



Mike Holt's

Article 555

MARINAS, BOATYARDS, AND DOCKING FACILITIES

Extracted from Understanding the National Electrical Code® Volume 2



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Author: Mike Holt

Technical Illustrator: Mike Culbreath

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ABOUT THE AUTHOR

Mike Holt is an author, businessman, educator, speaker, publisher and *NEC*® expert. He has written hundreds of electrical training books and articles, founded three successful businesses, and has taught thousands of electrical *Code* seminars across the United States and internationally.



Mike's approach to electrical training is based on his own experience as an electrician, contractor, inspector and teacher. He's always felt a responsibility to his students and to the electrical industry to provide education beyond the scope of just passing an exam. This commitment, coupled with the lessons he learned at the University of Miami's MBA program, have helped him build one of the largest electrical training and publishing companies in the United States.

Mike's one-of-a-kind presentation style and his ability to simplify and clarify technical concepts explain his unique position as one of the premier educators and *Code* experts in the country. His passion for the electrical field drives his goal to increase electrical safety and improve lives.

Mike's commitment to pushing boundaries and setting high standards extends into his personal life. He's an eight-time Overall National Barefoot Waterski Champion with more than 20 gold medals, many national records, and he has competed in three World Barefoot Tournaments. In 2015, at the tender age of 64, he started a new adventure—competitive mountain bike racing. Every day he continues to find ways to motivate himself, both mentally and physically.

Mike and his wife, Linda, reside in New Mexico and Florida, and are the parents of seven children and six grandchildren. As his life has changed over the years, a few things have remained constant: his commitment to God, his love for his family, and doing what he can to change the lives of others through his products and seminars.

*I dedicate this book to the
Lord Jesus Christ,
my mentor and teacher.
Proverbs 16:3*



ARTICLE 555

MARINAS, BOATYARDS, AND DOCKING FACILITIES

Introduction to Article 555—Marinas, Boatyards, and Docking Facilities

Water levels are not constant. Ocean tides rise and fall, while lakes and rivers vary in depth in response to rain. To provide power to a marina, boatyard, or docking facility, you must allow for these variations in water level between the point of use and the electric power source. Article 555 addresses this issue.

This article begins with the concept of the electrical datum plane. You might think of it as the border of a “demilitarized zone” for electrical equipment. Or, you can think of it as a line that marks the beginning of a “no man’s land” where you simply do not place electrical equipment. Once you determine where this plane is, do not place transformers, connections, or receptacles below that line.

Because of recent ESD (electric shock drowning) incidents, installations supplying shore power in marinas and boatyards have increased electrical safety with the use of GFP (ground fault protection), leakage devices, and warning signs to raise awareness of hazardous voltage and currents present in the water of marinas, boatyards, and docking facilities.

Part I. General

555.1 Scope

Article 555 covers the installations in dwellings and commercial areas of wiring and equipment for fixed or floating piers, wharfs, docks, floating buildings, and other areas in marinas and boatyards. ▶Figure 555–1



▶Figure 555–1

555.2 Definitions

Author’s Comment:

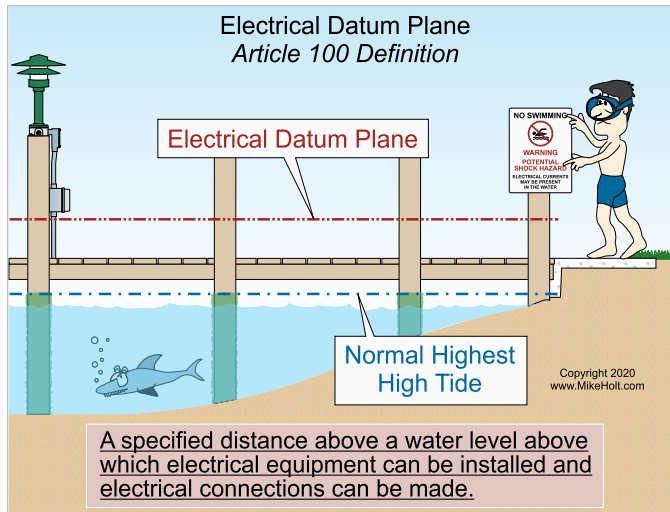
- ▶ Some of the definitions in this section of the text appear in Article 100 of the *Code*. They are included here as well for context and illustrative purposes.

Docking Facility. A covered or open, fixed or floating structure that provides access to the water and to which boats are secured.

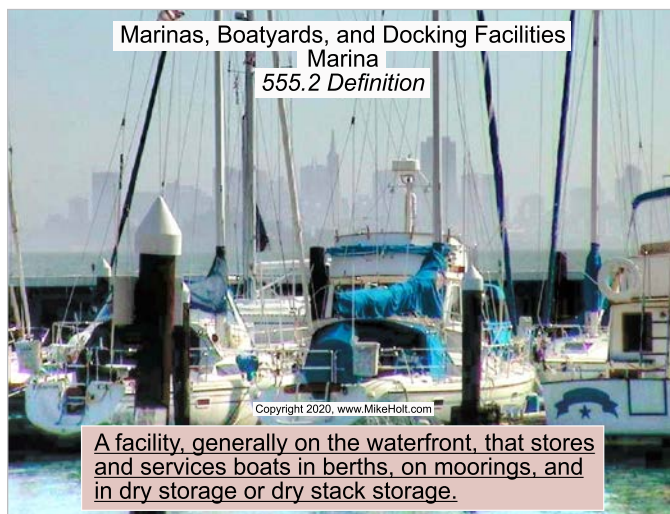
Electrical Datum Plane. A specified distance above a water level (which may or may not be subject to tidal fluctuation) above which electrical equipment can be installed and electrical connections can be made. ▶Figure 555–2

Marina. A facility, generally on the waterfront, that stores and services boats in berths, on moorings, and in dry storage or dry stack storage. ▶Figure 555–3

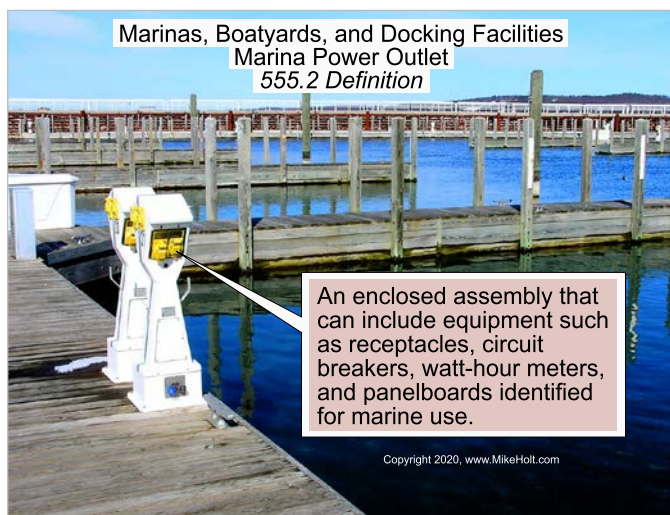
Marine Power Outlet. An enclosed assembly that can include equipment such as receptacles, circuit breakers, watt-hour meters, and panelboards approved for marine use. ▶Figure 555–4



► Figure 555-2



► Figure 555-3



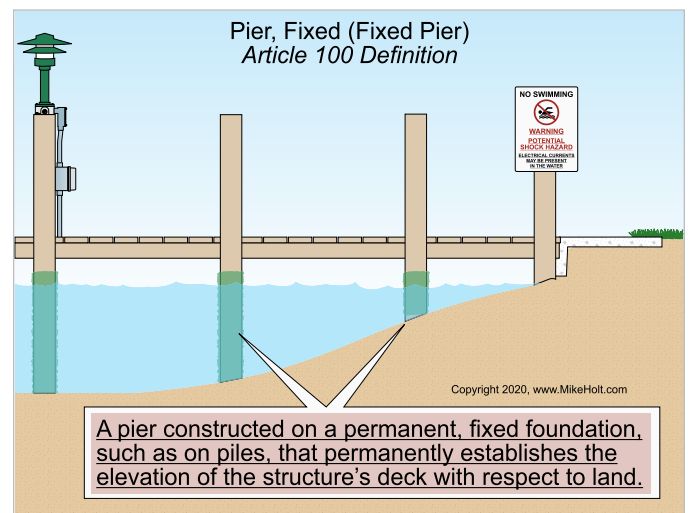
► Figure 555-4

Pier. A structure extending over the water and supported on a fixed foundation (fixed pier), or on flotation (floating pier), that provides access to the water. ►Figure 555-5



► Figure 555-5

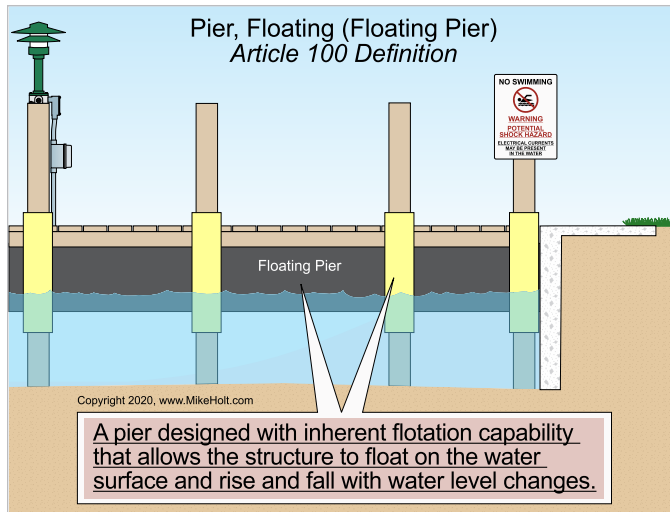
Pier, Fixed (Fixed Pier). A pier constructed on a permanent, fixed foundation (such as on piles) that permanently establishes the elevation of the structure's deck with respect to land. ►Figure 555-6



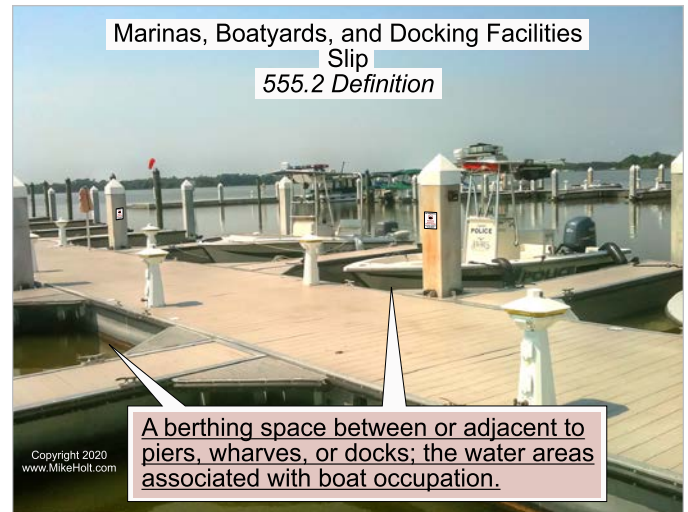
► Figure 555-6

Pier, Floating (Floating Pier). A pier designed with inherent flotation capability that allows the structure to float on the water surface and rise and fall with water level changes. ►Figure 555-7

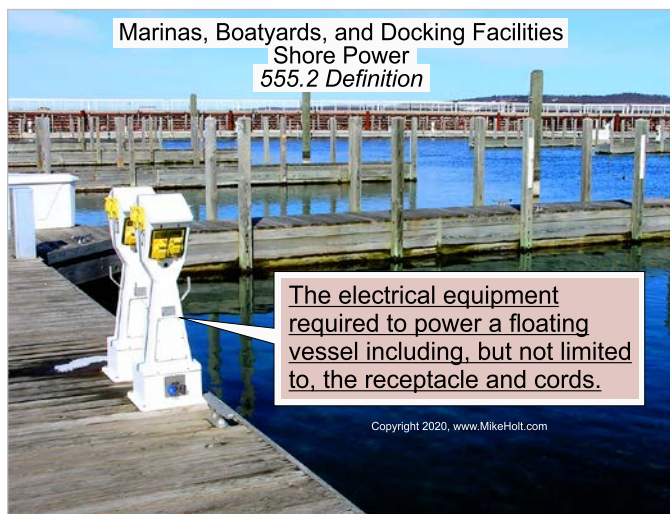
Shore Power. The electrical equipment required to power a floating vessel including, but not limited to, the receptacle and cords. ►Figure 555-8



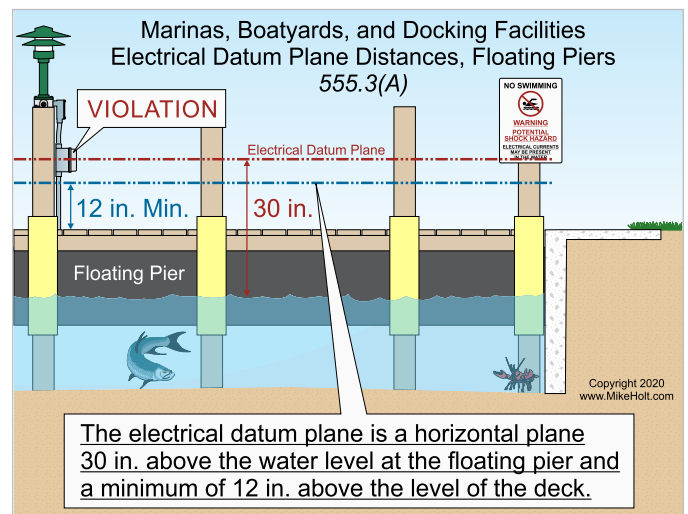
► Figure 555-7



► Figure 555-9



► Figure 555-8



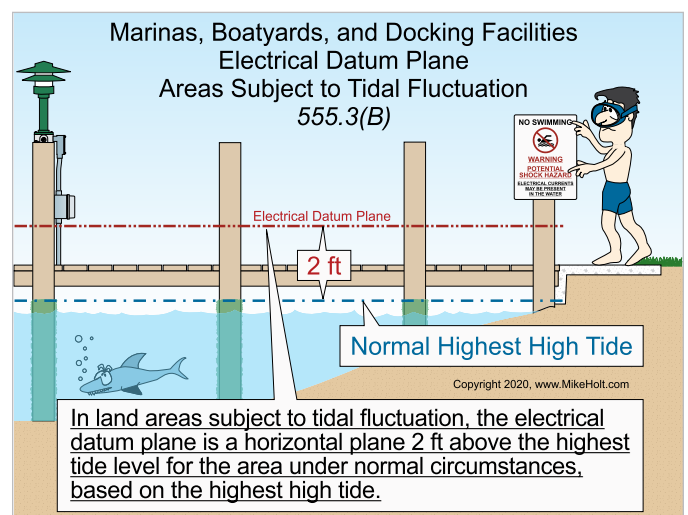
► Figure 555-10

Slip. A berthing space between or adjacent to piers, wharves, or docks; the water areas associated with boat occupation. ► Figure 555-9

555.3 Electrical Datum Plane Distances

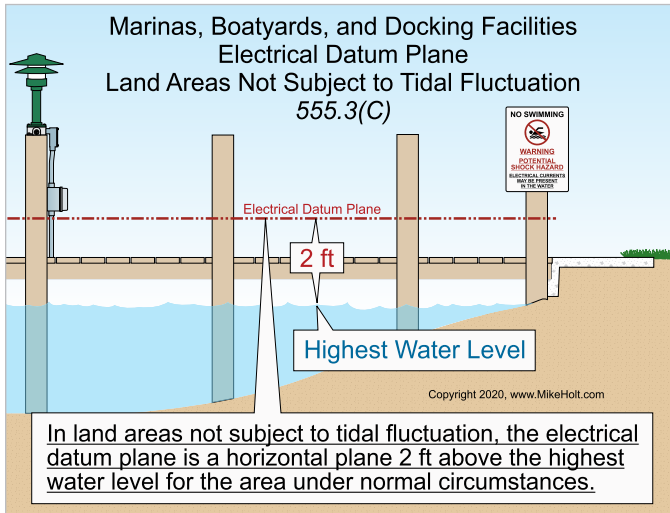
(A) Floating Piers. The electrical datum plane for floating piers and boat landing stages is a horizontal plane 30 in. above the water level at the floating pier and a minimum of 12 in. above the level of the deck. ► Figure 555-10

(B) Areas Subject to Tidal Fluctuations. In land areas subject to tidal fluctuation, the electrical datum plane is a horizontal plane 2 ft above the highest tide level for the area occurring under normal circumstances, based on the highest high tide. ► Figure 555-11



► Figure 555-11

(C) Areas Not Subject to Tidal Fluctuations. In land areas not subject to tidal fluctuation, the electrical datum plane is a horizontal plane 2 ft above the highest water level for the area occurring under normal circumstances. ▶Figure 555-12



▶Figure 555-12

555.4 Location of Service Equipment

The service equipment for a floating building, dock, or marina must be located on land adjacent to the structure served, but not on or in the structure itself.

555.5 Maximum Voltage

Pier power distribution systems must not exceed 250V phase to phase. Pier power distribution systems, where qualified personnel service the equipment under engineering supervision, are permitted to exceed 250V but these systems must not exceed 600V.

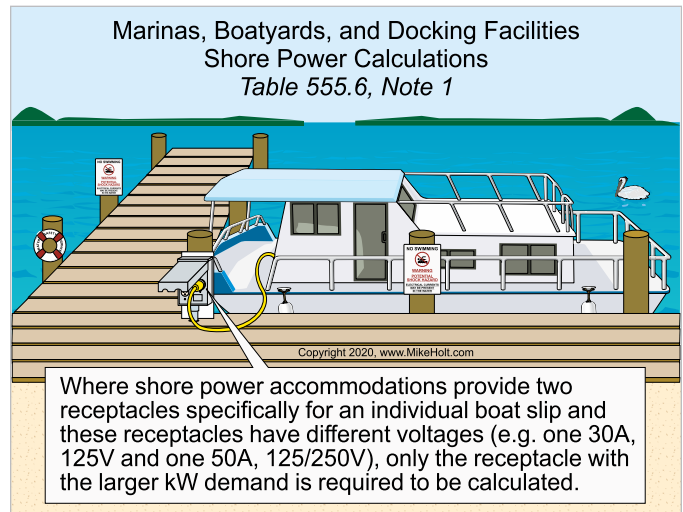
555.6 Load Calculations for Service and Feeder Conductors

When calculating service and/or feeder ampacities, the demand factors shown in Table 555.6 can be applied.

Table 555.6 Demand Factors

| Number of Shore Power Receptacles | Sum of the Rating of the Receptacles % |
|-----------------------------------|--|
| 1-4 | 100 |
| 5-8 | 90 |
| 9-14 | 80 |
| 15-30 | 70 |
| 31-40 | 60 |
| 41-50 | 50 |
| 51-70 | 40 |
| 71 and Over | 30 |

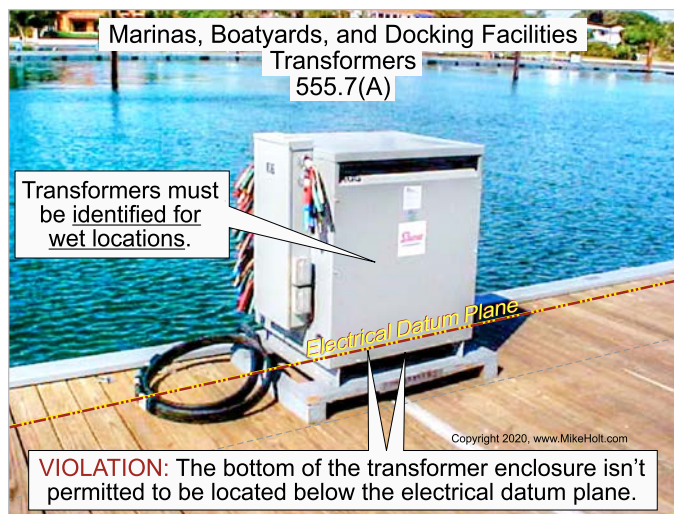
Note 1: Where shore power accommodations provide two receptacles specifically for an individual boat slip and these receptacles have different voltages (for example, one 30A, 125V and one 50A, 125/250V), only the receptacle with the larger kilowatt demand is required to be calculated. ▶Figure 555-13



▶Figure 555-13

555.7 Transformers

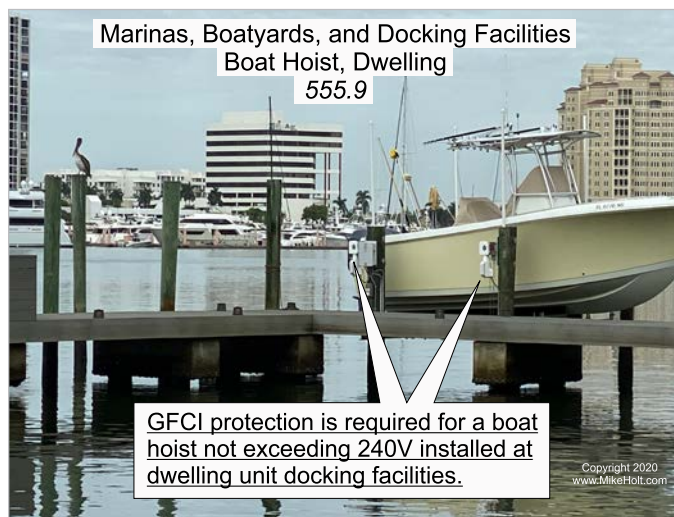
(A) General. Transformers and enclosures must be identified for wet locations. The bottom of the transformer enclosure is not permitted to be located below the electrical datum plane. ▶Figure 555-14



► Figure 555-14

555.9 Boat Hoists

GFCI protection is required for a boat hoist not exceeding 240V installed at dwelling unit docking facilities. ► Figure 555-15



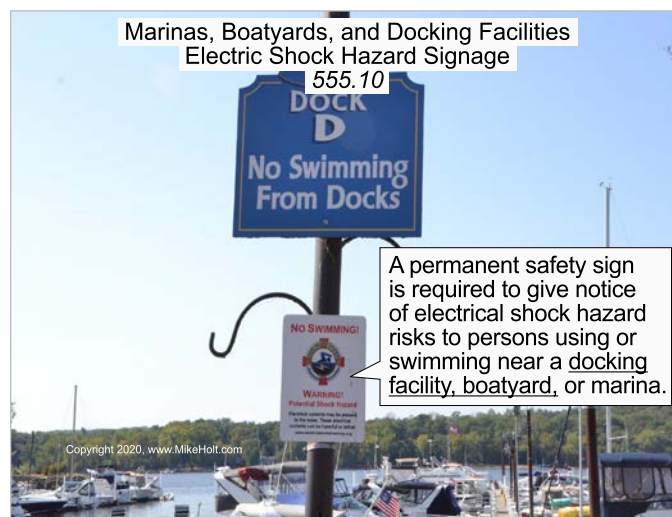
► Figure 555-15

Author's Comment:

- This section was previously covered in 210.8(C) but is now in Article 555 due to its scope now covering dwelling unit docking facilities.

555.10 Electric Shock Hazard Signage

A permanent safety sign is required to give notice of electrical shock hazard risks to persons using or swimming near a docking facility, boatyard, or marina. The safety sign must meet all of the following requirements: ► Figure 555-16



► Figure 555-16

- (1) The sign must warn of the hazards using effective words, colors, or symbols (or a combination) in accordance with 110.21(B)(1) and be of sufficient durability to withstand the environment.
- (2) The signs must be clearly visible from all approaches to a marina or boatyard facility.
- (3) The signs must state:

**WARNING—POTENTIAL SHOCK HAZARD—ELECTRICAL
CURRENTS MAY BE PRESENT IN THE WATER.**

555.11 Motor Fuel Dispensing Stations— Hazardous (Classified) Locations

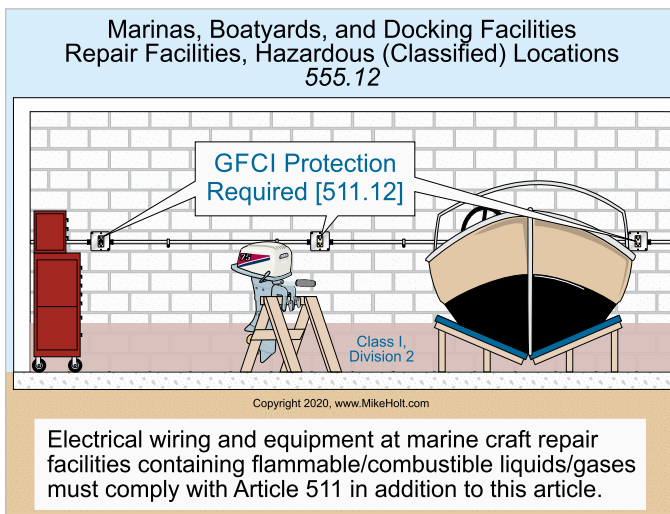
Electrical wiring and equipment located at or serving motor fuel dispensing locations must comply with Article 514 in addition to the requirements of this article. ► Figure 555-17



► Figure 555-17

555.12 Repair Facilities—Hazardous (Classified) Locations

Electrical wiring and equipment at marine craft repair facilities containing flammable or combustible liquids or gases must comply with Article 511 in addition to the requirements of this article. ►Figure 555-18



► Figure 555-18

Author's Comment:

- Important rules in Article 511 to consider include:
 - 511.3—Classification of Hazardous Areas
 - 511.4—Wiring and Equipment in Hazardous (Classified) Locations

- 511.7—Wiring and Equipment Above Hazardous (Classified) Locations
- 511.9—Explosionproof Seals
- 511.12—GFCI-Protected Receptacles

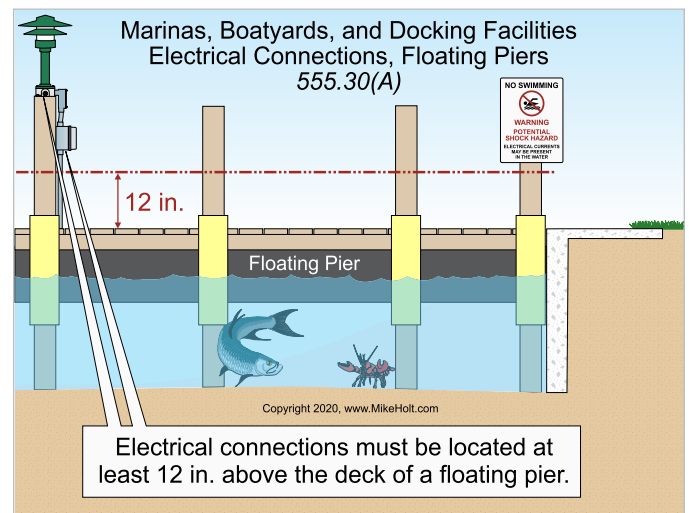
555.13 Bonding of Noncurrent-Carrying Metal Parts

Metal parts in contact with the water, metal piping, and noncurrent-carrying metal parts likely to become energized must be connected to the grounding bus in the panelboard using a solid copper conductor that is insulated, covered, or bare and not smaller than 8 AWG. Connections must be made in accordance with 250.8.

Part II. Marinas, Boatyards, and Docking Facilities

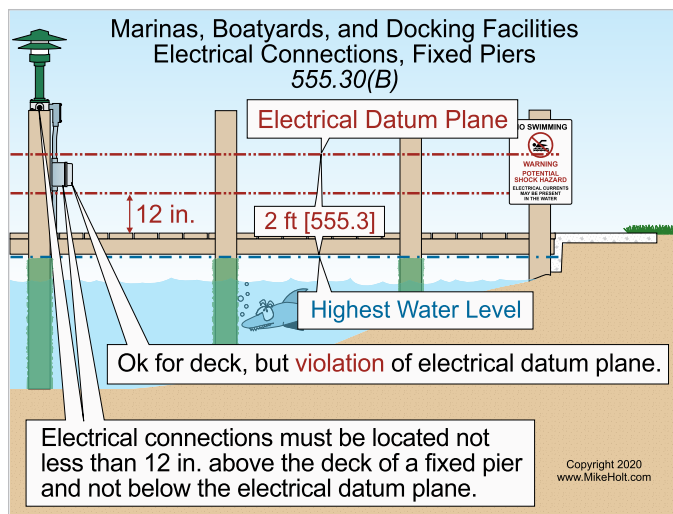
555.30 Electrical Connections

(A) **Floating Piers.** Electrical connections must be located at least 12 in. above the deck of a floating pier. ►Figure 555-19

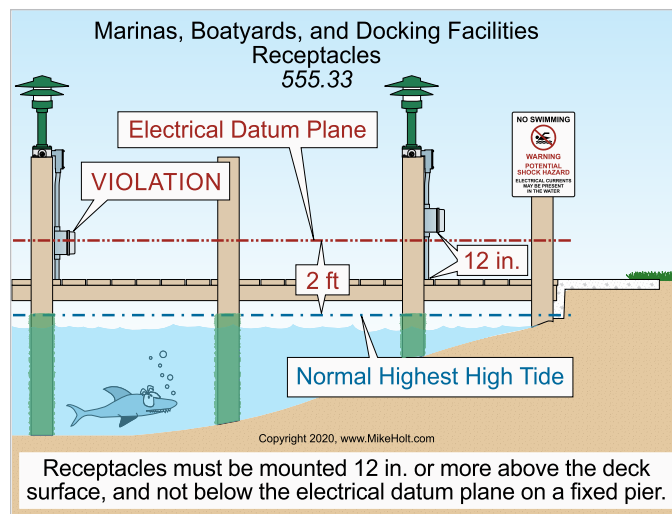


► Figure 555-19

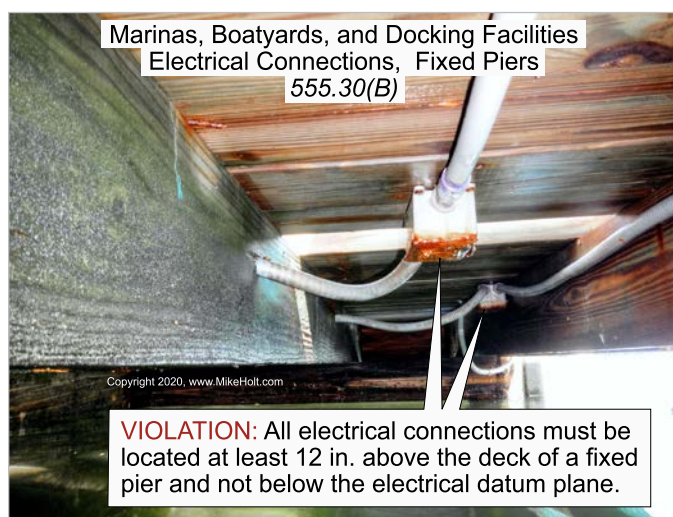
(B) **Fixed Piers.** Electrical connections must be located at least 12 in. above the deck of a fixed pier and not below the electrical datum plane. ►Figure 555-20 and ►Figure 555-21



▶ Figure 555-20



▶ Figure 555-22



▶ Figure 555-21

(C) Replacements. Replacement electrical connections for a floating pier must be located at least 12 in. above its deck. Conductor splices where located above the waterline but below the electrical datum plane for floating piers are required to be within junction boxes identified for wet locations, utilizing sealed wire connector systems listed and identified for submersion.

555.33 Receptacles

Receptacles must be mounted not less than 12 in. above the deck surface, and not below the electrical datum plane on a fixed pier.

▶ Figure 555-22

(A) Shore Power Receptacles.

(1) Enclosures. Receptacles intended to supply shore power to boats must be part of a listed marina power outlet enclosure and be installed in listed enclosures protected from the weather or in listed weatherproof enclosures.

(4) Ratings. Receptacles that provide shore power for boats must be rated at least 30A and must be of the pin and sleeve type if rated 60A or higher.

Author's Comment:

- ▶ The rating of the shore power receptacle does not depend on the length of the boat. The *Code* simply sets a minimum rating of 30A and leaves it up to the designer and/or owner to provide the receptacles they deem necessary based on the projected usage of the slips.

(B) Other Than Shore Power.

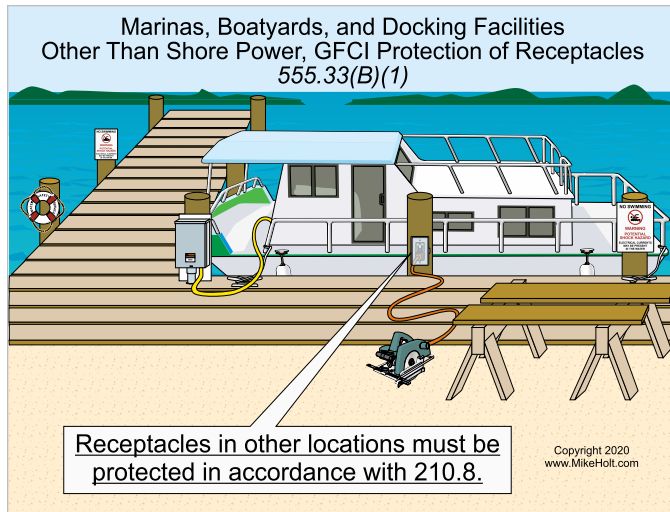
(1) GFCI Protection of Receptacles. Receptacles in other locations must be protected in accordance with 210.8. ▶ Figure 555-23

(C) Replacement Receptacles. Replacement receptacles must comply with 555.33.

555.34 Wiring Methods and Installation

(A) Wiring Methods.

(1) General. Any Chapter 3 wiring method identified for wet locations is permitted.



► Figure 555-23

(2) Portable Power Cables. Sunlight resistant, extra-hard usage portable power cables listed for wet locations having an outer jacket resistant to temperature extremes (not less than 167°F), oil, gasoline, ozone, abrasion, acids, and chemicals are 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.

(3) Temporary Wiring. Temporary wiring, except as permitted by Article 590, must not be used to supply power to boats.

(B) Installation.

(2) Outdoor Branch Circuits and Feeders. Multiple feeders and branch circuits are permitted and clearances for overhead branch-circuit and feeder wiring in locations of the boatyard other than those described in 555.34(B)(1) must be not less than 18 ft above grade. Only Part I of Article 225 applies to marina installations.

(3) Portable Power Cables.

- (a) Portable power cables permitted by 555.13(A)(2) must be:
 - (1) Properly supported.
 - (2) Located on the underside of the pier.
 - (3) Securely fastened by nonmetallic clips to structural members other than the deck planking.
 - (4) Not be subject to physical damage.
 - (5) Protected against chafing by a permanently installed oversized sleeve of nonmetallic material when cables pass through structural members.

- (b) Where portable power cables are used, there must be a junction box of corrosion-resistant construction with permanently installed terminal blocks on each pier section to which the feeders are connected. A listed marina power outlet employing terminal blocks/bars is permitted in lieu of a junction box. Metal junction boxes and covers, and metal screws and parts that are exposed externally to the boxes, must be of corrosion-resistant materials or protected by material resistant to corrosion.

(4) Protection. Rigid metal conduit, reinforced thermosetting resin conduit (RTRC) listed for aboveground use, or rigid polyvinyl chloride (PVC) conduit suitable for the location must be used to protect wiring above the decks of piers and landing stages.

555.35 Ground-Fault Protection of Equipment (GFPE) and Ground-Fault Circuit-Interrupter (GFCI) Protection

(A) Ground-Fault Protection. For other than floating buildings, ground-fault protection for docking facilities must be provided in accordance with the following:

(1) GFPE Protection. Receptacles installed in accordance with 555.33(A) can have individual GFPEs set to open at currents not exceeding 30 mA.

(2) GFCI Protection. All 15A and 20A, 125V receptacles for other than shore power must be protected in accordance with 555.33(B)(1) and (B)(2).

(3) Feeder and Branch-Circuit Conductors with GFPE. Feeder and branch-circuit conductors that are installed on docking facilities must be provided with GFPEs set to open at currents not exceeding 100 mA. Coordination with the feeder GFPE overcurrent protective device is permitted.

Ex to (3): Transformer secondary conductors of a separately derived system that do not exceed 10 ft and are installed in a raceway are permitted to be installed without ground-fault protection. This exception also applies to the supply terminals of the equipment supplied by the transformer secondary conductors.

(B) Leakage Current Measurement Device. Where more than three receptacles supply shore power to boats, a leakage current measurement device must be available and be used to determine leakage current from each boat that will utilize shore power.

Note 1: Leakage current measurement will provide the capability to determine when an individual boat has defective wiring or other problems contributing to hazardous voltage and current. The use of this test device will allow the facility operator to identify a boat that is

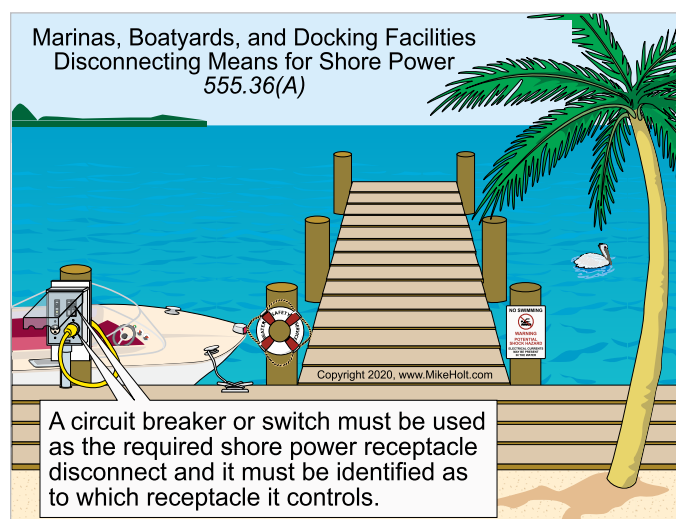
creating an electrical hazard. In some cases, a single boat may cause an upstream GFPE device protecting a feeder to trip even though multiple boats are supplied from the same feeder. The use of this test device will help the facility operator prevent a particular boat from contributing to hazardous voltage and current in the marina area.

Note 2: An annual test of each boat with the leakage current measurement device is a prudent step toward determining if a boat has defective wiring that may be contributing hazardous voltage and current. Where the leakage current measurement device reveals that a boat is contributing hazardous voltage and current, repairs should be made to the boat before it is permitted to utilize shore power.

555.36 Boat Receptacle Disconnecting Means

A disconnect must isolate each boat from its shore power receptacle.

(A) Type of Disconnecting Means. A circuit breaker or switch must be used as the required shore power receptacle disconnect and it must be identified as to which receptacle it controls. ▶Figure 555-24



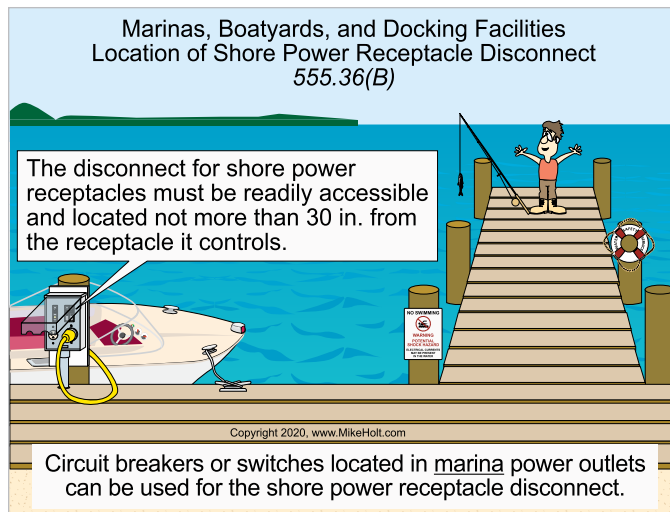
▶Figure 555-24

(B) Location. The disconnect for shore power receptacles must be readily accessible and located not more than 30 in. from the receptacle it controls. Circuit breakers or switches located in marina power outlets can be used for the shore power receptacle disconnect.

▶Figure 555-25

Author's Comment:

- ▶ This shore power receptacle disconnect is intended to eliminate the hazard of someone engaging or disengaging the boat's shore power attachment plug with wet, slippery hands, and possibly contacting energized blades.



▶Figure 555-25

555.37 Equipment Grounding Conductor

(A) Equipment to be Connected to the Equipment Grounding Conductor. The following items must 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 of Equipment Grounding Conductor. The equipment grounding conductor must be an insulated conductor with a continuous outer finish that is either green or green with one or more yellow stripes.

(C) Size of Equipment Grounding Conductor. The insulated equipment grounding conductor must be sized in accordance with 250.122, but not smaller than 12 AWG.

(D) Branch-Circuit Equipment Grounding Conductor. The insulated equipment grounding conductor for branch circuits must terminate at a grounding terminal in a remote panelboard or the grounding terminal in the main service equipment.

(E) Feeder Equipment Grounding Conductor. Where a feeder supplies a remote panelboard, an insulated equipment grounding conductor must extend from a grounding terminal in the service equipment to a grounding terminal in the remote panelboard.

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