

and drain fittings not connected to metallic piping, and towel bars, mirror frames, and similar nonelectrical equipment not connected to metal framing shall not be required to be bonded.

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

Exception No. 3: Small conductive surfaces of electrical equipment not likely to become energized, such as the mounting strap or yoke of a listed light switch or receptacle that is grounded, shall not be required to be bonded.

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

Part VIII. Electrically Powered Pool Lifts

680.80 General. Electrically powered pool lifts as defined in Article 100 shall comply with Part VIII of this article. Part VIII shall not be subject to the requirements of other parts of this article except where the requirements are specifically referenced.

680.81 Equipment Approval. Lifts shall be listed, labeled, and identified for swimming pool and spa use.

Exception No. 1: Lifts where the battery is removed for charging at another location and the battery is rated less than or equal to the low-voltage contact limit shall not be required to be listed or labeled.

Exception No. 2: Solar-operated or solar-recharged lifts where the solar panel is attached to the lift and the battery is rated less than or equal to 24 volts shall not be required to be listed or labeled.

Exception No. 3: Lifts that are supplied from a source not exceeding the low-voltage contact limit and supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall not be required to be listed or labeled.

680.82 Protection. Pool lifts connected to premises wiring and operated above the low-voltage contact limit shall be provided with GFCI protection and comply with 680.5.

680.83 Equipotential Bonding. Lifts shall be bonded in accordance with 680.26(B)(5) and (B)(7) using solid copper

conductors, insulated, covered, or bare, not smaller than 8 AWG. 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 lift area shall not be required to be extended or attached to remote panelboards, service equipment, or electrodes.

680.84 Switching Devices and Receptacles. Switches and switching devices that are operated above the low-voltage contact limit shall comply with 680.22(C). Receptacles for electrically powered pool lifts that are operated above the low-voltage contact limit shall comply with 680.22(A)(3) and (A)(4).

680.85 Nameplate Marking. Electrically powered pool lifts shall be provided with a nameplate giving the identifying name and model and rating in volts and amperes, or in volts and watts. If the lift is to be used on a specific frequency or frequencies, it shall be so marked. Battery-powered pool lifts shall indicate the type reference of the battery or battery pack to be used. Batteries and battery packs shall be provided with a battery type reference and voltage rating.

Exception: Nameplate ratings for battery-powered pool lifts shall only need to provide a rating in volts in addition to the identifying name and model.

ARTICLE 682

Natural and Artificially Made Bodies of Water

Part I. General

682.1 Scope. This article applies to the installation of electrical wiring for, and equipment in and adjacent to, natural or artificially made bodies of water not covered by other articles in this Code, such as, but not limited to, aeration ponds, fish farm ponds, storm retention basins, treatment ponds, and irrigation (channels) facilities.

Electrical equipment such as pumps, luminaires, and their associated supply wiring are frequently installed in lakes, ponds, aeration and treatment basins, and similar bodies of water. The requirements in Article 682 are designed to minimize the shock hazards inherent in those wet and damp locations. Artificially made bodies of water do not include the pools, fountains, and spas that are specifically covered under the scope of Article 680.

682.3 Other Articles. If the water is subject to boat traffic, the wiring shall comply with 555.34(B).

682.4 Industrial Application. This article shall not apply in industrial applications where there is alarm indication of equipment faults and the following conditions are in place:

- (1) Conditions of maintenance and supervision ensure that only qualified persons service and operate the installed systems.
- (2) Continued circuit operation is necessary for safe operation of equipment or processes.

682.5 Electrical Datum Plane Distances. The electrical datum plane shall consist of one of the following:

- (1) In land areas subject to tidal fluctuation, the electrical datum plane shall be a horizontal plane 600 mm (2 ft) above the highest tide level for the area occurring under normal circumstances, that is, highest high tide.
- (2) In land areas not subject to tidal fluctuation, the electrical datum plane shall be a horizontal plane 600 mm (2 ft) above the highest water level for the area occurring under normal circumstances.
- (3) In land areas subject to flooding, the electrical datum plane based on (1) or (2) above shall be a horizontal plane 600 mm (2 ft) above the point identified as the prevailing high water mark or an equivalent benchmark based on seasonal or storm-driven flooding from the authority having jurisdiction.

The electrical datum plane for floating structures and landing stages that are (a) installed to permit rise and fall response to water level, without lateral movement, and (b) that are so equipped that they can rise to the datum plane established for (1) or (2) above, shall be a horizontal plane 750 mm (30 in.) above the water level at the floating structure or landing stage and a minimum of 300 mm (12 in.) above the level of the deck.

See also

Article 100 for the definition of *electrical datum plane* and associated commentary

Part II. Installation

682.10 Electrical Equipment and Transformers. Electrical equipment and transformers, including their enclosures, shall be specifically approved for the intended location. No portion of an enclosure for electrical equipment not identified for operation while submerged shall be located below the electrical datum plane.

See also

640.10 for requirements covering the installation of audio system equipment near a body of water

682.11 Location of Electrical Distribution Equipment. On land, the equipment serving feeders shall comply with one of the following:

- (1) Be located no closer than 1.5 m (5 ft) horizontally from the shoreline, and live parts of the equipment are elevated

a minimum of 300 mm (12 in.) above the electrical datum plane

- (2) Be located no closer than the shoreline, and live parts of the equipment are located a minimum of 3 m (10 ft) above the electrical datum plane

682.12 Electrical Connections. Electrical connections shall comply with 682.12(A) or (B).

(A) General. All electrical connections not intended for operation while submerged shall be located at least 300 mm (12 in.) above the deck of a floating or fixed structure but not below the electrical datum plane on fixed structures. Conductor splices, within junction boxes identified for wet locations, using sealed wire connector systems listed and identified for submersion shall be required for floating structures where located above the waterline but below the electrical datum plane.

(B) Replacements. Replacement electrical connections located below the electrical datum plane shall be identified for submersion.

682.13 Wiring Methods and Installation. Wiring methods and installation shall comply with 682.13(A) through (C).

(A) Wiring Methods. Wiring methods suitable for use in wet locations that include an insulated equipment grounding conductor shall be permitted.

(B) Portable Power Cables. Extra-hard usage portable power cables that contain an insulated equipment grounding conductor rated not less than 75°C (167°F) and 600 volts shall be permitted as follows:

- (1) As permanent wiring on the underside of piers (floating or fixed)
- (2) Where flexibility is necessary as on piers composed of floating sections

(C) Submersible or Floating Equipment Power Connection(s). Submersible or floating equipment shall be cord-and-plug-connected, using extra-hard usage cord, as designated in Table 400.4 and listed with a "W" suffix.

682.14 Disconnecting Means. A disconnecting means shall be provided to isolate each submersible or floating electrical equipment from its supply connection(s) without requiring the plug to be removed from the receptacle. Plug and receptacle combinations shall be arranged to be suitable for the location while in use.

Exception: Equipment listed for direct connection and equipment anchored in place and incapable of routine movement caused by water currents or wind shall be permitted to be connected using wiring methods covered in 682.13.

(A) Type and Marking. The disconnecting means shall consist of a circuit breaker, a switch, or both, and shall be

specifically marked to designate which receptacle or other outlet it controls.

(B) Location. The disconnecting means shall be readily accessible on land, located not more than 750 mm (30 in.) from the receptacle it controls, and shall be located in the supply circuit ahead of the receptacle. The disconnecting means shall be located within sight of but not closer than 1.5 m (5 ft) from the shoreline and shall be elevated not less than 300 mm (12 in.) above the datum plane.

There is no restriction on the length of the flexible cord required by this section. In the case of tidal waters, the amount of fluctuation between low and high tides has a direct impact on the datum plane and shoreline benchmarks and, consequently, on the length of the flexible cord from the receptacle to the floating or submersible equipment.

See also

Article 100 for the definition of the term *shoreline*

682.15 Ground-Fault Protection. The GFCI requirements in this article, unless otherwise noted, shall be in addition to the requirements in 210.8. Ground-fault protective devices shall be listed and provided in accordance with 682.15(A) and (B). The protective device shall be located not less than 300 mm (12 in.) above the established electrical datum plane.

(A) Outlets. Outlets supplied by branch circuits not exceeding 150 volts to ground and 60 amperes, single-phase, shall be provided with ground-fault circuit-interrupter protection for personnel.

Based on the Article 100 definition of *outlet*, GFCI protection is required for all receptacle, lighting, and other power outlets that are associated with a natural or artificial body of water. For example, a water pump rated 240 volts and 50 amperes that is supplied either through a cord-and-plug or direct-wired connection would have GFCI protection because it is supplied via a receptacle outlet or an outlet intended for direct (hard-wired) connection of utilization equipment.

Δ (B) Feeder and Branch Circuits on Piers. Feeder and branch-circuit conductors that are installed on piers shall be provided with ground-fault protection not exceeding 30 mA. Coordination with downstream ground-fault protection shall be permitted at the feeder overcurrent protective device.

Exception No. 1: Transformer secondary conductors of a separately derived ac system, operating at voltages exceeding 15 volts ac, that do not exceed 3 m (10 ft) and are installed in a raceway shall be permitted to be installed without ground-fault protection. This exception shall also apply to the supply terminals of the equipment supplied by the transformer secondary conductors.

Exception No. 2: Low-voltage circuits not requiring grounding, not exceeding the low-voltage contact limit as defined in Article

100, and supplied by listed transformers or power supplies that comply with 680.23(A)(2) shall be permitted to be installed without ground-fault protection.

Part III. Grounding and Bonding

Δ 682.30 Grounding. Wiring and equipment within the scope of this article shall be grounded as specified in 555.37, 555.54, and the requirements in Part III of this article.

682.31 Equipment Grounding Conductors.

N (A) Equipment to Be Connected to Equipment Grounding Conductor. The following shall be connected to an equipment grounding conductor run with the circuit conductors in the same raceway, cable, or trench:

- (1) Metal boxes, metal cabinets, and all other metal enclosures
- (2) Metal frames of utilization equipment
- (3) Grounding terminals of grounding-type receptacles

(B) Type. Equipment grounding conductors shall be insulated copper conductors sized in accordance with 250.122 but not smaller than 12 AWG.

(C) Feeders. Where a feeder supplies a remote panelboard or other distribution equipment, an insulated equipment grounding conductor shall extend from a grounding terminal in the service to a grounding terminal and busbar in the remote panelboard or other distribution equipment.

(D) Branch Circuits. The insulated equipment grounding conductor for branch circuits shall terminate at a grounding terminal in a remote panelboard or other distribution equipment or the grounding terminal in the main service equipment.

(E) Cord-and-Plug-Connected Appliances. Unless double insulated, cord-and-plug-connected appliances shall be grounded by means of an equipment grounding conductor in the cord and a grounding-type attachment plug.

Exception: An equipment grounding conductor shall be permitted to be uninsulated if the EGC is part of a listed cable assembly identified for the environment and not subject to environments such as, but not limited to, storm water basins, sewage treatment ponds, and natural bodies of water containing salt.

682.32 Bonding of Non-Current-Carrying Metal Parts. All metal parts in contact with the water, all metal piping, tanks, and all non-current-carrying metal parts that are likely to become energized shall be bonded to the grounding terminal in the distribution equipment.

682.33 Equipotential Planes and Bonding of Equipotential Planes. An equipotential plane shall be installed where required in this section to mitigate step and touch voltages at electrical equipment.

(A) Areas Requiring Equipotential Planes. Equipotential planes shall be installed adjacent to all outdoor service equipment or disconnecting means that control equipment in or on water, that have a metallic enclosure and controls accessible to personnel, and that are likely to become energized. The equipotential plane shall encompass the area around the equipment and shall extend from the area directly below the equipment out not less than 900 mm (36 in.) in all directions from which a person would be able to stand and come in contact with the equipment.

(B) Areas Not Requiring Equipotential Planes. Equipotential planes shall not be required for the controlled equipment supplied by the service equipment or disconnecting means.

(C) Bonding.

(1) Bonded Parts. The parts specified in 682.33(C)(1) through (C)(3) shall be bonded together and to the electrical grounding system. Bonding conductors shall be solid copper, insulated, covered or bare, and not smaller than 8 AWG. Connections shall be made by exothermic welding or by listed pressure connectors or clamps that are labeled as being suitable for the purpose and are of stainless steel, brass, copper, or copper alloy.

(2) Outdoor Service Equipment and Disconnects. Outdoor service equipment or disconnecting means that control equipment in or on water, that have a metallic enclosure and controls accessible to personnel, and that are likely to become energized shall be bonded to the equipotential plane.

(3) Walking Surfaces. Surfaces directly below the equipment specified in 682.33(C)(2) but not less than 900 mm (36 in.) in all directions from the equipment from which a person would be able to stand and come in contact with the equipment shall be bonded to the equipotential plane. Bonding to this surface shall be wire mesh or other conductive elements on, embedded in, or placed under the walk surface within 75 mm (3 in.).

A person designated as a qualified person shall possess the skills and knowledge related to the construction and operation of the electrical equipment and installation and shall have received documented safety training on the hazards involved. Documentation of their qualifications shall be on file with the office of the establishment in charge of the completed installation.

- (3) Effective safeguards approved by the authority having jurisdiction are established and maintained.

The integrated electrical systems commonly used in large and complex industrial processes are designed, installed, and operated under stringent on-site engineering supervision. The control equipment, including overcurrent devices, is located so that it is accessible to qualified personnel, but that location might not meet — and is not required to meet — the conditions described in the Article 100 definition of the term *accessible, readily (readily accessible)*. Locating overcurrent devices and their associated disconnecting means so that they are not readily accessible to unqualified personnel is one of the preventive measures used to help maintain continuity of operation.

For some industrial processes, the sudden loss of electric power to vital equipment is an unacceptable level of risk, and an orderly shutdown procedure is necessary to prevent severe equipment damage, injury to personnel, or — in some extreme cases — catastrophic failure. Orderly shutdown is commonly employed in nuclear power-generating facilities, paper mills, and other areas with hazardous processes.

685.3 Application of Other Articles. The articles/sections in Table 685.3 apply to particular cases of installation of conductors and equipment, where there are orderly shutdown requirements that are in addition to those of this article or are modifications of them.

TABLE 685.3 Application of Other Articles

Conductor/Equipment	Section
More than one building or other structure	225, Part II
Ground-fault protection of equipment	230.95, Exception
Protection of conductors	240.4
Electrical system coordination	240.12
Ground-fault protection of equipment	240.13(1)
Grounding ac systems of 50 volts to less than 1000 volts	250.21
Equipment protection	427.22
Orderly shutdown	430.44
Disconnection	430.75, Exception Nos. 1 and 2
Disconnecting means in sight from controller	430.102(A), Exception No. 2
Energy from more than one source	430.113, Exception Nos. 1 and 2
Disconnecting means	645.10, Exception
Uninterruptible power supplies (UPS)	645.11(1)
Point of connection	705.12

ARTICLE

685

Integrated Electrical Systems

Part I. General

685.1 Scope. This article covers integrated electrical systems, other than unit equipment, in which orderly shutdown is necessary to ensure safe operation. An *integrated electrical system* as used in this article is a unitized segment of an industrial wiring system where all of the following conditions are met:

- (1) An orderly shutdown is required to minimize personnel hazard and equipment damage.
- (2) The conditions of maintenance and supervision ensure that qualified persons service the system. The name(s) of the qualified person(s) shall be kept in a permanent record at the office of the establishment in charge of the completed installation.