

# Swimming Pool Electrical Safety<sup>1</sup>

## Appropriate Licensing

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Please **verify** that your contractor has the appropriate license(s) and actual knowledge and experience for the necessary work.

An **electrical contractor** means a person who conducts business in the electrical trade field and who has the experience and knowledge install, repair, alter, add to, or design electrical wiring, fixtures, appliances, apparatus, raceways, and conduit, including the electrical installations and systems within plants and substations and **all** alarm systems and specialty categories.

A **residential pool/spa contractor** means a contractor whose scope of work involves, but is not limited to the same as the commercial pool/spa contractor except the construction of equipment rooms.

A **commercial pool/spa contractor** means a contractor whose scope of work involves, but is not limited to the construction, repair, and servicing of any swimming pool, or hot tub or spa, including the repair or replacement of existing equipment or the installation of new equipment.

A **swimming pool/spa servicing contractor** means a contractor whose scope of work involves the servicing and repair of any swimming pool or hot tub or spa. The scope of such work may include any necessary piping and repairs, replacement and repair of existing equipment, or installation of new additional equipment as necessary.

A **swimming pool specialty contractor** licensee may be issued in the areas of layout, structural, excavation, trim, decking, piping, and finishes. Swimming pool specialty contractors may not contract directly with the public, and must work under contract, under the supervision, and within the scope of work of a contractor licensed pursuant to Sections 489.105(3)(j) – (l), Florida Statutes.

## Permitting and Inspections

Check with the local city or county (if in an unincorporated area) building or planning department for required permitting and inspections.

**Note: Final electrical and barrier code inspection shall be completed prior to filling the pool with water (454.2.19 / R4501.19). Exemption: Vinyl liner and fiberglass pools are required to be filled with water upon installation.**

### <sup>1</sup> Disclaimer

This piece is intended to give the reader only general factual information current at the time of publication. This piece is not a substitute for professional advice and should not be used for guidance or decisions related to a specific design or construction project. At a minimum, you should refer to any updated laws, rules, codes, and regulations for requirements applicable to your specific project. This piece is not intended to reflect the opinion of any of the entities, agencies, or organizations identified in the materials and, if any opinions appear, are those of the individual author and should not be relied upon in any event.

The following **codes and standards** apply to swimming pools designed, built, and maintained and is not all inclusive. A short overview of the relevant electrical safety requirements as found in the 5th Edition of *Florida Building Code* (FBC) is as follows:

## **FBC – Building Chapter 4 Section 454 Swimming Pools and Bathing Places (Public and Private)**

A **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. A **private 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 non-portable spas.

**Electrical equipment** and wiring and installation, including the grounding of pool components shall conform to Chapter 27 Electrical (NFPA 70). **Underwater lighting** shall utilize transformers and low-voltage circuits with each underwater light being grounded. The maximum voltage for each light shall be 15 volts and the maximum incandescent lamp size shall be 300 watts. The location of the underwater lights\* shall be such that the underwater illumination is as uniform as possible and shall not be less than 18 inches (457 mm) below the normal operating water level determined by the center-line of the skimmer or top lip of the gutter. All underwater lights which depend upon submersion for safe operation shall have protection from overheating when not submerged. Alternative lighting systems which use 15 volts or less, or use no electricity in the pool or on the pool deck, such as LED (light emitting diode) fiber-optic systems, may be utilized if the manufactures specifications provide for the equivalency in watt output. **Pumps** shall be installed in accordance with the manufacturer's recommendations.

\* Measured from the top of the fixture lens.

**Note:** At this time only public pools are required to use low voltage lighting.

## FBC - Residential Chapter 42 Swimming Pools [Electrical Provisions] and Chapter 45 Private Swimming Pools

Important definitions include, but are not limited to:

**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

**No-Niche Luminaire.** A luminaire intended for installation above or below the water without a niche.

**Dry-Niche Luminaire.** A luminaire intended for installation in the floor or wall of a pool, spa or fountain in a niche that is sealed against the entry of water.

**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.

**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.

**Luminaires and related equipment.** Other than listed low-voltage luminaires not requiring grounding, all through-wall lighting assemblies, wet-niche, dry-niche, or no-niche luminaires shall be connected to an insulated copper equipment grounding conductor sized in accordance with Table E3908.12 but not smaller than 12 AWG. The junction box, transformer enclosure, or other enclosure in the supply circuit to a wet-niche or no-niche luminaire and the field-wiring chamber of a dry-niche luminaire shall be grounded to the equipment grounding terminal of the panel board. The equipment grounding terminal shall be directly connected to the panel board enclosure. The equipment grounding conductor shall be installed without joint or splice. In specific wiring configurations, the equipment grounding conductor may be permitted to be terminated on grounding terminals, ground-fault circuit- interrupter, clock-operated switch enclosure, or an outlet box used to enclose a snap switch.

**Underwater luminaires.** The design of an underwater luminaire supplied from a branch circuit either directly or by way of a transformer or power supply meeting the requirements of Section E4206.1, shall be such that, where the fixture is properly installed without a ground-fault circuit interrupter, there is no shock hazard with any likely combination of fault conditions during normal use (not relamping). In addition, a ground-fault circuit-interrupter shall be installed in the branch circuit supplying luminaires operating at more than the low-voltage contact limit. The installation of the ground-fault circuit-interrupter shall be such that there is no 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 with this requirement shall be obtained by the use of a listed underwater luminaire and by installation of a listed ground fault circuit-interrupter in the branch circuit or a listed transformer or power supply for luminaires operating at more than the low-voltage contact limit.*

**Maximum voltage.** Luminaires shall not be installed for operation on supply circuits over 150 volts between conductors.

**Luminaire location.** Luminaires mounted in walls shall be installed with the top of the fixture lens not less than 18 inches (457 mm) below the normal water level of the pool, except where the luminaire is listed and identified for use at a depth of not less than 4 inches (102 mm) below the normal water level of the pool.

**Wet-niche luminaires.** Forming shells shall be installed for the mounting of all wet-niche underwater luminaires and shall be equipped with provisions for conduit entries. Conduit shall extend from the forming shell to a suitable junction box or other enclosure located as provided in Section E4206.9. Metal parts of the luminaire and forming shell in contact with the pool water shall be of brass or other approved corrosion-resistant metal. The end of flexible-cord jackets and flexible-cord conductor terminations within a luminaire shall be covered with, or encapsulated in, a suitable potting compound. Grounding connection within a luminaire shall be similarly treated. Luminaires shall be bonded to and secured to the forming shell by a positive locking device that ensures a low-resistance contact and requires a tool to remove the luminaire from the forming shell.

**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 into the pool water.

**Dry-niche luminaires.** Dry-niche luminaires shall have provisions for drainage of water. Other than listed low voltage luminaires not requiring grounding, a dry-niche luminaire shall have means for accommodating one equipment grounding conductor for each conduit entry.

**No-niche luminaires.** No-niche luminaires shall be listed for the purpose and shall be installed in accordance with the requirements of Section E4206.5. Where connection to a forming shell is specified, the connection shall be to the mounting bracket.

## NEC Article 680 Swimming Pools, Fountains, and Similar Installations

### I. General

**Overhead Conductor Clearances.** Overhead service and other overhead conductors 750V and less must be located no less than 22.5 ft. from the water (Table 680.8A).

**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.

**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 (according to Article 100 within sight means visible and not more than 50 ft from one to another) 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.

### II. Permanently Installed Pools

**Motors.** Any wiring method employed shall contain an insulated copper equipment grounding conductor. Cable assemblies are permitted where located in the interior of a one-family dwelling. Flexible cords shall not exceed 3 ft. for cord-and-plug connected pool motors and outlets supplying pool pump motors connected to single-phase, 120 volt through 240 volt branch circuits, whether by receptacle or by direct connection, shall be provided with **GFCI protection** for personnel.

#### Lighting, Receptacles and Equipment.

Receptacles directly related to circulation or sanitation systems shall be 10-feet from inside walls of pool or not less than 6-feet where:

1. Consists of a single receptacle
2. Employ a locking configuration
3. Are of the grounding type
4. Have GFCI protection

Other receptacles shall be not less than 6-feet from the inside walls of the pool. Dwelling Units - No fewer than (1) 125-volt, 15- or 20-ampere receptacle shall be located not less than 6-feet from, and not more than 20-feet from, the inside wall of the pool and not greater than 6-feet, 6-inches above the floor / deck / grade level. All 15- and 20-ampere, 125-volt receptacles located within 20-feet of the inside wall of the pool shall be **GFCI protected**.

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

- (1) New Outdoor Installations: 12-foot minimum height above water level, extending 5-feet horizontally from inside walls of pool
- (2) Indoor Installations: Same as (1) OR can be reduced to 7 ft. 6 in. when GFCI protected
- (3) Existing Installations: 5-foot minimum height above water level, extending 5-feet horizontally from inside walls of pool, GFCI protected

**Switching Devices** shall be located not less than 5-feet horizontally from the inside walls of the pool and **Other Outlets** shall be located not less than 10-feet from the inside walls of the pool.

## Underwater Luminaires

**Wiring Extending Directly to the Forming Shell** shall be #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)

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**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.

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**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.

## Junction Boxes

**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
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**Installation.** Where the luminaire operates over the low voltage contact limit, the junction box location shall comply with (a) and (b). Where the luminaire operates at the low voltage contact limit or less, the junction box location shall be permitted to comply with (c).

- (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.
  - (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.
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**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.

**Feeders.** These provisions shall apply to any feeder on the supply side of panel boards 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) **Wiring Methods.** Feeders shall be installed in RMC or IMC or one of the other (6) methods.

**Exception:** *An existing feeder between existing remote panel board & service equipment shall be permitted to run in flexible metal conduit or an approved cable assembly that includes an equipment grounding conductor within its outer sheath.*

(B) **Grounding.** Shall be insulated.

**Equipotential Bonding.** The NFPA *Ready Reference NFPA 70 – Creating and Electrically Safe Environment for Swimming Pools* is provided in the addendum of this handout. We greatly appreciate NFPA allowing the inclusion of this Article 680 NEC reference.

### III. Storable Pools, Spas, and Hot Tubs

**Storable Swimming, Wading, or Immersion Pools** are constructed on or 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. Cord-connected pool filter **pumps** shall be provided with a GFCI that is integral to the cord or attachment plug. All electrical equipment for the storable pool and 125-volt, 15- and 20-ampere receptacles within 20 ft. of the storable pool shall be protected by a GFCI.

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**Luminaires** within the Low Voltage Contact Limit shall be a **listed** cord-and-plug connected lighting assembly that complies with items (1) – (4) and located in or on the wall of the pool. Over the Low Voltage Contact Limit but Not Over 150 Volts shall be a **listed** cord-and-plug connected lightning assembly that complies with 680.23(A) (5), items (1) – (5) and located in or on the wall of the pool.

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**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.



## IV. Spas and Hot Tubs

**Outdoor Installations** shall comply with Part I & II of Article 680. Flexible Conduit is 6 ft. maximum (external to the spa). A Cord-&-Plug Connection – 15 ft. maximum. Cable assemblies are permitted where located in the interior of a one-family dwelling.

**Equipotential Bonding** of perimeter surfaces is not required for outdoor spas and hot tubs if they meet the exception No. 1 – The metal bands or hoops used to secure wooden staves shall not be required to be bonded and exception No. 2 – The top rim of the spa is (28 in.) above the perimeter surfaces within (30 in.) of the spa.

**Indoor Installations** shall comply with Parts I and II of Article 680. Installation must be connected by any wiring method in 680. The equipotential bonding requirements for perimeter surfaces in 680.26(B) (2) shall not apply to a listed self-contained spa or hot tub installed above a finished floor.

## V. Fountains

The **general installation requirements** shall comply with Part I of Article 680. Fountains with water common to a pool shall comply with Part II of Article 680 and portable fountains shall comply with Parts II and III of Article 422.

All metal piping systems associated with the fountain shall be **bonded** to the equipment grounding conductor of the branch circuit supplying the fountain. 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) Panel boards that are not part of the service equipment and that supply any electrical equipment associated with the fountain

## VI. Pools and Tanks for Therapeutic Uses

Pools and tanks for therapeutic uses shall be GFCI protected. All metal parts and equipment of the tub or tank and any metal surfaces, metal wiring methods, and metal equipment shall be **bonded** together per listed requirements.

## VII. Hydromassage Bathtubs

A hydromassage bathtub is 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. An Individual branch circuit is required and readily accessible GFCI protection. 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.

All metal piping systems and all grounded metal parts in contact with the circulating water shall be **bonded** together using a solid copper bonding jumper, insulated, covered, or bare, not smaller than 8 AWG. The bonding jumper shall be connected to the terminal on the circulating pump motor that is intended for this purpose. The bonding jumper shall not be required to be connected to a double insulated circulating pump motor. The 8 AWG or larger solid copper bonding jumper 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 panel board, service equipment, or any electrode.



## Maintenance and Repair:

### Preventative maintenance, retrofitting/replacement, safety precautions

Simple tests on existing pools should include visual inspections, bonding test, grounding test and testing the GFCI outlets.

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A **Visual inspection** should include but not limited to an overall inspection of the pool, location and type of electrical service ground, existence of branch circuit grounds, location of main panel, any sub-panel serving pool, junction boxes, pumps, filters, heaters, metal ladders, fences, diving boards, etc. Turn on lights, etc. to verify operation. Check light lens color and mounting.

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A **Bonding test** using a properly calibrated analog multimeter should be conducted. Items to be tested should include but is not limited to metallic J-boxes and J-box grounds, pool/spa light mounting, electrical system grounds, metallic pump, filter and electrical enclosures and metal ladders, fences, water pipes adjacent (within 5 ft) to the pool/spa.

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A **Grounding test** should be conducted with the power off to lighting and pool equipment. Always lock out/tag out. Perform tests on items required to be grounded. Test GFCI for proper operation as well as outdoor GFCI receptacles.

## Technical amendments to Florida Building Code

Local jurisdictions have the opportunity to seek technical and administrative amendments to the Florida Building Code and several (Miami-Dade County, Broward County, Pinellas County Construction Industry Licensing Board) have done so on "*the maximum voltage for luminaire in any private or recreational bathing pools, electrical requirements, GFCI protection, and close out inspections*". It is important that the licensing professional is aware of not only the appropriate codes and standards, but local amendments. To search the Florida Building Code website for applicable technical amendments visit: [https://www.floridabuilding.org/bc/bc\\_srch.aspx](https://www.floridabuilding.org/bc/bc_srch.aspx)

## U.S. Consumer Product Safety Commission provisions/recommendations

UL 676 is the **Standard for Underwater Luminaires and Submersible Junction Boxes**. The standard's requirements cover underwater luminaire installation for swimming pools and similar structures, operating on supply circuits rated 150 volts or less in accordance with National Electric Code, NFPA 70.

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UL 1081 is the **Standard for Swimming Pool Pumps, Filters, and Chlorinators**. The standard's requirements apply to motor-operated nonsubmersible water pumps, pump-filter combinations and chlorinators for use with pools, hot tubs and spas in accordance with National Electric Code, NFPA 70. The pump is secured directly to the motor or the pump and motor are factory secured to a common frame. They may be permanently connected or cord- and plug-connected to the electrical supply.

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Products listed to the UL 676 and UL 1081 performance standards can be found on the UL Product Specification website: <http://productspec.ul.com/index.php>

## Reference and relevant local, state, and industry contacts

**Associations** representing manufacturers, builders, designers, distributors, suppliers, installers, retailers, service technicians and inspectors:

- International Association of Electrical Inspectors (IAEI): [www.iaei.org/web/Online](http://www.iaei.org/web/Online)
- National Electrical Manufacturers Association (NEMA): [www.nema.org/pages/default.aspx](http://www.nema.org/pages/default.aspx)
- Association of Pool & Spa Professionals (APSP): [www.apsp.org](http://www.apsp.org)
- Florida Swimming Pool Association (FSPA): [www.floridapoolpro.com](http://www.floridapoolpro.com)
- United Pool & Spa Association (UPSA): [www.upsaonline.com](http://www.upsaonline.com)

**Florida Building Commission. Florida Building Code (FBC) 5th Edition (2014)**, FBC – Building Chapter 4 Section 454 Swimming Pools and Bathing Places (Public and Private) and FBC – Residential Chapter 42 Swimming Pools [Electrical Provisions] and Chapter 45 Private Swimming Pools.

<https://floridabuilding.org/c/default.aspx>

**Florida Department of Business and Professional Regulations (DBPR). Construction Industry Licensing Board.** <http://www.myfloridalicense.com/dbpr/pro/cilb/>

**Florida Department of Business and Professional Regulations (DBPR) licensee search.**

<http://www.myfloridahomeenergy.com/help/library/water/pools/#sthash.bmadcgbldpuf>

**National Fire Protection Code (NFPA) NEC 70 Article 680 Swimming Pools, Fountains, and Similar Installations**

**UL Marking and Application Guide for Swimming Pool Equipment** – This guide is intended to assist code authorities, designers, and installers in determining the suitability of specific swimming pool products and address concerns related to fire, shock, plumbing, gas, and/or mechanical hazards.

[http://www.ul.com/wp-content/uploads/2014/04/SwimmingPoolSpa\\_MG.pdf](http://www.ul.com/wp-content/uploads/2014/04/SwimmingPoolSpa_MG.pdf)

**UL Product Specifications** - Quick references to find, specify, or verify UL Certified products for swimming pool (UL 676 and 1081) projects. <http://productspec.ul.com/index.php>

## Acknowledgements

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# NFPA® Ready Reference

## NFPA 70® – Creating an Electrically Safe Environment for Swimming Pools



### Equipotential Bonding in and Around Swimming Pools, Article 680 NEC®

This guide answers many common questions about equipotential bonding in and around swimming pools. This information is for use by professionals and is provided in this format as a handy, quick reference tool for use in the field. This is not a replacement for *NFPA 70®, National Electrical Code® (NEC®)*, 2011 Edition.

A person who is immersed in a pool or who is dripping wet has a large amount of exposed skin, and if lying or walking on a concrete deck or other conductive perimeter surface, is extremely vulnerable to any differences in electrical potential that might be present in the pool area. Creating an electrically safe environment in and around permanently installed swimming pools requires the installation of a bonding system with the sole function of establishing equal electrical potential (voltage) in the vicinity of the swimming pool.



### When is equipotential bonding required?

All indoor pools, permanently installed in-ground pools, and aboveground pools with depths greater than 1.0 m (42 in.) require equipotential bonding. The same applies for all spas and hot tubs installed indoors or outdoors unless they are listed self-contained and installed above a finished floor (see 680.43, Exception No. 2 and TIA 11-1).

These outdoor spas or tubs must have a vertical measurement greater than 720 mm (28 in.) from all permanent perimeter surfaces, and within 750 mm (30 in.) horizontally of the spa to the top rim of the spa to waive the bonding requirement. Equipotential bonding is required around permanently installed fountains that share water with a pool and inground, aboveground, or indoor pools and tubs for therapeutic use that are not readily disassembled. Storable pools and hydromassage bathtubs are not required to be provided with equipotential bonding.



### What is the difference between bonding and grounding?

Article 100 of the *National Electrical Code* defines bonding as *connected to establish electrical continuity and conductivity*. This is different from grounding, which is defined as *connecting to ground or to a conductive body that extends the ground connection*. 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.

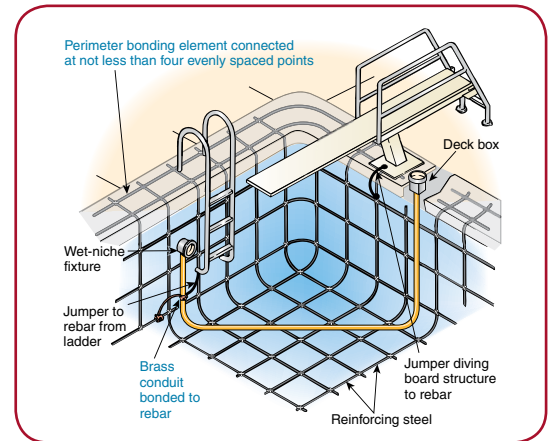


# Creating an Electrically Safe Environment for Swimming Pools

## What needs to be bonded?

The following parts must 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 corrosion-resistant metal.

- Conductive Pool Shells
- Perimeter Surfaces
- Metallic Components
- Underwater Lighting
- Metal Fittings
- Electrical Equipment
- Fixed Metal Parts
- Pool Water



Bonding of conductive metal equipment and parts associated with a swimming pool. Source: *National Electrical Code Handbook*, Exhibit 680.8, 2011 ed.

## Conductive Pool Shells

Pool shells constructed of poured concrete, pneumatically applied concrete, concrete block, and metal are considered to be conductive. Fiberglass and vinyl-lined pools are not.

There are two methods of accomplishing this bonding. One way is through the use of the reinforcing steel, which must not be the encapsulated type. The second method is used when the conductive pool shell will contain encapsulated steel or if there will be no steel present in the concrete. In this instance it is necessary to install a 300 mm (12 in.) by 300 mm (12 in.), 8 AWG bare solid copper grid that follows the contour of the pool.

## Perimeter Surfaces

The perimeter of pool is required to be bonded whether or not the pool shell is conductive. The perimeter surface is considered to be 1 m (3 ft) from the pool walls and unpaved (including grass), and paved and concrete surfaces all require bonding. Again, unencapsulated reinforcing steel is permitted to be utilized similar to the shell bonding. Alternately, a single 8 AWG bare solid copper conductor installed 450 mm (18 in.) to 600 mm (24 in.) from the inside pool wall and 100 mm (4 in.) to 150 mm (6 in.) below grade is permitted when it follows the contour of the pool perimeter. With a conductive pool shell, this perimeter bond must connect to the shell at a minimum of four points uniformly spaced about the perimeter.

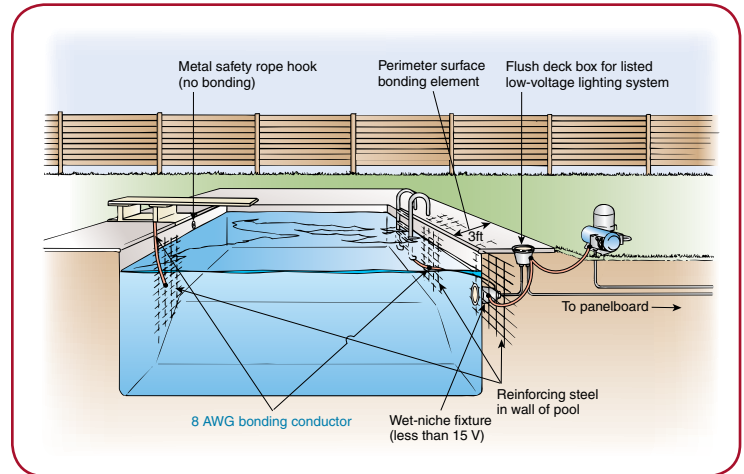
# Creating an Electrically Safe Environment for Swimming Pools

## Metallic Components, Underwater Lighting, Metal Fittings, and Electrical Equipment

Metallic components of the pool structure, including any reinforcing steel not part of the pool shell, must be bonded. Encapsulated reinforcing steel is not required to be bonded. No-niche underwater luminaires can have metal forming shells or mounting brackets that also require bonding. All metal fittings within or attached to the pool structure require bonding except for isolated fittings that are 100 mm (4 in.) or less in any dimension and that penetrate the pool structure not more than 25 mm (1 in.).

Electrical equipment associated with water circulation, such as the pump, or associated with a pool cover, including the motor, is also required to be bonded.

Metal parts of equipment listed as having double insulation do not require bonding because there are specific requirements for a double-insulated water pump motor. These pumps require a solid 8 AWG copper conductor to be run from the bonding grid to the pump area to provide for a possible replacement pump that is not double-insulated. If no connection between the bonding grid and premises equipment grounding system is present, then this future use bonding conductor is permitted to connect to the equipment grounding conductor of the pump.



A poured concrete pool with structural reinforcing steel that serves as the pool shell bonding grid. Source: *National Electrical Code Handbook*, Exhibit 680.12, 2008 ed.

## Fixed Metal Parts

There are many other fixed metal parts around a pool area that require bonding. Metal pipes, fences, awnings, door frames, and diving boards are examples of these additional parts. Fixed metal parts that are not within reach of a person in the pool area are not required to be bonded.

### Fixed metal parts are not required to be bonded if they are:

- separated from the pool by a permanent barrier that prevents contact by a person
- located greater than 1.5 m (5 ft) horizontally from the inside wall of the pool
- located greater than 3.7 m (12 ft) vertically above the maximum water level of the pool, observation stand, tower, platform, or diving structure.

## Pool Water

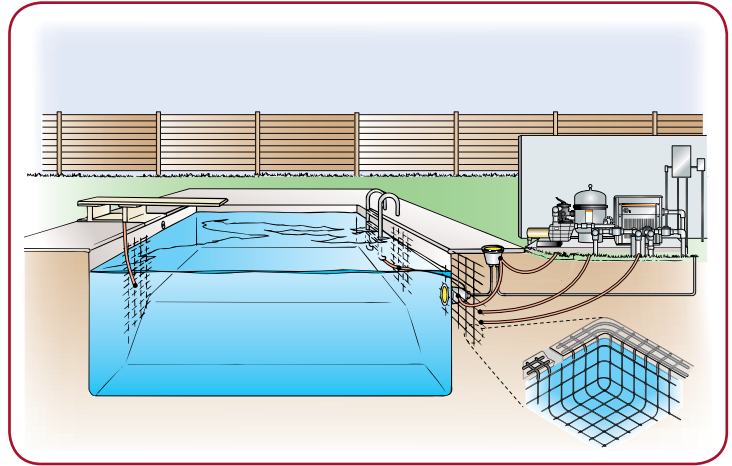
The pool water itself must also be bonded. A minimum 5800 mm<sup>2</sup> (9 in.<sup>2</sup>) of conductive surface is required to be in contact with the water. This is a part intentionally installed to achieve this bond but can be any of the other parts required to be bonded if the surface size requirement is met.

# Creating an Electrically Safe Environment for Swimming Pools

## Electrically Safe Pool Environment

A person in a swimming pool can receive a severe electric shock by reaching out and touching the energized casing of a faulty appliance, such as a radio. Electric current necessary to cause immobilization might not be fatal from an electrical shock perspective, but can lead to accidental drowning.

A person in a swimming pool can also receive an electric shock and be rendered immobile by a shock caused by differences in potential energy between many of the objects and surfaces around a pool. Equipotential bonding reduces differences in potential energy in and around the pool and creates an electrically safe environment.



## Additional References

To learn more about NFPA 70, see the *National Electrical Code Handbook*, available for purchase at [www.nfpa.org](http://www.nfpa.org).

If you are an NFPA member, NFPA technical staff are available to answer your specific questions about *NFPA 70, National Electrical Code*. Call 800-344-3555 between 9 am and 5 pm (EST) Monday through Friday. Please have your NFPA membership number on-hand. Not a member? Join by calling 800-344-3555 or visiting [www.nfpa.org/join](http://www.nfpa.org/join).

## Important Additional Information

This guide is not intended to be a substitute for the full text of the *National Electrical Code*. Review the full text of *NFPA 70, National Electrical Code*, which should always be consulted for a full understanding of its provisions. Visit [www.nfpa.org/70](http://www.nfpa.org/70), where you can register for free to view the full text of NFPA 70 and sign up to receive email notifications of amendments and new editions of NFPA 70 as they become available.

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