

**ONLINE ADVANCED (2023) 8TH
EDITION FLORIDA BUILDING CODE
SWIMMING POOL SAFETY**
FBC Course Number – 962.1

1 Hr. Course on Current issues/
status of code amendments for Electrical Safety related to swimming
pools

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Course Outline



Current issues/status of code amendments



Summary of relevant FBC and NEC codes and standards (UL)



Overview of proper ground and luminaire bonding, GFCIs, stray voltage



Review of proper maintenance/servicing, repair and retrofitting

Current issues/ status of code amendments

- Guidance for Pools and Spas in Flood Hazard Areas Florida Building Code (Adopted) 1612.4.2 Modification of ASCE 24 9.6 Pools. In-ground and above ground pools shall be designed to withstand all flood related loads and load combinations.
- Mechanical equipment for pools such as pumps, heating systems, and filtering systems, and their associated electrical systems shall comply with Chapter 7. Exception: Equipment for pools, spas and water features shall be permitted below the elevation required in Table 7-1 provided it is elevated to the extent practical, anchored to prevent flotation and resist flood forces and is supplied by branch circuits that have ground-fault circuit interrupter protection.





Current issues/ status of code amendments

- 4. Pool equipment buildings. Buildings that house pool equipment are accessory structures. The buildings must either be elevated or, if not elevated, be constructed to comply with the pertinent requirements for accessory buildings (allowed if used only for parking or storage) based on the flood zone.
- 5. Tanks. Tanks must meet the requirement to either be elevated or anchored to resist anticipated flood loads (e.g., Section 9.7 See ASCE 24-14).



Relevant Codes and Standards: FBC

- **8th Edition FBC - Residential: Chapter 42 & 45**
 - “Swimming pool” means any structure, located in a residential area, that is intended for swimming or recreational bathing and contains water over 24 inches deep, including, but not limited to, in-ground, aboveground, and on-ground swimming pools; hot tubs; and nonportable spas.

Relevant Codes and Standards: FBC

- **8th Edition FBC - Building: Section 454**
 - **Public swimming pool** or **public pool** means a watertight structure of concrete, masonry, or other approved materials which is located either indoors or outdoors, used for bathing or swimming by humans, and filled with a filtered and disinfected water supply, together with buildings, appurtenances, and equipment used in connection therewith.

Relevant Codes and Standards: FBC

- **8th Edition FBC - Building: Section 454**
(cont'd)
 - A public swimming pool or public pool shall mean a conventional pool, spa-type pool, wading pool, special purpose pool, or water recreation attraction, to which admission may be gained with or without payment of a fee and includes, but is not limited to, pools operated by or serving camps, churches, cities, counties, day care centers, group home facilities for eight or more clients, health spas, institutions, parks, state agencies, schools, subdivisions, or the cooperative living-type projects of five or more living units, such as apartments, boardinghouses, hotels, mobile home parks, motels, recreational vehicle parks, and townhouses. The term does not include a swimming pool located on the grounds of a private residence.









Relevant Codes and Standards:

FBC

- **Florida Building Code–Building Chapter 4**
 - 454.2.7.2– Pumps shall be installed in accordance with the manufacturer's recommendations.
 - 454.2.16 – Electrical wiring and equipment shall comply with Chapter 27 of the FBC (2020 / 2020 NEC). See FBC Ch. 35
 - 454.2.16 Electrical.– Electrical equipment wiring and installation, including the bonding and grounding of pool components, shall comply with Chapter 27 of the Florida Building Code, Building. Outlets supplying pool pump motors connected to single-phase 120-volt through 240-volt branch circuits, whether by receptacle or by direct connection, and outlets supplying other electrical equipment and underwater luminaires operating at voltages greater than the low voltage contact limit, connected to single-phase, 120 volt through 240 volt branch circuits, rated 15 or 20 amperes, whether by receptacle or by direct connection, shall be provided with ground-fault circuit interrupter protection for personnel.

Relevant Codes and Standards: FBC

- **Florida Building Code–
Building Chapter 4**
(cont'd)
 - 454.2.19 / Final
Inspection - Final
electrical and barrier
code inspection shall
be completed prior to
filling the pool with
water.
 - ◆ **Exception:** Vinyl
liner and fiberglass
pools are required
to be filled with
water upon
installation

Relevant Codes and Standards: FBC

- **Florida Building Code–
Building Chapter 4**
 - 454.1.4 – Electrical
Systems
 - ◆ .1.4.1 – Wiring and
equipment must
comply with the
NEC.
 - ◆ .1.4.2 – Artificial
lighting required
for all pools to be
used at night.

Relevant Codes and Standards: FBC

- **Florida Building Code–Building Chapter 4**
 - 454.1.4 – Electrical Systems (cont'd)
 - ◆ .4.2.1– Outdoor pools:
 - 3 feet at the pool water surface = 3 footcandles
 - Underwater = 1/2 watt per square foot
 - ◆ .4.2.2 – Indoor pools:
 - 3 feet at the pool water surface = 10 footcandles
 - Underwater = 8/10 watt per square foot
 - ◆ .4.2.3 – Underwater lighting:
 - 15 volts max. / 300 watts max.
 - Exempt when 15 footcandles is provided overhead.



Relevant Standards: NEC – Article 680

- 2020 (see FBC Chap. 35)
National Electric Code
(NEC) Article 680 -
Swimming Pools,
Fountains, & Similar
Installations:
 - I. General ***
 - II. Permanently
Installed Pools ***
 - III. Storable Pools
 - IV. Spas and Hot Tubs
 - V. Fountains
 - VI. Pools and Tubs for
Therapeutic Use
 - VII. Hydromassage
Bathtubs

Relevant Standards: NEC – Article 680

- Article 680.2 - 27 total definitions (be familiar)
- Article 100 Definitions also apply
- **LOW VOLTAGE CONTACT LIMIT** - A voltage not exceeding:
 - 15 volts (RMS) for sinusoidal AC
 - 21.2 volts peak for nonsinusoidal AC
 - 30 volts for continuous DC
 - 12.4 volts peak for DC that is interrupted at a rate of 10 to 200 Hz
- Permanent: > 42 in. or all indoor pools
- Storable: $\leq$ 42 in. or all pools nonmetallic, molded polymeric walls or inflatable fabric walls

Relevant Standards: NEC – Article 680

- 680.11(A) **Underground Wiring Location**
 - Shall not be permitted under the pool or within the area extending 5 ft. horizontally from the inside wall of the pool.



Relevant Standards: NEC – Article 680

- **680.13 Maintenance Disconnecting Means**
 - One or more means to simultaneously disconnect all ungrounded conductors shall be provided for all utilization equipment other than lighting. Each means shall be readily accessible and within sight from its equipment and shall be located at least 5 ft. horizontally from the inside walls of a pool, spa, or hot tub unless separated from the open water by a permanently installed barrier that provides a 5 ft. reach path or greater. This horizontal distance is to be measured from the water's edge along the shortest path required to reach the disconnect.



Relevant Standards: NEC – Article 680

- **II. Permanently Installed Pools**
 - 680.21 – Motors
 - **680.22 – Lighting, Receptacles, & Equipment ***
 - **680.23 – Underwater Luminaries ***
 - **680.24 – Junction Boxes and Electrical Enclosures for Transformers or Ground-Fault Circuit Interrupters. ***
 - 680.25 – Feeders
 - **680.26 – Equipotential Bonding ***
 - 680.27 – Specialized Pool Equipment

Relevant Standards:

NEC – Article 680

- **680.21 Motors – GFCI Protection and Pool Pump Motor Replacement**
- (C) GFCI Protection. Outlets supplying all pool motors on branch circuits rated 150 volts or less to ground and 60 amperes or less, single- or 3-phase, shall be provided with Class A ground-fault circuit-interrupter protection.
- *Exception: Listed lo-voltage motors not requiring grounding,*
- *with ratings not exceeding the low-voltage contact limit that are supplied by listed transformers or power*
- *supplies that comply with 680.23(A)(2), shall be permitted*
- *to be installed without GFCI protection.*
- (D) Where a pool pump motor in 680.21(C) is replaced for maintenance or repair, the replacement pump motor shall be provided with the ground-fault circuit-interrupter protection..



Relevant Standards: NEC – Article 680

- **RATIONALE OF CHANGE**
- The requirement has been modified to outlets supplying
- all pool motors and not just pool pump motors with
- wording that correlates to other GFCI requirements. It
- specifies pool motors rated 150 volts or less to ground
- and 60 amperes or less, single- or 3-phase, shall be
- provided with Class A GFCI protection. This change will
- expand the GFCI protection requirements to other
- voltage
- systems than previously required. The requirement
- has been modified to use the term outlet and removed
- the phrase “whether by receptacle or by direct connection”.
- A part (D) was added as a new requirement for pool
- pump motor replacement in accordance with part (C) to
- require GFCI protection. Unfortunate circumstances have
- driven this much needed change to help protect from
- electrocution associated with pool motors.

Relevant Standards: NEC – Article 680

- **680.22 Lighting, Receptacles, and Equipment**

- A. Receptacles:

- (1) Required Receptacle, Location

- Where a permanently installed pool is installed, no fewer than one 125-volt, 15- or 20-ampere receptacle on a general-purpose branch circuit shall be located 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. This receptacle shall be located not more than 2.0 m (6 ft 6 in.) above the floor, platform, or grade level serving the pool.

Relevant
Standards:
NEC –
Article 680

- **680.22 Lighting, Receptacles, and Equipment (cont'd)**
 - A. Receptacles:
 - (2) Circulation and Sanitation System, Location
Receptacles that provide power for water-pump motors or for other loads directly related to the circulation and sanitation system shall be located at least 1.83 m (6 ft) from the inside walls of the pool. These receptacles shall have GFCI protection and be of the grounding type.
 - (3) Other Receptacles, Location
Other receptacles shall be not less than 1.83 m (6 ft) from the inside walls of a pool.
 - (4) Ground-Fault Circuit-Interrupter (GFCI) and Special Purpose Ground-Fault Circuit-Interrupter (SPGFCI) Protection
All receptacles rated 125 volts through 250 volts, 60 amperes or less, located within 6.0 m (20 ft) of the inside walls of a pool shall have GFCI protection complying with 680.5(B) or SPGFCI protection complying with 680.5(C), as applicable.

Relevant Standards: NEC – Article 680

- **680.22 Lighting, Receptacles, and Equipment** (cont'd)

Luminaires, Lighting Outlets, & Ceiling-Suspended (Paddle) Fans:

New Outdoor: 12-foot minimum height above water level, extending 5-feet horizontally from inside walls of pool

Indoor: Same as (1) OR can be reduced to 7 ft. 6 in. when GFCI protected

Existing: 5-foot minimum height above water level, extending 5-feet horizontally from inside walls of pool, GFCI protected

Relevant Standards:

NEC – Article 680

- 680.22 **Lighting, Receptacles, and Equipment** (cont'd)
- **(C) Switching Devices**
- Switching devices shall 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 that provides at least a 1.5 m (5 ft) reach distance. Alternatively, a switch that is listed as being acceptable for use within 1.5 m (5 ft) shall be permitted.
- **(D) Other Outlets**
- Other outlets shall be not less than 3.0 m (10 ft) from the inside walls of the pool. Measurements shall be determined in accordance with 680.22(A)(5). Informational Note: Other outlets may include, but are not limited to, remote-control, signaling, fire alarm, and communications circuits.



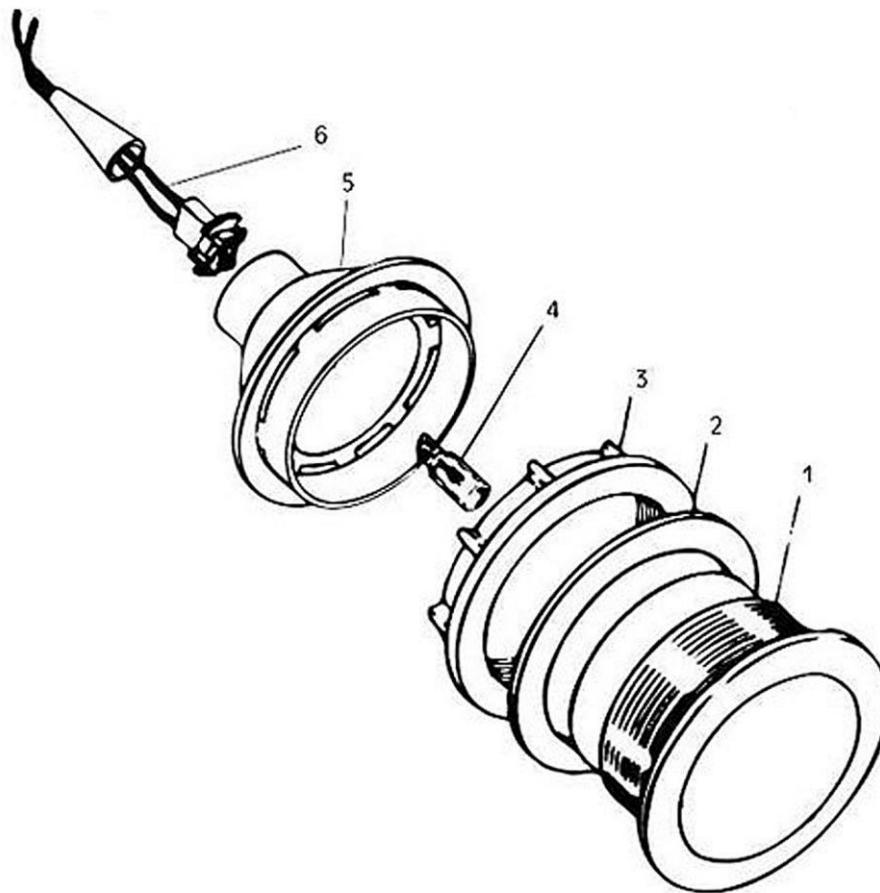
Relevant Standards: NEC – Article 680

- **680.23 – Underwater Luminaires**
 - A. General (Installation Instructions / Listing Req. / UL 676)
 - B. Wet-Niche Luminaires (completely surrounded by water)
 - C. Dry-Niche Luminaires (sealed against entry of water)
 - D. No-Niche Luminaires (without a niche)
 - E. Through-Wall Lighting Assembly



Wet-Niche Luminaire

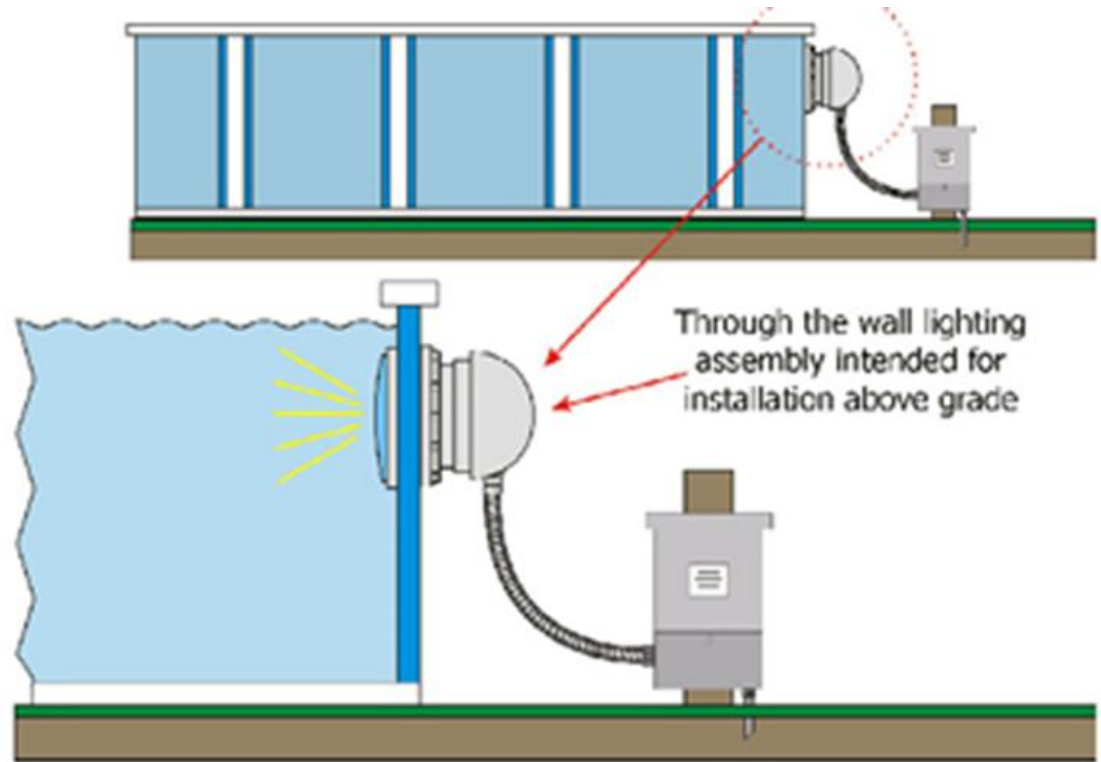
Dry-Niche Luminaire



No-Niche Luminaire



Through-Wall Lighting Assembly



Relevant Standards: NEC – Article 680

- 680.23(B)(2)(b) **Wiring Extending Directly to the Forming Shell**
 - #8 AWG insulated solid or stranded copper bonding jumper.
 - The termination at the forming shell shall be covered with a listed potting compound.
 - ◆ UL 676A / WCRY

Do it RIGHT!

CAUTION

National Electrical Code Article 680

Swimming Pools, Fountains
and similar Installations

"The termination of the 8 AWG equipment grounding conductor in the forming shell shall be covered with, or encapsulated in, a listed potting compound to protect the connection from the possible deteriorating effect of swimming pool water"



LISTED 9MA7

DID YOU KNOW?
• Some potting compounds have been banned!
• Silicone sealant is corrosive to copper!
What Should You Do?



Do it to CODE!



Relevant
Standards:
NEC –
Article 680

- 680.23(B)(6) **Servicing**
 - 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.

Relevant FBC
and NEC codes
and standards
(UL)

- 680.23(F)(2) **Equipment Grounding.**
 - Through-wall lighting assemblies, wet-niche, dry-niche, or no-niche luminaires shall be connected to an insulated copper equipment grounding conductor installed with the circuit conductors. The equipment grounding conductor shall be installed without joint or splice except as permitted in (F)(2)(a) and (F)(2)(b). The equipment grounding conductor shall be sized in accordance with Table 250.122 but shall not be smaller than 12 AWG.



Relevant Standards: NEC – Article 680

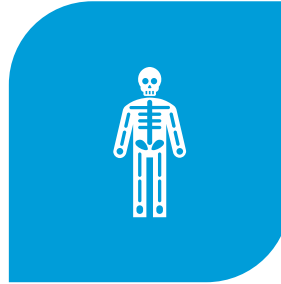
- **680.24 Junction Boxes, Transformer, GFCI Enclosure**
 - A. Junction Boxes – UL 1241 / WCEZ
 - B. Other Enclosures
 - C. Protection
 - D. Grounding Terminals
 - E. Strain Relief
 - F. Grounding



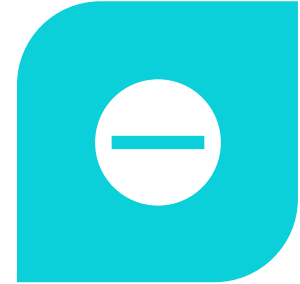
Relevant Standards:
NEC – Article 680

- 680.24(A)(1) **Construction.**
 - The junction box shall be listed as a swimming pool junction box and shall comply with the following conditions:
 - 1) Be equipped with threaded entries or hubs or a nonmetallic hub
 - 2) Be comprised of copper, brass, suitable plastic, or other approved corrosion-resistant material
 - 3) Be provided with electrical continuity between every connected metal conduit and the grounding terminals by means of copper, brass, or other approved corrosion-resistant metal that is integral with the box

Relevant Standards: NEC – Article 680



680.24(A)(2) **INSTALLATION.**



WHERE THE LUMINAIRE OPERATES OVER THE LOW VOLTAGE CONTACT LIMIT, THE JUNCTION BOX LOCATION SHALL COMPLY WITH (A)(2)(A) AND (A)(2)(B). WHERE THE LUMINAIRE OPERATES AT THE LOW VOLTAGE CONTACT LIMIT OR LESS, THE JUNCTION BOX LOCATION SHALL BE PERMITTED TO COMPLY WITH (A)(2)(C).

Relevant Standards:

NEC – Article 680

- 680.24(A)(2) **Installation.** (cont'd)
 - a) Vertical Spacing.** The junction box shall be located not less than (4 in.), measured from the inside of the bottom of the box, above the ground level, or pool deck, or not less than (8 in.) above the maximum pool water level, whichever provides the greater elevation.
 - b) Horizontal Spacing.** The junction box shall be located not less than (4 ft.) from the inside wall of the pool, unless separated from the pool by a solid fence, wall, or other permanent barrier.

Relevant
Standards:
NEC –
Article 680

- 680.24(A)(2) **Installation.** (cont'd)
 - c) **Flush Deck Box.** If used on a lighting system operating at the low voltage contact limit or less, a flush deck box shall be permitted if both of the following conditions are met:
 - 1) An approved potting compound is used to fill the box to prevent the entrance of moisture.
 - 2) The flush deck box is located not less than (4 ft) from the inside wall of the pool.

Relevant Standards: NEC – Article 680

- 680.24(E) **Strain Relief.** The termination of a flexible cord of an underwater luminaire within a junction box, transformer or power-supply enclosure, ground-fault circuit interrupter, or other enclosure shall be provided with a strain relief.

Relevant
Standards:
NEC –
Article 680

- 680.26 **Equipotential Bonding**
- **(A) Performance**
- The equipotential bonding required by 680.26(B) and (C) to reduce voltage gradients in the pool area shall be installed for pools with or without associated electrical equipment related to the pool.
- **(B) Bonded Parts**
- The parts specified in 680.26(B)(1) through (B)(7) shall be bonded together using solid copper conductors, insulated, covered, or bare, not smaller than 8 AWG or with rigid metal conduit of brass or other identified corrosion-resistant metal. Connections to bonded parts shall be made in accordance with 250.8. An 8 AWG or larger solid copper bonding conductor provided to reduce voltage gradients in the pool area shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes.

Relevant Standards: NEC – Article 680

680.25 Feeders. These provisions shall apply to any feeder on the supply side of panelboards supplying branch circuits for pool equipment covered in Part II of this article and on the load side of the service equipment or the source of a separately derived system.

(A) Feeders. Where feeders are installed in corrosive environments as described in 680.2, Corrosive Environment, the wiring method of that portion of the feeder shall be in accordance with 680.14 or shall be liquidtight flexible nonmetallic conduit. Wiring methods installed in corrosive environments shall contain an insulated copper equipment grounding conductor sized in accordance with Table 250.122, but not smaller than 12 AWG.

Where installed in noncorrosive environments, feeders shall comply with the general requirements in Chapter 3.

(B) Aluminum Conduit. Aluminum conduit shall not be permitted in the pool area where subject to corrosion.

Relevant Standards: NEC – Article 680



680.26 - **Equipotential Bonding**

- A. Performance.** The equipotential bonding required by this section shall be installed to reduce voltage gradients in the pool area.



Relevant Standards: NEC – Article 680

- 680.26(B) **Bonded Parts**
 - 1) Conductive Pool Shell
 - 2) Perimeter Surfaces
 - 3) Metallic Components
 - 4) Underwater Lighting
 - 5) Metal Fittings
 - 6) Electrical Equipment
 - 7) Fixed Metal Parts

Relevant Standards: NEC – Article 680

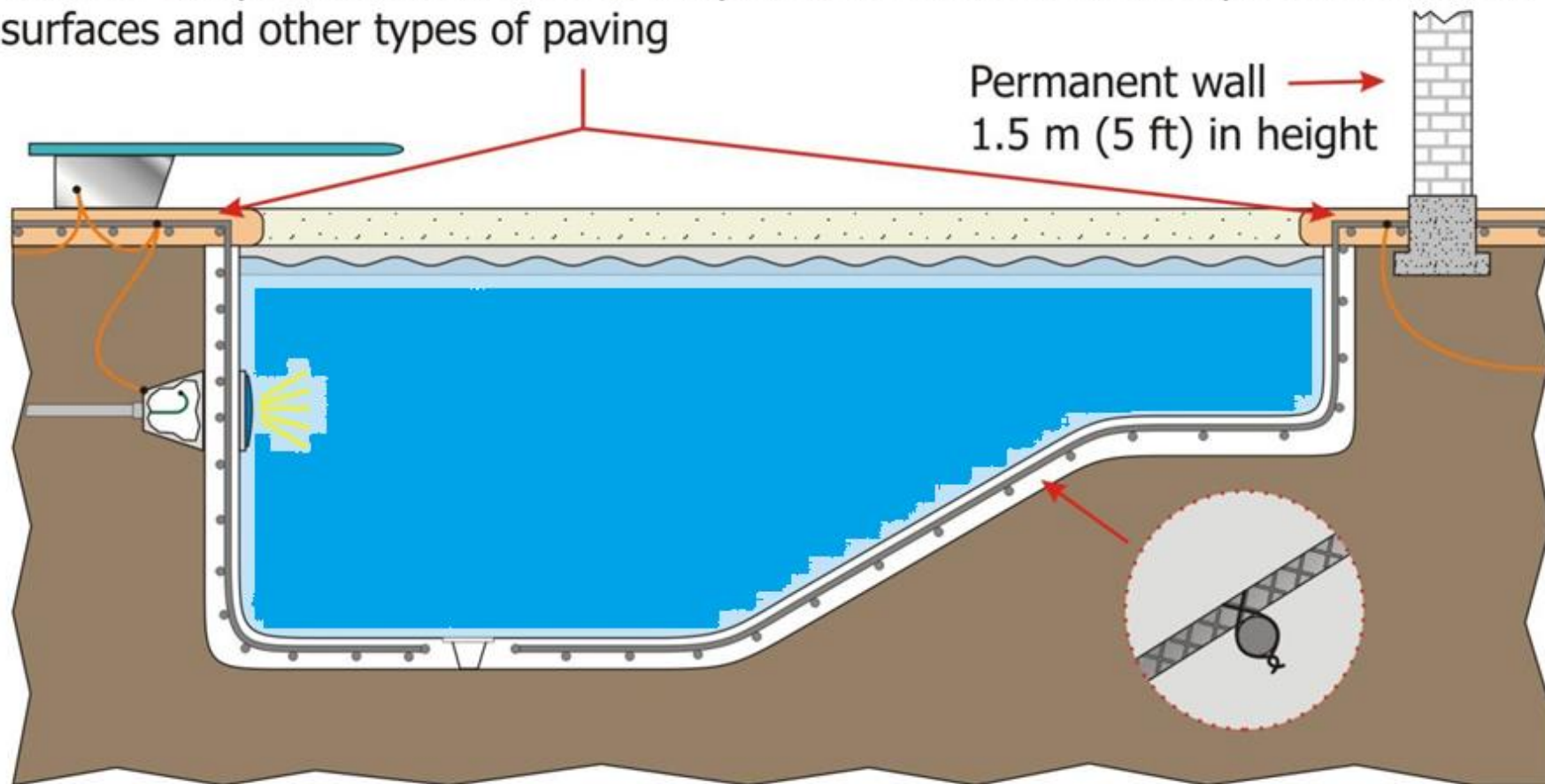
- 680.26(B) **Bonded Parts.**
- **(1) Conductive Pool Shells**
- 1. Bonding to conductive pool shells shall be provided as specified in 680.26(B)(1)(a) or (B)(1)(b). Cast-in-place concrete, pneumatically applied or sprayed concrete, and concrete block with painted or plastered coatings shall all be considered conductive materials due to water permeability and porosity. Reconstructed pool shells shall also meet the requirements of this section. Vinyl liners and fiberglass composite shells shall be considered to be nonconductive materials and not subject to these requirements. Structural Reinforcing Steel. Unencapsulated structural reinforcing steel shall be bonded together by steel tie wires or the equivalent. Where structural reinforcing steel is encapsulated in a nonconductive compound, a copper conductor grid shall be installed in accordance with 680.26(B)(1)(b).
- 2. Copper Conductor Grid. A copper conductor grid shall be provided and shall comply with the following:

Relevant Standards: NEC – Article 680

- 680.26(B) **Bonded Parts**
(cont'd)
 1. Be constructed of minimum 8 AWG bare solid copper conductors bonded to each other at all points of crossing in accordance with 250.8 or other approved means
 2. Conform to the contour of the pool
 3. Be arranged in a 300 mm (12 in.) by 300 mm (12 in.) network of conductors in a uniformly spaced perpendicular grid pattern with a tolerance of 100 mm (4 in.)
 4. Be secured within or under the pool no more than 150 mm (6 in.) from the outer contour of the pool shell

680.26(B)(2) Bonded Parts of Perimeter Surfaces

The perimeter surface shall extend for 1 m (3 ft) horizontally beyond the inside walls of the pool and shall include unpaved surfaces as well as poured concrete surfaces and other types of paving



Perimeter surfaces less than 1 m (3 ft) separated by a permanent wall or building 1.5 m (5 ft) in height or more shall require equipotential bonding on the pool side of the permanent wall or building

Relevant Standards: NEC – Article 680

- 680.26(B) **Bonded Parts**
(cont'd)
 - 3) **Metallic Components.** All metallic parts of the pool structure, including reinforcing metal not addressed in 680.26(B)(1)(a), shall be bonded. Where reinforcing steel is encapsulated with a nonconductive compound, the reinforcing steel shall not be required to be bonded.

Relevant Standards: NEC – Article 680

- 680.26(B) **Bonded Parts** (cont'd)
 - 4) **Underwater Lighting.** All metal forming shells and mounting brackets of no-niche luminaires shall be bonded.
 - ◆ **Exception:** Listed low-voltage lighting systems with nonmetallic forming shells shall not require bonding.

Relevant
Standards:
NEC –
Article 680

- 680.26(B) **Bonded Parts** (cont'd)
 - 5) **Metal Fittings.** All metal fittings within or attached to the pool structure shall be bonded. Isolated parts that are not over (4 in.) in any dimension and do not penetrate into the pool structure more than (1 in.) shall not require bonding.

Relevant Standards: NEC – Article 680

- 680.26(B) **Bonded Parts**
(cont'd)
 - 6) **Electrical Equipment.** Metal parts of electrical equipment associated with the pool water circulating system, including pump motors and metal parts of equipment associated with pool covers, including electric motors, shall be bonded.
 - ◆ **Exception:** Metal parts of listed equipment incorporating an approved system of double insulation shall not be bonded.
 - 7) **Fixed Metal Parts.** All fixed metal parts shall be bonded.

680.26(B)(7) Fixed Metal Parts

All fixed metal parts within 1.5 m (5 ft) horizontally and 3.7 m (12 ft) vertically of permanently installed pools must be bonded to the equipotential bonding grid



This would include but not limited to metal sheathed cables and raceways, metal piping, **metal awnings, metal fences, and metal door and window frames**

Relevant
Standards:
NEC –
Article 680

- 680.26(C) **Pool Water.**
 - An intentional bond of a minimum conductive surface area of (9-square inches) 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 680.26(B).



Relevant Standards: NEC – Article 680

- **680.27 Specialized Pool Equipment**
 - A. Underwater Audio Equipment – UL 1480 / UEAY**
 - 1) Speakers
 - 2) Wiring Methods
 - 3) Forming Shell & Metal Screen.

Relevant Standards: NEC – Article 680

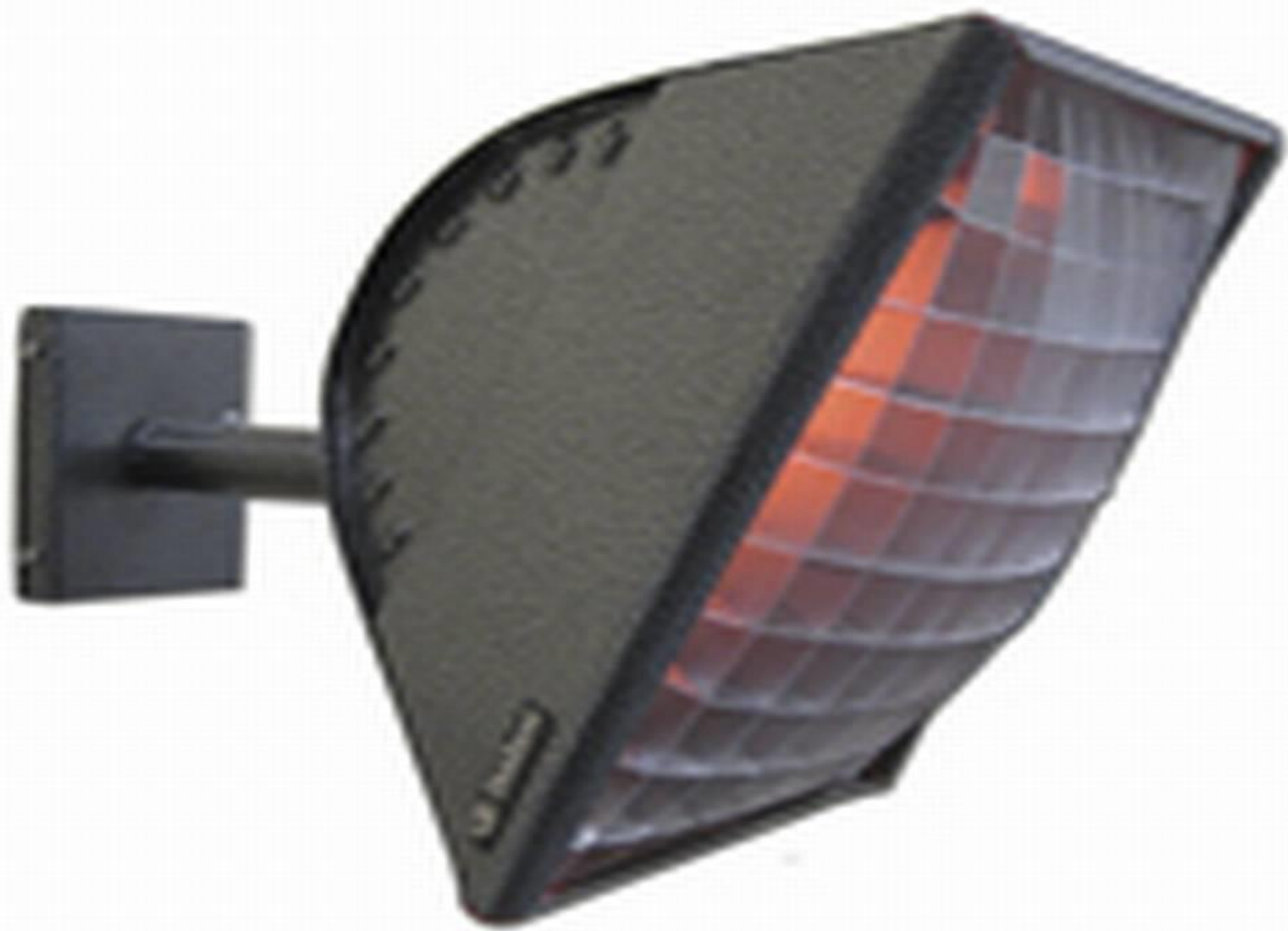
(B) Electrically Operated Pool Covers.

(1) Motors and Controllers. The electric motors, controllers, and wiring shall be located not less than 1.5 m (5 ft) from the inside wall of the pool unless separated from the pool by a wall, cover, or other permanent barrier. Electric motors installed below grade level shall be of the totally enclosed type. The device that controls the operation of the motor for an electrically operated pool cover shall be located such that the device operator has full view of the pool.

Exception: Motors that are part of listed systems with ratings not exceeding the low-voltage contact limit that are supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall be permitted to be located less than 1.5 m (5 ft) from the inside walls of the pool.







Relevant Standards: NEC – Article 680

III. Storable Pools

- **Storable Swimming, Wading, or Immersion Pool** - those that constructed on/above the ground and are capable of holding water to a maximum depth of 42 in., or a pool with nonmetallic, molded polymeric walls or inflatable walls regardless of dimension.
 - 680.30 – General
 - 680.31 – Pumps
 - 680.32 – Ground-Fault Circuit Interrupters Required
 - 680.33 – Luminaires
 - 680.34 – Receptacle Locations

Relevant FBC and NEC codes
and standards (UL)

- **Pumps / GFCI Protection**
Storable Pools shall comply with Part I & III of Article 680
 - **680.31 Pumps**
 - ◆ Cord-connected pool filter pumps shall be provided with a GFCI that is integral to the cord or attachment plug.
 - **680.32 GFCI Protection Required**
 - ◆ All electrical equipment for the storable pool & 125-volt, 15- and 20-ampere receptacles within 20 ft of the storable pool shall be protected by a GFCI.

Relevant Standards: NEC – Article 680

680.33 **Luminaires**

(A) Within the Low-Voltage Contact Limit

A luminaire shall be part of a cord-and plug connected lighting assembly. This assembly shall be listed as an assembly for the purpose and have the following construction features:

No exposed metal parts

A luminaire lamp that is suitable for use at the supply voltage

An impact-resistant polymeric lens, luminaire body, and transformer enclosure

A transformer or power supply meeting the requirements of 680.23(A)(2) with a primary rating not over 150 V

(B) Over the Low-Voltage Contact Limit but Not Over 150 Volts

A lighting assembly without a transformer or power supply and with the luminaire lamp(s) operating at not over 150 volts shall be permitted to be cord-and-plug-connected where the assembly is listed as an assembly for the purpose. The installation shall comply with 680.23(A)(5), and the assembly shall have the following construction features:

No exposed metal parts

An impact-resistant polymeric lens and luminaire body

A GFCI with open neutral conductor protection as an integral part of the assembly

The luminaire lamp permanently connected to the GFCI with open-neutral protection

Compliance with the requirements of 680.23(A)

Relevant Standards: NEC – Article 680

- **680.34 Receptacle Locations**
 - Receptacles shall not be located less than (6 ft) from the inside walls of a pool. In determining these dimensions, the distance to be measured shall be the shortest path 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.

Relevant
Standards:
NEC –
Article
680

Spas & Hot Tubs

680.40 General – UL 1563 / WBYQ / WCZW

680.41 Emergency Switch for Spas & Hot Tubs

680.42 – *Outdoor Installations**

680.43 – *Indoor Installation**

680.44 - Protection

Relevant Standards: NEC – Article 680

680.42 Outdoor Installations. A spa or hot tub installed outdoors shall comply with the provisions of Parts I and II of this article, except as permitted in 680.42(A) and (B), that would otherwise apply to pools installed outdoors.

Relevant Standards:

NEC – Article 680

- **680.42 Outdoor Installations**
 - ◆ A spa or hot tub installed outdoors shall comply with the provisions of Parts I and II of this article, except as permitted in 680.42(A) and (B), that would otherwise apply to pools installed outdoors.

Relevant Standards: NEC – Article 680

- 680.43 **Indoor Installations**
 - ◆ Receptacles – Location & Protection
 - ◆ Luminaires / Fans – Elevation Requirements
 - ◆ Switches – Location
 - ◆ Bonding – (5) parts
 - ◆ Methods of Bonding – (3) methods
 - ◆ Grounding – (2) requirements
 - ◆ Underwater Audio Equipment – Part II

Relevant Standards: NEC – Article 680

V. Fountains

- 680.50 **General**
- 680.51 **Luminaires,
Submersible Pumps, &
Other
Submersible Equipment***
- 680.52 **Junction Boxes
& Other Enclosures**
- 680.54 **Bonding***
- **Grounding***
- 680.55 **Methods of
Grounding**
- 680.56 **Cord-and-Plug
Connected Equipment**
- 680.57 **Signs**
- 680.68 **GFCI
Protection for Adjacent
Receptacle Outlets**

Relevant Standards: NEC – Article 680

- 680.50 **General**
 - Fountains with water common to a pool shall comply with Part II of the Article
 - Portable fountains shall comply with Parts II & III of Article 422

Relevant
Standards:
NEC –
Article 680

- 680.51 **Equipment**
 - A. GFCI Protection requirements
 - B. Operating Voltage limitations
 - C. Luminaire Lenses requirements
 - D. Overheating Protection requirements
 - E. Wiring method requirements
 - F. Servicing of equipment
 - G. Stability of equipment / fastening

Relevant Standards: NEC – Article 680

680.54 Grounding and Bonding.

(A) Grounding. The following equipment shall be connected to the equipment grounding conductor:

- (1) Other than listed low-voltage luminaires not requiring grounding, all electrical equipment located within the fountain or within 1.5 m (5 ft) of the inside wall of the fountain
- (2) All electrical equipment associated with the recirculating system of the fountain
- (3) Panelboards that are not part of the service equipment and that supply any electrical equipment associated with the fountain

Informational Note: See 250.122 for sizing of these conductors.

(B) Bonding. The following parts shall be bonded together and connected to an equipment grounding conductor on a branch circuit supplying the fountain:

- (1) All metal piping systems associated with the fountain
- (2) All metal fittings within or attached to the fountain
- (3) Metal parts of electrical equipment associated with the fountain water-circulating system, including pump motors
- (4) Metal raceways that are within 1.5 m (5 ft) of the inside wall or perimeter of the fountain and that are not separated from the fountain by a permanent barrier
- (5) All metal surfaces that are within 1.5 m (5 ft) of the inside wall or perimeter of the fountain and that are not separated from the fountain by a permanent barrier
- (6) Electrical devices and controls that are not associated with the fountain and are located less than 1.5 m (5 ft) of the inside wall or perimeter of the fountain

Relevant Standards: NEC – Article 680

- **680.54 Grounding.**
 - The following equipment shall be grounded:
 - 1) All electrical equipment located within the fountain or within (5 ft) of the inside wall of the fountain
 - 2) All electrical equipment associated with the recirculating system of the fountain
 - 3) Panelboards that are not part of the service equipment and that supply any electrical equipment associated with the fountain

Relevant
Standards:
NEC –
Article 680

VI. Pools & Tanks for Therapeutic Use

- 680.60 – General
- 680.61 – Permanently Installed Therapeutic Pools
- 680.62 – Therapeutic Tubs / Tanks

Relevant Standards:

NEC – Article 680

- **Tubs & Tanks**

- A. 680.62 Therapeutic Tubs (Hydrotherapeutic Tanks)

Therapeutic tubs, used for the submersion and treatment of patients, that are not easily moved from one place to another in normal use or that are fastened or otherwise secured at a specific location, including associated piping systems, shall comply with Part VI.

- (A) Protection

- A. Except as otherwise provided in this section, the outlet(s) that supplies a self-contained therapeutic tub or hydrotherapeutic tank, a packaged therapeutic tub or hydrotherapeutic tank, or a field-assembled therapeutic tub or hydrotherapeutic tank shall be GFCI protected.

Relevant
Standards:
NEC –
Article 680

VII. Hydromassage Bathtubs - 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.

- 680.70 – General
- 680.71 – Protection
- 680.72 – Other Electrical Equipment
- 680.73 – Accessibility
- 680.74 – Bonding

Relevant Standards: NEC – Article 680

680.71 Protection

- Individual branch circuit required
- Readily accessible GFCI protection

680.73 Accessibility

- The bathtub's electrical equipment shall be accessible without damaging the building structure or building finish.
- The receptacle shall be installed within (1 ft) of the opening.

Relevant
Standards:
NEC –
Article 680

680.74 Bonding.

(A) General. The following parts 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, metal raceways, and metal piping within 1.5 m (5 ft) of the inside walls of the tub and not separated from the tub by a permanent barrier
- (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) Non-current-carrying metal parts of electrical devices and controls that are not associated with the hydromassage tubs within 1.5 m (5 ft) from such units

Exception No. 1: Small conductive surfaces not likely to become energized, such as air and water jets, supply valve assemblies, and drain fittings not connected to metallic piping, and towel bars, mirror frames, and similar nonelectrical equipment not connected to metal framing shall not be required to be bonded.

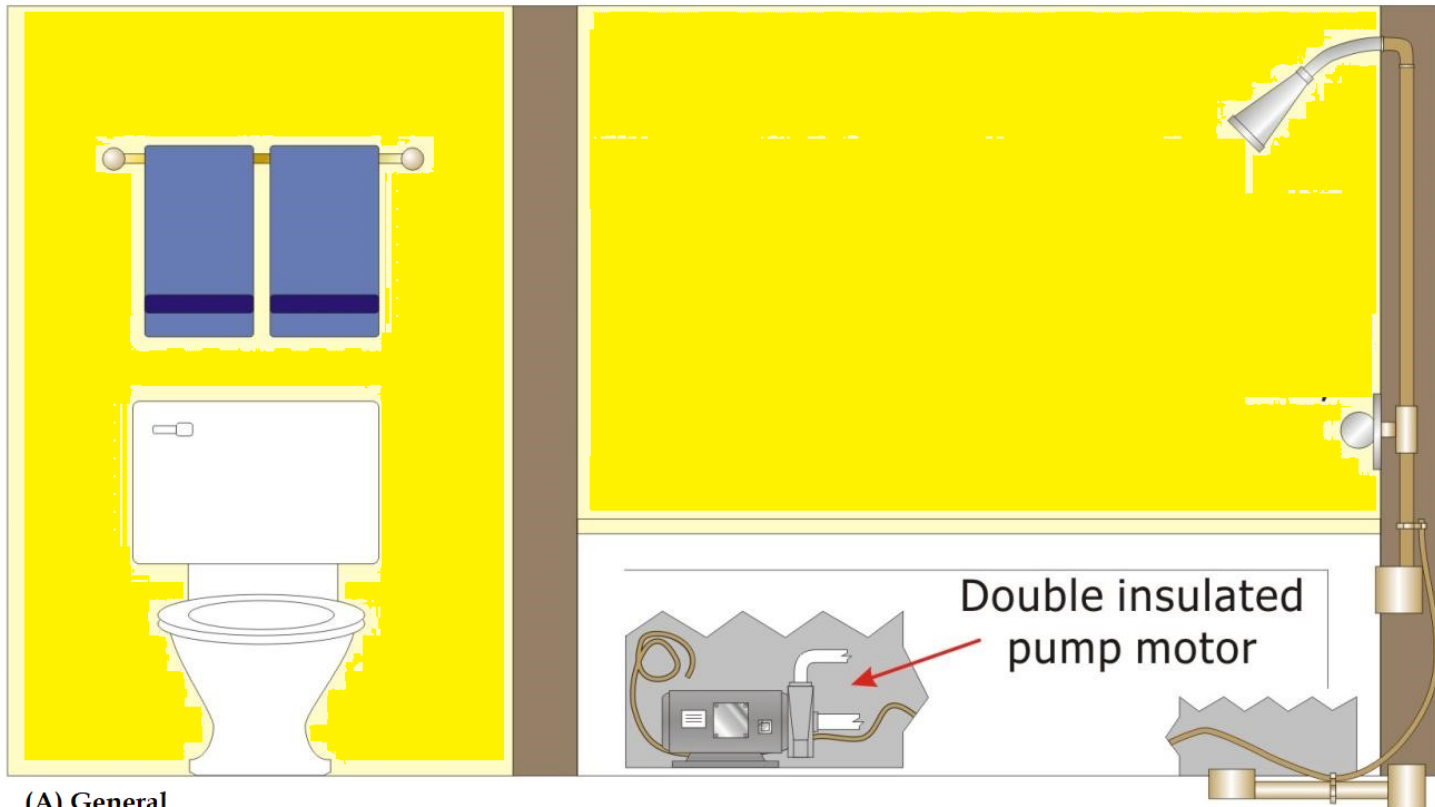
Exception No. 2: Double-insulated motors and blowers shall not be bonded.

Relevant Standards:

NEC – Article 680

- **680.62 (B) Bonding**
- The following parts shall be bonded together:
- All metal fittings within or attached to the tub structure
- Metal parts of electrical equipment associated with the tub water circulating system, including pump motors
- 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
- All 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
- Electrical devices and controls that are not associated with the therapeutic tubs and located within 1.5 m (5 ft) from such units.
- Exception: Small conductive surfaces not likely to become energized, such as air and water jets and drain fittings not connected to metallic piping, and towel bars, mirror frames, and similar nonelectrical equipment not connected to metal framing, shall not be required to be bonded.

680.74 Hydromassage Bathtub - Bonding



(A) General

The following parts shall be bonded together:

All metal fittings within or attached to the tub structure that are in contact with the circulating water

Metal parts of electrical equipment associated with the tub water circulating system, including pump and blower motors

Metal-sheathed cables, metal raceways, and metal piping within 1.5 m (5 ft) of the inside walls of the tub and not separated from the tub by a permanent barrier

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

Non-current-carrying metal parts of electrical devices and controls that are not associated with the hydromassage tubs within 1.5 m (5 ft) from such units

Ground and
luminaire
bonding, GFCIs,
stray voltage

- **(B) Bonding Conductor**
- All metal parts required to be bonded by this section shall be bonded together using a solid copper bonding jumper, insulated, covered, or bare, not smaller than 8 AWG. The bonding jumper(s) shall be required for equipotential bonding in the area of the hydromassage bathtub and shall not be required to be extended or attached to any remote panelboard, service equipment, or any electrode. In all installations a bonding jumper long enough to terminate on a replacement non-double-insulated pump or blower motor shall be provided and shall be terminated to the equipment grounding conductor of the branch circuit of the motor when a double-insulated circulating pump or blower motor is used.

Ground and
luminaire
bonding, GFCIs,
stray voltage

- It is possible to accomplish equipotential bonding without providing grounding. Although some equipment in NEC 680.26 might ultimately be connected to ground, equipotential **bonding is accomplished by bonding conductive components within reach of the pool.**

Ground and luminaire bonding, GFCIs, stray voltage

- **Bonding vs. grounding**
 - To reduce confusion, the NEC now more correctly refers to equipotential bonding
 - **Equipotential surface** voltages between all points in or out of the water are approximately equal.
 - Bonding is required even without any electrical equipment



Ground and luminaire bonding, GFCIs, stray voltage

- A properly-installed equipotential bonding system can divert current to earth through the pool/deck structure and not through the water.
- The earth cannot and must not be used as a grounding conductor.

Ground and luminaire bonding, GFCIs, stray voltage

- An equipment ground wire is not the same as a bond wire; grounding to the electrical systems ground bus cannot be used in lieu of proper bonding, even when both are call for.



Ground and
luminaire
bonding, GFCIs,
stray voltage

- The pool structure includes the deck and coping!
- **Fixed metal parts with 5 feet of the pool must be bonded.**
- All metal fittings *within or attached to the pool structure* greater than 4" in any dimension and penetrating into the structure more than 1" **must** be bonded!

Ground and
luminaire
bonding, GFCIs,
stray voltage

- **Double-insulated pump motors**
 - **Must** have a #8 AWG solid copper bonding wire run from pool to an accessible point in pump area
 - Motors with a grounding screw must connect to equipment ground conductor of motor circuit at the motor
 - If bonding grid is not grounded, you must connect it to equipment grounding conductor of motor circuit at the motor.

Ground and luminaire bonding, GFCIs, stray voltage

Coated/encapsulated rebar cannot serve as a bonding grid to create the equipotential surface.



Copper wire grid connections must be per 250.8 or other approved means and must be connected to the bonding system:

Exothermic
welding
(cadwelding)

Listed pressure
connectors

Listed clamps

Other listed means
– may include a
copper wire grid
under or in a
conductive pool
shell.

Ground and luminaire bonding, GFCIs, stray voltage

- Intentional bonding connection to the water only required when none of the bonded parts are in direct connection with the pool water
 - Minimum 9 sq. in. in contact with the water (e.g., 3" × 3" plate) at all times
 - Must be corrosion-resistant
 - Must be located where it is not exposed to physical damage or dislodgement during usual pool activities]
 - **Must be connected to the equipotential bonding grid**

- **Light fixture repairs can affect bonding**
 - Electrical bonding between the light and niche occurs at the attachment screw. **This is the only reliable connection between the light and niche!**
 - While an electrical connection between the hooks on the light fixture and the niche can exist for a while after installation, **it is not reliable!**

Maintenance/servicing/
repair



Maintenance/servicing/repair

- **Light fixture repairs** (cont'd)
 - Installing after-market repair parts such as float-in rings and plastic light fixture clamping devices can destroy the electrical safety connection between the light fixture and the bonded niche!

Maintenance/servicing/repair

- **Bonding light to broken niche or plaster ring**
 - For situations where light cannot bond to niche, or no niche exists (plaster ring only).
 - Add #12 solid copper green bonding wire in niche.
 - Connect wire to light ring using lugs and split bolts. Make sure screws are brass or stainless steel.

Maintenance/servicing/repair

- **Bonding light** (cont'd)
 - Tape or cable tie wire to light cored and bond to niche (if available) or J-box.
 - Make sure screws are tight!
 - Use sealant such as *Skotchkote*[™] (3M) on lugs and split bolts and pot any connection at rear of niche.



Maintenance/servicing/repair

- **Simple tests on existing pools**
 - Visual inspection
 - Bonding test
 - Grounding test
 - GFCI test

Resources

- Associations representing manufacturers, builders, designers, distributors, suppliers, installers, retailers, service technicians and inspectors:
 - International Association of Electrical Inspectors (IAEI): www.iaei.org/web/Online
 - National Electrical Manufacturers Association (NEMA): www.nema.org/pages/default.aspx
 - Association of Pool & Spa Professionals (APSP): www.apsp.org
 - Florida Swimming Pool Association (FSPA): www.floridapoolpro.com
 - United Pool & Spa Association (UPSA): www.upsaonline.com



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