Electrical Code Compliance

Wednesday, September 17th, 2025

Introduction

- Chris Dolan – Marina Electrical Equipment
- Manufacturer of Power Pedestals / Distribution Gear
- Williamsburg, Virginia
- In marina industry since 2000
- Member of NFPA 303 Code Making Committee
- Former AMI board member

Continuing Education Credit – 1 Hour

Credit(s) earned on completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

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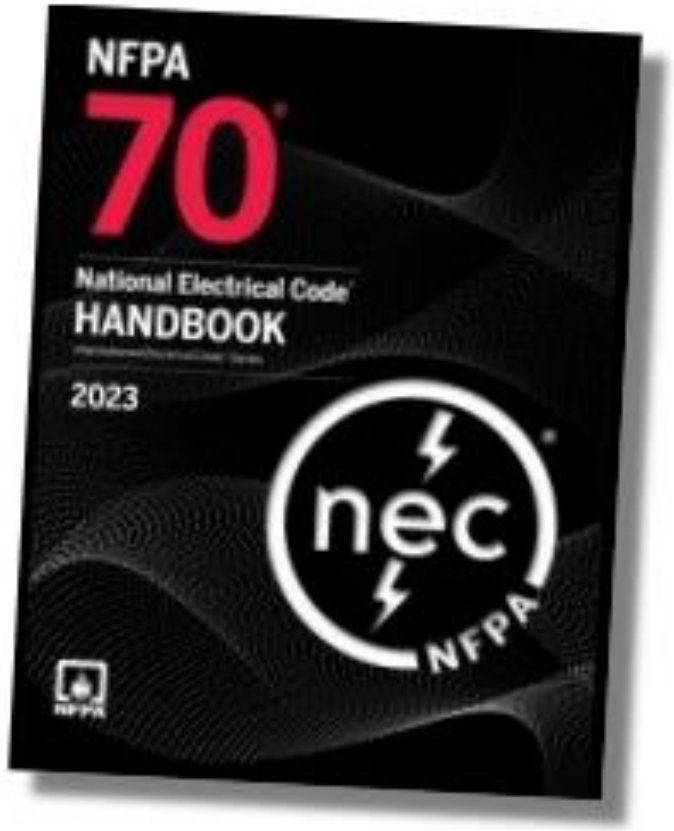
Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

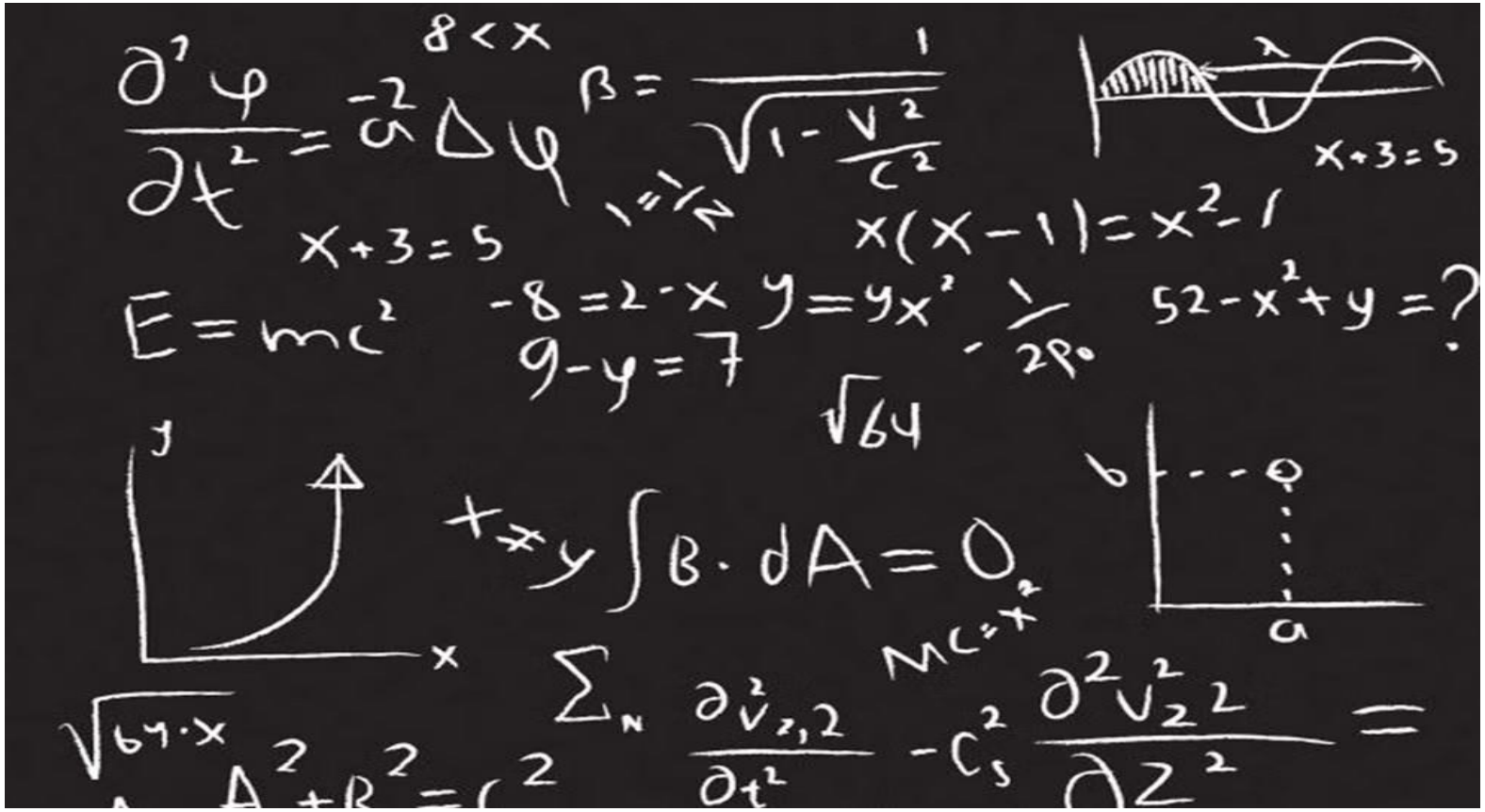
Focus and Agenda –NEC 555

Today's focus will be on critical changes to the National Electrical Code – specifically 555 Marinas, Boatyards, Floating Buildings, and Commercial and Noncommercial Dock Facilities.

- 2023 Latest Edition
- Code by Code
- Major Changes



Translations Not Equations



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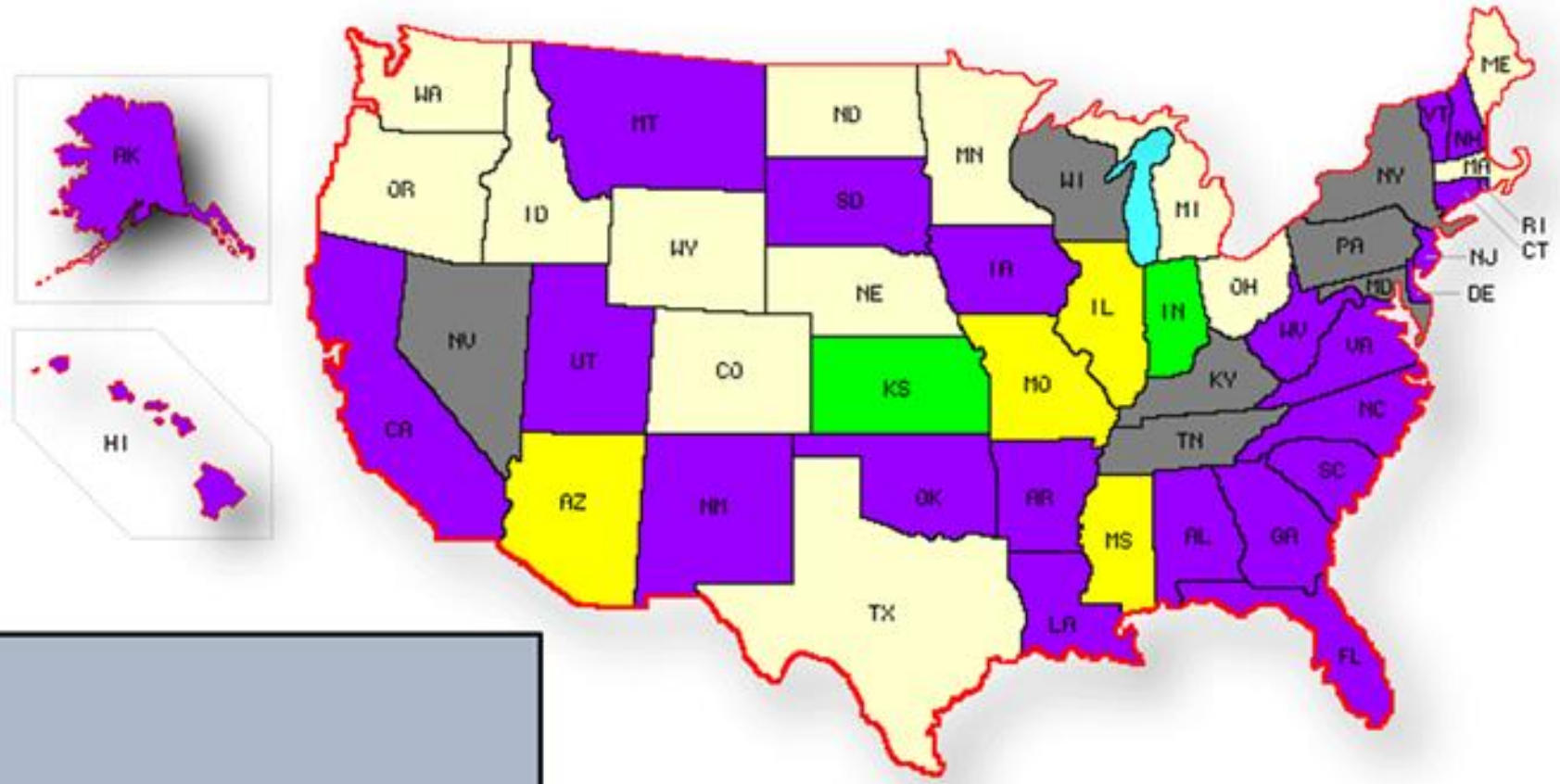
General Note: Code Adoption (08/01/2024)

- States adopt versions of the National Electrical Code at different times.
- Map Courtesy of NFPA.org



2023 NEC® - 13
2020 NEC® - 24
2017 NEC® - 7
2008 NEC® - 2
County/Municipality NEC® regulation only - 4

555.1 Scope

Any location on the water that a boat can use.

555.1 Scope

Fixed

Floating

555.1 Scope

Piers, Wharves, Docks

Buildings

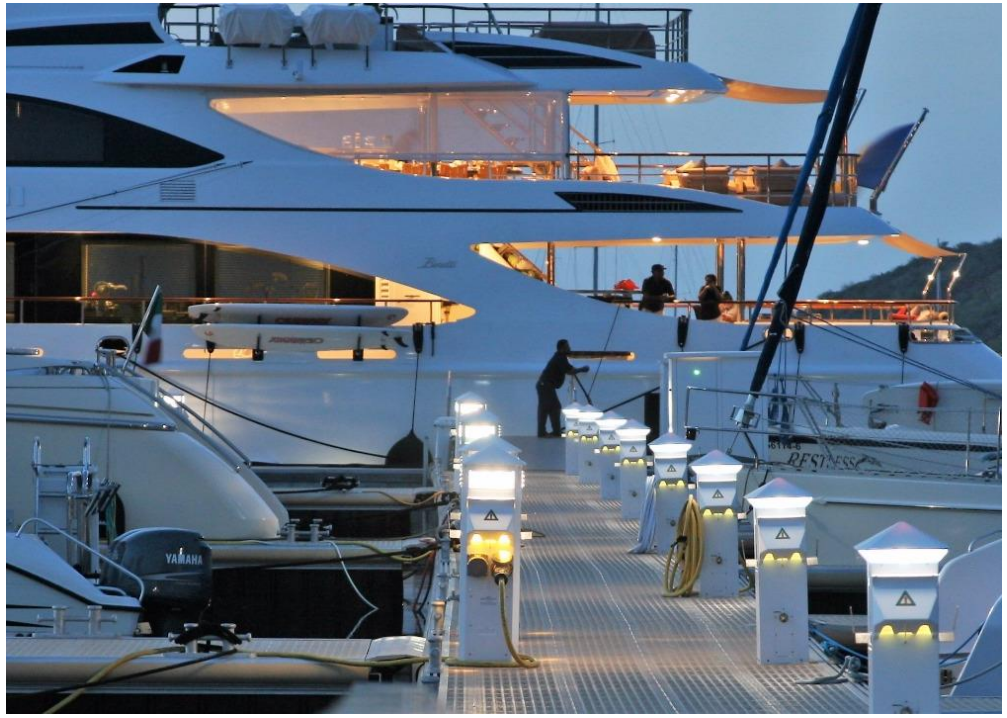
555.1 Scope

Yacht Clubs

Houseboat Marinas

555.1 Scope

Residential



Megayachts

555.1 Scope

Docking

Repair / Maintenance

555.1 Scope

Storage

Fueling

555.1 Scope

Public

Private

555.1 Scope

Floating Homes

Floating Churches

555.1 Scope

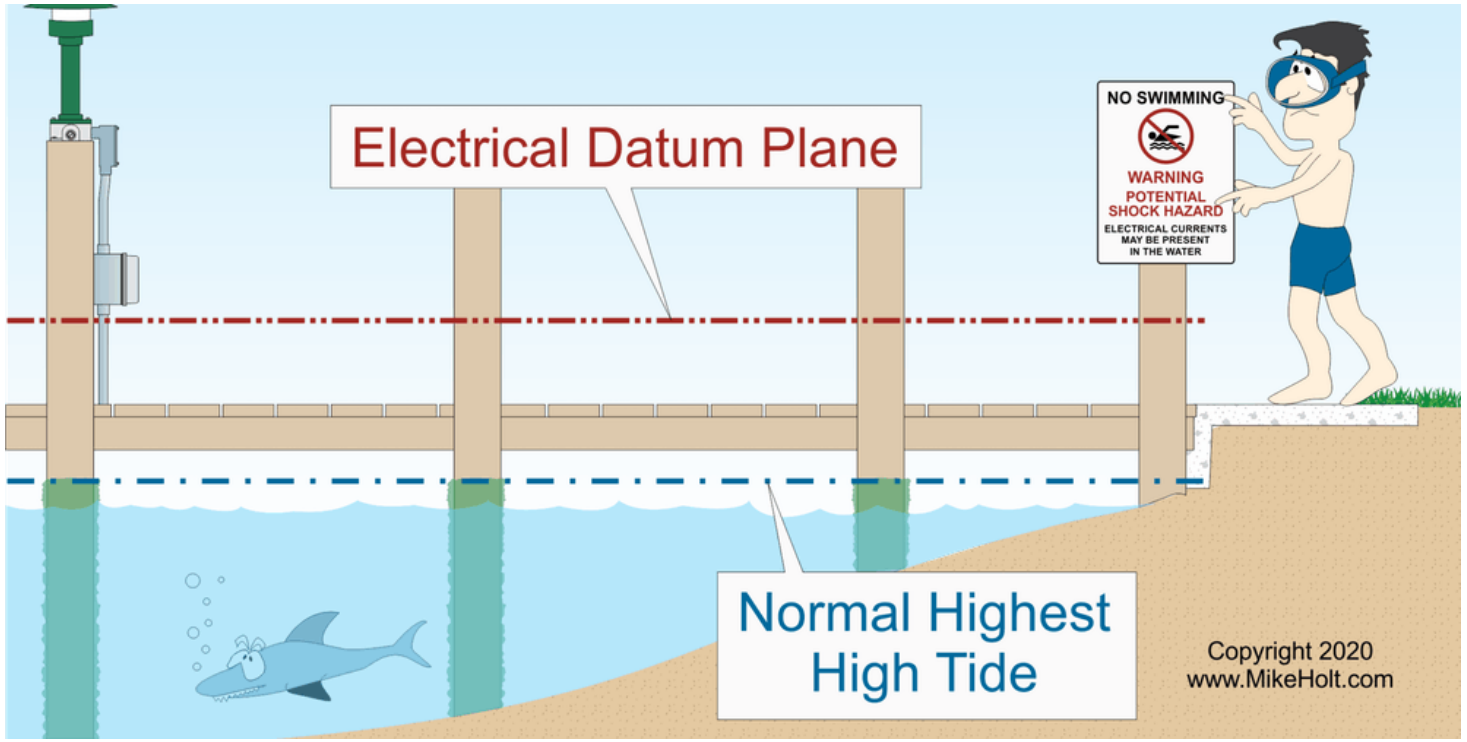
Any Location on the Water

555.3 Electrical Datum Plane

- Baseline height for where items can be located on a dock.

- Established under normal circumstances.

555.3 Electrical Datum Plane – Floating Docks

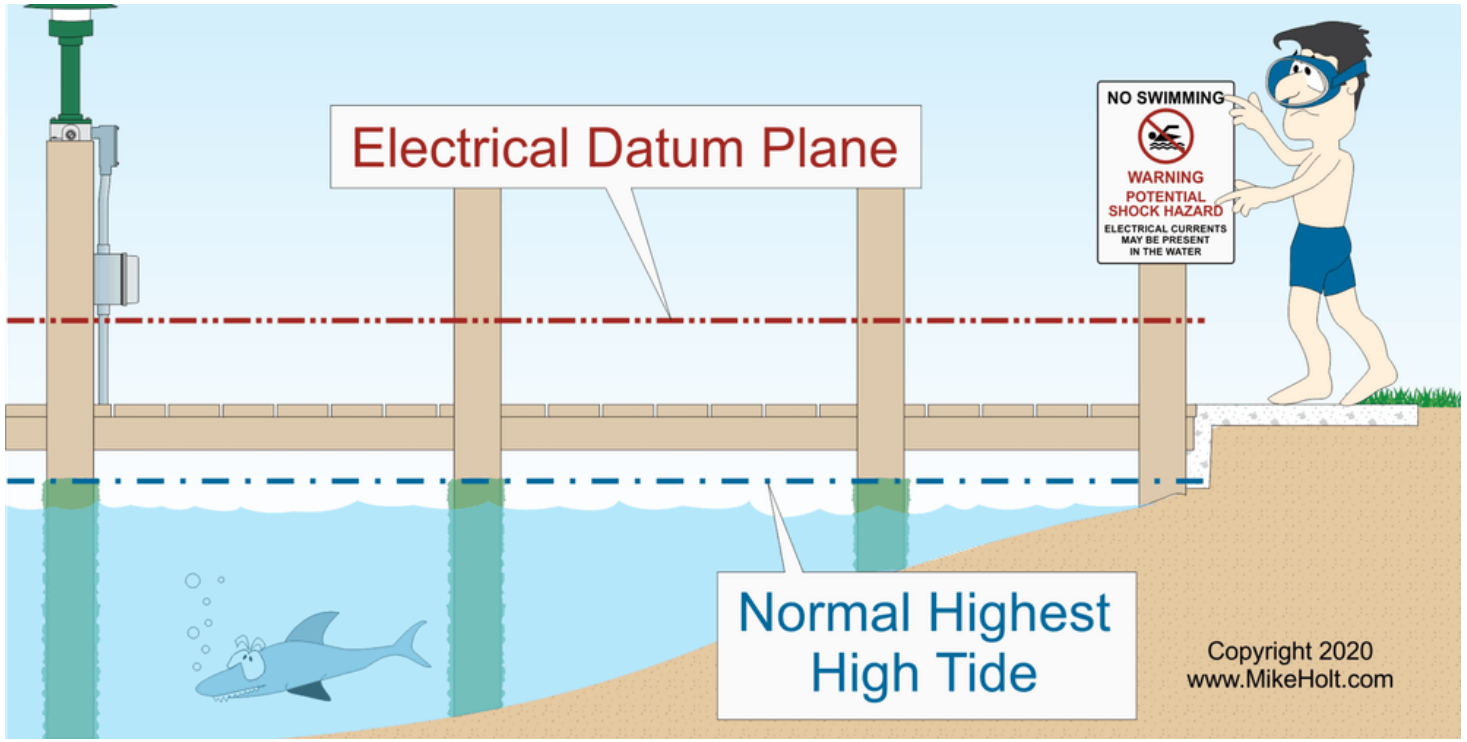


Minimums:

- 30" above water level
- 12" above the deck
- Baseline: high tide under normal circumstances

Diagram from www.MikeHolt.com

555.3 Electrical Datum Plane – Fixed Docks



Minimums:

- 24" above highest tide
- 12" above the deck
- Baseline: high tide under normal circumstances for tidal and non-tidal areas

Diagram from www.MikeHolt.com

555.3 Electrical Datum Plane – Normal Conditions

Rain

Snow

555.3 Electrical Datum Plane – Extreme Conditions

Extreme - Hurricanes

Extreme - Drought

555.4 Location of Service Equipment

Service Equipment

- Service Equipment = switch or disconnect that kills power to something (dock, building, etc.)

Minimums:

- On land
- Minimum 5’ away
- Not located on the structure
- 12” above the electrical datum plane

555.4 Location of Service Equipment

12" Above Datum Plane

In Case of Emergency

555.5 Maximum Voltage

- Nothing larger than 600V, but l*ocal codes and ordinances overrule national codes*

555.6 Load Calculations for Service and Feeder Conductors

- You must use NEC tables for service and load calculations *(but remember local utilities do not have to follow the same rule).*

555.7 Transformers

Transformer

New Installation:

- Suitable for wet locations

- *Bottom of the enclosure* must be located above the electrical datum plane – at least 12" high

Replacement:

- Suitable for wet locations

555.10 Signage

Permanent Safety Signs:

- Durable
- Visible from All Approaches
  - Water
  - Land

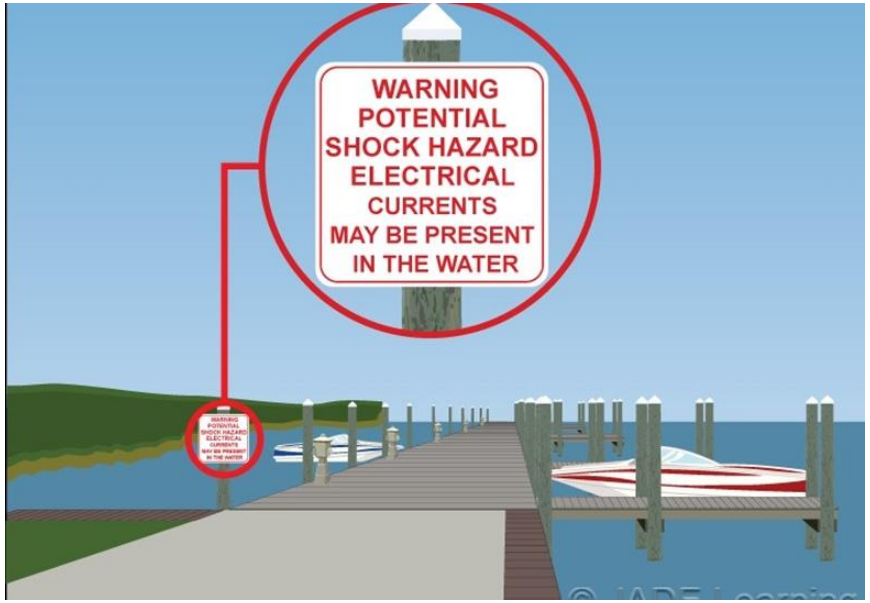


Photo from JADELearning (www.jadelearning.com)

General Note – *Recommendation / NOT CODE*

- Do not allow swimming in your marina.
- Post signs prohibiting swimming in the marina.

Codes Omitted from Presentation So Far…

- 555.8 Marine Hoists, Railways, Cranes, and Monorails
- 555.11 Motor Fuel Dispensing Stations
  - See NEC Article 514
- 555.12 Repair Facilities
  - Don't keep items that can blow up near items that can make them blow up

555.13 Bonding on Non-Current Carrying Metal Parts

Photo from Dock Boxes Unlimited (www.dockboxes)

- All metal parts in water including dock frames, metal piping, ladders, boat lift parts, etc…
- **Likely** to be energized
- Not connected to a circuit breaker
- Needs to be connected to the ground bus in a panelboard
- **Solid** copper, #8-gauge or larger

555.13 Bonding on Non-Current Carrying Metal Parts

Definition of likely in code speak:

- "Could it happen without something falling out of the sky?"

  - Mike Holt

- If a wire comes loose during a storm, could it contact:
  - a dock frame?
  - a metal pipe?
  - a ladder?
  - a boat lift component?

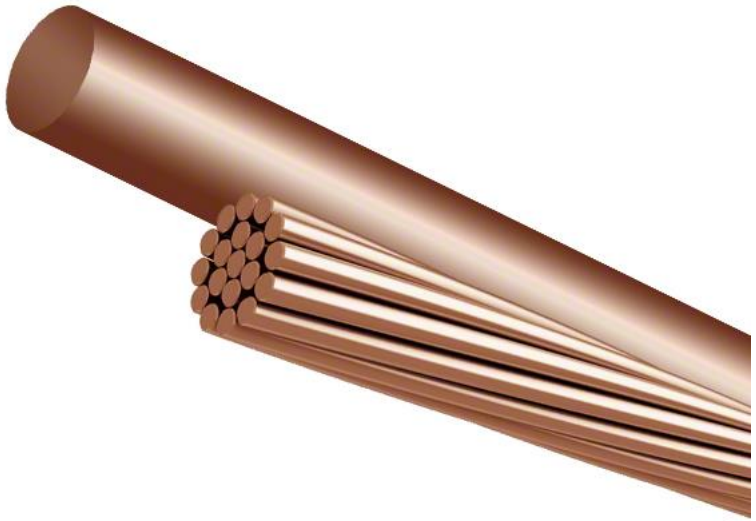
- Answer yes – bond it.

555.13 Bonding on Non-Current Carrying Metal Parts

Photo from Structurmarine

Solid Copper Connection

- Currently required
- Solid vs. multi-conductor - flexibility



555.15 Replacement of Equipment

- If work changes:
  - Fit?
  - Form?
  - Function?
  - Must comply with the latest code requirements
- Maintenance vs. Modification
- Damage

555.15 Replacement of Equipment

- Maintenance
  - Light Bulb
  - Receptacle / Breaker
  - Meter

- Modification
  - New dock
  - New panel
  - New cable

555.15 Replacement of Equipment

- Damage
  - ***Natural***

- Identify
- Document
- Use a qualified person

- Work requiring complete replacement (housing) must be up to the ***latest code***.

- Replacing components must be to ***the edition of the code the gear was originally installed.***

555.15 Replacement of Equipment

- Damage
  - ***Unnatural***

- Identify
- Document
- Use a qualified person

- Work requiring complete replacement (housing) must be up to the ***latest code***.

- Replacing components must be to ***the edition of the code the gear was originally installed.***

555.30 Electrical Equipment and Connections

- All electrical connections above 12”
- Fixed or floating docks
- No connections below datum plane
- Does not apply to wiring
- Does apply to connections or wiring
- Applies to new equipment and replacements

555.30 Electrical Equipment and Connections

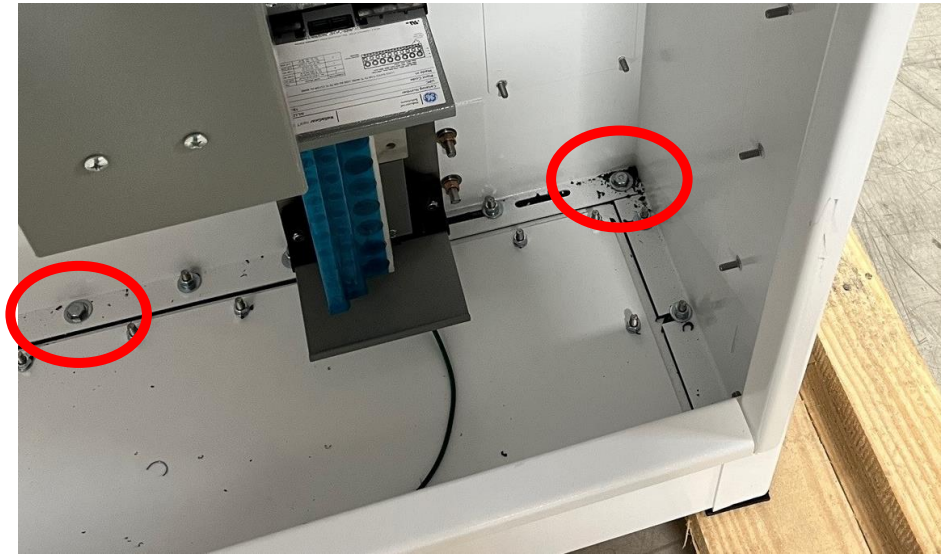
- Components and enclosures ***listed*** for submersion (not watertight) are ok.

- Listed products go through stringent tests to ensure products meet certain safety guidelines.

555.31 Electrical Equipment Enclosures

External Mounting

- No additional requirements



Internal Mounting

- Requires mounting hardware to be sealed – prevent water seepage

555.31 Electrical Equipment Enclosures

- No interference with mooring lines

555.32 Circuit Breakers, Switches, Panelboards, and Marina Power Outlets

- Enclosures are gasketed
- Can be operated without exposing dangerous connections
- Include a weep hole

555.33 Receptacles

- At least 12” high
- Not below electrical datum plane

555.33 Receptacles

- Enclosures must be listed as a ***marina power outlets***

- Listed products are designed for use in wet locations.

555.33 Receptacles

- Requires proper strain relief
  - Catenary angle
  - Reduces strain on cable caused by weight of the cord set
  - Very important for larger amperages

555.33 Receptacles

- Each receptacle requires a circuit breaker
  - Same amperage
  - Same voltage

- Photo:
  - Receptacle - Breaker
  - 50A 125/250V – 50A, 2-Pole
  - 30A 125V – 30A, 1-Pole
  - 20A 125V GFCI – 20A, 1-Pole

555.33 Receptacles

- Shore power at least 30A
- 30A and 50A receptacle must be twist-lock
- 60A or larger must be pin and sleeve
- Avoid using splitters and adapters

General Note – *Adapters and Splitters*

- Most "Y-Adapter" cord sets are not listed products and do not provide the proper circuit protection for a safe electrical connection.

- Listed products go through stringent tests to ensure products meet certain safety guidelines.

General Note – *Adapters and Splitters*

General Note – *Adapters and Splitters*

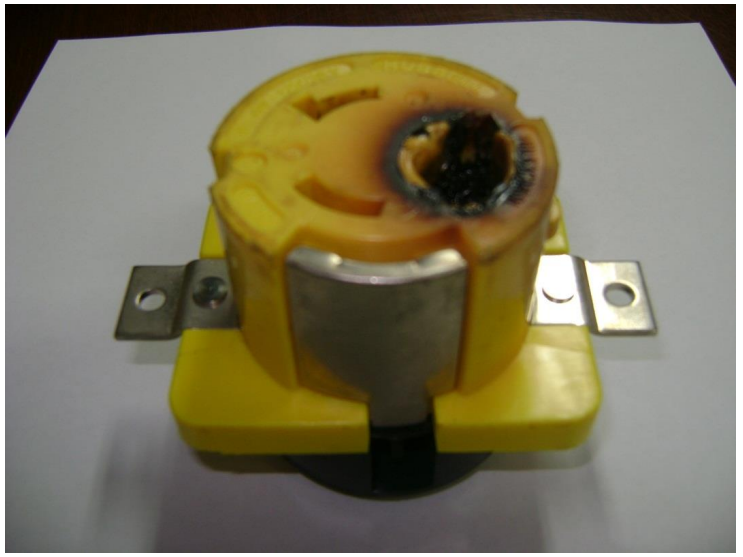
General Note – *Listed Products*

- Listed products go through stringent tests to ensure products meet certain safety guidelines.

UL LISTED ETL LISTED CSA CE

General Note – *Listed Products*

- Overloading or overheating a receptacle can lead to melting, burning, arching, and potential fire.



General Note – *Listed Products*

555.33 Receptacles

30A, 125V

- Twist-lock
- Requires 30mA ground-fault protection

20A, 125V GFCI

- Not for powering boats
- Labeled: "Not For Shore Power"
- Must be internally ground-fault protected

50A, 125/250V

- Twist-lock
- Requires 30mA ground-fault protection

555.33 Receptacles

<u>100A 125/250V</u>

- Pin and sleeve
- Requires 30mA ground-fault protection

<u>100A 120/208V</u>

- Pin and sleeve
- Requires 30mA ground-fault protection

<u>100A and 200A 480V</u>

- Pin and sleeve
- Requires 30mA ground-fault protection

Cam-Locks

Cam-Locks

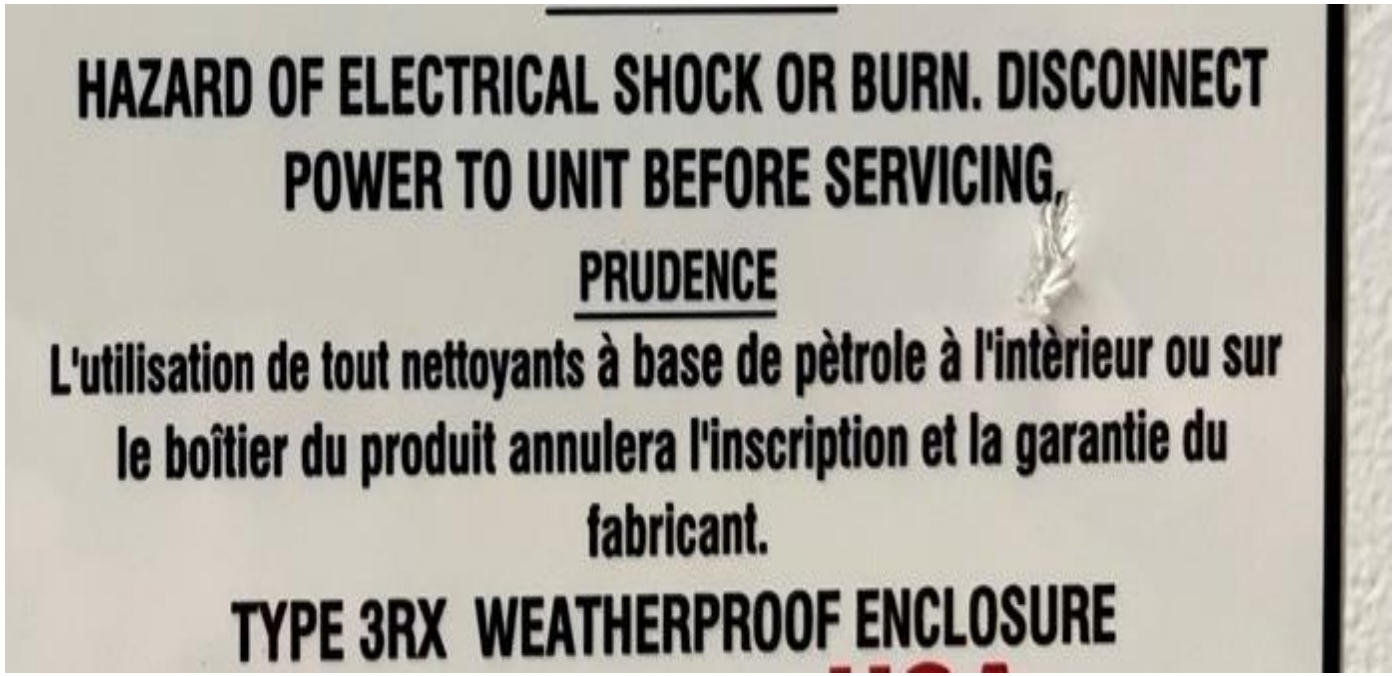
- 100A – 800A
- Requires 30mA ground-fault protection
- Preferred by a majority of captains
  - Testing
  - Fit
  - Capability

Receptacle Selection

Boat Size	Minimum Requirement	Preferred
25' and Under	(1) 20A GFCI	(1) 30A and (1) 20A GFCI
25' to 35'	(1) 30A	(2) 30A
36' – 42'	(2) 30A	(1) 50A
43' – 50'	(1) 50A	(2) 50A
51' – 65'	(2) 50A	(2) 50A
66' – 70'	(2) 50A	(2) 50A and (1) 100A 125/250V
71' – 80'	(2) 50A and (1) 100A 125/250V	(2) 100A 125/250V
81' – 95'	(2) 100A 125/250V	(2) 100A 125/250V and (2) 100A 120/208V
96' – 115'	(2) 100A 120/208V	(2) 100A 120/208V and (2) 100A 480V
116' – 150'	(2) 100A 120/208V and (2) 100A 480V	(2) 100A 480V and (1) 200A 480V*
151' – 200'	(2) 100A 480V and (1) 200A 480V*	(2) 200A 480V*
201' +	(2) 200A 480V*	(2) 200A 480V*

*** Cam-Lock Connectors Highly Recommended**

555.34 Wiring Methods and Installation - General



- Listed for wet locations and include insulated equipment ground

555.34 Wiring Methods and Installation – Portable Power Cables

- Extra-hard usage

- Rated 600V or higher

555.34 Wiring Methods and Installation – Portable Power Cables

- Listed for environment

- Underside of piers or where flexibility is necessary

555.34 Wiring Methods and Installation – Overhead Wiring

- Avoid contact with masts

555.34 Wiring Methods and Installation – Portable Power Cables

- Properly supported

- Located on underside of piers
  - Not on top

555.34 Wiring Methods and Installation – Portable Power Cables

- Not subject to physical damage
- Protected against chaffing
- Securely fastened w/ non-metallic clips

555.34 Wiring Methods and Installation – Protection

- If you can see cable / wire above the dock, cover it up with PVC or metal conduit

- Use fittings listed for wet locations

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

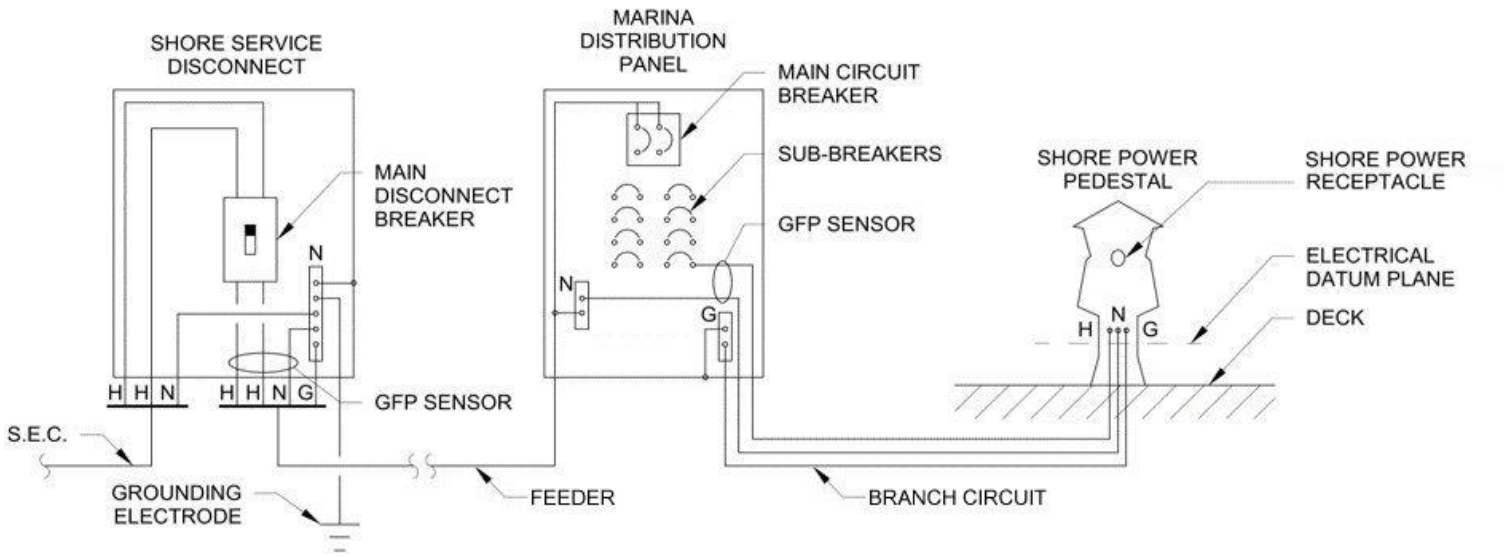


Diagram Courtesy of Gary Loftis

- ***Feeders*** must be protected at 100mA or less
- Feeder – cable or wire powering distribution equipment.
- Examples include cables going to
  - a Transformer
  - a Disconnect
  - a Panelboard

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

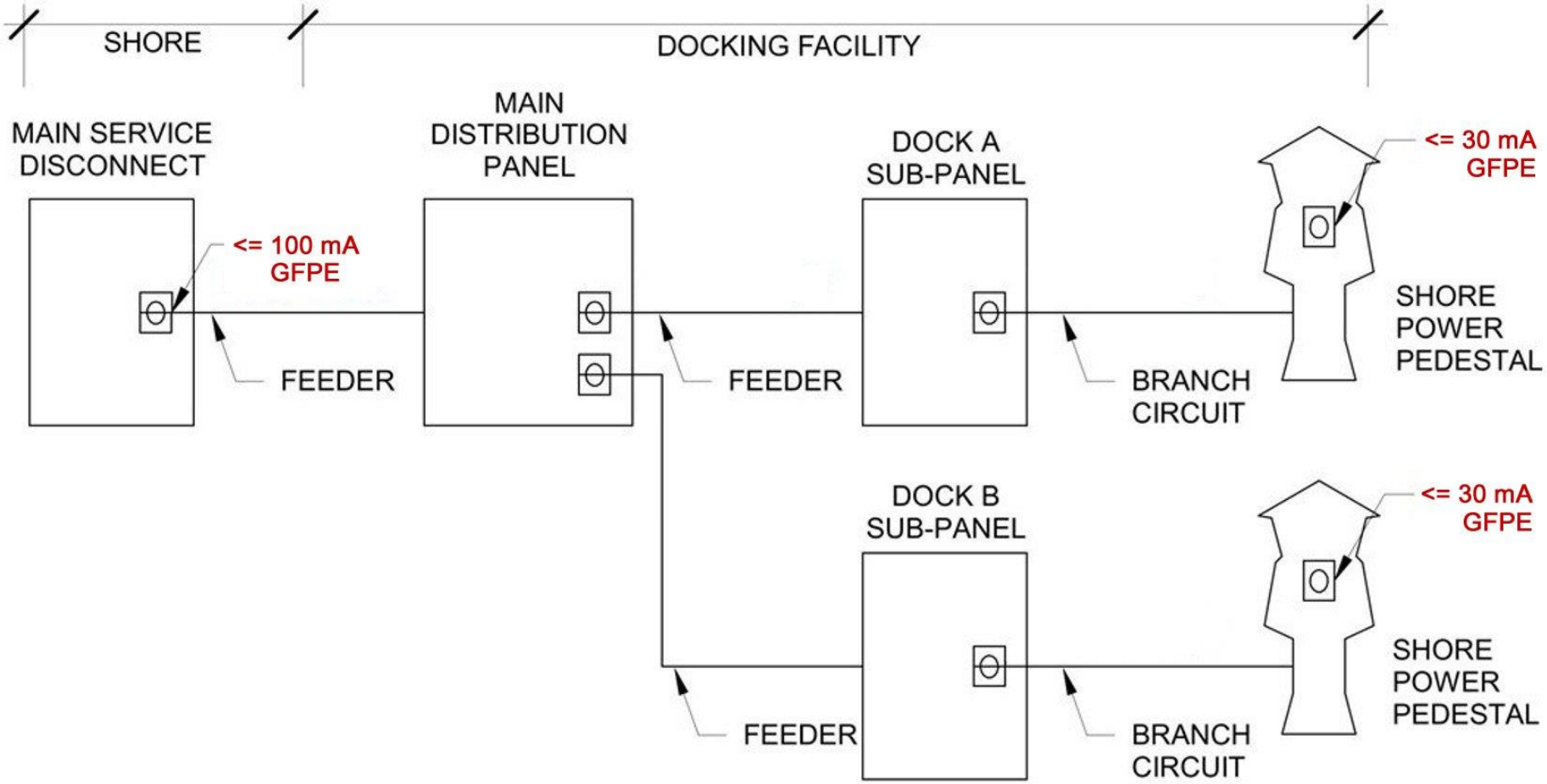


Diagram Courtesy of Gary Loftis

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

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

- ***<u>Receptacles in pedestals</u>*** must be protected at 30mA or less
- 30A and above used for shore-power = 30mA or less
- Anything not for shore power = 5mA or less

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

- ***Rules governing receptacles in pedestals*** also apply to cam-lock connections

- 30A and above used for shore-power = 30mA or less

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

- ***Boat lifts and hoists*** must be protected at 5mA or less

- Some control boxes include ground-fault protection. Some will require a GFI breaker.

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

- ***<u>Facilities with more than three (3) receptacles for boats</u>*** must have a leakage testing device for boats.

- Each boat must be tested prior to plugging into the marina.

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

- ***<u>Will become effective January 1, 2026.</u>***
- No grandfather clauses.
- No adoption delays.

555.36 Disconnecting Means for Shore Power Connection(s)

- Each receptacle requires an independent circuit breaker.
- Breaker must be within 30" of the receptacle it controls.
- Must be located so turning off the breaker disconnects power to the receptacle.

555.36 Disconnecting Means for Shore Power Connection(s)

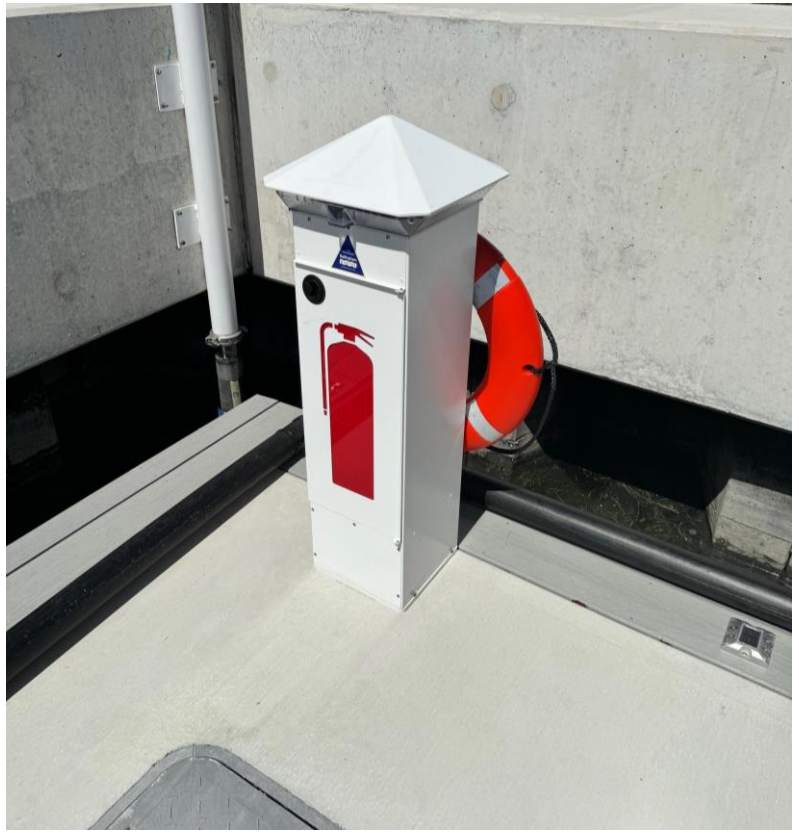
- Each marina power outlet shall have an emergency shutoff device that must:
  - be within sight of the power outlet.
  - be externally operable.
  - be manually resettable.
  - deenergize all power to the power outlet.

555.36 Disconnecting Means for Shore Power Connection(s)

- Key point – a circuit breaker handle cannot be used to accomplish this portion of the code.

- What can be used:
  - Disconnect
  - Molded case switch
  - Push Button

- Purpose is to cut off power to marina in the event of an emergency



555.37 Equipment Grounding Conductor

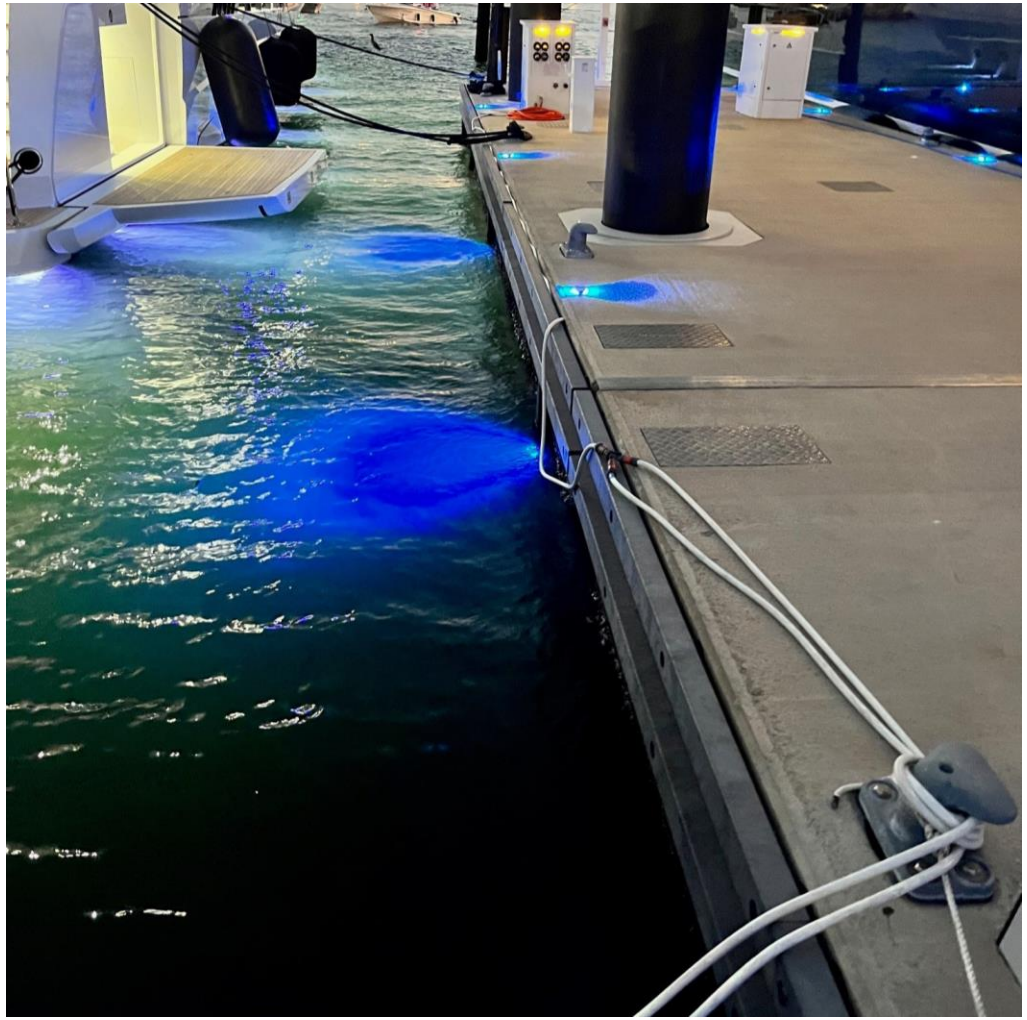
- An equipment grounding conductor no smaller than #12 AWG is required for:
  - all metal enclosures, boxes, or cabinets
  - all metal frames
  - all grounding terminals on receptacles
    - prewired by manufacturers

555.37 Equipment Grounding Conductor

- Equipment grounding conductor (ECG) must be insulated
- Required for the following:
  - from remote panelboards back to the service or disconnecting means
  - branch circuits going back to remote panelboards

555.38 Luminaires

- Must be listed
- If underwater must be designed to be underwater
- Operate at a low voltage (DC)
- Much like a swimming pool



555.50 – 555.56 Floating Buildings

- Very similar to codes that apply to marinas
- Requires a disconnect on shore
- Use flexible cable where needed for tidal fluctuation
- Requires ground-fault protection of 100mA or less

555.50 – 555.56 Floating Buildings

- Electrical and nonelectrical parts in building must be grounded
- Equipment grounding conductors must be present
- Grounding conductors must be identified
- A grounding electrode is required on shore

NFPA 303

We will also examine NFPA 303 – Fire Protection Standard for Marinas and Boatyards.

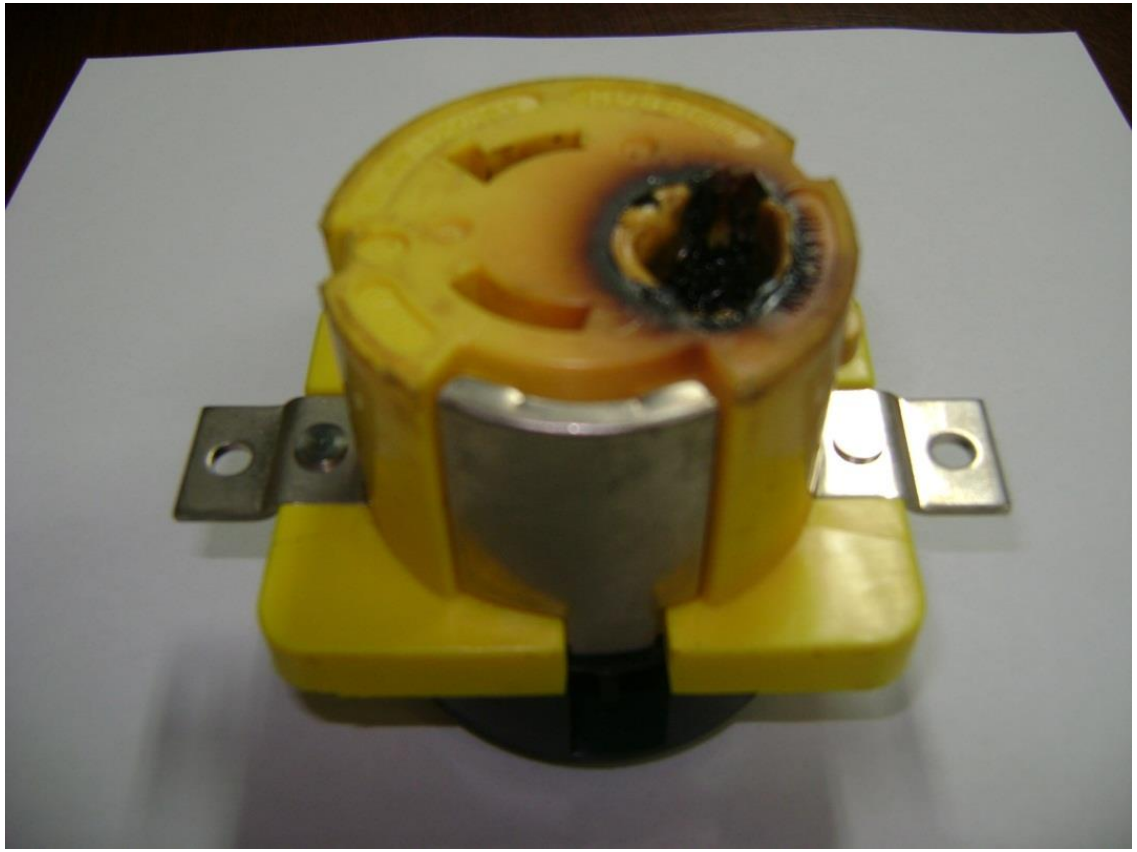
- 2021 Latest Edition
- NEC 555 and NFPA 303 are very similar
- One Exception: Inspections and Testing

NFPA 303 5.20: Inspection, Testing, and Maintenance of Electrical Wiring and Equipment

- Inspection of all:
  - Electrical wiring including cable
  - Ground connections
  - Conduit and supports
  - Pedestals and utility centers
  - Distribution gear
  - Receptacles and circuit breakers
- Required annually
- Needs to be documented

NFPA 303 5.20

NFPA 303 5.20



NFPA 303 5.20

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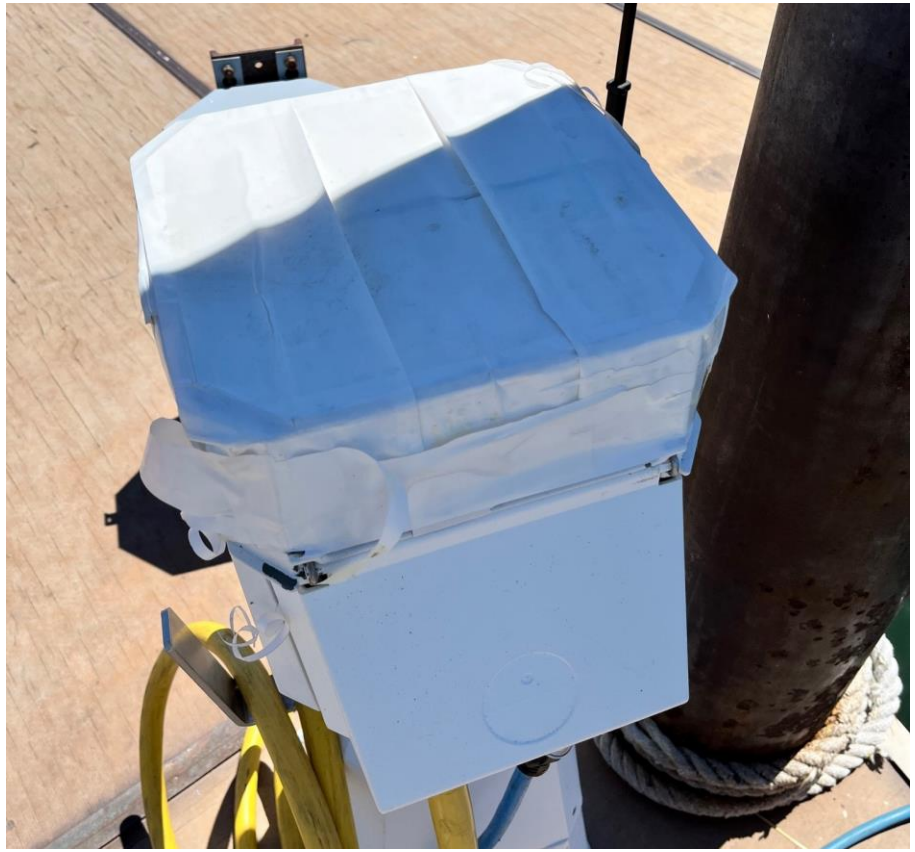
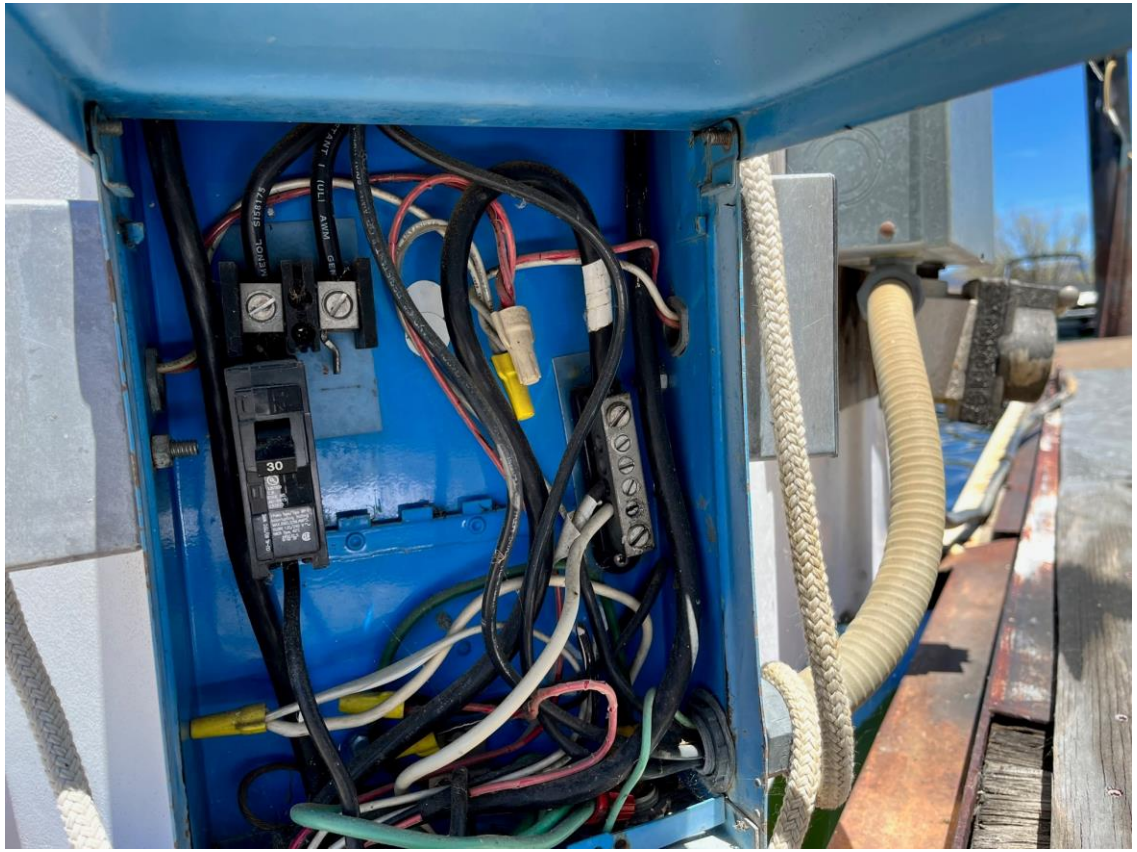




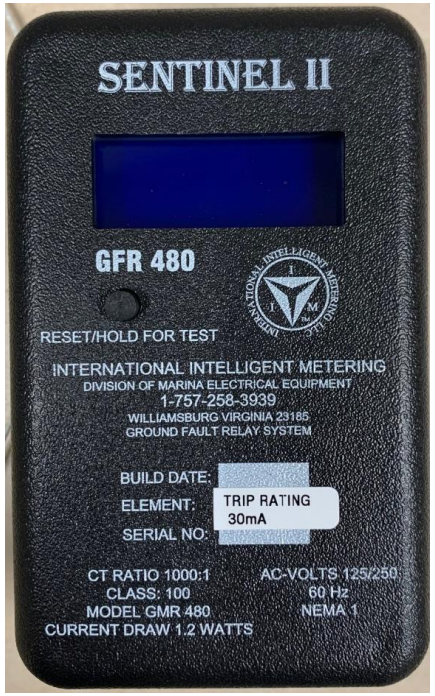
NFPA 303 4.8: Ground-Fault Testing for Marinas

- All vessels shall be tested for the presence of ac ground faults at the time of the initial connection to the marina electrical system…
- Required annually
- Vessel must display leakage under 30mA
- Retroactive within 2-years of adoption
- Needs to be documented
- Why?
- How and Where?

Why Is Testing Required?

- Identify boats with potentially dangerous electrical leakage problems before they connect to your marina electrical system.
- Typically ground-fault monitor tied to various receptacles and circuit breakers designed to evaluate the integrity of a boat's electrical system.
- Visual displays help provide added piece of mind that a boat connecting to your marina is electrically safe.

How and Where to Test?



<u>Monitors:</u>

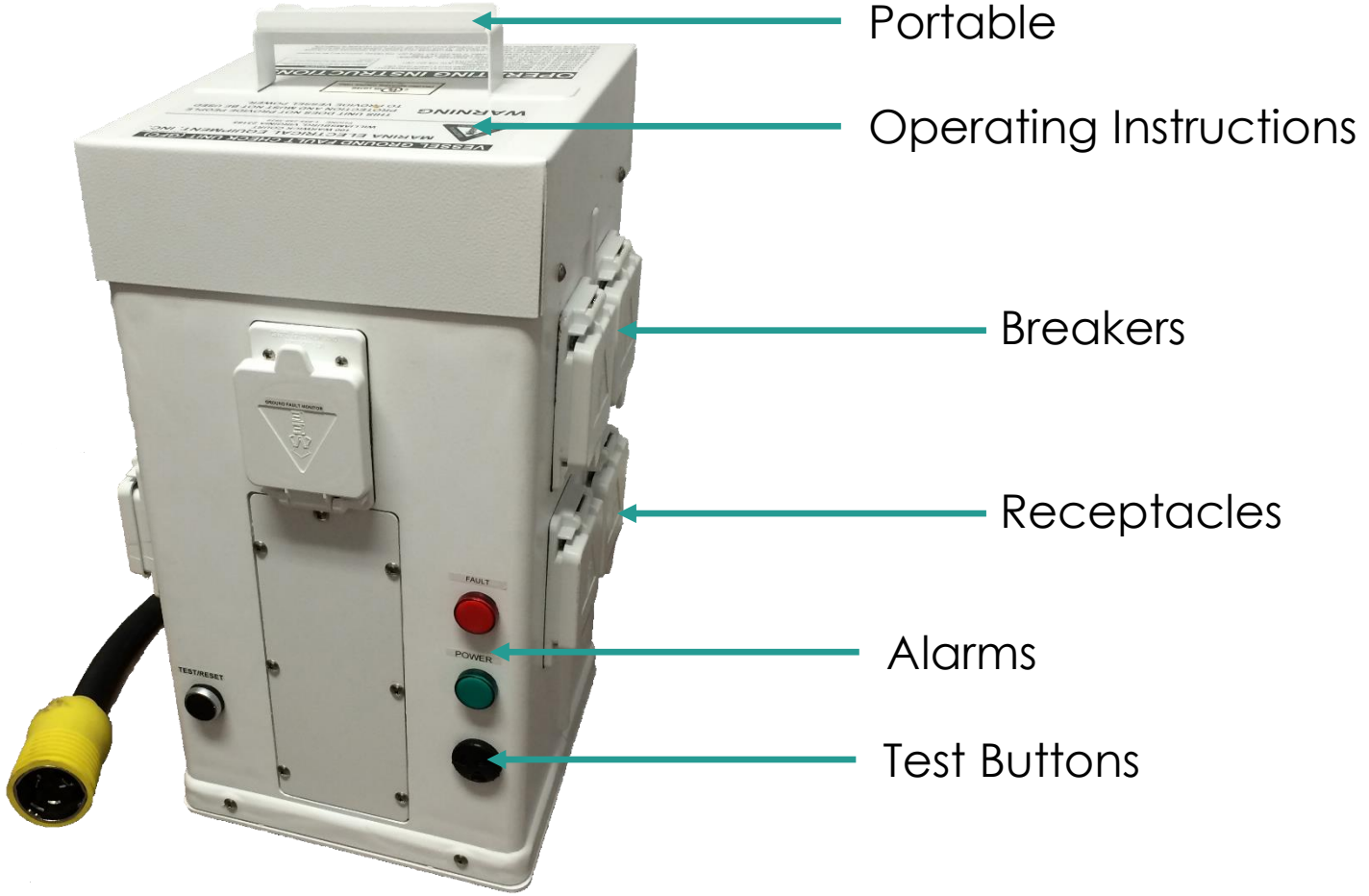
- **<u>Types:</u>**
  - Single-Channel
  - Multi-Channel
  - Integral CT
  - Digital Displays

- **<u>Locations:</u>**
  - Portable
  - Permanent
    - Fuel Piers
    - Greeting Docks

Typical Testing Procedure

1. Turn off all breakers on the power pedestal and testing device.
2. Turn off all circuits on the vessel.
3. Plug the power cord or cords into the testing device and then into the pedestal.
4. Energize the power outlet supply and then the testing device.
5. Energize the VGFCU (main and branch breakers) – See Notice.
6. Energize all of the circuits on the vessel one at a time and ***document*** the ground-fault reading.
7. If the readings do not exceed 30mA, the vessel is code compliant.
8. If the readings exceed 30mA, the vessel is not code compliant and should be barred from plugging in until repairs have been made and the vessel has been retested.

Portable Testing Devices



Portable Testing Carts

Cord Set Testers

Permanent Testing Locations

<u>Permanent Testing Pedestals:</u>

- Isolated from main marina
- Available attendant
  - Fuel Dock
  - Dockmaster's Office
  - Greeting Dock
- Signage – ***<u>Testing Purposes Only</u>***
- Ideal for transient facilities
- Trained attendant(s)
- Document arrival time, testing times, and readings

Importance of Testing Documentation

Current	Effects
15 mA to 20 mA	Pain shock, muscle contraction

Importance of Testing Documentation

Personnel Protection Protects Humans From Electrical Shock Hazards

Equipment Protection Protects Equipment From Harmful Leakage Current.

PRODUCT IDENTIFICATION TABLE

TEST BUTTON COLOR	CORRESPONDING GROUND FAULT CALIBRATION	TYPE OF PROTECTION
WHITE	5mA	PERSONNEL
RED	10mA	EQUIPMENT
AMBER	30mA	EQUIPMENT

Table 7.7: QO-GFI Circuit Breakers

Ampere Rating◆ (A)	Qwik-Gard Circuit Breakers With Ground Fault Circuit Interrupter							
	1P 120 Vac				2P Common Trip 120/240 Vac		3P Common Trip 208Y/120 Vac	
	10 k AIR		22 k AIR		10 k AIR		10 k AIR	
	1 Space Required		1 Space Required		2 Spaces Required		3 Spaces Required	
	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price	Cat. No.	$ Price
15	QO115GFI	233.	QO115VHGFI	482.	QO215GFI	413.	QO315GFI	791.
20	QO120GFI	233.	QO120VHGFI	482.	QO220GFI	413.	QO320GFI	791.
25	QO125GFI	233.	QO125VHGFI	482.	QO225GFI	413.	—	—
30	QO130GFI	233.	QO130VHGFI	482.	QO230GFI	413.	QO330GFI	791.
40	—	—	—	—	QO240GFI	413.	QO340GFI	791.
50	—	—	—	—	QO250GFI	413.	QO350GFI	791.
60	—	—	—	—	QO260GFI★	413.	—	—

QO-EPD/EPE

QO-EPD/EPE circuit breakers provide overload and short circuit protection combined with Class B ground fault protection. They are designed to provide ground fault protection of equipment at a 30 milliampere level (EPD) or 100 milliamp level (EPE). They are not designed to protect people from electrical shock.

General Electrical Safety

- Electrical work should only be completed by certified electricians.
  - Marina work should comply with all NEC and NFPA codes.
  - Routine maintenance and inspections should be performed at least annually per NFPA 5.20 "Maintenance of Electrical Wiring and Equipment."
    - Document inspections and maintenance for liability purposes.
  - Boat owners should have all electrical work completed by ABYC certified electricians.
    - Boat owners should also document inspections and maintenance for liability purposes.

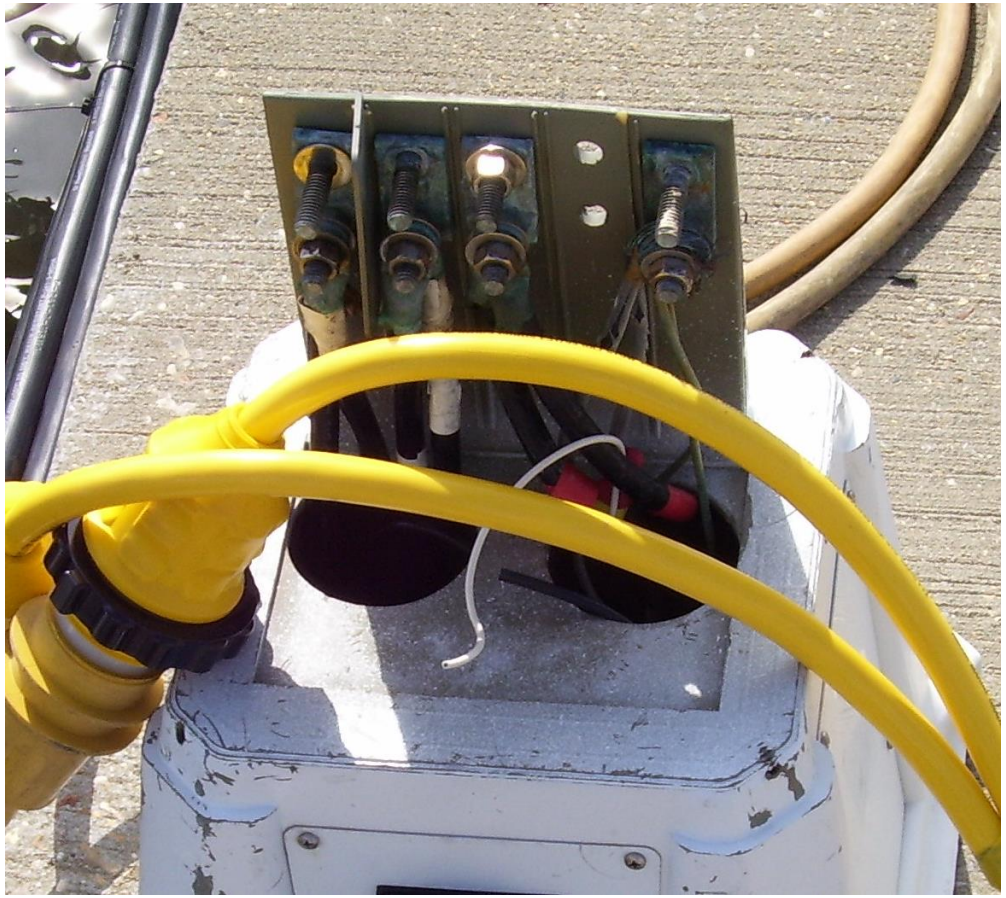
Other Items to Look Out For…

Homemade Cord Sets and Adapters

Suspicious Locations

Missing Doors

Damage



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Questions?

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