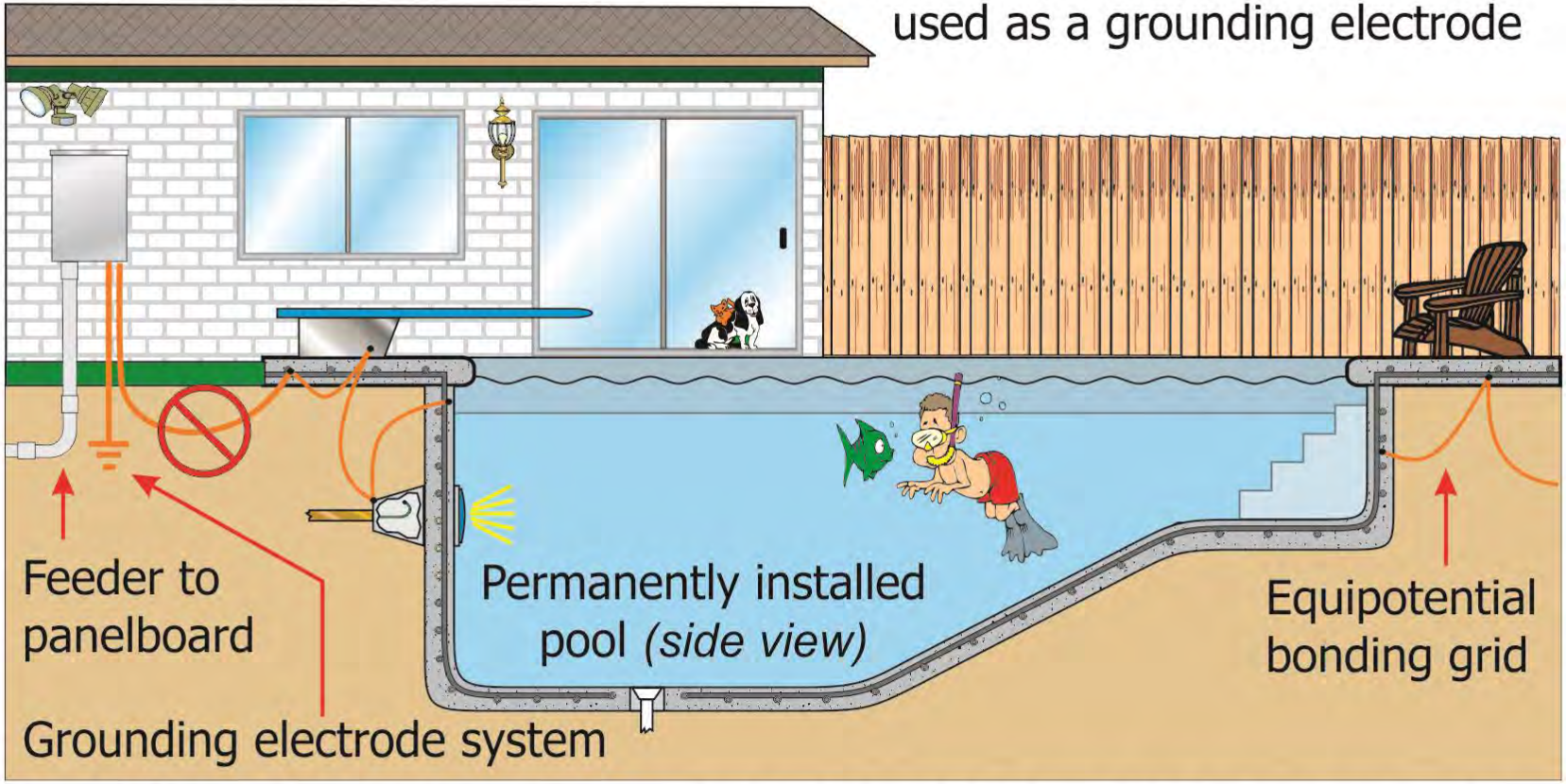
NEC 680.26

E4204 Equipotential Bonding *(cont.)*

- The structures and structural reinforcing steel of an **in-ground swimming pool** as described in E4204.2 *[NEC 680.26(B)(1) and (B)(2)]* are now **prohibited from being used as a grounding electrode**
- Important clarification to point out the difference between grounding and bonding
- Equipotential bonding requirements of E4204 *(NEC 680.26)* are to reduce voltage gradients *(difference of voltage potential between two conducting objects)*, not to create a grounding electrode system for a building or structure

E3608.7 Not Permitted for Use as Grounding Electrodes

The structures and structural reinforcing steel of an in-ground swimming pool as described in 680.26(B)(1) and (B)(2) are prohibited from being used as a grounding electrode



The provisions of 680.26 for equipotential bonding are to reduce voltage gradients *(difference of voltage potential between two conducting objects)*, not to establish a grounding electrode system for a building or structure

NEC 250.52(B)(3)

E4204 Equipotential Bonding *(cont.)*

- E4204.1 - Performance [*NEC* 680.26(A)]
- E4204.2 - Bonded Parts [*NEC* 680.26(B)]
  - (1) Conductive Pool Shells *(Belly steel)*
  - (2) Perimeter Surfaces *(Deck steel)*
  - (3) Metallic Components
  - (4) Underwater Lighting
  - (5) Metal Fittings
  - (6) Electrical Equipment
  - (7) Fixed Metal Parts
- E4204.3 - Pool Water [*NEC* 680.26(C)]


Perimeter Surface
Conductive Pool Shell

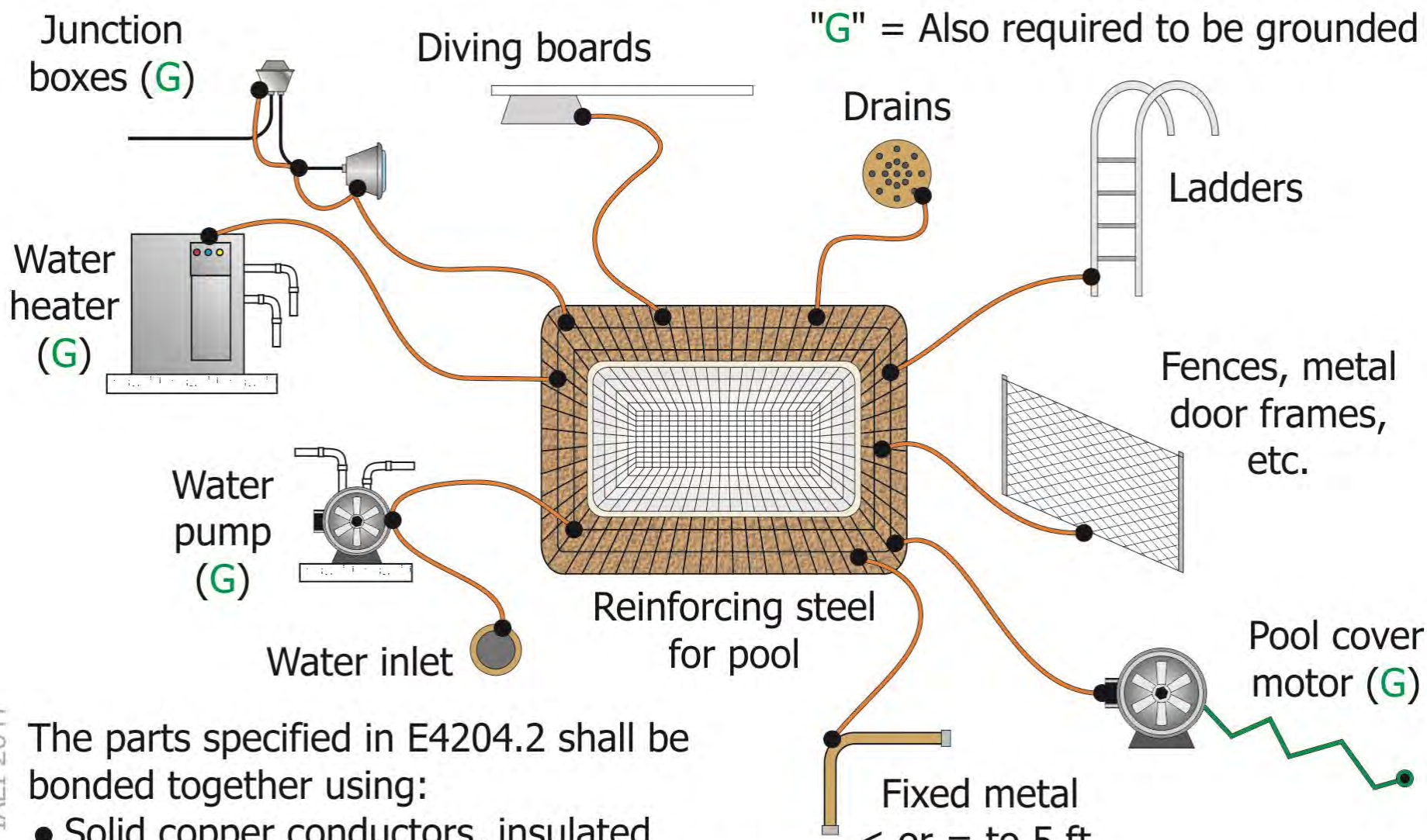
E4204 Equipotential Bonding *(cont.)*

- The equipotential bonding grid includes but not limited to:
  - All metallic parts of the pool including structural reinforcing steel of the pool shell and perimeter surface

    (Tie wires are suitable for bonding of structural steel)
  - All metal forming shells of underwater luminaires
  - All metal fittings within or attached to the pool structure *(Small parts exempted)*
- *Note: Isolated small parts not over 100 mm (4 in.) do not require bonding*

NEC 680.26(B)

E4204.2 Equipotential Bonding



The parts specified in E4204.2 shall be bonded together using:

- Solid copper conductors, insulated covered, or bare, not smaller than 8 AWG
- Rigid metal conduit of brass or other identified corrosion-resistant metal

NEC 680.26(B)


Conductive Pool Shell –
Structural Reinforcing Steel


Conductive Perimeter Surface –
Structural Reinforcing Steel


DIRECT
BURIAL


CHARLOTTE PIPE

SCH 40 280 PSI @73°F PVC1120 ASTM D1785

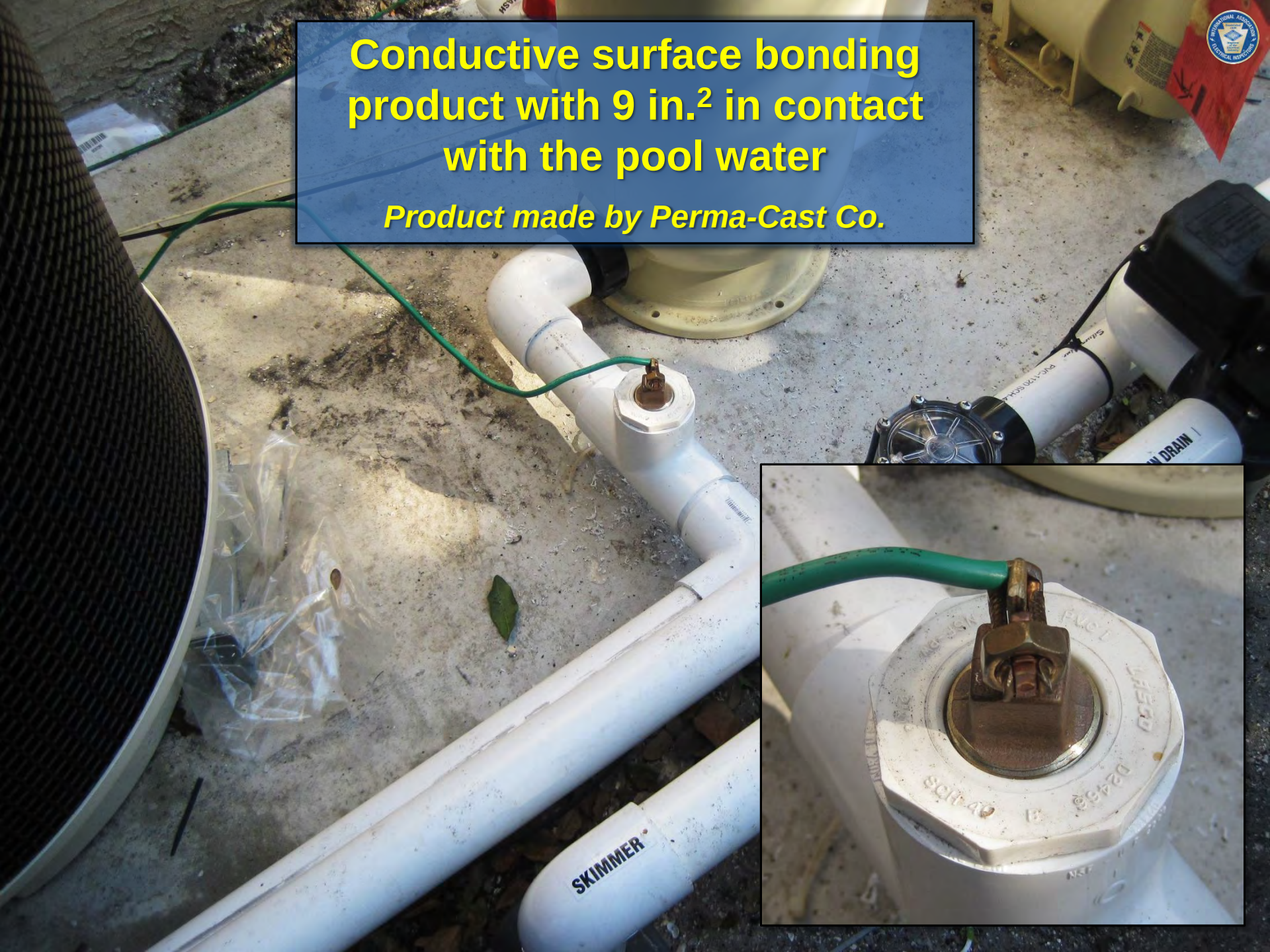
E4204.3 Bonding of Pool Water

- An intentional bond of a minimum conductive surface area of **5800 mm^2 (9 in.^{2})** shall be installed in contact with the pool water
- This bond shall be permitted to consist of parts that are required to be bonded in E4204.2 *[NEC 680.26(B)]*
- This would include **5800 mm^2 (9 in.^{2})** in contact with the pool water for such things as:
  - Metal ladders
  - Metal luminaire forming shells
  - Metal handrails, etc.

NEC 680.26(C)


Bonded parts with 9 in.^{2} in contact
with the pool water


Bonded parts with 9 in.^{2} in contact with the pool water
3 FT
NO DIVING


Conductive surface bonding product with 9 in.^{2} in contact with the pool water
Product made by Perma-Cast Co.
SKIMMER

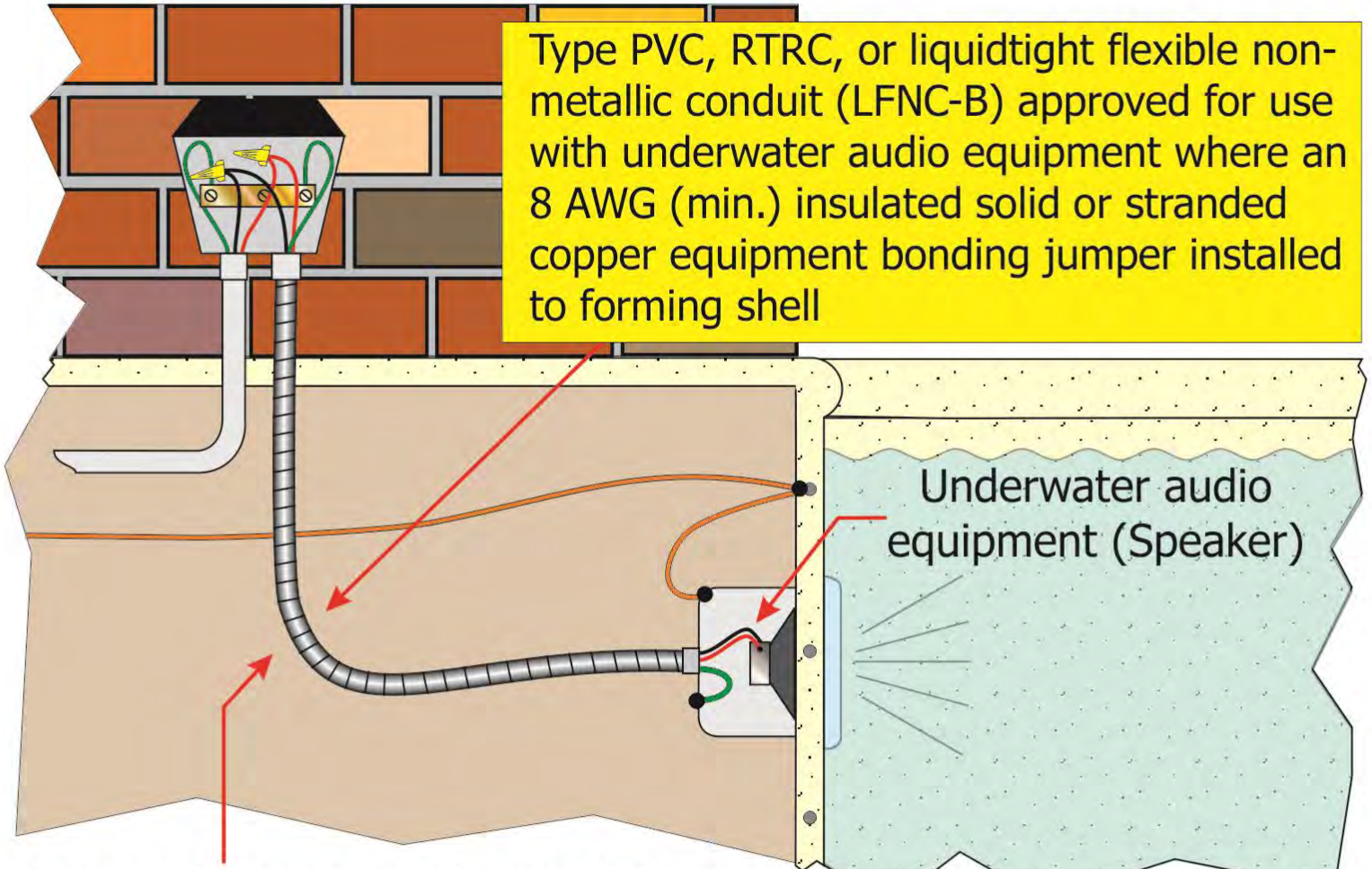

Conductive surface bonding product with 9 in.^{2} in contact with the pool water
Product made by Perma-Cast Co.

E4206.10
Underwater Audio Equipment

- All underwater audio equipment and similar installations must be **listed and specifically identified for the purpose**
- Each underwater speaker must be mounted in an **approved metal forming shell** *(must be metal)*
  - Front enclosed by a **captive metal screen** or equivalent
  - Bonded to and secured to the forming shell by a **positive locking device** that assures a low-resistance contact
- Special tool typically required to open forming shell for installation or servicing of the speaker
- Forming shell must be installed in a recess in the wall or floor of the pool

NEC 680.27(A)(2)

E4206.10 Underwater Audio Equipment



Acceptable wiring methods: Rigid metal conduit or intermediate metal conduit of brass or other identified corrosion-resistant metal, liquidtight flexible nonmetallic conduit (LFNC-B), rigid PVC conduit, or rigid RTRC conduit

Wiring Methods for Permanently Installed Pool-Associated Motors

- Wiring methods permitted to be utilized for a permanently installed pool, spa, or hot tub motor will depend on the type of environment the motor is installed in
- Wiring methods installed in a **corrosive environment** as described in IRC E4202.2 *(NEC 680.14)* shall be listed and identified for use in such areas
- Wiring methods installed in a **corrosive environment** shall be considered to be resistant to the corrosive environment and shall consist of:
  - Rigid metal conduit
  - Intermediate metal conduit
  - Rigid polyvinyl chloride conduit
  - Reinforced thermosetting resin conduit
  - Type MC cable listed for a corrosive environment [IRC Table 4202.1 or *NEC* 680.21(A)(1)]
- See IRC E4202.2.1 *[NEC 680.14(B)]*

Wiring Methods for Permanently Installed Pool-Associated Motors *(cont.)*

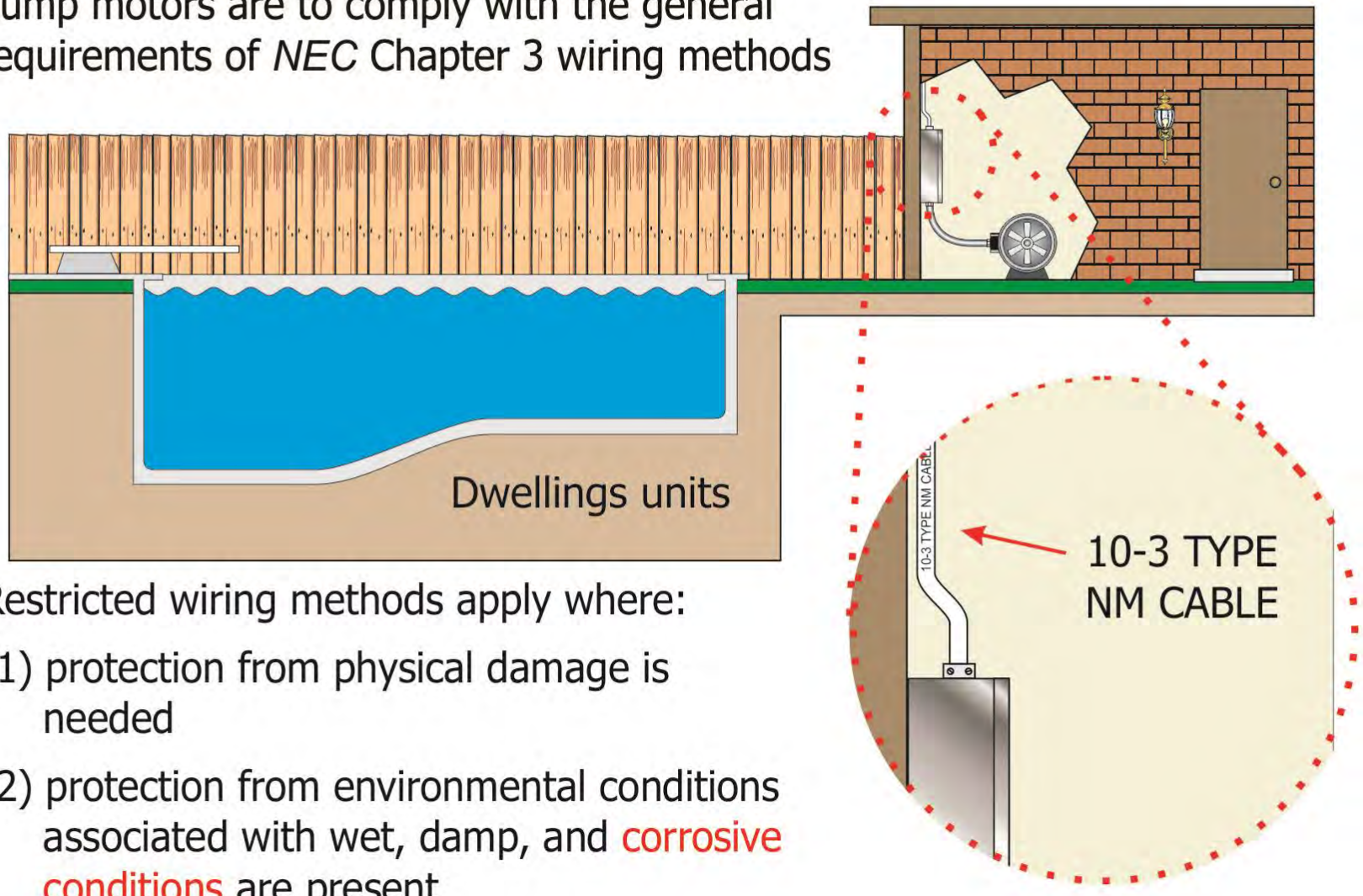
- All motors associated with permanently installed pools and installed in a **corrosive environment** are required to be connected to an **equipment-grounding conductor**
- EGC to be sized based on the rating of the overcurrent protective device ahead of the branch circuit supplying the motor in conjunction with IRC Table E3908.12 *(NEC Table 250.122)*
- This EGC must be:
  - Insulated
  - Copper conductor
  - Not smaller than 12 AWG
- See IRC E4205.2 *[NEC 680.21(A)(1)]*

Wiring Methods for Permanently Installed Pool-Associated Motors *(cont.)*

- Where installed in **noncorrosive environments** *(such as on or inside the dwelling unit)* branch circuits would simply need to comply with the general requirements in **IRC Chapter 38** *(NEC Chapter 3)*
- This could be nonmetallic-sheathed cable (Type NM cable) in dry locations
- See IRC E4202.2 and E4205.2 *[NEC 680.21(A)(1)]*

E4202.1, E4202.2 Wiring Methods (Motors)

Where installed in noncorrosive environments *(such as the interior of a dwelling unit)*, branch circuits wiring methods for permanently installed swimming pool pump motors are to comply with the general requirements of *NEC* Chapter 3 wiring methods



Restricted wiring methods apply where:

(1) protection from physical damage is needed

(2) protection from environmental conditions associated with wet, damp, and corrosive conditions are present

NEC 680.21(A)(1)


Century
Rated HP x S.F. = 1.50 x 1.15
Jandy
WFTR120
Jandy Pro Series
CAUTION / PRECAUCIÓN
This pump is for use with permanently installed pools only. Do not use with storable pools. Tested for swimming pool and spa use. All electrical connections must be made by qualified personnel in compliance with all applicable codes.
Esta bomba es para piscinas de instalación fija. No usar en piscinas almacenables. Uso aprobado en piscinas de natación y spas. Personal calificado debe efectuar todas las conexiones eléctricas de acuerdo con códigos aplicables.
H0317300 Rev B
Jandy Pro Series
WARNING / ADVERTENCIA
ELECTRICAL HAZARD CAN CAUSE SEVERE INJURY OR DEATH
• Connect ground wire to green grounding screw before operating motor.
EL RIESGO ELÉCTRICO PUEDE CAUSAR LESIONES GRAVES E INCLUSO LA MUERTE.
• Conecte el cable a tierra al tornillo verde de descarga a tierra antes de operar el motor.

E4205.6
Feeders Supplying Pool Equipment

- Wiring methods permitted for a feeder on the supply side of a panelboard that supplies pool-associated equipment for permanently installed pools, spa, or hot tubs will depend on the type of environment the feeder is exposed to
- Feeder wiring methods installed in a corrosive environment as described in IRC E4202.2 [*NEC* 680.14] shall be listed and identified for use in such areas and shall be considered to be resistant to the corrosive environment
- Feeder to consist of:
  - Rigid metal conduit
  - Intermediate metal conduit
  - Rigid polyvinyl chloride conduit
  - Reinforced thermosetting resin conduit
  - Liquidtight flexible nonmetallic conduit [IRC E4205.6 or *NEC* 680.25(A)]
- See IRC E4202.2.1 *[NEC 680.14(B)]*

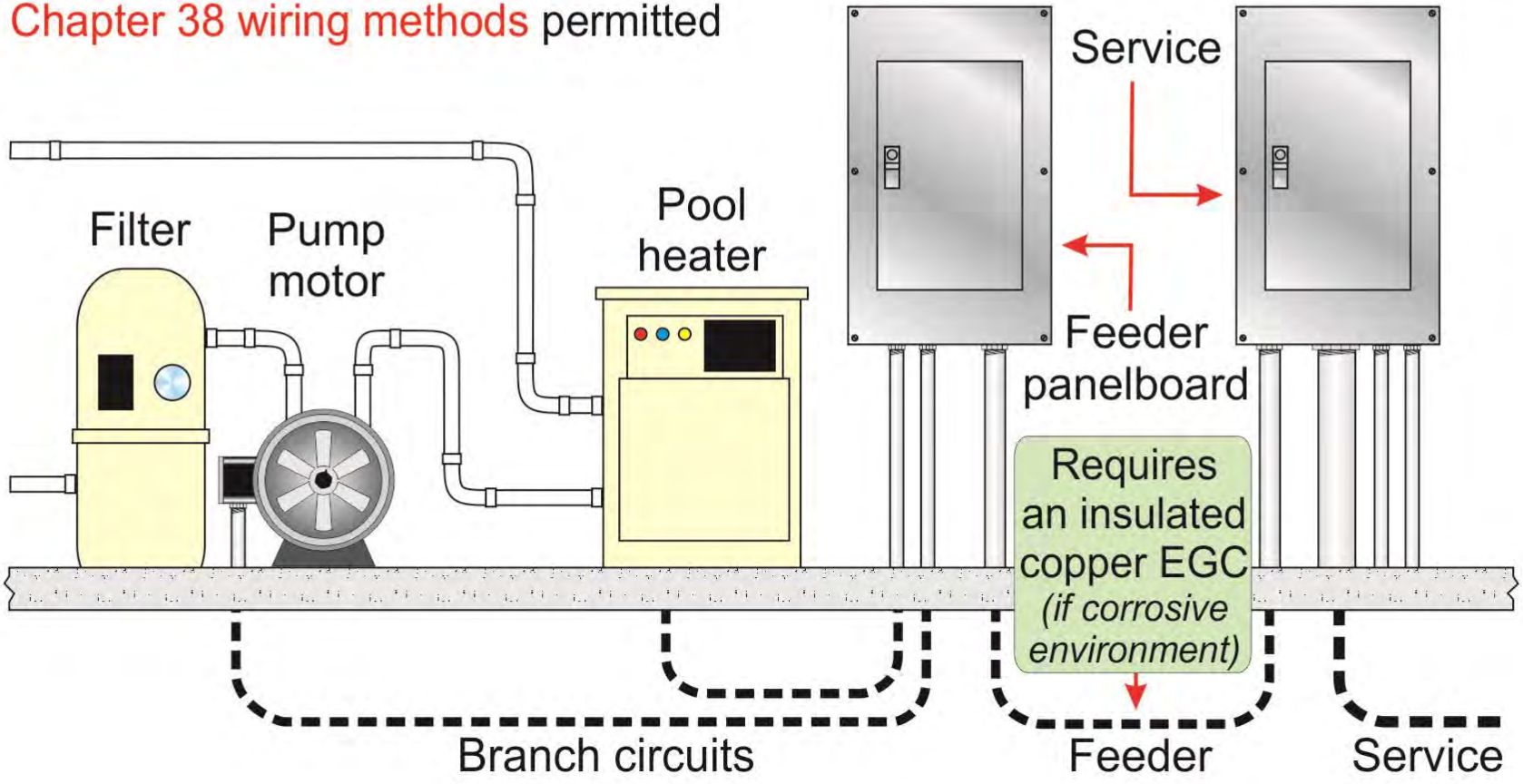
NEC 680.25(A)

E4205.6 Feeder to Swimming Pool Panelboard

Feeder to swimming pool panelboard requires restricted wiring methods only in areas where harsh conditions *(physical damage, environmental conditions, corrosive conditions, etc.)* are present

Requires an insulated, copper equipment grounding conductor *(not smaller than 12 AWG)* where installed in a corrosive environment

In noncorrosive environments, IRC Chapter 38 wiring methods permitted

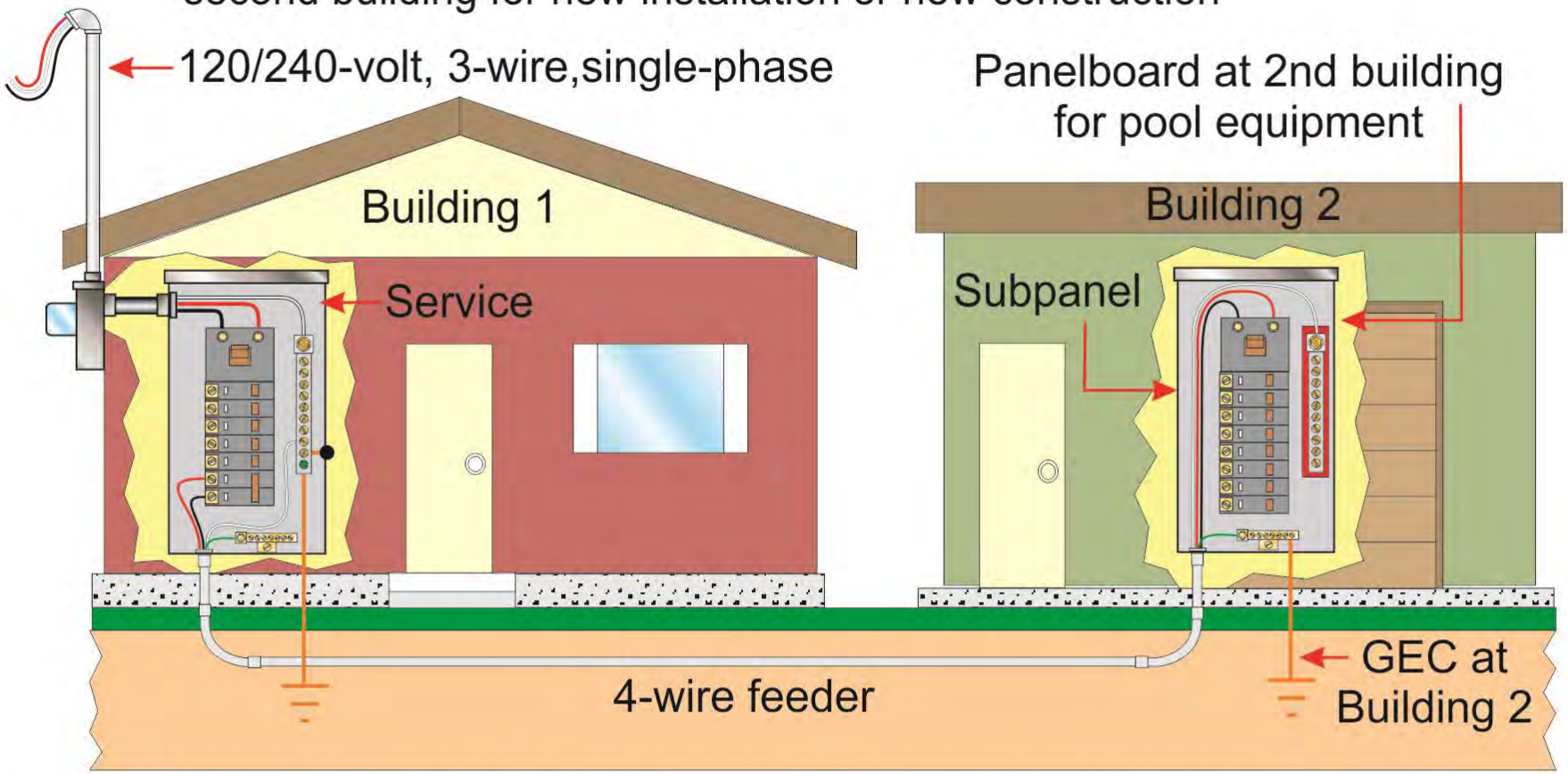


E3607.3 Swimming Pool Panelboards in Other Buildings

- Where a feeder supplies a panelboard at a separate building or structure, an equipment grounding conductor (EGC) must be installed and be connected to the building or structure disconnecting means and to the established grounding electrode(s) at the separate building or structure
- Any installed grounded conductor to the separate building or structure must be isolated from and is not permitted to be connected to the EGC terminal bar or to the grounding electrode(s)
- EGC run with the feeder must be insulated (if installed in a corrosive environment) and connected to the EGC terminal of the panelboard at the separate building or structure
- See exception for installations made in compliance with previous editions of the *Code (existing installations only)*

E3607.3 Pool Panelboards in Other Buildings

Equipment grounding conductor required in feeder for grounding at second building for new installation or new construction



Feeder requires an EGC to the pool equipment building and separation of the neutral conductors and EGCs at Building 2

Connect grounding electrode conductor(s) at Building 2 to feeder disconnect enclosure *(equipment grounding terminal bar)*

Low-Voltage Gas-Fired Luminaires, Decorative Fireplaces, Fire Pits, and Similar Equipment

- Listed low-voltage gas-fired units using **low-voltage ignitors** are permitted to be located **less than 1.5 m (5 ft)** from the inside walls of the pool
- Units **do not require grounding** and are supplied by listed transformers or power supplies with outputs that **do not exceed the low-voltage contact limit**
- **Metallic equipment** associated with such listed low-voltage gas-fired units must be bonded to the **equipotential bonding grid**
- Any **metallic gas piping** for this type of units must be bonded
- With the inclusion of **electronic ignitors** for these devices, *NEC* regulations needed for this type of equipment
- Provisions for low-voltage gas fire equipment needed with the conversion of gas luminaire technology away from manual ignition and toward the use of low-voltage electronic ignitors
- See IRC E4203.4.7

NEC 680.22(B)(7)

E4203.4.7 Low-Voltage Gas-Fired Equipment

New requirements added for low-voltage gas-fired luminaires, decorative fireplaces, fire pits, and similar equipment

Listed low-voltage gas-fired luminaires, decorative fireplaces, fire pits, and similar equipment using low-voltage ignitors with outputs that do not exceed the low-voltage contact limit shall be permitted to be located less than 1.5 m (5 ft) from the inside walls of a permanently installed pool

NEC 680.22(B)(7)

Storable Pools, Storable Spas, and Storable Hot Tubs

E4201.2 Definitions

- **Permanently Installed Swimming, Wading, Immersion, and Therapeutic Pools:** "Those that are constructed in the ground or partially in the ground, and all others capable of holding water in a **depth greater than 1.0 m (42 in.)**, and all pools installed inside of a building, regardless of water depth, whether or not served by electrical circuits of any nature."
- **Storable Swimming, Wading, or Immersion Pools; or Storable/Portable Spas and Hot Tubs:** "Swimming, wading, or immersion pools that are **intended to be stored** when not in use, constructed on or above the ground and are capable of holding water to a **maximum depth of 1.0 m (42 in.)**, or a pool, spa, or hot tub constructed on or above the ground, with nonmetallic, molded polymeric walls or inflatable fabric walls regardless of dimension."

NEC 680.2

E4201.1 Definitions: Storable Swimming, Wading, or Immersion Pools; or Storable/Portable Spas and Hot Tubs

Swimming, wading, or immersion pools are intended to be stored when not in use, constructed on or above the ground

Mut be capable of holding water to a maximum depth of 1.0 m (42 in.), or a pool, spa, or hot tub constructed on or above the ground, with nonmetallic, molded polymeric walls or inflatable fabric walls regardless of dimension


Lay-Z-Spa
Vegas

E4207.1 Pump Motors for Storable Pools, Storable Spas, or Storable Hot Tubs

- A **cord-connected** pool filter pump motor, used for a storable pool, storable spa, or storable hot tub must incorporate an **approved system of double insulation** or its equivalent
- Must be provided with a means for grounding only the internal and nonaccessible, non–current-carrying metal parts of the appliance
- Means for grounding must be by an **equipment grounding conductor** that is run with the power-supply conductors within the flexible cord
- EGC must be properly terminated in a **grounding-type attachment plug** having a fixed grounding contact member
- Must have **GFCI** protection that is an **integral part of the attachment plug** or located in the power supply cord within **300 mm (12 in.)** of the attachment plug

NEC 680.31

E4207.1 Pump Motors for Storable Pools, Storable Spas, or Storable Hot Tubs *(cont.)*

- Listed pump motors for storable swimming pools, storable spas, and storable hot tubs permitted to have minimum **7.5 m (25 ft)** supply cord *(per its listing)*
- Product safety standard for storable pool pumps, **UL 1081** ***(Standard for Swimming Pool Pumps, Filters, and Chlorinators)***
- UL Product Spec *(formally UL White Book)* (Category **WCSX**), requires they be marked with the word **"CAUTION"** and the following or equivalent statement:

This Pump Is for Use with Storable Pools Only —

Do Not Use with Permanently-Installed Pools

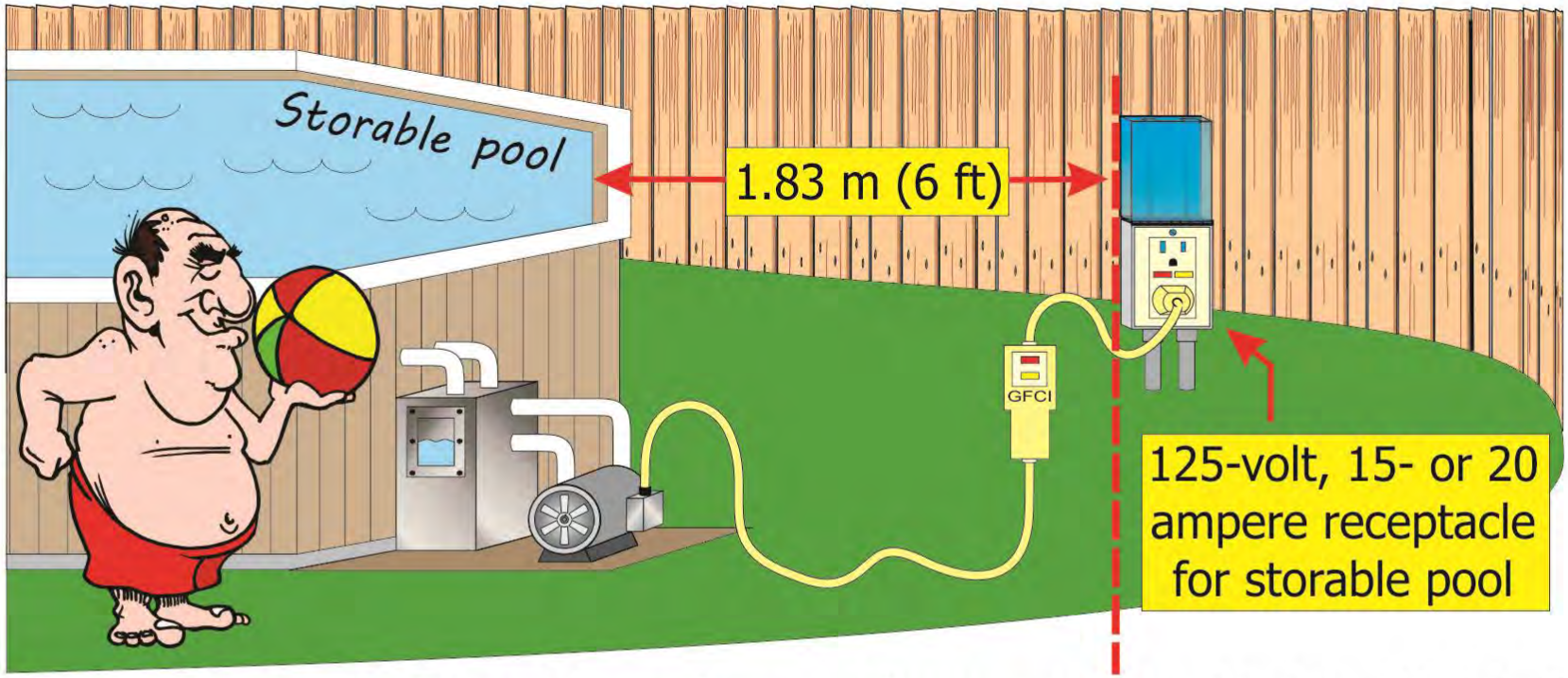
NEC 680.31

Luminaires for Storable Pools, Storable Spas, or Storable Hot Tubs

- A luminaire installed in or on the wall of a storable pool, storable spa, or storable hot tub are typically a **through-wall lighting assembly**
- For luminaires that operate **within the low voltage contact limits**, **must** be part of a cord- and plug-connected lighting assembly
- Lighting assembly operating at **over the low voltage contact limits** *(without a transformer or power supply)* and **not over 150 volts** shall be **permitted** to be cord-and-plug-connected where the assembly is listed as an assembly for the purpose
- See IRC E4207.3.1 and E4207.3.2

NEC 680.33(A) and (B)

GFCI and Receptacle Locations for Storable Pools



Receptacles for or at storable pools, storable spas, or storable hot tubs shall meet the following requirements:

- Cannot be located less than 1.83 m (6 ft) from the inside walls [E4207.4]
- All 125-volt, 15- or 20-ampere receptacles located within 6.0 m (20 ft) of the inside walls shall be GFCI-protected [E4207.2]
- Cord- and plug-connected filter pumps shall be provided with a GFCI that is an integral part of the attachment plug or located in the power supply cord within 300 mm (12 in.) of attachment plug [E4207.1]

NEC 680.34, 680.32, 680.31

Spa or Hot Tub Installed Outdoors

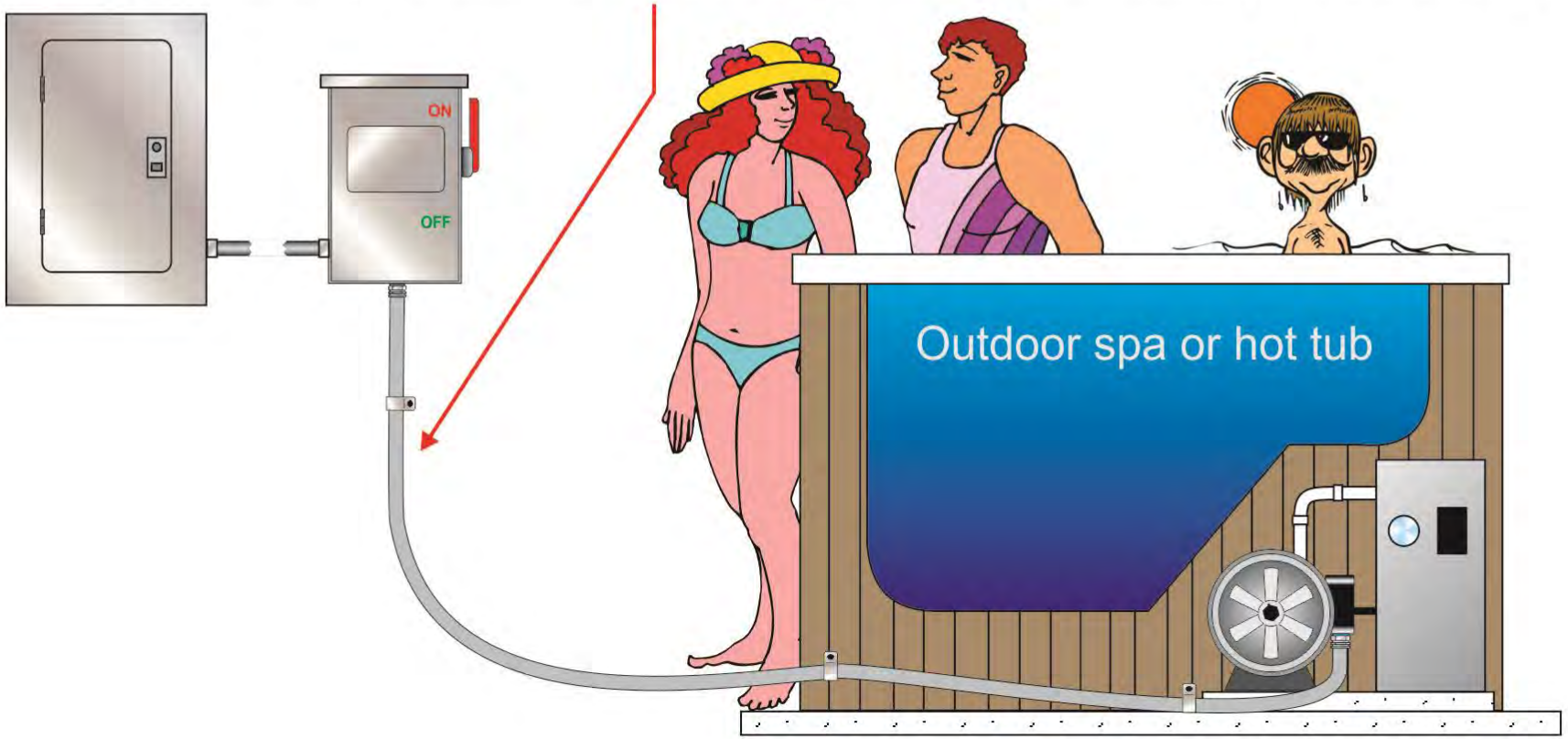
- Spas or hot tubs installed outdoors must generally comply with the provisions that apply to **permanently installed pools**
- All rules for **receptacles**, **luminaires**, **grounding and bonding** that apply to a permanently installed swimming pool also apply to spas and hot tubs that are installed outdoors
- **Two alternatives** to this general rule allow for **listed packaged units** utilizing a factory-installed remote panelboard to be connected with:
  - **Liquidtight flexible metal conduit** or **liquidtight flexible nonmetallic conduit** installed per its listing and the manufactures specifications
  - **Cord- and plug-connected** with a cord not longer than 4.6 m (15 ft) when protected by a GFCI
- See IRC E4202.2 and Table E4202.1

NEC 680.42(A)(1) and (A)(2)

Table E4202.1 Outdoor Spas and Hot Tubs

Listed packaged spa or hot tub equipment assemblies or self-contained spas or hot tubs are permitted to use liquidtight flexible metal conduit or liquidtight flexible nonmetallic conduit

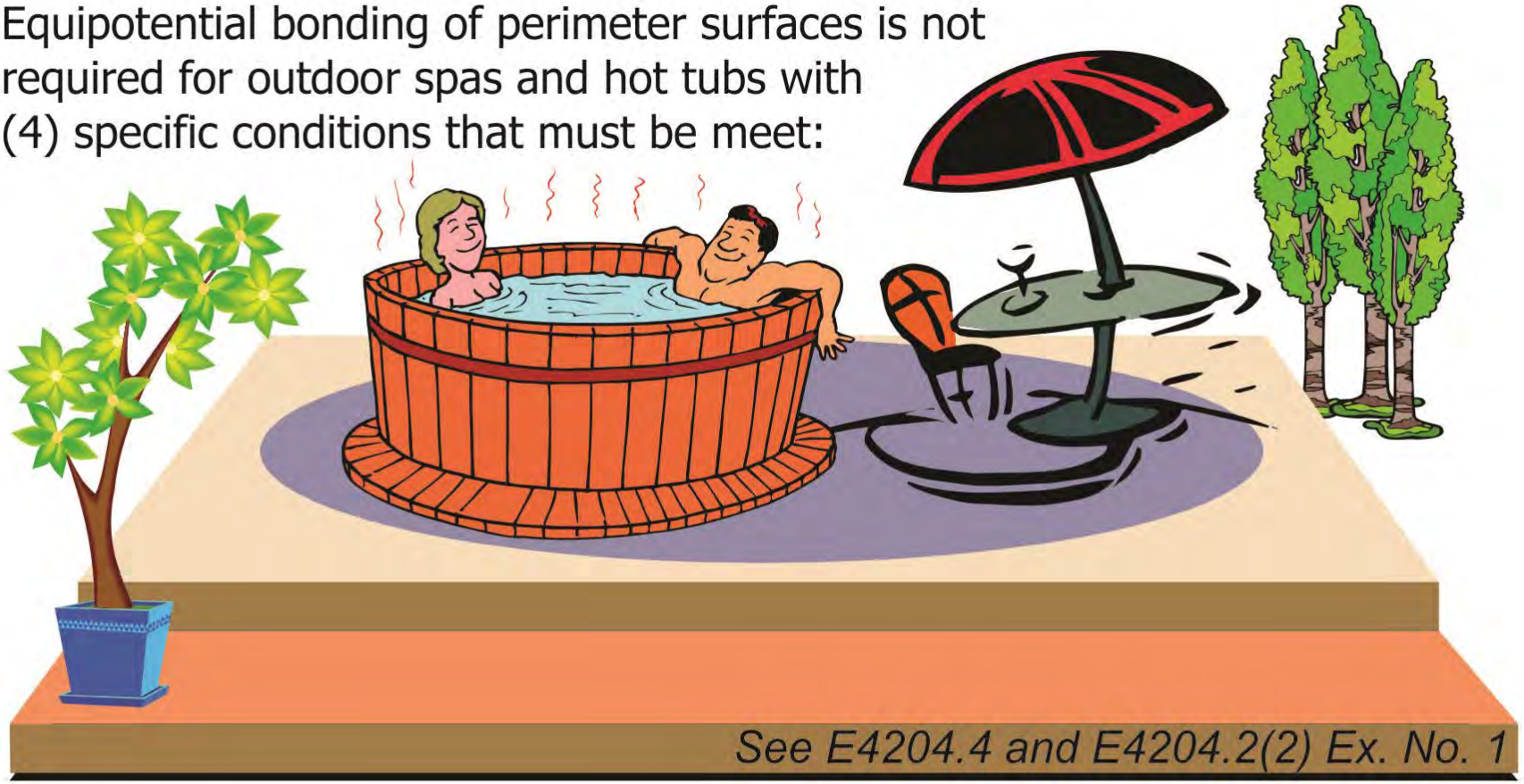
LFNC permitted in lengths longer than 1.8 m (6 ft) where securely fastened at intervals not exceeding 900 mm (3 ft) and within 300 mm (12 in.) on each side of every outlet box, junction box, cabinet, or fitting [*NEC* 356.10(5) and 356.30(1)]



NEC 680.42(A)(1), 356.10(5), 356.30(1)

Outdoor Spas and Hot Tubs (Bonding)

Equipotential bonding of perimeter surfaces is not required for outdoor spas and hot tubs with (4) specific conditions that must be meet:



(1) Listed as a self-contained spa for aboveground use

(2) Not be identified as suitable only for indoor use

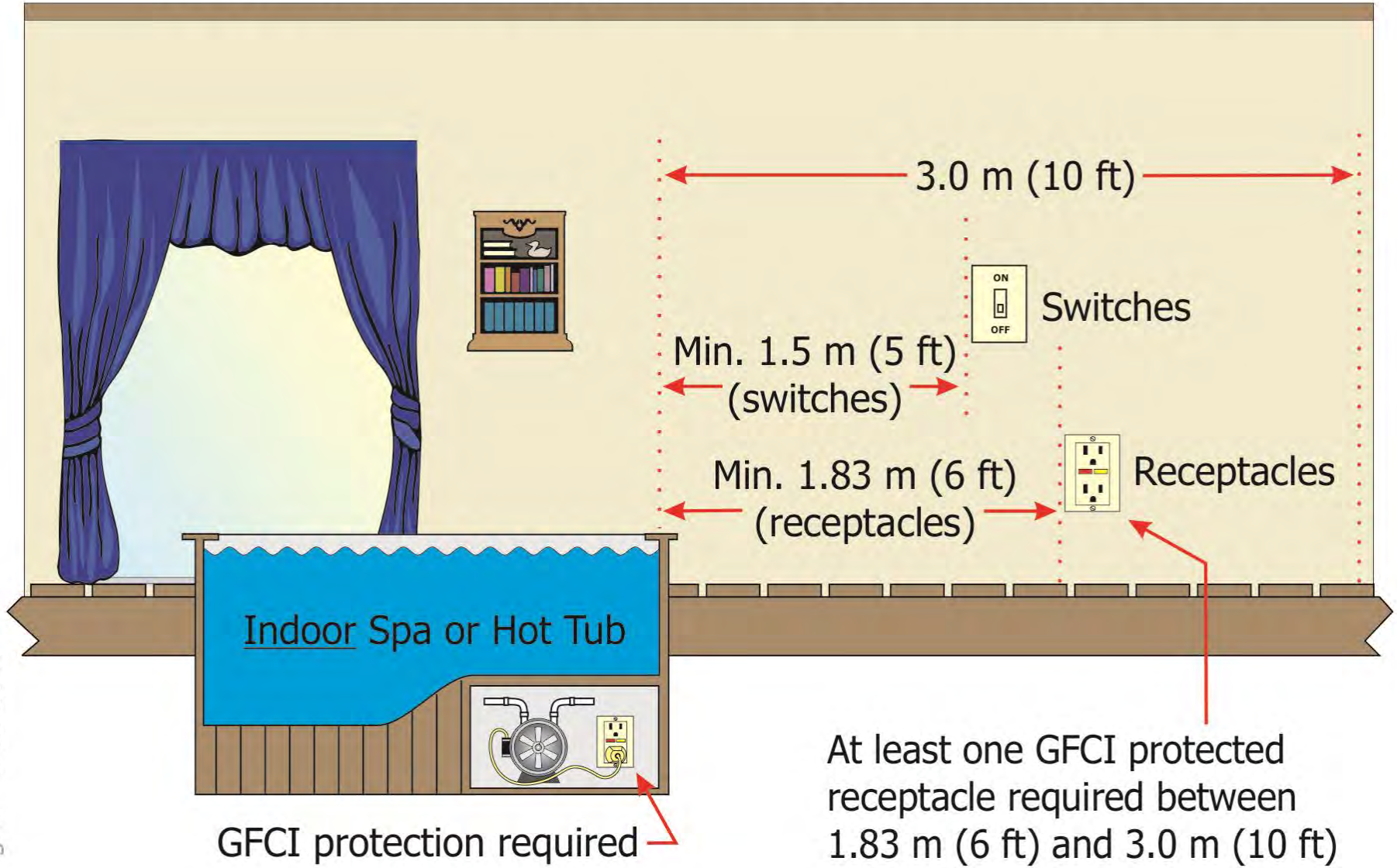
(3) Installation per manufacturer's instructions and located on or above grade

(4) Top rim located at least 710 mm (28 in.) above all perimeter surfaces that are within 760 mm (30 in.) (horizontally) from the spa or hot tub

NEC 680.42(B)

E4203 Indoor Spas and Hot Tubs

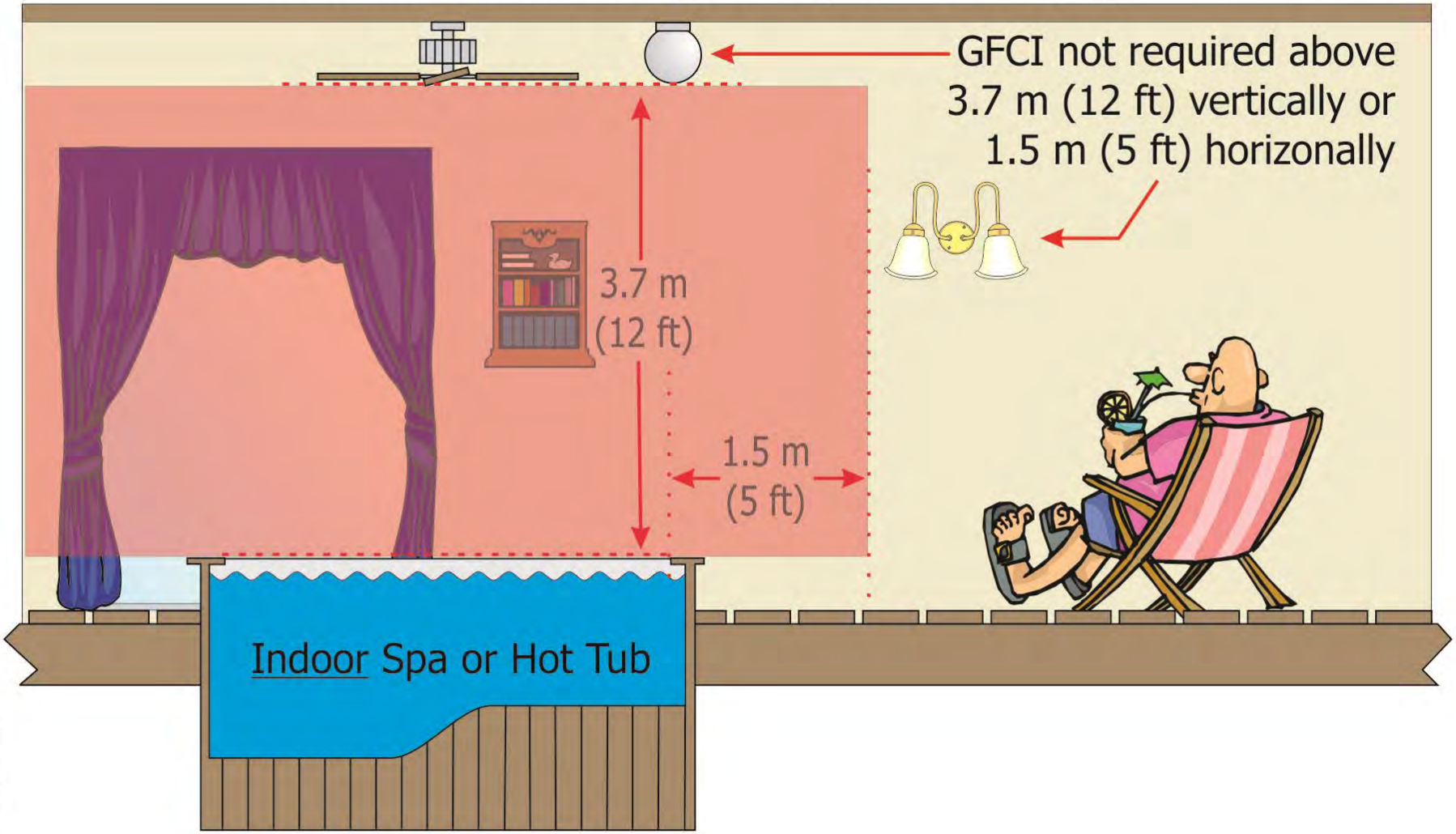
Receptacles [E4203.1.5, E4203.1.6] & Switches [E4203.2]



NEC 680.43(A) & (C)

E4203.4 Indoor Spas and Hot Tubs

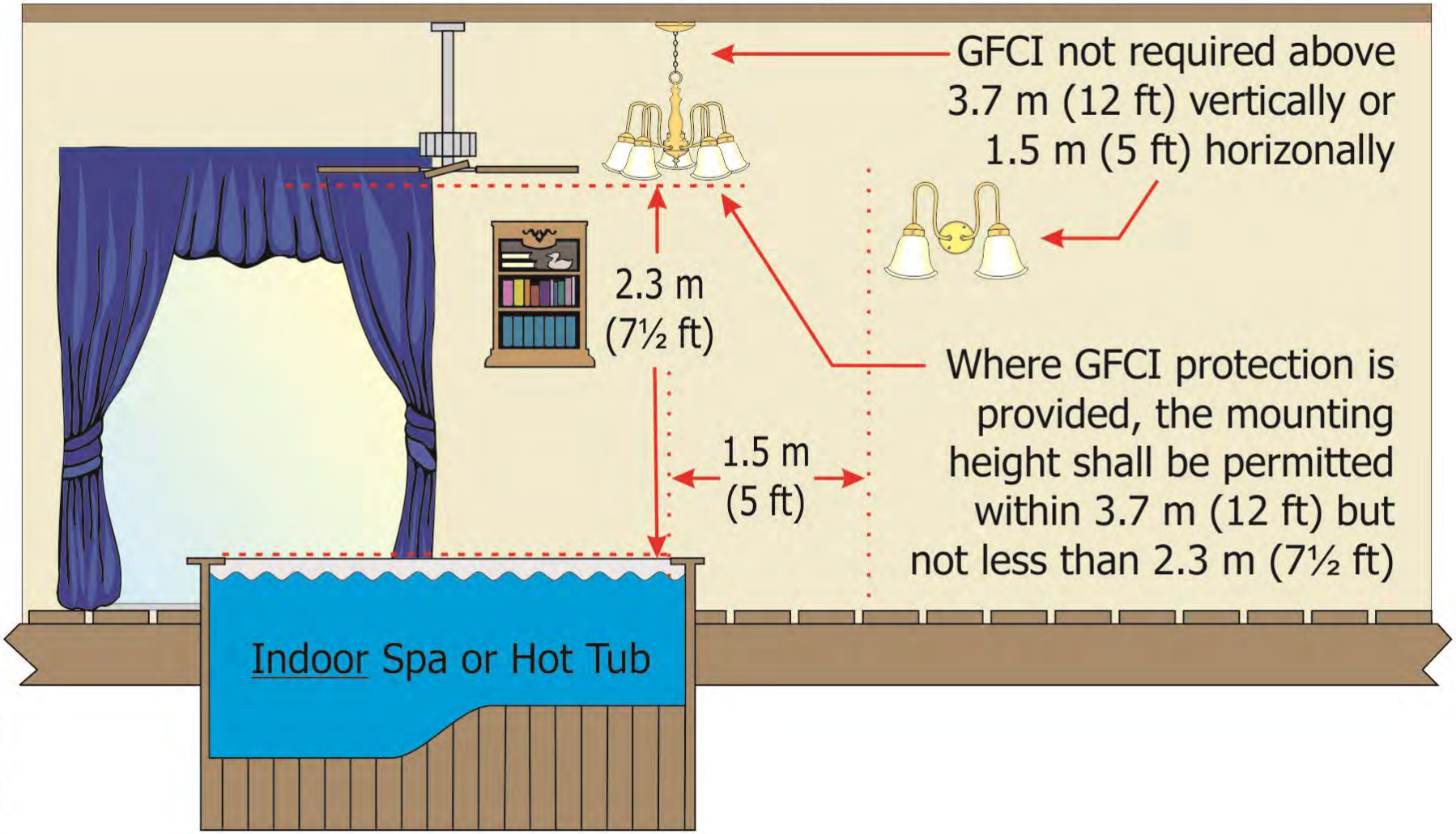
Luminaires & Ceiling Fans [E4203.4.5(1)]



NEC 680.43(B)(1)(a)

E4203.4 Indoor Spas and Hot Tubs

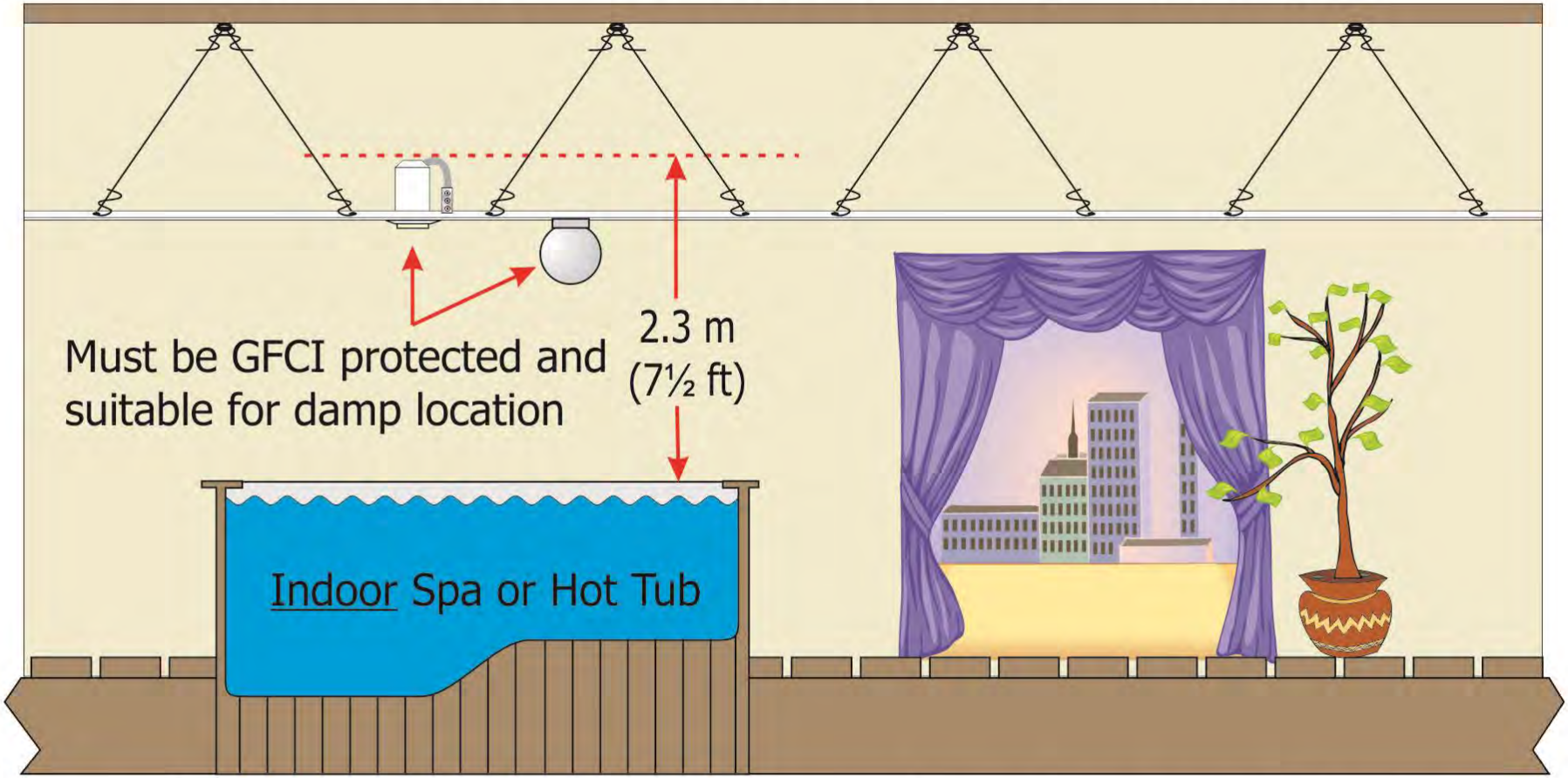
Luminaires & Ceiling Fans [E4203.4.5(1)]



NEC 680.43(B)(1)(b)

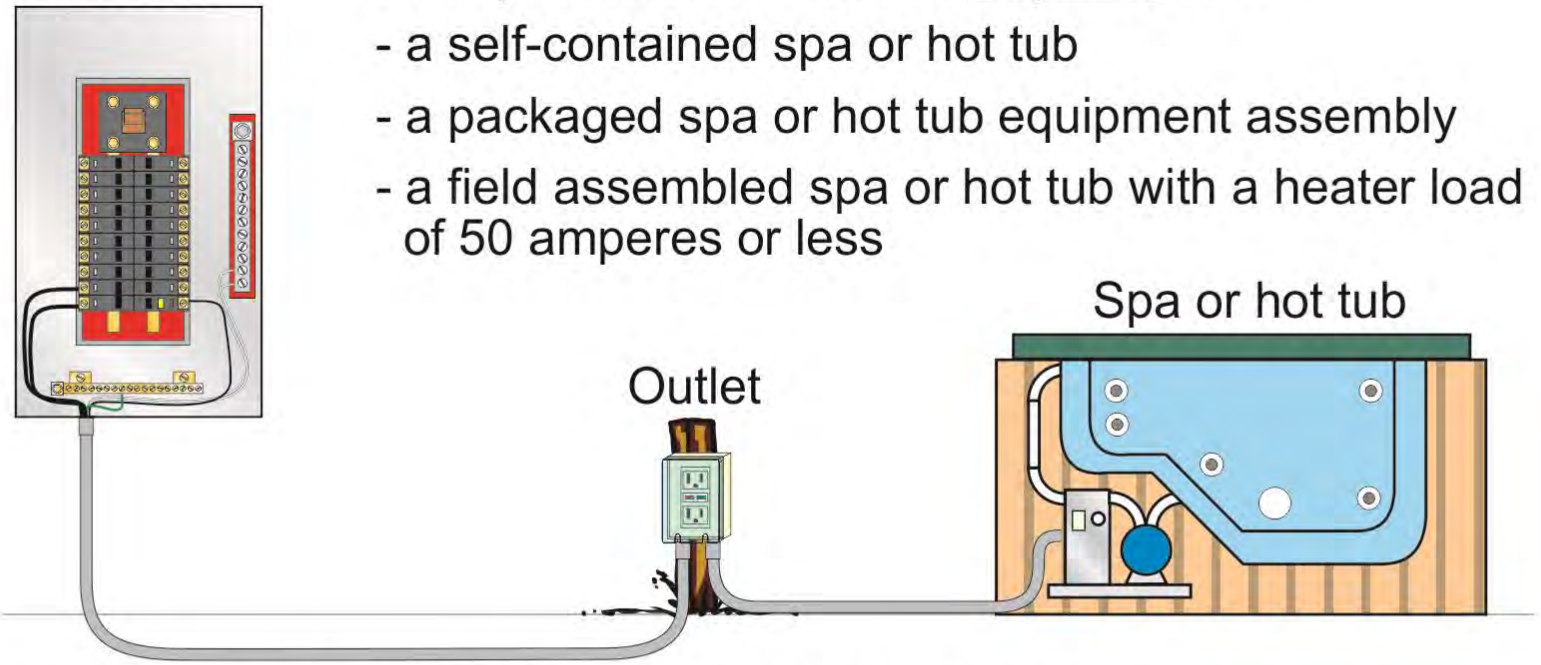
E4203.4 Indoor Spas and Hot Tubs

Recessed & Surface-Mounted Luminaires [E4203.4.5(2)]



Permitted less than 2.3 m (7½ ft) if recessed or surface-mounted luminaire with glass or plastic globe, nonmetallic body, or metallic body isolated from contact

E4208.1 GFCI Protection for Spas and Hot Tubs



GFCI protection of outlet <u>required</u> for:

- a self-contained spa or hot tub
- a packaged spa or hot tub equipment assembly
- a field assembled spa or hot tub with a heater load of 50 amperes or less

Additional GFCI protection <u>not required</u> for:

- Listed self-contained unit or listed packaged equipment assembly marked to indicate integral GFCI protection is provided for all electrical parts within the unit or assembly
- Field-assembled spa or hot tub rated greater than 250 volts or 3-phase with a heater load of more than 50 amperes
- Combination pool/hot tub commonly bonded with GFCI provided for pool

Hydromassage Bathtubs

- **Definition: Hydromassage Bathtub:** "A permanently installed bathtub equipped with a recirculating piping system, pump and associated equipment. It is designed so it can **accept, circulate, and discharge water** upon each use." [E4201.2]
- General requirements for hydromassage bath tubs are addressed at E4209 of IRC
- Required to comply with Part VII only of *NEC* Article 680
- Part VII is a "stand-along" part of *NEC* Article 680
- Not required to comply with other parts of *NEC* Article 680 *(such as Part I-General Requirements) [NEC 6802.70]*

E4209.2 GFCI Protection for Hydromassage Bathtubs

- Hydromassage bathtubs and their associated electrical components shall be on an **individual branch circuit** and protected by a **readily accessible GFCI** device

- All 125-volt, single-phase receptacles *(not exceeding **30 amperes**)* and located within **1.83 m (6 ft)** of the inside walls of hydromassage tubs shall be GFCI protected

NEC 680.71

E4209.2 GFCI for Hydromassage Bathtub

Hydromassage bathtub electrical equipment requires GFCI protection from individual branch circuit

GFCI device required to be readily accessible

All 125-volt, single phase receptacles (up to 30 ampere) located within 1.83 m (6 ft) of hydromassage tub require GFCI protection

NEC 680.71

E4209.3, E4209.4 Hydromassage Bathtubs

- Luminaires, switches, receptacles, and other electrical equipment located in the same room, and not directly associated with a hydromassage bathtub, shall be installed in accordance with the requirements of the IRC relative to the installation of electrical equipment in bathrooms or the requirements of *NEC* Chapters 1-4 [E4209.3 or *NEC* 680.72]
- Hydromassage bathtub electrical equipment shall be **accessible** without damaging the building structure or building finish [E4209.4 or *NEC* 680.73]
- Where cord- and plug-connected with receptacle under tub skirt, the receptacle shall be installed so that its face is within **direct view** and not more than **300 mm (1 ft)** from the opening [E4209.4 or *NEC* 680.73]

NEC 680.72, 680.73

E4209.4 Accessibility for Hydromassage Bathtub

Hydromassage bathtub electrical equipment shall be accessible without damaging the building structure or building finish

A receptacle for a cord- and plug-connected hydromassage bathtub, located under the tub and accessible only through an access opening, must be installed so that the receptacle face is within direct view from the service access opening and located not more than 300 mm (1 ft) from the opening

NEC 680.73

E4209.5
Bonding at Hydromassage Bathtubs

- The following parts associated with a hydormassage shall be bonded together:
  - (1) All **metal fittings** within or attached to the tub structure that are in contact with the circulating water
  - (2) **Metal parts of electrical equipment** associated with the tub water circulating system, including pump and blower motors
  - (3) Metal-sheathed cables and raceways and **metal piping** that are within **1.5 m (5 ft)** of the inside walls of the tub and not separated from the tub by a permanent barrier

NEC 680.74(A)

E4209.5
Bonding at Hydromassage Bathtubs *(cont.)*

- The following parts associated with a hydormassage shall be bonded together: *(cont.)*
  - (4) All **exposed metal surfaces** that are within **1.5 m (5 ft)** of the inside walls of the tub and not separated from the tub area by a permanent barrier
  - (5) **Electrical devices and controls** that are not associated with the hydromassage tubs and that are located within **1.5 m (5 ft)** from such units
- **Small conductive surfaces** not likely to become energized **not required to be bonded** *(air and water jets, drain fittings not connected to metallic piping, towel bars, mirror frames)*
- **Double-insulated motors** not required to be bonded

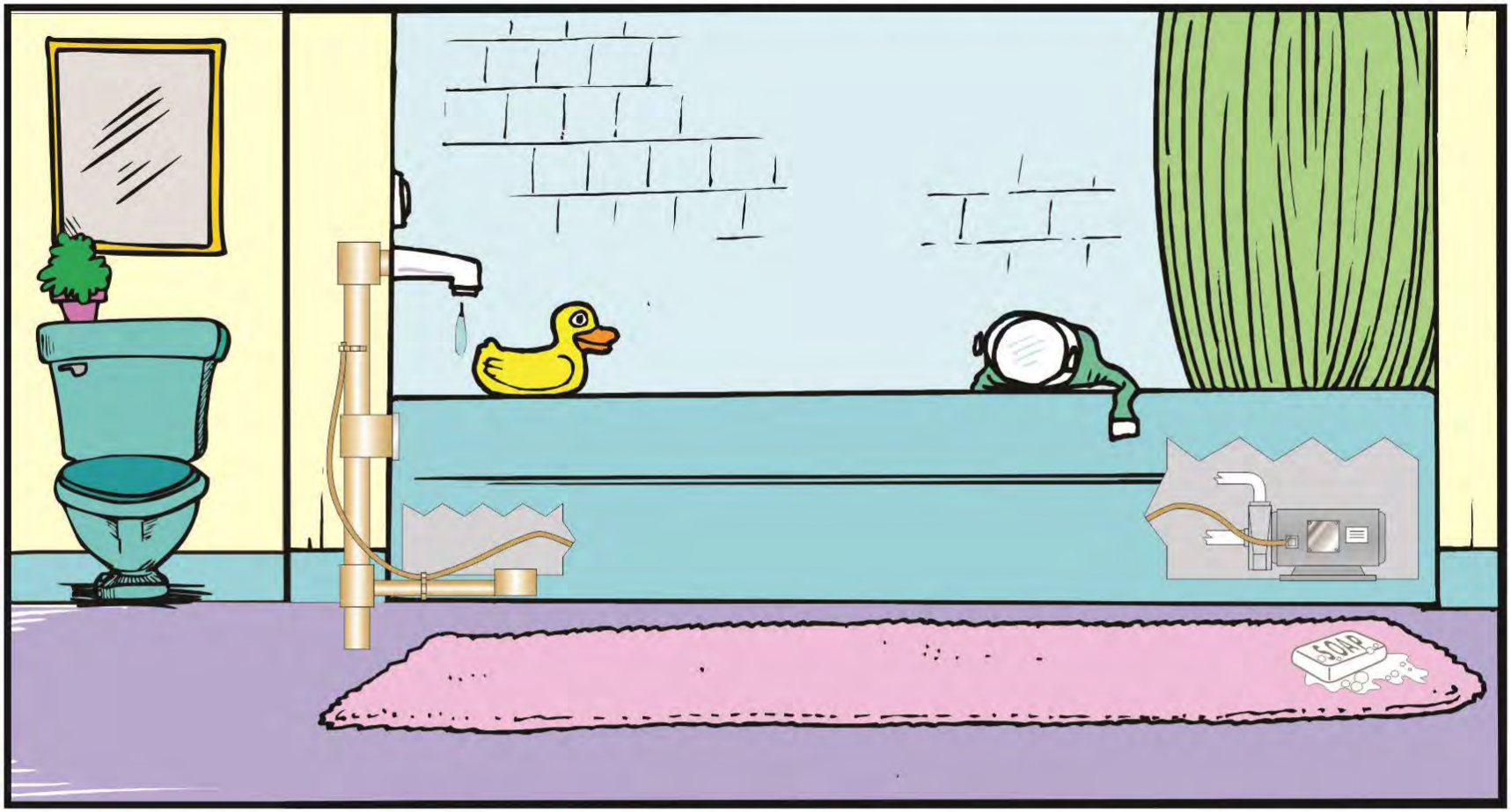
NEC 680.74(A)

E4209.6
Bonding at Hydromassage Bathtubs *(cont.)*

- A **8 AWG** or larger **solid copper** bonding jumper:
  - Can be insulated, covered, or bare
  - Required for **equipotential bonding** in the area of the hydromassage bathtub
  - Not required to be extended or attached to any remote panelboard, service equipment, or any electrode
- A 8 AWG or larger solid copper bonding jumper shall be installed long enough to terminate on a **replacement non-double-insulated pump motor**
- This bonding jumper is to **terminated to the EGC** of the branch circuit of the motor when a double-insulated circulating pump motor is used

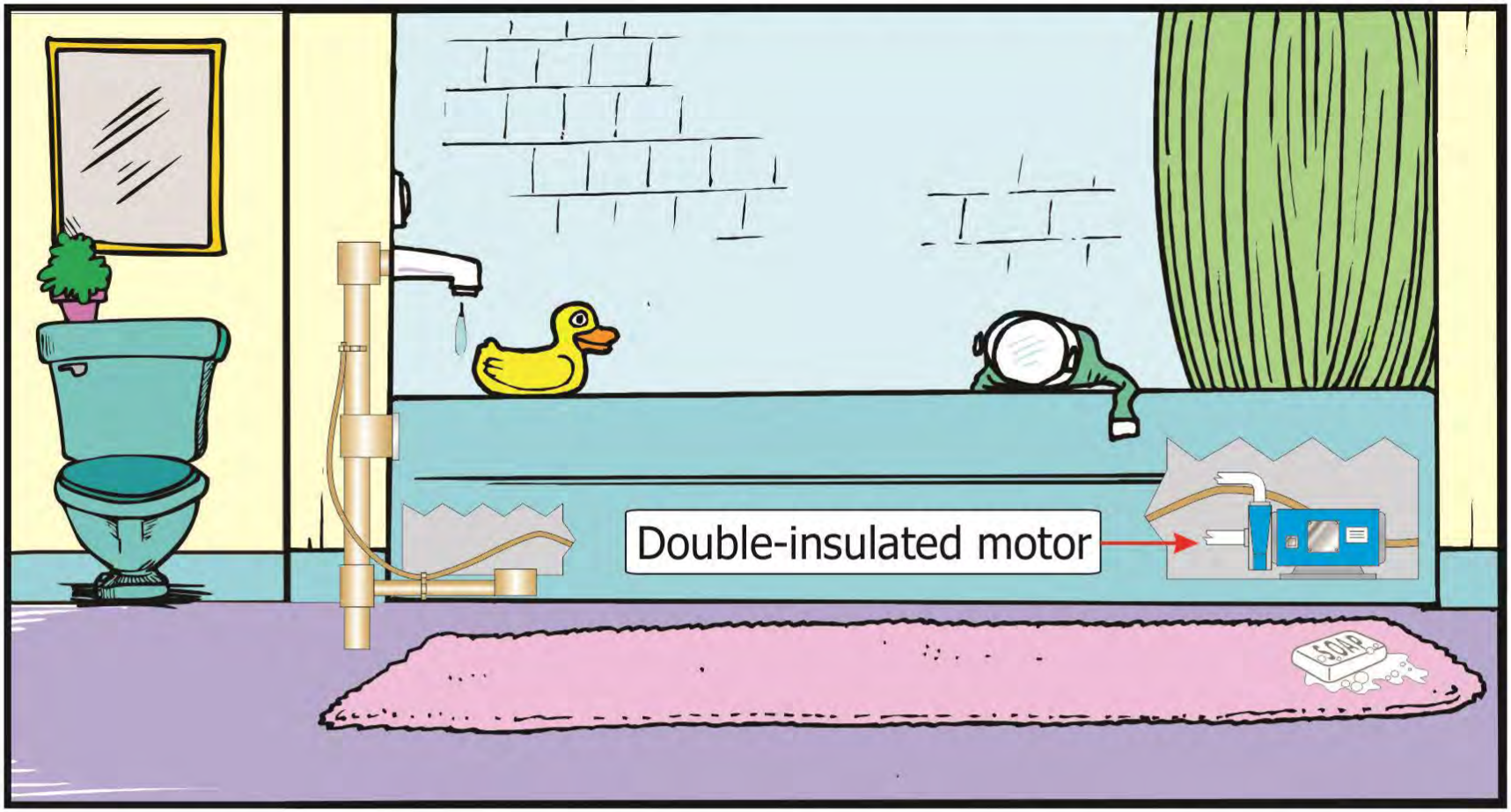
NEC 680.74(B)

E4209.5 Bonding Requirements



Items required to be bonded: All metal fittings within or attached to tub in contact with circulating water, any metal parts of electrical equipment associated with the circulating system, all metal-sheathed cables, race-ways, metal piping, all exposed metal surfaces *(not separated from tub by a permanent barrier)*, electrical devices and controls *(not associated with tub)* located within 1.5 m (5 ft) from such units

E4209.6 Bonding Requirements



Bonding jumper not required to be connected to double-insulated pump motor

8 AWG or larger solid copper bonding jumper is required to be long enough to terminate on a replacement non-double-insulated circulating pump motor *(terminated to EGC of branch circuit of DI motor)*

NEC 680.74(B)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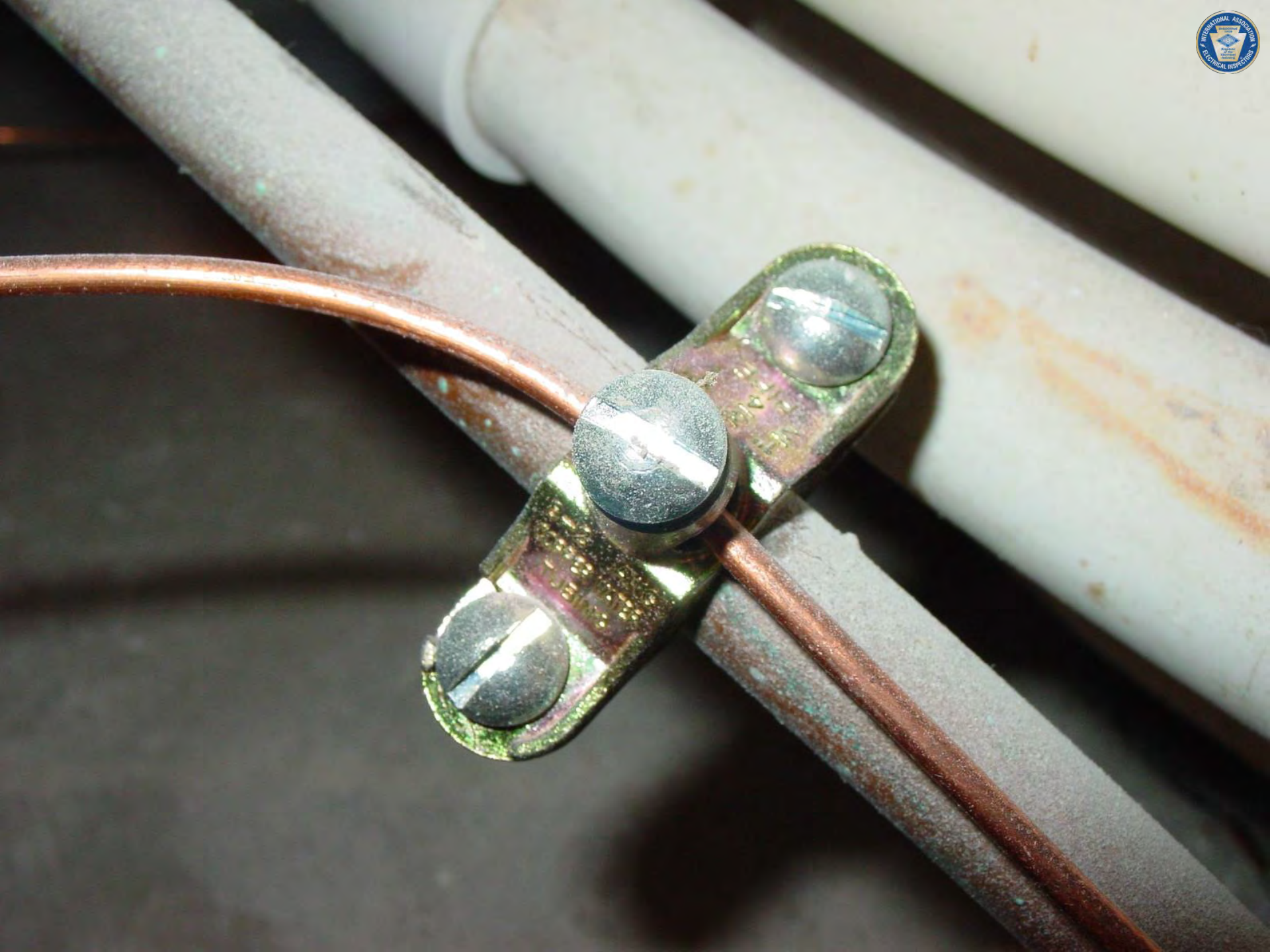
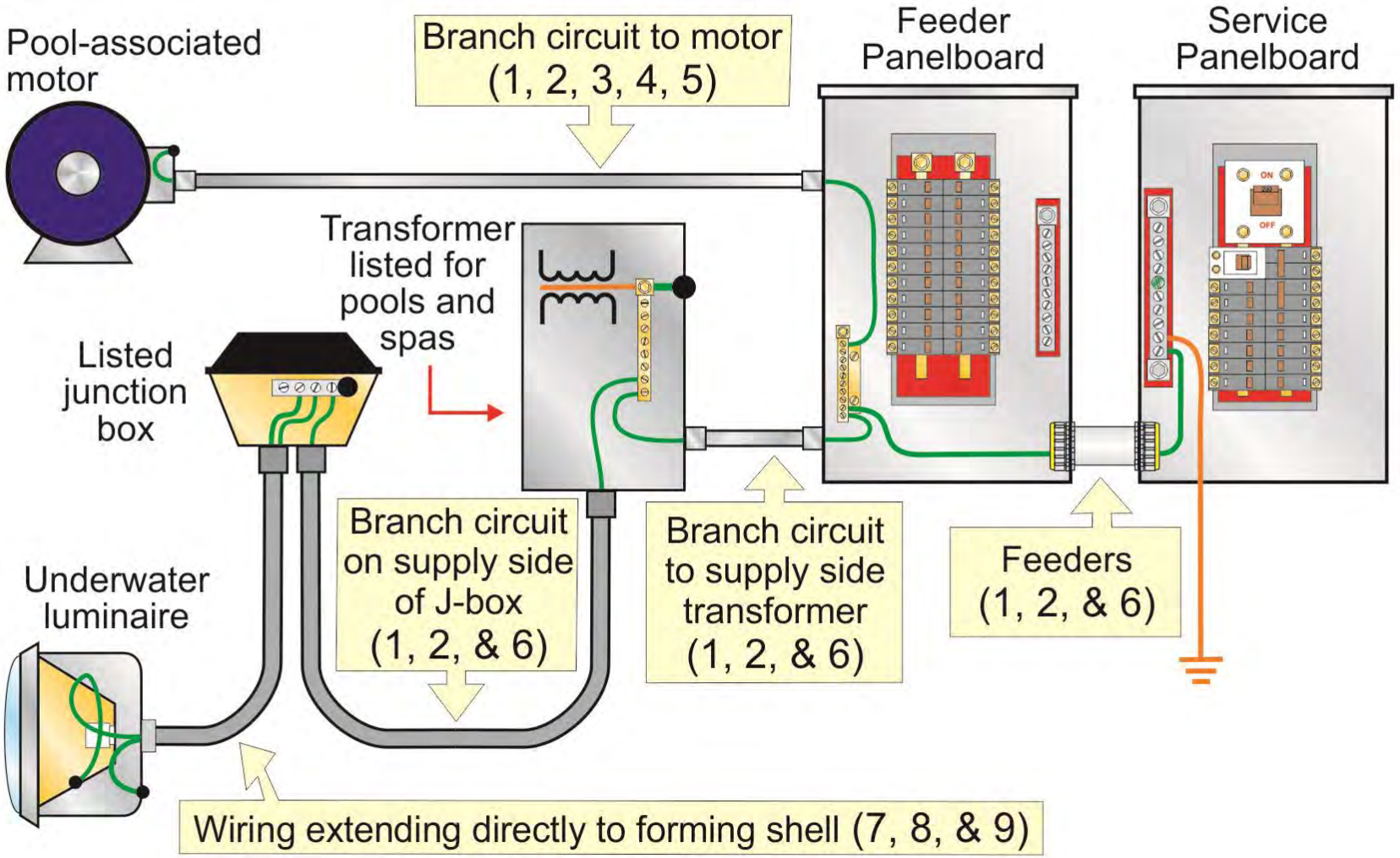


EGC & Wiring Method Requirements for Pools

Equipment Grounding Conductor (EGC) Connections and Wiring Methods from Service to Permanently Installed Pool Equipment



Legend: *(see next slide)*

EGC & Wiring Method Requirements for Pools

Equipment Grounding Conductor (EGC) Connections and Wiring Methods from Service to Permanently Installed Pool Equipment

Legend:

1. Where installed in a corrosive environment; Rigid metal conduit, intermediate metal conduit, rigid polyvinyl chloride PVC conduit, and reinforced thermosetting resin conduit with an insulated copper EGC sized in accordance with *NEC* Table 250.122 or IRC Table E3908.12 but not smaller than 12 AWG.
2. Where installed in noncorrosive environments, branch circuits or feeders to comply with the general requirements in *NEC* Chapter 3 or IRC Chapter 38.
3. For motors installed in a corrosive environment; Wiring methods of List Item No. 1 or Type MC cable listed for the environment with an insulated copper EGC sized in accordance with *NEC* Table 250.122 or IRC Table E3908.12 but not smaller than 12 AWG.
4. For a motor application; Liquidtight flexible metal or liquidtight flexible nonmetallic conduit with listed fittings permitted where flexibility required.
5. Flexible cord permitted for connections at motors.
6. Where feeders or branch circuits on the supply side of enclosures and junction boxes connected to conduits run to underwater luminaire are installed in a corrosive environment; Wiring methods of List Item No. 1 or liquidtight flexible nonmetallic conduit with an insulated copper EGC sized in accordance with *NEC* Table 250.122 or IRC Table E3908.12 but not smaller than 12 AWG.
7. Wet-niche or no-niche luminaire supplied by flexible cord; Insulated copper EGC that is an integral part of the cord and not smaller than the supply circuit conductors and not smaller than 16 AWG.
8. For underwater luminaires; Rigid metal, intermediate metal, liquidtight flexible nonmetallic or rigid polyvinyl chloride PVC conduit. Metal conduit must be of brass or other corrosion-resistant metal.
9. For underwater luminaires; Where a nonmetallic conduit is used, an 8 AWG insulated solid or stranded copper bonding jumper installed in conduit unless a listed low-voltage lighting system not requiring grounding is used.

Swimming Pools and Similar Installations for Dwelling Units

2018 IRC

Training Presentation by:

International Association of Electrical Inspectors

ICC 2019
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