

**National Marine Manufacturers Association**  
**Product Compliance Specialist Examination**  
**Storage Batteries and Chargers/Inverters and**  
**Galvanic Isolators (2022 MY)**  
**ABYC E-10 (7/16) and A-31 (7/20) and A-28 (7/19)**

**E-10**

1. Batteries can be connected in series or parallel to form a battery bank or as a single battery meeting the needed CCA or MCA ratings and Reserve Capacity. Which statement is true?
  - a. Appropriate charging means for battery banks should be considered.
  - b. Series connections provide higher voltage and parallel connections provide higher current capacity.
  - c. Only 2 batteries can be connected in series or parallel.
  - d. Both A and B are correct.
  
2. Wiring connections at the battery must meet certain requirements. Which statement best describes a proper installation?
  - a. Wing nuts are a good choice for connecting all sizes of conductors to the battery terminals.
  - b. A maximum of 4 properly crimped and sized ring terminals with the largest conductor closest to the battery and no flat washers used except directly under the lock washer, is the proper installation.
  - c. Multiple conductors must be fastened with the largest ring terminal directly under the lock washer with smaller ring terminals between it and the battery so that no flat washers are needed.
  - d. Ring terminals that are soldered to the conductor installed with flat washers between each ring terminal is the preferred method of attachment to battery terminals.
  
3. The area 12" above and around the plane of the surface where the battery terminals are installed, referred to as the Dielectric Shielding Envelope, has certain restrictions. Which of the following statements is true?
  - a. No uninterrupted fuel line can pass through this area, whether metal or fuel hose.
  - b. No metal objects can be installed inside the envelope.
  - c. If a metallic fuel system component is installed inside the 12" envelope, it must be shielded with dielectric material.
  - d. The 12" measurement is made from the battery terminal.

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4. The positive terminal of a battery must be marked "P" or "+" or "POS" and the terminal must be protected from contact with metal objects:
  - a. Only if installed in a gasoline engine compartment.
  - b. With a boot or non-conductive shield that covers all parts of the ungrounded terminal, or install the battery inside a covered battery box, or install the battery inside a compartment specifically designed only for the battery(s) on all boats.
  - c. With a boot covering the part of the positive terminal that is connected to the battery cable(s) on all boats.
  - d. Only if the battery is a flooded cell type of battery.
  
5. Batteries must be installed so that they cannot move around inside the boat, and the installation must be tested and the results of the test documented. What is the best procedure to comply with this requirement?
  - a. Push, pull and lift every battery to prove < 1" movement.
  - b. Pull on the battery box or tray (with battery installed) with a force of twice the battery weight with no movement of the box or tray.
  - c. Perform the test in answer (a) with a pulling force of 90 pounds or twice the battery weight, whichever is less and document the results.
  - d. Pull each different battery installation with a pulling force of twice the battery weight applied to the center of gravity of the battery for 1 minute, vertically, fore & aft parallel to boat centerline, and port & starboard perpendicular to boat centerline with maximum movement of 1" and document the results.
  
6. Battery installation locations have several restrictions. These are:
  - a. Batteries shall not be installed, without an intervening barrier, directly below electrical equipment susceptible to attack from corrosive gases.
  - b. Batteries shall not be installed directly above or below a fuel tank, fuel filter, or fitting in a fuel line without an intervening sole, floor or deck.
  - c. Batteries can never be installed directly above or below an uninterrupted fuel line.
  - d. Both a & b are correct.
  
7. The battery installation must protect the boat from spilled electrolyte. Which statement below describes the proper battery installation?
  - a. Install only gel-cell or AGM batteries which do not require containment of electrolyte.
  - b. Only lead-acid batteries must be installed in a box or tray that will contain incidental spills of electrolyte.
  - c. Install all battery types in a properly secured box or tray.
  - d. Angles of heel for sailboats and accelerations for powerboats should not be considered for battery installations.

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8. When batteries are charged, hydrogen gas is discharged. Which statement below best describes the proper method for dealing with hydrogen gas?
- a. A vent system or other means shall be provided to permit the discharge from the boat of hydrogen gas released by the battery.
  - b. Hydrogen gas is so volatile that it is not a problem.
  - c. Natural ventilation according to H-2 should be installed in the compartment containing the battery.
  - d. There are no requirements for venting the hydrogen gas if lithium-ion battery systems are installed or if sealed batteries such as gel cell or AGM batteries are always used.

**A-31**

9. DC connections for battery chargers, inverters and inverter/chargers are shown in Figures 1, 2, 3, and 4 of A-31. Which statement is true?
- a. Battery chargers and inverter/chargers always have over-current protection at both ends of the output positive conductor.
  - b. Inverters have only one over-current protection in the output positive conductor.
  - c. Battery chargers and inverter/chargers may have over-current protection at both ends of the output positive conductor but must always have the over-current protection within 7" of the connection to the DC electrical system.
  - d. Both b & c are true.
10. A pre-wired battery charger must be installed:
- a. So that the 120 volt/15 amp plug can never be within 24" of the fuel tank vent deck fitting and connected to the battery(s) with the unmodified ring terminals and fuses and conductors that are provided by the charger manufacturer.
  - b. Outside a gasoline engine compartment or fuel tank area.
  - c. So that the battery(s) being charged are not more than 36" from the charger.
  - d. So that all AC wiring and connections conform to E-11, even when it is the only AC powered device onboard.
11. A pre-wired battery charger must have all o the items except:
- a. Over-current protection installed within 7" of the ring terminals that connect the output conductors to the battery
  - b. Over-current protection in the DC negative lead(s).
  - c. A 115-volt, 3 prong, 15 amp plug on a 72" maximum length cord.
  - d. A warning label at the 15 amp AC plug giving connection instructions located on the cord near the plug or near the plug housing if the label on the cord is not readily visible.

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12. Permanently installed battery chargers shall:
  - a. Always have strain relief installed within 6" of the case by the boat builder for all wiring passing through the battery charger case even if strain relief is integral with the case.
  - b. Be mounted at least 12" above the normal accumulation of bilge water.
  - c. Have accessible controls and located so that hinged covers and access plates can be opened.
  - d. Be provided with an ammeter and voltmeter to show charger status.
  
13. Inverter and inverter/charger installations shall include:
  - a. A visible means such as a voltmeter or lamp installed at the main electrical distribution panel to show that the inverter is on-line or in standby mode.
  - b. Physical protection from drippage or falling objects for all units, even if such protection is integral to the unit.
  - c. A Warning Label installed at the inverter battery bank stating that the system includes a DC to AC inverter.
  - d. An integral GFCI outlet or any remote GFCI outlet that is available.
  
14. Inverter and inverter/charger AC electrical installations are shown in Figures 2, 3, and 4 of A-31. Which statement is correct?
  - a. The shore power neutral is grounded through the shore power cable and shall not be grounded onboard the boat.
  - b. The inverter output neutral shall be grounded at the inverter.
  - c. The inverter/charger output neutral shall be grounded at the inverter/charger only when the device is the AC power source (operating in the invert mode).
  - d. All of the above statements are true.
  
15. A battery charger, inverter or inverter/charger which has metallic case must:
  - a. Have a green or green with yellow stripe DC grounding conductor connecting the metallic case to the engine negative terminal or its busbar, in addition to the positive and negative current carrying conductors. This grounding conductor may be one size smaller than the current carrying conductors.
  - b. Be installed outside a diesel or gasoline engine compartment.
  - c. Have a DC Grounding conductor of ampacity equal to that of the DC positive conductor for all installations.
  - d. Have a 16-gauge DC grounding conductor installed for all installations.

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**A-28**

16. Regarding required markings and labels on the isolator, which of the following statements are true?
  - a. The identification of the independent laboratory that manufactured the isolator must be marked on the unit.
  - b. "Ignition Protected" or SAE J1171 Marine or ABYC C-1500 shall be marked on all galvanic isolators.
  - c. For isolators using studs or terminals the size of the nut must be marked on the unit.
  - d. "Fail-Safe per ABYC A-28" shall be marked on the unit and and it must have a label indicating possible loss of galvanic isolation due to a lightning strike.
  
17. The current rating of the galvanic isolator must be:
  - a. Equal to the sum of the ratings of the shore power disconnect breakers if dual shore power is installed and a galvanic isolator is installed in each shore power supply.
  - b. Equal to or greater than the rating of the main shore power disconnect circuit breaker.
  - c. Tested by the boat builder after installation.
  - d. High enough to withstand all electrical failures and still provide isolation
  
18. A galvanic isolator is a device connected in series with the shore power grounding conductor that functions as:
  - a. An open circuit to block low voltage galvanic current.
  - b. A short circuit to allow AC fault current to pass.
  - c. A monitor to show when galvanic corrosion is happening.
  - d. Both a and b above are true statements.
  
19. Galvanic Isolators shall be connected in series with the green shore power grounding conductor using the following method:
  - a. Quick connect fasteners.
  - b. Using a properly sized breaker or fuse.
  - c. Provided pig tails or studs & nuts with properly sized green conductors.
  - d. With a conveniently located on-off switch.

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20. Which of the following is true regarding the proper location for installing a galvanic isolator?
- a. The galvanic isolator shall be installed in a ventilated, dry, and accessible location not to exceed the temperature rating of the unit.
  - b. The galvanic isolator shall be installed within 15" of the electrical panel.
  - c. The galvanic isolator shall be installed near the back of the shore power inlet.
  - d. There are no location requirements if the isolator is a fail-safe unit.