



## 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.

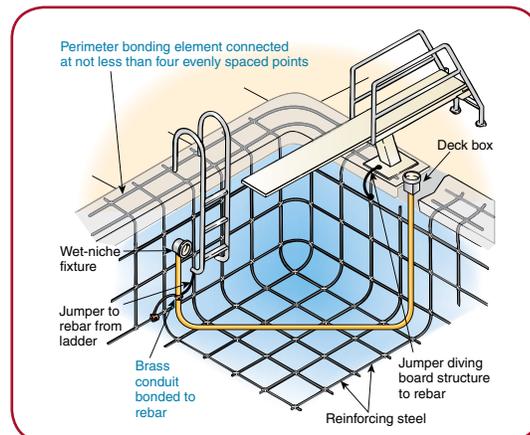


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## What needs to be bonded?

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.



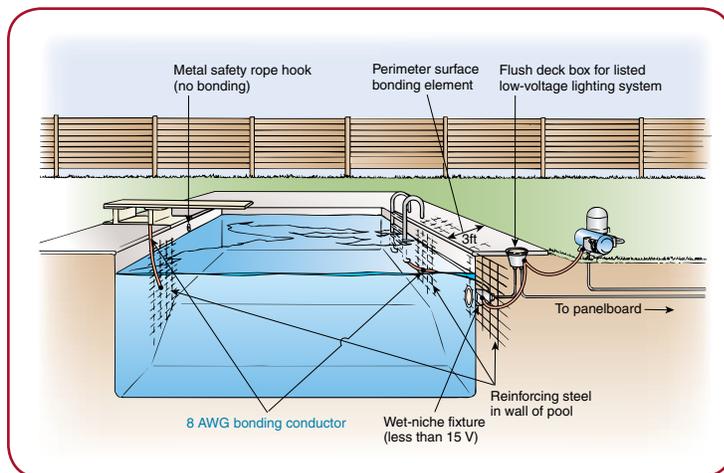
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## Metallic Components, Underwater Lighting, Metal Fittings, and Electrical Equipment

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.

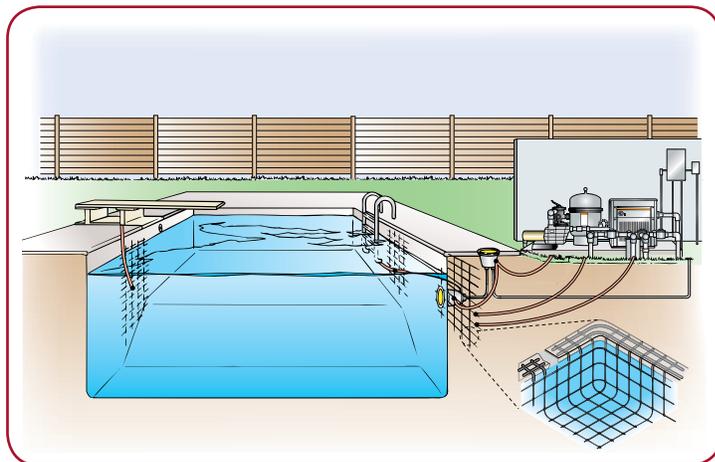


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## Electrically Safe Pool Environment

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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