



News from the Electrical Inspection Division

February 1, 2009

We are now using the 2008 NEC code for any permits pulled after Building AP# 122841 and Electrical AP# 122857.

SE cable and Tamper Resistant Receptacles are now in effect as of July 3, 2008. (Permits issued after numbers – Building #125442, Electrical # 125420.)

Arc-Fault Circuit-Interrupter Protection for Dwelling Units, and Receptacles in Damp and Wet Locations to be listed for such use - are now in effect as of January 1, 2009. (Permits issued after - Building # 136054, Electrical #136008).

Approved Plans on Job:

The builder or contractor knows that they are required to have the correct updated plans for us on the job at the time of inspection. When you compare the plans with the construction on the job and they don't match the "stamped" set of plans; our inspectors will fail the job and **activate a 40.00 trip charge.** It is the contractor's **responsibility** to get the corrected plans on the job site. Then (he/she) can call the inspection back in.

Spring is just around the corner, with that in mind, bonding for the equipotential bonding grid of a pool installation is as follows.

680.26 Equipotential Bonding.

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

It is important to understand the difference between the terms *bonding* and *grounding* as they apply to Article 680. As defined in Article 100, bonding is "connected to establish electrical continuity and conductivity." As described in 680.26(A), the function of equipotential bonding differs from the primary function of bonding to meet the requirements of Article 250 in that providing a path for ground-fault current is not the function of the equipotential bonding grid and associated bonding conductors.

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. A person who is immersed in a pool or who is dripping wet, has a large amount of exposed skin, and is lying or walking on a concrete deck or other conductive perimeter surface is extremely vulnerable to any differences in electrical potential that may be present in the pool area.

The primary purpose of bonding in and around swimming pools is to ensure that voltage gradients in the pool area are not present. Section 680.26(B) specifies that the 8 AWG conductor's only function is equipotential bonding to eliminate the voltage gradient in the pool area and the bonding conductor is not required to extend or connect to any parts or

equipment other than those covered in 680.26(B)(1) through (B)(7) and to a pool water bonding element covered in 680.26(C).

The reason for electrically connecting all of the metal parts described in 680.26(B)(1) through (7) is to ensure that they all are at the same electrical potential. This bonding reduces possible injurious or disabling shock hazards created by stray currents in the ground or piping connected to the swimming pool. Stray currents can also exist in nonmetallic piping because of the low resistivity of chlorinated water. See Exhibit 680.10.

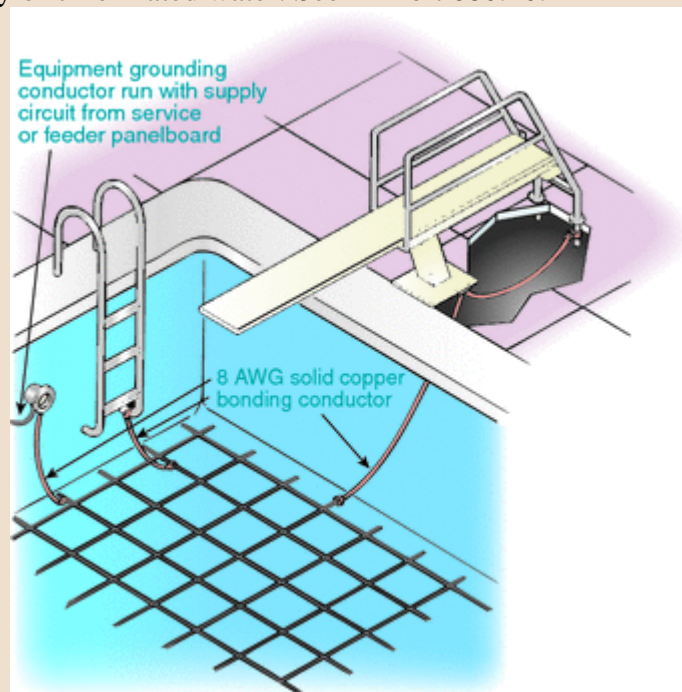


Exhibit 680.10 Bonding of conductive metal parts in a swimming pool.

(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.

(1) Conductive Pool Shells. Bonding to conductive pool shells shall be provided as specified in 680.26(B)(1)(a) or (B)(1)(b). Poured 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. Vinyl liners and fiberglass composite shells shall be considered to be nonconductive materials.

(a) *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).

Conductive pool shells include those constructed of poured concrete, pneumatically applied concrete, concrete block, and, of course, metal. Fiberglass and vinyl-lined pools are not considered to be conductive pool shells and are not subject to having a bonding grid installed around the entire contour of the pool shell.

Encapsulated reinforcing steel is not likely to provide the conductivity necessary to establish the required common bonding grid around the contour of a conductive pool shell. A bonding grid around the contour of the pool shell will not be formed if the steel is effectively encapsulated by a listed compound during installation and manufacturing. Therefore, a

bonding connection to the encapsulated reinforcing steel is not required; however, a bonding grid around the contour of a conductive pool shell must be provided. The copper bonding grid is required to be constructed as prescribed in 680.26(B)(1)(b). See Exhibit 680.11.

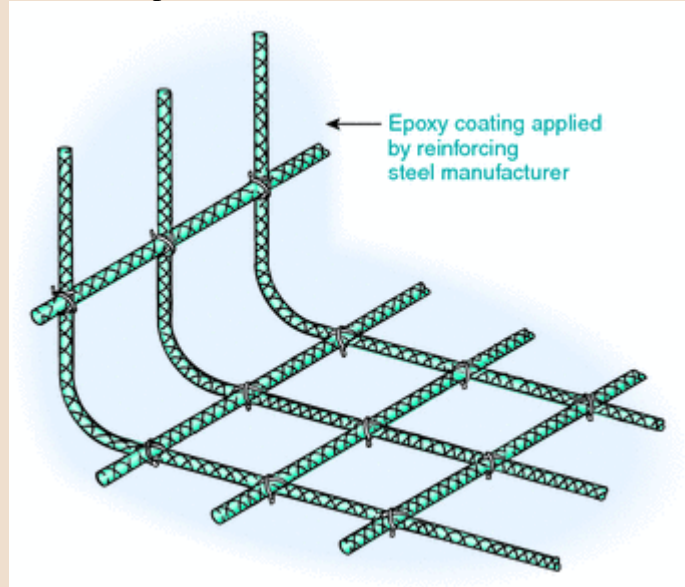


Exhibit 680.11 Epoxy-coated rebar, which does not require bonding.

In Exhibit 680.12, structural reinforcing steel serves as a common point to which all metal appurtenances associated with the pool are connected. This method of connection is one way of satisfying the requirement to bond all metal parts together. Individual pieces of hardware such as the hooks used to attach safety or lane ropes, that are less than 4 in. in any dimension and do not penetrate into the pool structure more than 1 in. are not required to be bonded, per 680.26(B)(5). The flush deck box meets the provisions of 680.24(A).

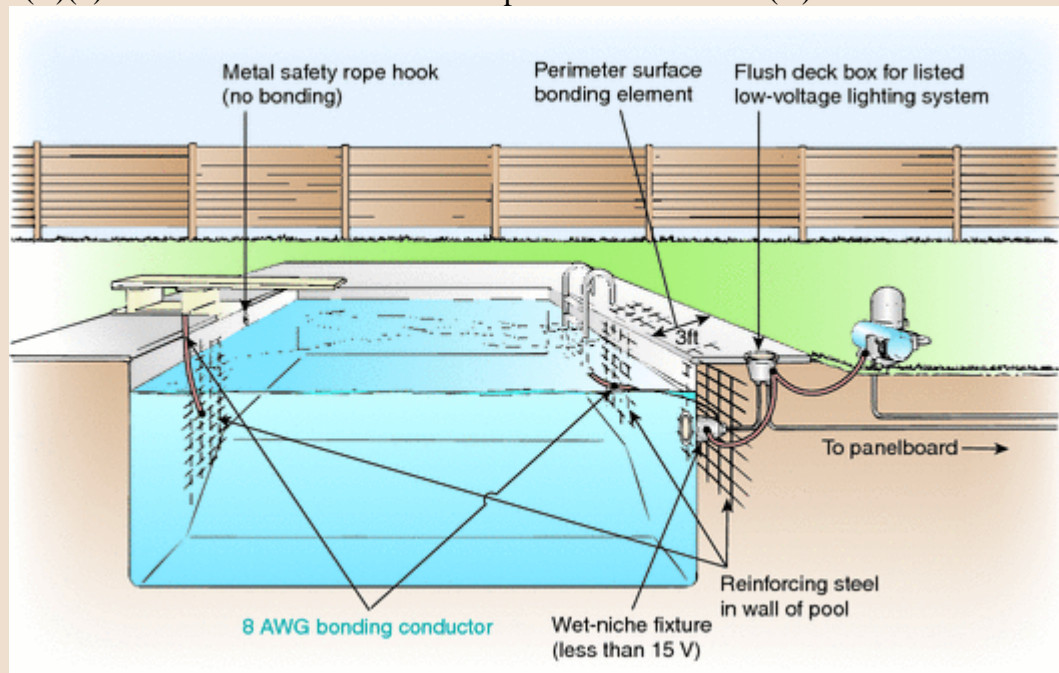


Exhibit 680.12 A poured-concrete pool with structural reinforcing steel that serves as the pool shell bonding grid.

(b) *Copper Conductor Grid.* A copper conductor grid shall be provided and shall comply with (b)(1) through (b)(4).

- (1) Be constructed of minimum 8 AWG bare solid copper conductors bonded to each other at all points of crossing

- (2) Conform to the contour of the pool and the pool deck
- (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

(2) 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 and other types of paving. Bonding to perimeter surfaces shall be provided as specified in 680.26(B)(2)(a) or (2)(b) and shall be attached to the pool reinforcing steel or copper conductor grid at a minimum of four (4) points uniformly spaced around the perimeter of the pool. For nonconductive pool shells, bonding at four points shall not be required.

The requirement for bonding perimeter surfaces now applies to paved and unpaved surfaces. An example of an unpaved perimeter surface would be the lawn surrounding a permanently installed aboveground swimming pool. Where the paved portion of the perimeter surface extends less than 3 ft horizontally from the inside walls of the pool, the perimeter bonding grid must be continued under the adjacent unpaved perimeter surface. If physical constraints (such as a wall or other physical barrier) prevent the perimeter from extending 3 ft beyond the inside walls of the pool, the bonding grid is required only to extend under the available perimeter area.

The perimeter bonding grid can be comprised of structural reinforcing metal (re-bar or welded wire mesh) that is conductive to the perimeter surface and installed in or under the perimeter surface. Where structural reinforcing steel is not available, a single, bare, solid 8 AWG or larger copper conductor can be installed around the perimeter of the pool in an area measuring between 18 in. and 24 in. from the inside pool walls. This 8 AWG bonding conductor can be installed in the paving material (i.e., in the concrete), or it can be buried in the material (*subgrade*) below the paving material. Where buried, the bonding conductor is to be not less than 4 in. and not more than 6 in. below the surface level of the subgrade material.

The perimeter surface bonding medium has to be connected, at four evenly spaced points around the pool perimeter, to either the structural steel of a conductive pool shell or to the copper bonding grid provided for the conductive pool shell that has encapsulated re-bar or no re-bar at all. Connection between the perimeter bonding medium and nonconductive pool shells is not required.

(a) *Structural Reinforcing Steel.* Structural reinforcing steel shall be bonded in accordance with 680.26(B)(1)(a).

(b) *Alternate Means.* Where structural reinforcing steel is not available or is encapsulated in a nonconductive compound, a copper conductor(s) shall be utilized where the following requirements are met:

- (1) At least one minimum 8 AWG bare solid copper conductor shall be provided.
- (2) The conductors shall follow the contour of the perimeter surface.
- (3) Only listed splices shall be permitted.
- (4) The required conductor shall be 450 to 600 mm (18 to 24 in.) from the inside walls of the pool.
- (5) The required conductor shall be secured within or under the perimeter surface 100 mm to 150 mm (4 in. to 6 in.) below the subgrade.

(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.

(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.

(5) Metal Fittings. All metal fittings within or attached to the pool structure shall be bonded. Isolated parts that are not over 100 mm (4 in.) in any dimension and do not penetrate into the pool structure more than 25 mm (1 in.) shall not require bonding.

(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.

(a) *Double-Insulated Water Pump Motors.* Where a double-insulated water pump motor is installed under the provisions of this rule, a solid 8 AWG copper conductor of sufficient length to make a bonding connection to a replacement motor shall be extended from the bonding grid to an accessible point in the vicinity of the pool pump motor. Where there is no connection between the swimming pool bonding grid and the equipment grounding system for the premises, this bonding conductor shall be connected to the equipment grounding conductor of the motor circuit.

(b) *Pool Water Heaters.* For pool water heaters rated at more than 50 amperes and having specific instructions regarding bonding and grounding, only those parts designated to be bonded shall be bonded and only those parts designated to be grounded shall be grounded.

(7) Metal Wiring Methods and Equipment. Metal-sheathed cables and raceways, metal piping, and all fixed metal parts shall be bonded.

The metal parts required to be bonded per 680.26(B) include all metal parts of electrical equipment associated with the water-circulating system of the pool, all metal parts of the pool structure, and all fixed metal parts, which include conduit and piping, metal door frames, and metal window frames, within 5 ft of the inside walls of the pool and not separated by a permanent barrier. Other examples of fixed metal parts covered by this requirement include metal fences and metal awnings. The bonding of these parts can be accomplished by one or more of the following methods using a solid 8 AWG or larger, insulated, covered, or bare copper conductor. See Exhibit 680.13. Brass or other corrosion-resistant metal conduit can also be used as a bonding conductor for connecting metal parts together.

- Connecting the parts directly to each other in series or parallel configurations
- Connecting the parts to the unencapsulated structural metal forming the shell of a conductive pool or connecting the parts to a copper conductor grid system used around the contour of a conductive pool shell
- Connecting the parts together using the pool shell constructed of bolted or welded steel as a common connection point. See Exhibit 680.13
- Connecting the parts to the perimeter bonding grid consisting of either structural reinforcing steel (re-bar or welded wire mesh) or a solid 8 AWG bare copper conductor encircling the perimeter of the pool

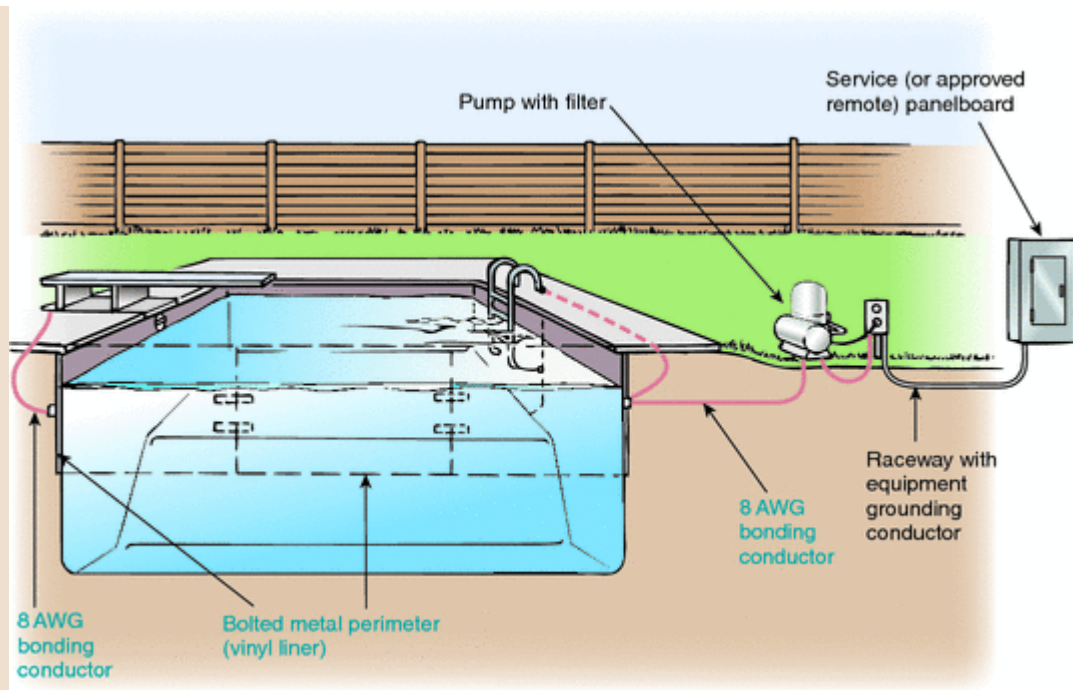


Exhibit 680.13 A metal-perimeter (e.g., steel or aluminum) pool with bolted or welded sections. The metal pool perimeter, the metal ladder, metal diving board, and pump motor are all connected together using 8 AWG solid copper bonding conductors.

Exhibit 680.14 illustrates the use of brass rigid metal conduit or other corrosion-resistant metal conduit as a means to connect electrical equipment, such as the forming shell of a wet-niche luminaire, to the pool reinforcing steel.

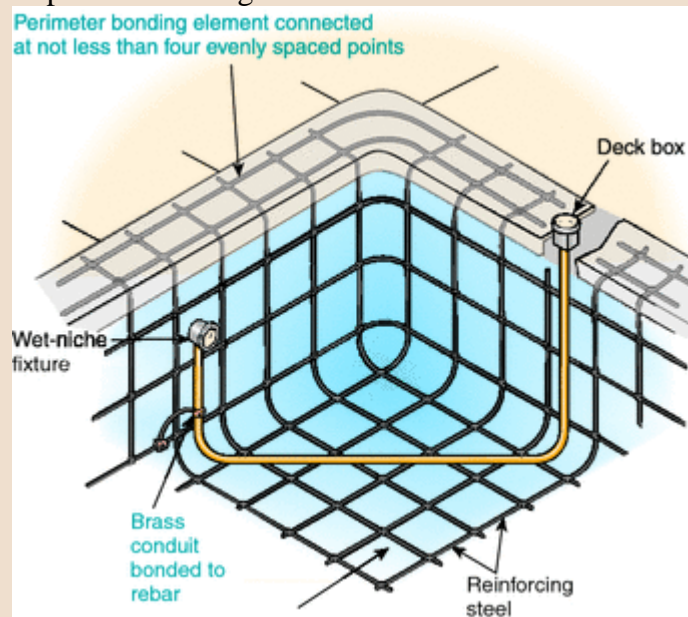


Exhibit 680.14 Brass rigid metal conduit used as a means to connect electrical equipment to the common bonding grid.

As specified in 250.8 for the grounding and bonding connections required by Article 250, exothermic welding, pressure connectors and clamps specifically listed for the purpose, and other listed means are permitted as the method of connecting bonding conductors to swimming pool equipment required to be bonded. Connections in pool areas must be suitable for wet conditions and high levels of chlorine. High concentrations of chlorine in swimming pool water make the wet locations in the vicinity of swimming pool areas (including many

pool pump rooms) a corrosive environment. The integrity of the bonding connections should be periodically inspected, particularly those bonding connections between the 8 AWG copper conductor and, for instance, an aluminum (or other dissimilar metal) ladder. See Exhibit 680.15 for an illustration of two acceptable methods of making swimming pool bonding connections.

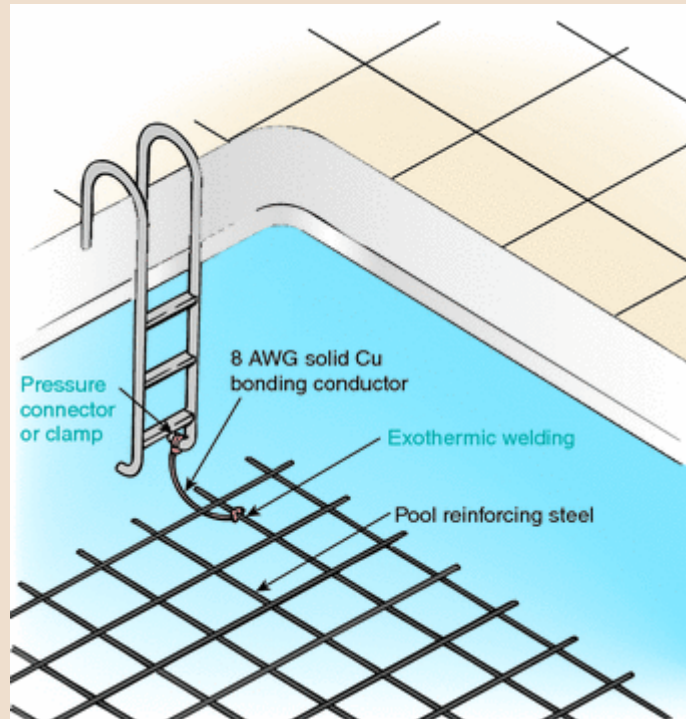


Exhibit 680.15 Bonding connections in a swimming pool.

Exception No. 1: Those separated from the pool by a permanent barrier shall not be required to be bonded.

Exception No. 2: Those greater than 1.5 m (5 ft) horizontally of the inside walls of the pool shall not be required to be bonded.

Exception No. 3: Those greater than 3.7 m (12 ft) measured vertically above the maximum water level of the pool, or as measured vertically above any observation stands, towers, or platforms, or any diving structures, shall not be required to be bonded.

(C) Pool Water. An intentional bond of a minimum conductive surface area of 5806 mm² (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 680.26(B).

Code Questions and Concerns:

Please send any questions or comments to marklt@cityofws.org enter *CODE QUESTIONS* under the subject. We would like to hear from you.

Thanks,

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