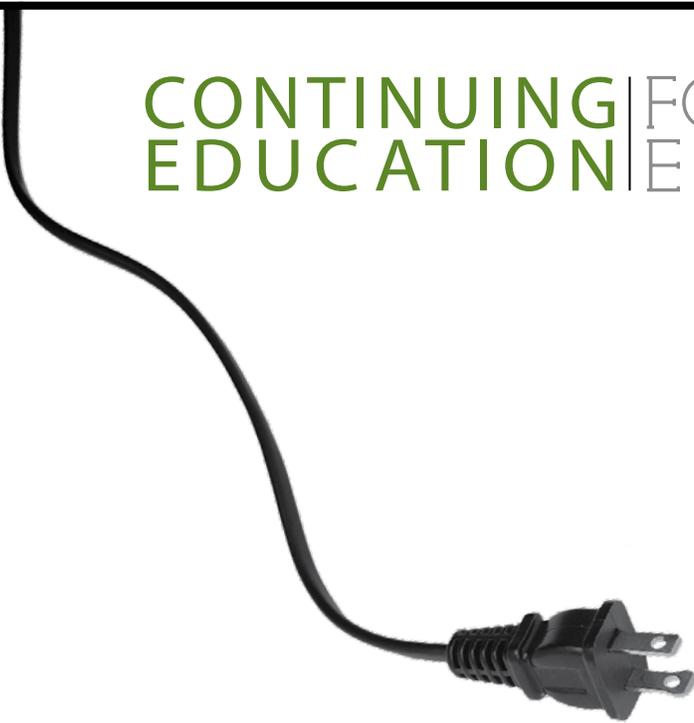


# **WCI** Wisconsin Contractors Institute

## CONTINUING EDUCATION | FOR WISCONSIN ELECTRICIANS

**2017 NEC Article 680**  
**3 Hours**



**WISCONSIN CONTRACTORS INSTITUTE**  
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DISCLAIMER NOTE: This course is APPROVED by the Wisconsin Department of safety and professional services for continuing education to renew your electrical license and is not intended to replace or supersede any state or local adopted codes.

## ARTICLE 680

Article 680 is organized into 7 different parts that deal with specific requirements with regards to pools and bodies of water. The specific parts are as follows:

- I. General
- II. Permanently Installed Pools
- III. Storable Pools, Storable Spas, and Storable Hot Tubs
- IV. Spas and Hot Tubs
- V. Fountains
- VI. Pools and Tubs for Therapeutic Use
- VII. Hydro massage Bathtubs

**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.

**(NEW) 680.2 Electrically Powered Pool Lift.** An electrically powered lift that provides accessibility to and from a pool or spa for people with disabilities.

**Packaged Spa or Hot Tub Equipment Assembly.** A factory fabricated unit consisting of water-circulating, heating, and control equipment mounted on a common base, intended to operate a spa or hot tub. Equipment can include pumps, air blowers, heaters, lights, controls, sanitizer generators, and so forth.

**Hydro massage Bathtub.** A permanently installed bathtub equipped with a recirculating piping system, pump, and associated equipment. It is designed so it can accept, circulate, and discharge water upon each use.

**Permanently Installed Decorative Fountains and Reflection Pools.** Those that are constructed in the ground, on the ground, or in a building in such a manner that the fountain cannot be readily disassembled for storage, whether or not served by electrical circuits of any nature. These units are primarily constructed for their aesthetic value and are not intended for swimming or wading.

**Permanently Installed Swimming, Wading, Immersion, and Therapeutic Pools.** Those that are constructed in the ground or partially in the ground, and all others capable of holding water in a depth greater than 1.0 m (42 in.), and all pools installed inside of a building, regardless of water depth, whether or not served by electrical circuits of any nature.



## EXAM QUESTIONS

1. What part of Article 680 should be referenced when installing a permanently installed pool?
  - A. I
  - B. II
  - C. III
  - D. V
2. What are primarily constructed for their aesthetic value and are either in the ground, on the ground, or in a building and cannot be readily disassembled for storage?
  - A. Fountains
  - B. Permanently Installed Swimming, Wading, Immersion, and Therapeutic Pools
  - C. Storable Swimming, Wading, or Immersion Pool
  - D. Permanently installed decorative fountains and reflection pools

3. **What term best describes an electrically powered lift that provides accessibility to and from a pool or spa for people with disabilities?**
  - A. Powered Pool Lift, Electric
  - B. Electronically Powered Pool Lift
  - C. Electrically Powered Pool Lift
  - D. Powered Pool Lift, Electronic
4. **Information regarding the installation requirements for Hydro Massage Bathtubs can be found in what part of Article 680?**
  - A. V
  - B. I
  - C. III
  - D. VII
5. **What term covers bathtubs with a recirculating piping system, pump, and associated equipment that is designed to be permanently installed?**
  - A. Spa or hot tub
  - B. Hydro massage bathtub
  - C. Pool
  - D. Equipment, fixed
6. **If installing a storable hot tub, what part of Article 680 should be referenced?**
  - A. VII
  - B. I
  - C. III
  - D. V
7. **What listed term is capable of holding water greater than the depth of 42 inches?**
  - A. Contained Permanently Installed Swimming, Wading, Immersion, and Therapeutic Pools
  - B. Permanently Installed Decorative Fountains and Reflection Pools
  - C. Storable Swimming, Wading, or Immersion Pool
  - D. Self Therapeutic Tubs or Hydrotherapeutic Tanks
8. **What best defines a fixture that is sealed from the entry of water that is installed in the floor or wall of pools, spas, or fountains?**
  - A. Wet-niche Luminaire
  - B. Dry-niche Luminaire
  - C. No-niche Luminaire
  - D. Through-wall lighting assembly
9. **What part of Article 680 deals with fountains?**
  - A. V
  - B. I
  - C. III
  - D. VII
10. **What is a factory fabricated unit consisting of water-circulating, heating, and control equipment mounted on a common base intended to operate a spa or hot tub?**
  - A. Portable equipment
  - B. Spa or hot tub
  - C. Packaged spa or hot tub equipment assembly
  - D. Cord-and-plug-connected equipment
11. **What part of Article 680 deals with the general requirements for pools and other structures that contain water and have electrical power?**
  - A. III
  - B. I
  - C. VII
  - D. V

**Pool.** Manufactured or field-constructed equipment designed to contain water on a permanent or semi-permanent basis and used for swimming, wading, immersion, or therapeutic purposes.

**Self-Contained Therapeutic Tubs or Hydrotherapeutic Tanks.** A factory-fabricated unit consisting of a therapeutic tub or hydrotherapeutic tank with all water-circulating, heating, and control equipment integral to the unit. Equipment may include pumps, air blowers, heaters, light controls, sanitizer generators, and so forth.

**Spa or Hot Tub.** A hydro massage pool, or tub for recreational or therapeutic use, not located in health care facilities, designed for immersion of users, and usually having a filter, heater, and motor-driven blower. It may

be installed indoors or outdoors, on the ground or supporting structure, or in the ground or supporting structure. Generally, a spa or hot tub is not designed or intended to have its contents drained or discharged after each use.

**Storable Swimming, Wading, or Immersion Pools; or Storable/Portable Spas and Hot Tubs.** Swimming, wading, or immersion pools that are intended to be stored when not in use, constructed on or above the ground and are capable of holding water to a maximum depth of 1.0 m (42 in.), or a pool, spa, or hot tub constructed on or above the ground, with nonmetallic, molded polymeric walls or inflatable fabric walls regardless of dimension.

**(NEW) 680.7 Grounding and Bonding Terminals.** Grounding and bonding terminals shall be identified for use in wet and corrosive environments. Field-installed grounding and bonding connections in a damp, wet, or corrosive environment shall be composed of copper, copper alloy, or stainless steel. They shall be listed for direct burial use.

**Article 680.8 Cord-and-plug-connected equipment.** Fixed or stationary equipment other than underwater luminaires, for a permanently installed pool shall be permitted to be connected with a flexible cord and plug to facilitate the removal or disconnection for maintenance or repair.

**680.10 Electric Pool Water Heaters.** All electric pool water heaters shall have the heating elements subdivided into loads not exceeding 48 amperes and protected at not over 60 amperes. The ampacity of the branch-circuit conductors and the rating or setting of overcurrent protective devices shall not be less than 125 percent of the total nameplate-rated load.



### PART 3 EXAM QUESTIONS

- |  |  |
|--|--|
| <p>12. What is generally designed to not have its contents drained or discharged after each use?</p> <ul style="list-style-type: none"> <li>A. Hydro massage bathtub</li> <li>B. Pool</li> <li>C. Fountains</li> <li>D. Spa or hot tub</li> </ul>  | <p>14. What maximum depth is listed for a nonmetallic pool to still be considered storable?</p> <ul style="list-style-type: none"> <li>A. 40</li> <li>B. 46</li> <li>C. 48</li> <li>D. 42</li> </ul>   |
| <p>13. What is designed to permanently or semi permanently contain water on the basis that it is used for swimming, wading, immersion, or therapeutic purposes?</p> <ul style="list-style-type: none"> <li>A. Spa or hot tub</li> <li>B. Pool</li> <li>C. Fountains</li> <li>D. Hydro massage bathtub</li> </ul> | <p>15. What best defines fixed or stationary equipment other than underwater luminaires for a permanently installed pool to facilitate the removal or disconnection for maintenance or repair?</p> <ul style="list-style-type: none"> <li>A. Hydro massage bathtub</li> <li>B. Spa or hot tub</li> <li>C. Fountains</li> <li>D. Cord-and-plug-connected equipment</li> </ul> |

16. What is a grounding terminal installed in the wet and corrosive environment around a pool required to be listed for?
- A. Moisture resistance
  - B. Hard usage
  - C. Direct burial
  - D. All listed answers

17. What is the maximum current electric pool water heaters are required to have their heating elements subdivided into?
- A. 48
  - B. 24
  - C. 60
  - D. 12

**(NEW) 680.14 (A) General.** Areas where pool sanitation chemicals are stored, as well as areas with circulation pumps, automatic chlorinators, filters, open areas under decks adjacent to or abutting the pool structure, and similar locations shall be considered to be a corrosive environment. The air in such areas shall be considered to be laden with acid, chlorine, and bromine vapors, or any combination of acid, chlorine, or bromine vapors, and any liquids or condensation in those areas shall be considered to be laden with acids, chlorine, and bromine vapors, or any combination of acid, chlorine, or bromine vapors.

**(Revised) Article 680.21 Motors (A) Wiring methods (1) general.** Wiring methods installed in the corrosive environment described in 680.14 shall comply with 680.14(B) or shall be type MC cable listed for that location. Wiring methods installed in these locations 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, branch circuits shall comply with the general requirements in Chapter 3.



**Article 680.22 lighting, receptacles, and equipment (A) receptacles (1) Required Receptacle, Location.** Where a permanently installed pool is installed at a dwelling unit(s), 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.

**(Revised) 680.22 (A)(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.

**680.22 Lighting, Receptacles, and Equipment (B) (1) New Outdoor Installation Clearances.** In outdoor pool areas, luminaires, lighting outlets, and ceiling suspended (paddle) fans installed above the pool or the area extending 1.5 m (5 ft) horizontally from the inside walls of the pool shall be installed at a height not less than 3.7 m (12 ft) above the maximum water level of the pool.

## EXAM QUESTIONS

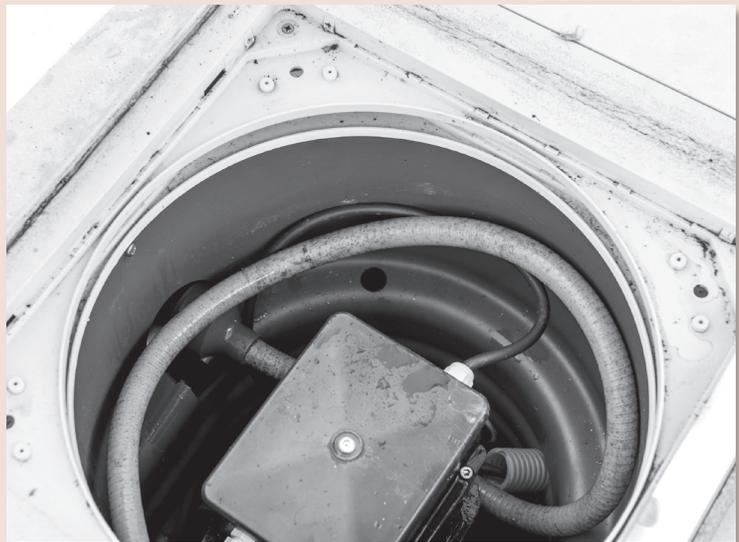
18. What type of environment is the storage of pool chemicals considered?
- Particulate hazard
  - Class 1 division 1
  - Combustible
  - Corrosive
19. What table must be used when installing an equipment grounding conductor in a pool area?
- 250.66
  - 250.122
  - 250.104
  - 250.102(D)
20. What is the minimum size an insulated copper equipment grounding conductor can be when installed in a pool area?
- 12 AWG
  - 14 AWG
  - 10 AWG
  - 8 AWG
21. How far from the inside wall of a pool are receptacles that power water-pump motors for the sanitation system required to be?
- 6 ft
  - 4 ft
  - 5 ft
  - 10 ft
22. How many 125-volt, 15- or 20-ampere receptacle are required to be installed around a permanent dwelling unit pool?
- 4
  - 2
  - 1
  - 3
23. What is the minimum height above a pool that a paddle fan can be installed?
- (7 ft 6 in)
  - (5 ft)
  - (12 ft)
  - (10 ft.)

**680.22 Lighting, Receptacles, and Equipment (B) (2) Indoor Clearances.** For installations in indoor pool areas, the clearances shall be the same as for outdoor areas unless modified as provided in this paragraph. If the branch circuit supplying the equipment is protected by a ground-fault circuit interrupter, the following equipment shall be permitted at a height not less than 2.3 m (7 ft 6 in.) above the maximum pool water level:

- Totally enclosed luminaires
- Ceiling-suspended (paddle) fans identified for use beneath ceiling structures such as provided on porches or patios

**680.22 Lighting, Receptacles, and Equipment (B) (3) Existing Installations.** Existing luminaires and lighting outlets located less than 1.5 m (5 ft) measured horizontally from the inside walls of a pool shall be not less than 1.5 m (5 ft) above the surface of the maximum water level, shall be rigidly attached to the existing structure, and shall be protected by a ground-fault circuit interrupter.

**680.22 Lighting, Receptacles, and Equipment (B) (4) GFCI Protection in Adjacent Areas.** Pool luminaires, lighting outlets, and ceiling-suspended (paddle) fans installed in the area extending between 1.5 m (5 ft) and 3.0 m (10 ft) horizontally from the inside walls of a pool shall be protected by a ground-fault circuit



interrupter unless installed not less than 1.5 m (5 ft) above the maximum water level and rigidly attached to the structure adjacent to or enclosing the pool.

**(NEW) 680.22 (B)(7) Low-Voltage Gas-Fired Luminaires, Decorative Fireplaces, Fire Pits, and Similar Equipment.**

Listed low-voltage gas-fired luminaires, decorative fireplaces, fire pits, and similar equipment using low-voltage ignitors that do not require grounding, and are supplied by listed transformers or power supplies that comply with 680.23(A)(2) with outputs that do not exceed the low-voltage contact limit shall be permitted to be located less than 1.5 m (5 ft) from the inside walls of the pool. Metallic equipment shall be bonded in accordance with the requirements in 680.26(B). Transformers or power supplies supplying this type of equipment shall be installed in accordance with the requirements in 680.24. Metallic gas piping shall be bonded in accordance with the requirements in 250.104(B) and 680.26(B)(7).

**680.22 Lighting, Receptacles, and Equipment (C) Switching Devices.** Switching devices shall be located around pools 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. Alternatively, a switch that is listed as being acceptable for use within 1.5 m (5 ft) shall be permitted.

**(Revised) 680.23 Underwater luminaires (A)(2) Transformers and Power Supplies.** Transformers and power supplies used for the supply of underwater luminaires, together with the transformer or power supply enclosure, shall be listed, Labeled, and identified for swimming pool and spa use. The transformer or power supply shall incorporate either a transformer of the isolated winding type, with an ungrounded secondary that has a grounded metal barrier between the primary and secondary windings, or one that incorporates an approved system of double insulation between the primary and secondary windings.

## EXAM QUESTIONS

24. How are luminaires required to be protected that extend between 1.5 m (5 ft) and 3.0 m (10 ft) horizontally from the inside of a pool?
- GFCI
  - AFCI
  - Water resistant lens covers
  - Nonmetallic fixture covers
25. What type of transformer/power supply can be used around pool areas besides one that incorporates an approved system of double insulation between the primary and secondary windings?
- Transformer of the isolated winding type, with a grounded secondary that has an ungrounded nonmetallic barrier between the primary and secondary windings
  - Transformer of the isolated winding type, with a grounded secondary that has an ungrounded metal barrier between the primary and secondary windings
  - Transformer of the isolated winding type, with an ungrounded secondary that has a grounded metal barrier between the primary and secondary windings
  - No listed answer
26. How are luminaires and lighting outlets in existing pool locations required to be attached?
- With guarded coverings
  - Securely
  - Openly
  - Rigidly
27. How far from the inside wall of a pool can a fire pit using low-voltage ignitors not requiring grounding supplied by a listed power supply be installed?
- 6 ft
  - 4 ft
  - 5 ft
  - 10 ft
28. What is the minimum height above the max pool water level that a totally enclosed luminaire GFCI protected can be installed in an indoor pool area?
- 3.7 m (12 ft.)
  - 1.5 m (5 ft)
  - 4.4 m (14.5 ft)
  - 2.3 m (7 ft 6 in)

29. What is the minimum distance horizontally from the inside walls of a pool that switching devices can be installed? Assume there is no permanent barrier between the pool and the switching device.

- A. 5 ft.
- B. 6 ft.
- C. 6 ft. 6 inches
- D. 7 ft. 6 inches

**(Revised) 680.23 Underwater luminaires (A)(3) GFCI Protection, Lamping, Relamping, and Servicing.** Ground-fault circuit-interrupter protection for personnel shall be installed in the branch circuit supplying luminaires operating at voltages greater than the low-voltage contact limit. 680.23 Underwater luminaires

**680.23 (A)(5) Location, Wall-Mounted Luminaires.** Luminaires mounted in walls shall be installed with the top of the luminaire lens not less than 450 mm (18 in.) below the normal water level of the pool, unless the luminaire is listed and identified for use at lesser depths. No luminaire shall be installed less than 100 mm (4 in.) below the normal water level of the pool.

**680.23 Underwater luminaires (B) Wet-Niche Luminaires (1) Forming Shells.** Forming shells shall be installed for the mounting of all wet-niche underwater luminaires and shall be equipped with provisions for conduit entries. Metal parts of the luminaire and forming shell in contact with the pool water shall be of brass or other approved corrosion-resistant metal. All forming shells used with nonmetallic conduit systems, other than those that are part of a listed low-voltage lighting system not requiring grounding, shall include provisions for terminating an 8 AWG copper conductor.

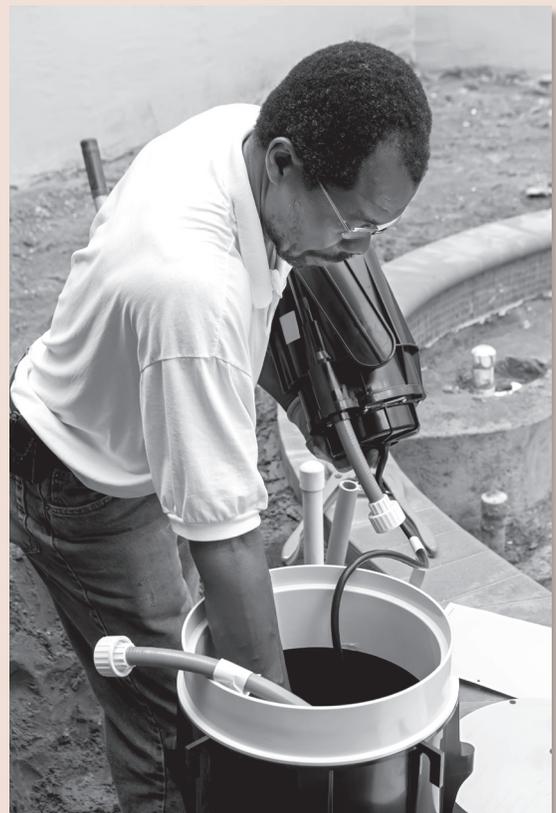
**680.23 Underwater luminaires (B) Wet-Niche Luminaires (2) Wiring Extending Directly to the Forming Shell.** Conduits shall be installed from the forming shell to a junction box or other enclosure conforming to the requirements in 680.24. Conduit shall be rigid metal, intermediate metal, liquidtight flexible nonmetallic, or rigid nonmetallic.

(a) Metal Conduit. Metal conduit shall be approved and shall be of brass or other approved corrosion-resistant metal.

(b) Nonmetallic Conduit. Where a nonmetallic conduit is used, an 8 AWG insulated solid or stranded copper bonding jumper shall be installed in this conduit unless a listed low-voltage lighting system not requiring grounding is used.

The bonding jumper shall be terminated in the forming shell, junction box or transformer enclosure, or ground fault circuit-interrupter enclosure. The termination of the 8 AWG bonding jumper 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 pool water.

**680.23 Underwater luminaires (B) Wet-Niche Luminaires (3) Equipment Grounding Provisions for Cords.** Other than listed low-voltage lighting systems not requiring grounding wet-niche luminaires that are supplied by a flexible cord or cable shall have all exposed non-current carrying metal parts grounded by an insulated copper equipment grounding conductor that is an integral part of the cord or cable. This grounding conductor shall be connected to a grounding terminal in the supply junction box, transformer enclosure, or other enclosure. The grounding conductor shall not be smaller than the supply conductors and not smaller than 16 AWG.



**680.23 Underwater luminaires (B) Wet-Niche Luminaires (4) Luminaire Grounding Terminations.** The end of the flexible-cord jacket and the flexible-cord conductor terminations within a luminaire shall be covered with, or encapsulated in, a suitable potting compound to prevent the entry of water into the luminaire through the cord or its conductors. If present, the grounding connection within a luminaire shall be similarly treated to protect such connection from the deteriorating effect of pool water in the event of water entry into the luminaire.

**680.23 Underwater luminaires (B) Wet-Niche Luminaires (5) Luminaire Bonding.** The luminaire 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. Bonding shall not be required for luminaires that are listed for the application and have no non-current-carrying metal parts.

**680.23 Underwater luminaires (B) Wet-Niche Luminaires (6) Servicing.** All wet-niche luminaires that 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.

## EXAM QUESTIONS

30. What must be done with flexible-cord jackets and conductors of a wet-niche luminaire that are terminated within the luminaire itself to prevent water from entering?
- Encapsulated in a suitable potting compound
  - Taped
  - Nothing required
  - Glue
31. Nonmetallic conduit for a wet niche luminaire system is required to include provisions for terminating what size copper conductor?
- 12 AWG
  - 10 AWG
  - 14 AWG
  - 8 AWG
32. The grounding of wet-niche luminaires using nonmetallic conduit is required to have a number 8 AWG installed unless this is used?
- Grounding type fixture
  - Non-metallic junctionbox
  - Listed low-voltage lighting system
  - No listed answer
33. What is the minimum distance that the top of a luminaire lens can be set below the normal water level of a pool?
- 24 in.
  - 18 in.
  - 36 in.
  - 12 in.
34. Which of the following is not an accepted means for connecting an equipment grounding conductor to wet-niche luminaires that are supplied by a flexible cord or cable?
- Grounding terminal
  - Transformer enclosure
  - Split-bolt
  - Supply junction box
35. When re-lamping underwater luminaires at more than the low voltage contact limit, what is required to be installed to make sure there is a no shock hazard?
- Install double insulated luminaires
  - AFCI
  - GFCI
  - All listed answers
36. How long is the cord of a wet-niche luminaire required to be for general maintenance?
- 48 inches
  - No special instructions
  - Long enough to move to a deck or dry location
  - 60 inches

**680.23 Underwater luminaires (C) Dry-Niche Luminaires. (1) Construction.** A dry-niche luminaire shall have provision 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.

**680.23 Underwater luminaires (C) Dry-Niche Luminaires. (2) Junction Box.** A junction box shall not be required but, if used, shall not be required to be elevated or located as specified in 680.24(A)(2) if the luminaire is specifically identified for the purpose.

**680.23 Underwater luminaires (D) No-Niche Luminaires.** A no-niche luminaire shall meet the construction requirements of 680.23(B) (3) and be installed in accordance with the requirements of 680.23(B). Where connection to a forming shell is specified, the connection shall be to the mounting bracket.



**680.23 Underwater luminaires (E) Through-Wall Lighting Assembly.** A through-wall lighting assembly shall be equipped with a threaded entry or hub, or a nonmetallic hub, for the purpose of accommodating the termination of the supply conduit. A through wall lighting assembly shall meet the construction requirements of 680.23(B) (3) and be installed in accordance with the requirements of 680.23(B). Where connection to a forming shell is specified, the connection shall be to the conduit termination point.

**680.23 Underwater luminaires (E) Through-Wall Lighting Assembly.** A through-wall lighting assembly shall be equipped with a threaded entry or hub, or a nonmetallic hub, for the purpose of accommodating the termination of the supply conduit. A through wall lighting assembly shall meet the construction requirements of 680.23(B) (3) and be installed in accordance with the requirements of 680.23(B). Where connection to a forming shell is specified, the connection shall be to the conduit termination point.

**(Revised) 680.23 (F)(1) Wiring Methods.** Where branch-circuit wiring on the supply side of enclosures and junction boxes connected to conduits run to underwater luminaires are installed in corrosive environments as described in 680.14, the wiring method of that portion of the branch circuit shall be as required in 680.14(B) or shall be liquid-tight flexible nonmetallic conduit. Wiring methods installed in corrosive environments as described in 680.14 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, branch circuits shall comply with the general requirements in Chapter 3.

*Exception: Where connecting to transformers or power supplies for pool lights, liquidtight flexible metal conduit shall be permitted. The length shall not exceed 1.8 m (6 ft) for any one length or exceed 3.0 m (10 ft) in total*

## EXAM QUESTIONS

37. What is the smallest insulated copper equipment grounding conductor that can be installed to comply with 680.14?
- 10 AWG
  - 12 AWG
  - 14 AWG
  - 8 AWG

38. What construction requirement must through-wall lighting assemblies for dry-niche luminaires meet according to Article 680?
- 680.23 (A)
  - 680.22 (B)
  - 680.23 (E)
  - 680.23 (B) (3)

39. How many equipment grounding conductor termination points are required for each conduit when using a dry-niche luminaire?
- 2
  - 3
  - 1
  - No Requirement
40. When is it permissible to use type AC cable on the supply side of enclosures and junction boxes connected to wet-niche and no-niche luminaires?
- Installed within buildings
  - When encased in concrete
  - When protected from moisture
  - AC cable is excluded from Article 680
41. What is the maximum total length permitted for liquid tight flexible conduit feeding a transformer that powers pool lighting?
- 1.8 m (6ft)
  - 3.0 m (10ft)
  - 1.5m (5ft)
  - 3.7 m (12ft)

**680.23(F) Branch-Circuit Wiring (2) Equipment Grounding.** 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 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.

**Exception:** An equipment grounding conductor between the wiring chamber of the secondary winding of a transformer and a junction box shall be sized in accordance with the overcurrent device in this circuit.

(a) If more than one underwater luminaire is supplied by the same branch circuit, the equipment grounding conductor, installed between the junction boxes, transformer enclosures, or other enclosures in the supply circuit to wet-niche luminaires, or between the field-wiring compartments of dry-niche luminaires, shall be permitted to be terminated on grounding terminals.

(b) If the underwater luminaire is supplied from a transformer, ground-fault circuit interrupter, clock-operated switch, or a manual snap switch that is located between the panelboard and a junction box connected to the conduit that extends directly to the underwater luminaire, the equipment grounding conductor shall be permitted to terminate on grounding terminals on the transformer, ground-fault circuit interrupter, clock-operated switch enclosure, or an outlet box used to enclose a snap switch.

**680.23(F) Branch-Circuit Wiring (3) Conductors.** Conductors on the load side of a ground fault circuit interrupter or of a transformer, used to comply with the provisions of 680.23(A)(8), shall not occupy raceways, boxes, or enclosures containing other conductors unless one of the following conditions applies:

- (1) The other conductors are protected by ground-fault circuit interrupters.
- (2) The other conductors are equipment grounding conductors and bonding jumpers as required per 680.23(B)(2)(b).
- (3) The other conductors are supply conductors to a feed through-type ground-fault circuit interrupter.



(4) Ground-fault circuit interrupters shall be permitted in a panelboard that contains circuits protected by other than ground-fault circuit interrupters.

**680.24 Junction Boxes and Electrical Enclosures for Transformers or Ground-Fault Circuit Interrupters (A) Junction Boxes (1) Construction.** The junction box shall be listed, labeled, and identified 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

**680.24 Junction Boxes and Electrical Enclosures for Transformers or Ground-Fault Circuit Interrupters. (A) Junction Boxes (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).

(a) Vertical Spacing. The junction box shall be located not less than 100 mm (4 in.), measured from the inside of the bottom of the box, above the ground level, or pool deck, or not less than 200 mm (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 1.2 m (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 1.2 m (4 ft) from the inside wall of the pool.

## EXAM QUESTIONS

42. **What is NOT a construction requirement for junction boxes listed for use in swimming pool areas?**
  - A. Continuity between every connected metal conduit
  - B. Equipped with threaded entries or hubs or nonmetallic hub
  - C. Be of an approved corrosion-resistant material
  - D. Having a weather proof seal, insulated attached lock nuts, and be listed
43. **What is the equipment grounding conductor permitted to do if multiple underwater luminaries are supplied by the same branch circuit?**
  - A. Use split bolts for terminations
  - B. Sized to the largest single conductor
  - C. Terminate on grounding terminals
  - D. Sized to the largest overcurrent device
44. **What listed article is a luminaire that operates at the low voltage contact limit or less required to comply with?**
  - A. 680.24 (A) (2) (a)
  - B. 680.24 (A) (2) (c)
  - C. 680.24 (A) (2) (b)
  - D. 680.24 (A) (2) (d)
45. **What type of luminaire(s) does not require grounding with regards to Article 680?**
  - A. 120voltAC
  - B. Listed low-voltage luminaires
  - C. Variable voltage luminaire(s)
  - D. All luminaries must be grounded
46. **What is the minimum distance a flush deck box can be mounted from the inside wall of a pool?**
  - A. 3.0 m (10 ft)
  - B. 100 mm (8 in)
  - C. 1.2 m (4 ft)
  - D. No minimum requirement

**680.24 Junction Boxes and Electrical Enclosures for Transformers or Ground-Fault Circuit Interrupters (C) Protection.** Junction boxes and enclosures mounted above the grade of the finished walkway around the pool shall not be located in the walkway unless afforded additional protection, such as by location under diving boards, adjacent to fixed structures, and the like.

**680.24 Junction Boxes and Electrical Enclosures for Transformers or Ground-Fault Circuit Interrupters (D) Grounding Terminals.** Junction boxes, transformer and power-supply enclosures, and ground-fault circuit interrupter enclosures connected to a conduit that extends directly to a forming shell or mounting bracket of a no-niche luminaire shall be provided with a number of grounding terminals that shall be no fewer than one more than the number of conduit entries.

**680.24 Junction Boxes and Electrical Enclosures for Transformers or Ground-Fault Circuit Interrupters (E) Strain Relief.** The terminations 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.

**680.24 Junction Boxes and Electrical Enclosures for Transformers or Ground-Fault Circuit Interrupters (F) Grounding.** The equipment grounding conductor terminals of a 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 connected to the equipment grounding terminal of the panelboard. This terminal shall be directly connected to the panelboard enclosure.

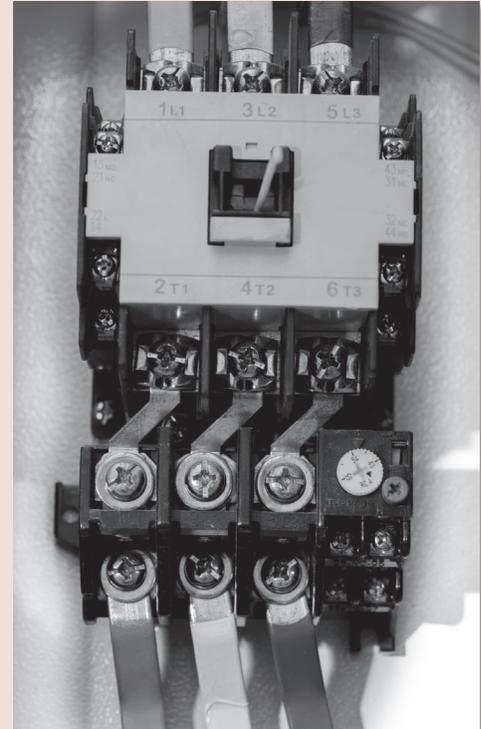
**680.25 Feeders.** These provisions shall apply to any feeder on the supply side of panelboards supplying branch circuits for pool equipment covered in Part II of this article and on the load side of the service equipment or the source of a separately derived system.

**(Revised) 680.25(A) Feeders.** Where feeders are installed in corrosive environments as described in 680.14, the wiring method of that portion of the feeder shall be as required in 680.14(B) or shall be liquidtight flexible nonmetallic conduit. Wiring methods installed in corrosive environments as described in 680.14 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.

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

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

**680.26 Equipotential Bonding (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.



## EXAM QUESTIONS

47. What is the flexible cord of an underwater luminaire within a junction box required to have installed?
- Strain relief
  - Forming shell
  - Approved lugs
  - An approved potting compound
48. What is the minimum number of grounding terminals required in a transformer or GFCI enclosures that extend to the forming shell or mounting bracket of a no-niche luminaire?
- At least eight
  - At least one for each conduit entry
  - One more than the number of conduit entries
  - No listed answer
49. Where are the equipment grounding conductor terminals of a transformer enclosure required to be connected?
- Conduit hub
  - Ground bar
  - Panelboard
  - Luminaire
50. What article is required to be followed when making the connections to bonded parts in pool areas?
- 250.66
  - 250.122
  - 250.32
  - 250.8
51. What table is required to be used to size equipment grounding conductors?
- 250.122
  - 250.66
  - 250.102(D)
  - 250.103(A)
52. Why is equipotential bonding in pool areas required?
- To complete the bonding system
  - Not required
  - Reduce voltage gradients
  - To have a clear and present path to ground
53. What part of Article 680 addresses feeders on the supply side of panelboards supplying branch circuits for pool equipment?
- III
  - II
  - I
  - IV
54. Where is a #6 AWG solid copper bonding conductor used to reduce voltage gradients in pool areas not required to connect?
- Remote panelboards
  - Luminaires
  - The forming shell
  - The rebar mat

**680.26 Equipotential Bonding (B) Bonded Parts (1) Conductive Pool Shells.** Bonding to conductive pool shells that 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.* Un-encapsulated 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).

(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. The bonding shall be 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

**(Revised) 680.26 Equipotential Bonding (B) Bonded Parts (2) Perimeter Surfaces.** The perimeter surface to be bonded shall be considered to extend for 1 m (3 ft) horizontally beyond the inside walls of the pool and

shall include unpaved surfaces and other types of paving. Perimeter surfaces separated from the pool by a permanent wall or building 1.5 m (5 ft) in height or more shall require equipotential bonding only on the pool side of the permanent wall or building. 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.



(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 mm to 600 mm (18 in. 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.

**680.26 Equipotential Bonding (B) Bonded Parts (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.

**680.26 Equipotential Bonding (B) Bonded Parts (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.*

## EXAM QUESTIONS

55. Reinforcing steel is not required to be \_\_\_\_\_ when the steel is encapsulated in a non-conductive compound.
  - A. Thermally welded
  - B. Covered
  - C. Intrinsically safe
  - D. Bonded
56. With regards to conductive pool shells, what is considered a nonconductive material?
  - A. Plastered coatings
  - B. Fiberglass composite shells
  - C. Pneumatically applied concrete
  - D. All listed answers
57. If you have an unpaved perimeter surface that is 4 ft. wide, what is the minimum distance that the bonding grid must be extended horizontally into this surface?
  - A. .5 m (1.5 ft)
  - B. 1.5 m (5 ft)
  - C. 2.0 m (6 ft)
  - D. 1.0 m (3 ft)
58. When constructing a copper conductor grid for equipotential bonding in a pool area, what is the standard arrangement for the grid pattern?
  - A. 300-mm (12-in.) by 300-mm (12-in.)
  - B. 150-mm (6 in.) by 150-mm (6 in.)
  - C. 450-mm (18 in.) by 450-mm (18 in.)
  - D. 100-mm (4 in.) by 100-mm (4 in.)

59. How many points of connection does the bonding grid to perimeter surfaces need to have around pool areas?
- 2
  - 1
  - 4
  - No Listed Answer
60. When steel is encapsulated in a nonconductive compound, a copper conductor grid is required to be installed in accordance with what listed section?
- 680.26 (B) (1) (a)
  - 680.26 (B) (1) (b)
  - 250.8
  - 680.26 (B.) (1)

**680.26 Equipotential Bonding (B) Bonded Parts (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.

**680.26 Equipotential Bonding (B) Bonded Parts (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.*

**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.

**680.26 Equipotential Bonding (B) Bonded Parts (7) Fixed Metal Parts.** All fixed metal parts shall be bonded including, but not limited to, metal-sheathed cables and raceways, metal piping, metal awnings, metal fences, and metal door and window frames.

*Exception No. 1: Those separated from the pool by a permanent barrier that prevents contact by a person 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.*

**680.26 Equipotential Bonding (C) Pool Water.** Where none of the bonded parts is in direct connection with the pool water, the pool water shall be in direct contact with an approved corrosion-resistant conductive surface that exposes not less than 5800 mm<sup>2</sup> (9 in.<sup>2</sup>) of surface area to the pool water at all times. The conductive surface shall be located where it is not exposed to physical damage or dislodgement during usual pool activities, and it shall be bonded in accordance with 680.26(B).

**680.27 Specialized Pool Equipment (A) Underwater Audio Equipment (1) Speakers.** Each speaker shall be mounted in an approved metal forming shell, the front of which is enclosed by a captive metal screen, or equivalent, that is bonded to, and secured to, the forming shell by a positive locking device that ensures a low-resistance contact and requires a tool to open for installation or servicing of the speaker. The forming shell shall be installed in a recess in the wall or floor of the pool.



## EXAM QUESTIONS

61. Where is the bonding jumper used with underwater audio equipment required to terminate?
- Speaker
  - Underwater bracket
  - Reclamation plate
  - Forming shell
62. Which of the following does not fall under the bonding of fixed metal parts around pools?
- Flexible metal conduit
  - Metal piping
  - Metal doors
  - Metal awnings
63. What is the largest dimension that isolated parts do not require bonding if penetrating into the pool structure at 1 inch or less?
- 200 mm (8 in)
  - 100 mm (4 in)
  - 25 mm (1 in)
  - 50 mm (2 in)
64. What is the minimum distance horizontally from the inside wall of a pool where all fixed metal parts of a pool area are not required to be bonded?
- 3 feet
  - 4 feet
  - 5 feet
  - 6 feet
65. What is the minimum amount of surface area required to bond and be in direct contact with pool water at all times?
- 18 inches<sup>2</sup>
  - 9 inches<sup>2</sup>
  - 4.5 inches<sup>2</sup>
  - No listed answer
66. Which of the following metal parts of electrical equipment with regards to pool areas is required to be bonded?
- Water circulating system
  - Pool covers
  - Electric motors
  - All listed answers

**680.27 Specialized Pool Equipment (A) Underwater Audio Equipment (2) Wiring Methods.** Rigid metal conduit of brass or other identified corrosion-resistant metal, liquidtight flexible nonmetallic conduit (LFNC-B), rigid polyvinyl chloride conduit, or reinforced thermosetting resin conduit shall extend from the forming shell to a listed junction box or other enclosure as provided in 680.24. Where rigid polyvinyl chloride conduit, reinforced thermosetting resin conduit, or liquidtight flexible nonmetallic conduit is used, an 8 AWG insulated solid or stranded copper bonding jumper shall be installed in this conduit. The bonding jumper shall be terminated in the forming shell and the junction box. The termination of the 8 AWG bonding jumper in the forming shell shall be covered with, or encapsulated in, a listed potting compound to protect such connection from the possible deteriorating effect of pool water.

**680.27 Specialized Pool Equipment. (A) Underwater Audio Equipment (3) Forming Shell and Metal Screen.** The forming shell and metal screen shall be of brass or other approved corrosion resistant metal. All forming shells shall include provisions for terminating an 8 AWG copper conductor.

**680.27 Specialized Pool Equipment (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 operator has full view of the pool.

**680.27 Specialized Pool Equipment (B) Electrically Operated Pool Covers (1) Motors and Controllers.** (NEW) 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.

**680.27 Specialized Pool Equipment (B) Electrically Operated Pool Covers (2) Protection.** The electric motor and controller shall be connected to a circuit protected by a ground-fault circuit interrupter.

**680.27 Specialized Pool Equipment (C) Deck Area Heating (1) Unit Heaters.** Unit heaters shall be rigidly mounted to the structure and shall be of the totally enclosed or guarded type. Unit heaters shall not be mounted over the pool or within the area extending 1.5 m (5 ft) horizontally from the inside walls of a pool.

**680.27 Specialized Pool Equipment (C) Deck Area Heating (2) Permanently Wired Radiant Heaters.** Radiant electric heaters shall be suitably guarded and securely fastened to their mounting device(s). Heaters shall not be installed over a pool or within the area extending 1.5 m (5 ft) horizontally from the inside walls of the pool and shall be mounted at least 3.7 m (12 ft) vertically above the pool deck unless otherwise approved.

**(NEW) 680.28 Gas-Fired Water Heater.** Circuits serving gas-fired swimming pool and spa water heaters operating at voltages above the low-voltage contact limit shall be provided with ground-fault circuit-interrupter protection for personnel.

## EXAM QUESTIONS

67. What is the minimum height vertically that wired radiant heaters around pool areas are required to be installed?
- 17 ft.
  - 10 ft.
  - 15 ft.
  - 12 ft.
68. Unless separated by a wall, what is the minimum distance that motors and controllers can be from the inside of the pool?
- 1.5 m (5 ft)
  - 1.2 m (4 ft)
  - 3.7 m (12 ft)
  - 1.0 m (3 ft)
69. Which of the following is not an approved wiring method for underwater audio equipment with regards to pool areas?
- Rigid metal conduit of brass
  - Liquidtight flexible metal conduit
  - Rigid polyvinyl chloride conduit
  - Thermosetting resin conduit
70. When using reinforced thermosetting resin conduit for a pool area, a solid or stranded copper bonding jumper of what size is required to be in the conduit?
- Non-insulated 6 AWG
  - Non-insulated 8 AWG
  - Insulated 6 AWG
  - Insulated 8 AWG
71. What are circuits serving gas-fired spa water heaters operating at voltages above the low-voltage contact limit required to be provided with?
- Arc-fault circuit-interrupter
  - Ground-fault circuit-interrupter
  - Fused disconnects
  - Bi-metal overloads
72. What is the minimum distance horizontally from the inside wall of a pool that a unit heater can be installed?
- 10 ft
  - 5 ft
  - 12 ft
  - No listed answer

**680.31 Pumps.** A cord-connected pool filter pump shall incorporate an approved system of double insulation or its equivalent and shall be provided with means for grounding only the internal and non-accessible non-current-carrying metal parts of the appliance. The means for grounding shall be an equipment grounding conductor run with the power-supply conductors in the flexible cord that is properly terminated in a grounding-type attachment plug having a fixed grounding contact member. Cord-connected pool filter pumps shall be provided with a ground-fault circuit interrupter that is an integral part of the attachment plug or located in the power supply cord within 300 mm (12 in.) of the attachment plug.

**680.32 Ground-Fault Circuit Interrupters Required.** All electrical equipment, including power-supply cords, used with storable pools shall be protected by ground-fault circuit interrupters. All 125-volt, 15- and 20-ampere receptacles located within 6.0 m (20 ft) of the inside walls of a storable pool shall be protected by a ground-fault circuit interrupter. 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.



**Informational Note:** For flexible cord usage, see 400.4.

**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:

- (1) No exposed metal parts
- (2) A luminaire lamp that is suitable for use at the supplied voltage
- (3) An impact-resistant polymeric lens, luminaire body, and transformer enclosure
- (4) A transformer or power supply meeting the requirements of 680.23(A)(2) with a primary rating not over 150 volts

**680.33 Luminaires (B) Over the Low Voltage Contact Limit But Not over 150 Volts.** According to this article, 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:

- (1) No exposed metal parts
- (2) An impact-resistant polymeric lens and luminaire body
- (3) A ground-fault circuit interrupter with open neutral conductor protection as an integral part of the assembly
- (4) The luminaire lamp permanently connected to the groundfault circuit interrupter with open-neutral protection
- (5) Compliance with the requirements of 680.23(A)

**680.34 Receptacle Locations.** Receptacles shall not be located less than 1.83 m (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.

## EXAM QUESTIONS

73. When installing low voltage luminaires for storable pools, which of the following is a requirement for construction?
- Grounding of metal parts
  - Impact-resistant polymeric lens
  - Transformer must be rated over 150 volts
  - No Listed Answer
74. What are all storable pools that contain a pump required to be protected by?
- GFCI
  - AFCI
  - No special requirements
  - Quick acting overloads (QAO)
75. What is the shortest distance that a receptacle can be located from the inside wall of a storable pool?
- 2.0 m (7 ft 6 in)
  - 1.5 m (5 ft)
  - 1.83 m (6 ft)
  - 3.0 m (10 ft)
76. What is the approved system that a cord-connected pool filter pump is required to incorporate?
- Edison Fuses
  - Completely isolated
  - Be Double insulated
  - AFCI protected

**680.41 Emergency Switch for Spas and Hot Tubs.** A clearly labeled emergency shutoff or control switch for the purpose of stopping the motor(s) that provide power to the recirculation system and jet system shall be installed at a point readily accessible to the users and not less than 1.5 m (5 ft) away, adjacent to, and within sight of the spa or hot tub. This requirement shall not apply to one-family dwellings.

**680.42 Outdoor Installations (A) Flexible Connections.** Listed packaged spa or hot tub equipment assemblies or self-contained spas or hot tubs utilizing a factory-installed or assembled control panel or panelboard shall be permitted to use flexible connections as covered in 680.42(A)(1) and (A)(2).

- (1) Flexible Conduit. Liquidtight flexible metal conduit or liquidtight flexible nonmetallic conduit shall be permitted in lengths of not more than 1.8 m (6 ft) external to the spa or hot tub enclosure in addition to the length needed within the enclosure to make the electrical connection.
- (2) Cord-and-Plug Connections. Cord-and-plug connections with a cord not longer than 4.6 m (15 ft) shall be permitted where protected by a ground-fault circuit interrupter.



**680.42 Outdoor Installations (C) Interior Wiring to Outdoor Installations.** In the interior of a dwelling unit or

in the interior of another building or structure associated with a dwelling unit, any of the wiring methods recognized or permitted in Chapter 3 of this Code shall be permitted to be used for the connection to motor disconnecting means and the motor, heating, and control loads that are part of a self-contained spa or hot tub or a packaged spa or hot tub equipment assembly. Wiring to an underwater luminaire shall comply with 680.23 or 680.33.

**680.43 Indoor Installations.** A spa or hot tub installed indoors shall comply with the provisions of Parts I and II of this article except as modified by this section and shall be connected by the wiring methods of Chapter 3.

*Exception No. 1: Listed spa and hot tub packaged units rated 20 amperes or less shall be permitted to be cord-and plug-connected to facilitate the removal or disconnection of the unit for maintenance and repair.*

*Exception No. 2: 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.*

## EXAM QUESTIONS

77. Besides being readily acceptable, what is an emergency switch for a spa or hot tub required to be?
- Within sight
  - Not less than 5 ft. away
  - Red in color
  - No higher than 5 ft. above finished grade
78. What type of raceway is permitted for a listed packaged hot tub assembly?
- Metal Clad Cable
  - Electrical metallic conduit
  - Liquidtight flexible nonmetallic conduit
  - Intermediate metal conduit\
79. Cord-and-plug connections are permitted in outdoor spa and hot tub installations as long as the cord is less than \_\_\_\_\_ .
- 4.6 m (15 ft)
  - 3.0 m (10 ft)
  - 6.0 m (20 ft)
  - 3.7 m (12 ft)
80. What chapter's wiring methods are required to be used when installing wiring from the inside of a single-family dwelling to an outdoor spa or hot tub?
- Chapter 1
  - Chapter 2
  - Chapter 6
  - Chapter 3

**680.43 Indoor Installations (A) Receptacles.** At least 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 exceeding 3.0 m (10 ft) from, the inside wall of the spa or hot tub.

(1) **Location.** Receptacles shall be located at least 1.83 m (6 ft) measured horizontally from the inside walls of the spa or hot tub.

(2) **Protection, General.** Receptacles rated 125 volts and 30 amperes or less and located within 3.0 m (10 ft) of the inside walls of a spa or hot tub shall be protected by a ground fault circuit interrupter.

(3) **Protection, Spa or Hot Tub Supply Receptacle.** Receptacles that provide power for a spa or hot tub shall be ground-fault circuit-interrupter protected.

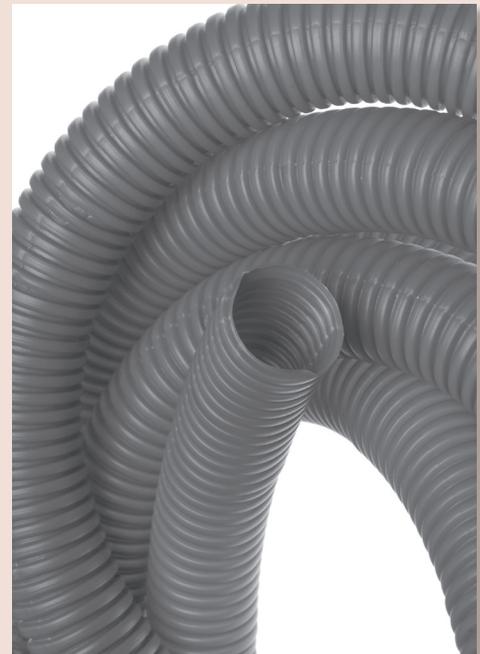
(4) **Measurements.** In determining the dimensions in this section addressing receptacle spacing, the distance to be measured shall be the shortest path the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall, ceiling, doorway with hinged or sliding door, window opening, or other effective permanent barrier.

**680.43 Indoor Installations (B) Installation of Luminaires, Lighting Outlets, and Ceiling-Suspended (Paddle) Fans.** (1) **Elevation.** Luminaires except as covered in 680.43(B)(2), lighting outlets, and ceiling-suspended (paddle) fans located over the spa or hot tub or within 1.5 m (5 ft) from the inside walls of the spa or hot tub shall comply with the clearances specified in (B)(1)(a), (B)(1)(b), and (B)(1)(c) above the maximum water level.

(a) *Without GFCI.* Where no GFCI protection is provided, the mounting height shall be not less than 3.7 m (12 ft).

(b) *With GFCI.* Where GFCI protection is provided, the mounting height shall be permitted to be not less than 2.3 m (7 ft 6 in.).

(c) *Below 2.3 m (7 ft 6 in.).* Luminaires meeting the requirements of item (1) or (2) and protected by a ground fault circuit interrupter shall be permitted to be installed less than 2.3 m (7 ft 6 in.) over a spa or hot tub:



- (1) Recessed luminaires with a glass or plastic lens, nonmetallic or electrically isolated metal trim, and suitable for use in damp locations
- (2) Surface-mounted luminaires with a glass or plastic globe, a nonmetallic body, or a metallic body isolated from contact, and suitable for use in damp locations

## EXAM QUESTIONS

- 81. If a customer wants a fan above their indoor spa and there is GFCI protection, what is the minimum height that the fixture can be mounted?**
- A. 3.7 m (12 ft)
  - B. 2.3 m (7 ft 6 in)
  - C. 3.0 m (10 ft)
  - D. There must always be GFCI protection
- 82. If a customer wants a fan above their indoor spa and there is no GFCI protection, what is the minimum height that the fixture can be mounted?**
- A. 3.7 m (12 ft)
  - B. 2.3 m (7 ft 6 in)
  - C. 3.0 m (10 ft)
  - D. Must have GFCI protection
- 83. The receptacles for an indoor spa or hot tub must always be located so that the supply cord is?**
- A. Run so there is no tripping hazard
  - B. Kept from physical damage
  - C. Run to the shortest path
  - D. No special requirements
- 84. A customer has an indoor hot tub that is 9 ft. away from the nearest 15-amp outlet. What is the requirement for this outlet?**
- A. Must be 20 amps rated
  - B. No special requirement
  - C. GFCI protected
  - D. Must be 20 amps rated and GFCI protected

**680.43 Indoor Installations (D) Bonding.** The following parts shall be bonded together:

- (1) All metal fittings within or attached to the spa or hot tub structure
- (2) Metal parts of electrical equipment associated with the spa or hot tub water circulating system, including pump motors, unless part of a listed, Labeled, and identified self-contained spa or hot tub
- (3) Metal raceway and metal piping that are within 1.5 m (5 ft) of the inside walls of the spa or hot tub and that are not separated from the spa or hot tub by a permanent barrier
- (4) All metal surfaces that are within 1.5 m (5 ft) of the inside walls of the spa or hot tub and that are not separated from the spa or hot tub area by a permanent barrier

*Exception: Small conductive surfaces not likely to become energized, such as air and water jets and drain fittings, where not connected to metallic piping, towel bars, mirror frames, and similar nonelectrical equipment, shall not be required to be bonded.*

- (5) Electrical devices and controls that are not associated with the spas or hot tubs and that are located less than 1.5 m (5 ft) from such units; otherwise, they shall be bonded to the spa or hot tub system

**680.43 Indoor Installations (E) Methods of Bonding.** All metal parts associated with the spa or hot tub shall be bonded by any of the following methods:

- (1) The interconnection of threaded metal piping and fittings
- (2) Metal-to-metal mounting on a common frame or base
- (3) The provisions of a solid copper bonding jumper, insulated, covered, or bare, not smaller than 8 AWG



**680.43 Indoor Installations (G) Underwater Audio Equipment.** Underwater audio equipment shall comply with the provisions of Part II of this article.

**680.44 Protection.** Except as otherwise provided in this section, the outlet(s) that supplies a self-contained spa or hot tub, a packaged spa or hot tub equipment assembly, or a field assembled spa or hot tub shall be protected by a ground-fault circuit interrupter.

**(A) Listed Units.** If so marked, a listed, labeled, and identified self-contained unit or a listed, labeled, and identified packaged equipment assembly that includes integral ground-fault circuit interrupter protection for all electrical parts within the unit or assembly (pumps, air blowers, heaters, lights, controls, sanitizer generators, wiring, and so forth) shall be permitted without additional GFCI protection.

**(B) Other Units.** A field-assembled spa or hot tub rated 3 phase or rated over 250 volts or with a heater load of more than 50 amperes shall not require the supply to be protected by a ground-fault circuit interrupter.

**680.50 General.** The provisions of Part I and Part V of this article shall apply to all permanently installed fountains as defined in 680.2. Fountains that have water common to a pool shall additionally comply with the requirements in Part II of this article. Part V does not cover self-contained, portable fountains. Portable fountains shall comply with Parts II and III of Article 422.

## EXAM QUESTIONS

85. What part of Article 680 does not cover self-contained, portable fountains?
- Part II
  - Part III
  - Part IV
  - Part V
86. What part of Article 422 are portable fountains required to comply with?
- II and III
  - I and IV
  - V
  - VII and VIII
87. When bonding metal piping for indoor spas and hot tubs, the metal bonding has to be made within \_\_\_\_\_ unless it is separated by a permanent barrier.
- 1.5 m (5 ft)
  - 3.0 m (10 ft)
  - 1.83 m (6 ft)
  - 1.0 m (3 ft)
88. What part of Article 680 is underwater audio equipment required to comply with?
- Part III
  - Part V
  - Part IV
  - Part II
89. Which of the following is not an acceptable means of bonding indoor spa and hot tubs?
- Metal to metal on a common frame
  - Using a solid copper bonding jumper, insulated, covered, or bare, not smaller than #10 AWG
  - Interconnection of threaded metal piping
  - Using a solid copper bonding jumper, insulated, covered, or bare, not smaller than 8 AWG

**680.51 Luminaires, Submersible Pumps, and Other Submersible Equipment. (F) Servicing.** All equipment shall be removable from the water for re-lamping or normal maintenance. Luminaires shall not be permanently embedded into the fountain structure such that the water level must be reduced or the fountain drained for re-lamping, maintenance, or inspection.

**680.55 Methods of Grounding (B) Supplied by a Flexible Cord.** Electrical equipment that is supplied by a flexible cord shall have all exposed non-current-carrying metal parts grounded by an insulated copper equipment grounding conductor that is an integral part of this cord. The equipment grounding conductor shall be connected to an equipment grounding terminal in the supply junction box, transformer enclosure, power supply enclosure, or other enclosure.

**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 conform to Part VI.

**(A) Protection.** 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 protected by a ground fault circuit interrupter.

**(1) Listed Units.** If so marked, a listed, labeled, and identified self-contained unit or a listed, labeled, and identified packaged equipment assembly that includes integral ground-fault circuit-interrupter protection for all electrical parts within the unit or assembly (pumps, air blowers, heaters, lights, controls, sanitizer generators, wiring, and so forth) shall be permitted without additional GFCI protection.



**(2) Other Units.** A therapeutic tub or hydrotherapeutic tank rated 3 phase or rated over 250 volts or with a heater load of more than 50 amperes shall not require the supply to be protected by a ground-fault circuit interrupter.

**680.62 Therapeutic Tubs (Hydrotherapeutic Tanks). (B) Bonding.** The following parts shall be bonded together:

- (1) All metal fittings within or attached to the tub structure
- (2) Metal parts of electrical equipment associated with the tub water circulating system, including pump motors
- (3) Metal-sheathed cables and raceways and metal piping that are within 1.5 m (5 ft) of the inside walls of the tub and not separated from the tub by a permanent barrier
- (4) 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
- (5) 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.*

**680.62 Therapeutic Tubs (Hydrotherapeutic Tanks) (D) Grounding. (1) Fixed or Stationary Equipment.** The equipment specified in (a) and (b) shall be connected to the equipment grounding conductor.

(a) Location. All electrical equipment located within 1.5 m (5 ft) of the inside wall of the tub shall be connected to the equipment grounding conductor.

(b) Circulation System. All electrical equipment associated with the circulating system of the tub shall be connected to the equipment grounding conductor.

## EXAM QUESTIONS

- 90. When a fountain is connected by a flexible cord, where is the equipment grounding conductor required to be connected?**
- A. Main bonding jumper
  - B. Equipment bonding jumper
  - C. Equipment grounding terminal
  - D. No listed answer