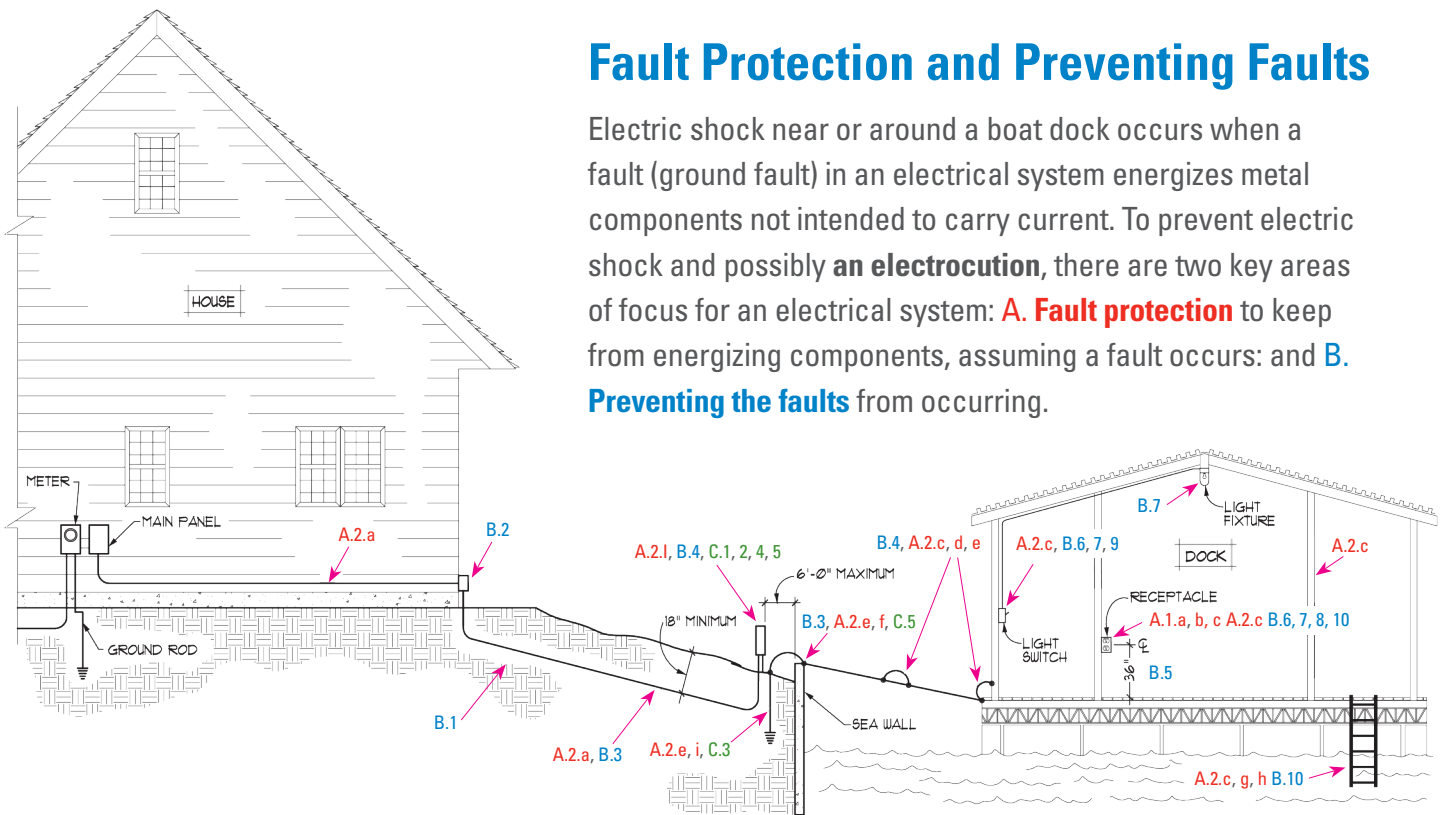


# Fault Protection and Preventing Faults

Electric shock near or around a boat dock occurs when a fault (ground fault) in an electrical system energizes metal components not intended to carry current. To prevent electric shock and possibly an **electrocution**, there are two key areas of focus for an electrical system: **A. Fault protection** to keep from energizing components, assuming a fault occurs; and **B. Preventing the faults** from occurring.



**A. Fault Protection** – despite how well something is installed, electrical faults on docks can occur due to various reasons such as water intrusion into the electrical equipment, wear from the weather and the movement from wave action on the docks. The most critical thing for personnel safety on docks with electrical service is to ensure you have adequate protection from faults. The following items are required for fault protection:

1. All electrical power going to a dock must be protected by a Ground Fault Circuit Interrupter (GFCI).
  - a. All outlet receptacles shall be GFCI protected.
  - b. All shore power assemblies shall be of the Marine Twist Lock type and GFCI protected. A disconnecting means must be within 30 inches of the outlet or approved pedestal installation.
  - c. All GFCI's shall work when tested (recommend at least once per month).
2. A proper grounding and bonding system with less than 1.0 Ohms resistance must connect all metal components and electrical components to the ground at the power source (ground rod at the meter base or main panel at the house). This low-impedance circuit facilitates the operation of the overcurrent devices during a ground fault condition and limits the voltage to ground during these fault conditions.

- a. The feeder from the main panel (closest to the power source/ meter) to any sub panel supplying electrical power to a dock shall be 4 wire for 240 volt systems or 3 wire for 120 volt systems and sized for the load.
- b. The grounding conductor must be verified to have less than 1.0 Ohms resistance when tested from the dock or dock sub panel back to the power source at the house, meter or transformer.
- c. All non-current carrying metal parts of the docking facility such as metal piping, metal equipment enclosures, metal frames of the structure and ramps, metal swim ladders and other metals in contact with the water or may become electrically energized shall be electrically bonded to the equipment grounding system.
- d. All metal enclosure and exposed metal parts of the electrical system shall be bonded to the grounding bus with approved terminals.
- e. All exposed grounding conductors on the dock shall have continuous outer finish that is green, including all bonding wires.
- f. A bonding jumper with a loop (sized in compliance with NEC 250.66 but not smaller than #6 AWG) shall be installed around all hinge points of metal ramps, floating structures, and docks subject to elevation changes due to the changes in the water levels. All bonding jumpers shall be connected with a through bolt and locking nut (self-tapping screws are not approved).

- g. Any metal ladder on the dock shall have #6 wire jumpers to dock frame from ladder base and to ladder if hinged (frame can be bolted to dock frame).
- h. A detachable ladder needs to have specs showing that it is bondable.
- i. The grounding conductors shall be connected to the grounding bus in the sub-panel. Grounding bus and grounded bus must be separated.
- j. An insulated equipment-grounding conductor (sized in compliance with NEC 250.122, but not smaller than #12 AWG) shall be installed inside all conduit systems with the circuit conductors.

**B. Prevention of faults** – many of the National Electrical Code requirements are aimed at preventing ground faults through proper installation, use of proper equipment, and proper workmanship. The following specific items are required to prevent faults on docks:

1. Conduit that is buried from the power source (building, house, etc.) to the dock sub-panel shall be schedule 40 PVC for underground use.
2. Any junction box on the outside of the building or house serving the dock sub-panel shall be weatherproof.
3. The feeder from the sub-panel to the dock shall be schedule 40 PVC (sunlight resistant) or an approved material and must be liquid tight flexible conduit at all pivot points.
4. All conduits shall be sized for the conductors.
5. All general use outlet receptacles shall be a minimum 36 inches from the finished dock surface.
6. All cabinets and cutout boxes shall be a minimum of ¼ inch of airspace between the enclosure and supporting surface.
7. All enclosures below eight (8) feet or exposed to weather shall be in weatherproof enclosures and suitable for wet locations with allowable weep holes.
8. All general use receptacles shall be weather resistant type and have an attachment plug cover (“in use” type).
9. All switches shall be in weatherproof enclosures or cabinets.

10. Receptacles, switch boxes and junction boxes shall not be within six (6) feet of a ladder for the dock.
11. All wiring methods and conductors shall be suitable for wet locations
12. All wiring shall meet 2011 locally adopted Article 554, “Residential Docks” for private dwelling docks.
13. All wiring shall meet 2011 NEC Article 555, “Marinas and Boatyards” for all other docks.

**C. Other Requirements** – below are some other dock electrical requirements that do not have to do with either fault protection or preventing faults but are requirements for other purposes:

1. A sub-panel for all power serving a dock shall be at the seawall or shoreline within six (6) feet of the dock ramp and shall have a disconnecting means easily recognizable in an emergency.
2. The bottom height of the dock sub-panel with overcurrent device(s) and disconnecting means shall be 42 inches above the dock walkway.
3. A grounding electrode (ground rod) (in compliance with NEC 250.52, 250.53, 250.56) shall be in place at the dock sub-panel (at least eight (8) feet long and trade size of ½ inch). This grounding electrode is for lightning protection and mishaps with higher voltage lines. The grounding electrode at the seawall is not for carrying fault currents and does not provide the ground fault protection discussed in Section A of this document!
4. The grounding bus of the dock sub-panel shall be connected to the ground rod with a correctly sized grounding conductor (per NEC 250.66, minimum #6 AWG) attached with a separate clamp directly to the grounding rod.
5. #6 grounding wire from the ground rod to the metal parts of the ramp with approved terminals attached with through bolts and lock nuts.
6. 2011 National Electrical Code (NEC) applies with Authority Having Jurisdiction (AHJ) additions.