

CERTIFICATE

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Document Name: ABYC E-01: Bonding of Direct Current Systems

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BONDING OF DIRECT CURRENT SYSTEMS

PROJECT E-1 (ADOPTED WITH PROPOSED REVISIONS MAY 30, 1972)

E-1-72

E-1.1. *PURPOSE*

This standard establishes requirements and recommended methods for bonding direct-current electrical systems:

- to provide a low-resistance electrical path, within the confines of the hull, between otherwise isolated metallic objects, particularly those in common contact with sea water and potentially subject to electrolytic corrosion due to stray currents;
- to prevent the possible existence of an electrical potential on exposed metallic enclosures of electrical equipment;
- to provide a low resistance path to ground for voltages that may be considerably in excess of those for which the system is designed, as might occur when lightning strikes, and
- to minimize radio interference.

E-1.2. *SCOPE*

This standard applies to all boats equipped with direct-current electrical systems operating below 50 volts.

E-1.3. *DEFINITIONS*

- a. *Ground* — A surface or mass at the potential of the earth's surface, established at this potential by a conducting connection (intentional or accidental) with the earth, including any metal area which forms part of the wetted surface of the hull.
- b. *Bonding* — The electrical connection of the exposed, metallic, non-current carrying parts to the ground (negative) side of the direct current system.
- c. *Common Bonding Conductor* — An electrical conductor, usually running fore and aft, to which all equipment bonding conductors are connected.
- d. *Bonding Conductor* — A normally non-current-carrying conductor used to connect the non-current-carrying metal parts of a boat and the non-current carrying parts of direct current devices on the boat to the boat's bonding system.
- e. *Engine Negative Terminal* — The point on the engine at which the negative battery cable is connected.

E-1.4 *BONDING SYSTEM*

a. *General*

- (1) All boats equipped with a permanently installed electrical system shall be equipped with a bonding system.
- (2) A bonding system shall consist of:
 - Common Bonding Conductor

- Common Bonding Conductor connection to negative side of electrical system
- Individual Bonding Conductors connected to the Common Bonding Conductor
- Individual Bonding Conductor connections to the non-current-carrying metallic parts of electrical equipment.

- (3) Bonding conductors shall be color coded according to ABYC E-3 "Wiring Identification on Boats".
- (4) Bonding conductors shall be separate from the AC and DC electrical system grounded conductors. (See E-8, "Alternating Current Electrical Systems" and E-9, "Direct Current Electrical Systems".)
- (5) Bonding conductors shall be permanent, continuous, and at least of the same size as the conductors leading to the equipment to conduct safely any currents likely to be imposed on them due to stray-current leakage or short circuits; and in all instances shall be of sufficient size to permit operation of over-current devices in the associated circuits. The engine bonding conductor shall have a current-carrying capacity at least as great as the largest bonding conductor in the bonding system.
- (6) In multi-engine installations with cross-over starting systems, the engines shall be bonded together with a cable large enough to carry the starting current. The connections of this bonding cable shall be independent of any other electrical connections to the engines. This bonding cable shall be independent of current-carrying conductors as provided in ABYC E-9, "Direct Current Electrical Systems."

Note: the bonding wire (or cables) to the engine(s) must be large enough to carry cranking current, because a break in the cranking circuit could cause the cranking current to flow in an alternate path (such as fuel lines).

- (7) The common bonding conductor shall be uninsulated copper or bronze strip, copper tubing, bare tinned-copper wire or insulated copper wire of the proper gauge. Copper braid shall not be used for this purpose.
 - (a) Common Bonding conductors fabricated from copper or bronze strip shall have a minimum thickness of 1/32 inch and be no less than 1/2 inch in width.
 - (b) Wire, where used as the common bonding conductor, shall be at least no. 8 AWG.

Note: These requirements are based on both physical strength and the ability to make and maintain low-resistance connections, as well as current ratings.

- (8) Where the bonding system is used as a part of the lightning protective system, conductor sizes shall be as specified in ABYC E-4, "Lightning Protection".
- b. *Items to be Bonded* — Exposed, metallic non-current-carrying parts of the following items shall have provision for, and be connected to, the bonding system.
- (1) Propulsion and auxiliary engines. It is recommended that this bonding conductor be connected to the engine negative terminal.
 - (2) Metallic enclosures of all electrical apparatus including:

- (a) Motor, generator and pump frames or enclosures.

Note: When the metallic frames of electrical accessories are directly attached to the frame of an engine, the engine bonding connection will serve to bond all such accessories.

- (b) Cabinets and control boxes.
- (c) Radio-equipment cabinets and enclosures of other electronic devices.
- (d) Metallic conduit, cable sheaths, or armoring.

- (3) Fuel tanks, fuel-fill deck fittings, and electrically operated fuel pumps and valves.

- (4) Battery trays (lead-lined).

c. Items Not Required to be Bonded

- (1) Electrically isolated thru-hull fittings need not be connected to the bonding system. (See ABYC E-2, "Cathodic Protection".)
- (2) Other electrically isolated metallic items except as recommended in ABYC E-4, "Lightning Protection".

E-1.5. INSTALLATION OF BONDING SYSTEM

- a. General* – The method of installation of the bonding system should be as illustrated in Figure 1.

- b. Common Bonding Conductor* – The common bonding conductor shall be installed in a fore-and-aft direction such that it will not be totally or partially submerged in bilge water and in a manner that will permit bonding conductors to be as short and direct as possible.

- (1) Splices in the common bonding conductor shall provide electrical continuity and mechanical strength equivalent to the original conductor.
- (2) Metal fastenings, when used to secure the common bonding conductor to the hull, shall be equivalent to or more noble than the copper conductor.
- (3) Connections shall be accessible for inspection and maintenance.

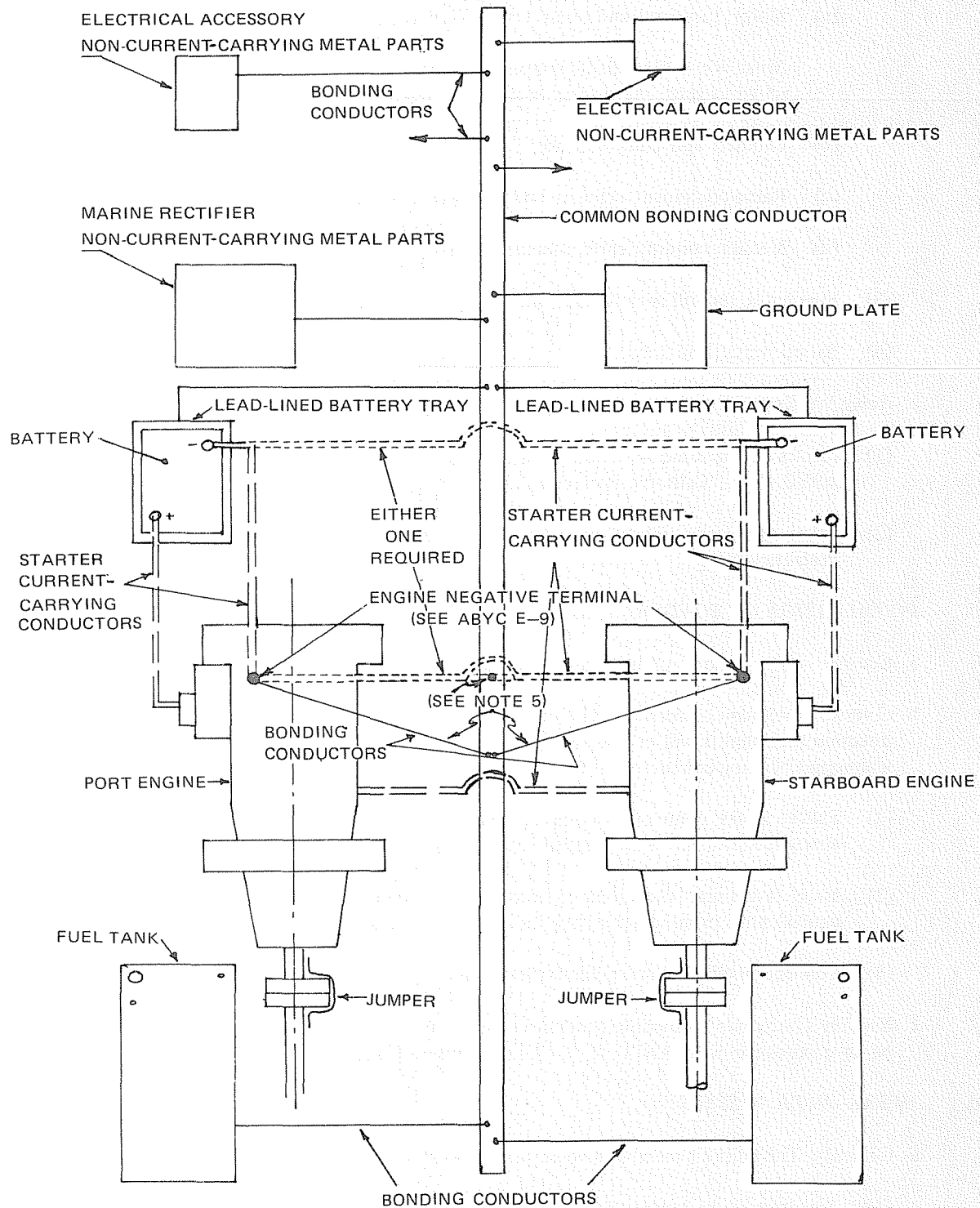
- c. Bonding Conductor* – Bonding conductors need not be insulated. Installation and connections shall be in accordance with ABYC E-9, "Direct Current Electrical Systems".

E-1.6. METAL-HULL VESSELS

- a. General* – The hull of a metal-hull vessel may serve as the common bonding conductor.

- (1) Any item to be bonded (See paragraph 4.b.) not in contact with the hull requires a bonding conductor to the hull.
- (2) If the item to be bonded is connected to a thru-hull fitting galvanically incompatible with the hull, it shall be insulated from the thru-hull fitting and the thru-hull fitting shall be insulated from the hull.

FIGURE 1



Notes:

1. Wires adjacent to each other throughout system
2. Electrical equipment may be internally grounded
3. System should be polarized throughout.
4. Switchboard and distribution-panel cabinets, if constructed of metal, shall be bonded.
5. Bonding conductors not required here if this starter current-carrying conductor is connected to the common bonding conductor.