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11.7.2.2.1.4.2. all non-current carrying parts of the boat's AC electrical system, <u>including</u> 11.7.2.2.1.4.3. <u>the engine negative terminal or its bus</u>.

Capt. Rifkin also has a very good article on his website on why galvanic isolators need special attention regarding the need for fail safe designs.

What next?

That depends.

If you plan to do your own systems installation, then it goes without saying that becoming extremely familiar with ABYC standards that cover electrical, propane or Compressed Natural Gas, fuel systems, ventilation, refrigeration, or anything else you are not trained in will mean the difference in a good survey for insurance purposes, or too many costly mistakes that will have to be corrected before insurance can be bound.

On the other hand, if you can afford to have things done by others then you'll want to be sure they are done to ABYC standards by ABYC certified technicians.

ABYC makes it easy to find certified techs in your state. A recent search for ABYC certified marine electricians in Washington returned 126 names. To do your own search, go to https://www.abycinc.org/certification/directorySearch.cfm and select the appropriate categories from the drop down menus.

Anyone can join ABYC. The standards are available on line on the ABYC website www.abycinc.org and ABYC members can contact Judith Ramsey at (410) 990-4460 for a FREE three-day trial subscription.

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Capt. Thorsen is member: of Society of Accredited Marine Surveyors, Metal Boat Society, International Association of Marine Investigators, and ABYC and is ABYC Standards Accredited.

The AC Grounding to DC Grounding Connection: the Rationale for Safety

By Capt. David Rifkin (USN, Ret.)

Good grounding (aka "bonding" as discussed in the National Electric Code) is essential for a variety of reasons. It's a key ingredient for personal safety (both inside the boat and in the water), provides protection from stray current corrosion, and acts as a means to transfer energy from a lightning strike into the water (although lightning protection is inherent in the construction of metal boats). The AC to DC grounding connection is part of this bonding system and is required by the ABYC standards, specifically E-11.5.2.7.

Consider the following reasoning. If all exposed metals are effectively bonded together, any electrical fault that would tend to energize a metallic case or component would energize them all to the same voltage potential. This means that there will be no difference in potential between objects, reducing the shock hazard inside the boat. If this aggregate of bonded components is faithfully connected to the grounding conductor from the source (ashore or on the boat, it doesn't matter), then there is little chance that the voltage potentials on exposed metals will rise. Rather, there is a good chance that the resulting fault current will trip a circuit breaker securing power to the faulty component. By the way, this is the primary purpose of the green grounding wire that runs back and joins the neutral at any newly derived power source (e.g. shore power, transformer secondary, genset, or inverter).

Let's look closer at what's happening inside a boat connected directly to shore power. Assume that there is no connection between the AC and DC grounding buses and that there are AC conductors running alongside DC conductors with no sheathing to separate the two (note that separation is required by ABYC standard E-11.16.4.1.5). Now let's say a DC conductor overheats, melting its insulation along with that of an adjacent hot AC conductor such that the two conductors make electrical contact. This will cause the entire DC grounding system to go up in voltage to the AC line voltage, and means that any underwater metals connected to the DC grounding system (e.g. metal hulls, prop shafts, rudders, etc.) will now serve to transmit this electrical energy into the water as it tries to get back to its source ashore. This situation will cause electrical shocks to be felt on underwater metals in saltwater, and can be (has been, in fact) lethal to anyone even near the boat in freshwater.

Eight year old Lucas Ritz, son of Kevin Ritz (a Pacific NW resident) was killed in 1999 behind a boat that suffered from the material deficiency described above. Had the connection between the AC and DC grounding systems been intact, the main breaker on the boat, or the pedestal breaker on the dock, would have likely tripped from the excessive fault current flowing in the water. And Lucas would still be with us, along with other victims of similar circumstances we have documented.

Clearly, good grounding and bonding can be a life saver. That's why it's required by the ABYC standards for boats, and the National Electric Code for shore applications. You may try to rationalize some objections to it, but they are all trumped by having the safest environment possible, especially where electricity is being used on the water. Any concerns for corrosion are comprehensively addressed by ABYC standards (which marry very well with all grounding and bonding requirements). Please free to contact me at quality-marinesvcs@comcast.net for more information in this area.

⚓ Capt. Rifkin teaches marine electrical and corrosion certification courses for ABYC, leads a day-long seminar to improve a marine surveyor's understanding and inspection of marine electrical systems, is involved in a USCG study to enhance boat and marina electrical safety, and writes technical papers for the community.