# December 2023 Newsletter – Leakage Current

## Photo Essay: Leakage Current

It’s an insidious, and frequently misunderstood, phenomenon; AC power leaking into water, creating an electric field around the vessel.  Under the right, or wrong, circumstances, this field, depending on its strength and the water’s salinity, can lead to electrocution or in-water electric shock drowning, otherwise known as ESD (more on that here), or an onboard fire.

As bad as this phenomenon is, its measurement is also frequently misunderstood; I routinely encounter marine industry professionals slapping a clamp ammeter onto a shore cord, reading the current flow, and then pronouncing them afflicted with leakage.  In fact, the method for measuring shore power leakage requires an additional step in order to determine if the leakage originates on the vessel whose cord is being measured, or one nearby.  Once the measurement is taken (the accompanying image indicates 280 milliamps of leakage; well above the danger threshold is 30 milliamps), the shore power to the vessel being tested must be turned off, ideally at the dock pedestal.  If the leakage current drops significantly, or disappears all together, then this vessel has a serious fault, which should be identified and corrected without hesitation.  If the current flow remains largely unchanged, then the vessel whose cord is being measured is simply a conduit for leakage current to return to its source.  There is no recourse in the latter case, and it is not necessarily dangerous to the “conduit vessel”, however, the leakage remains a safety issue, and its source should be identified and resolved, and an under no circumstances should

anyone swim around docks and vessels that are energized with shore power. *In all cases, anomalies should be investigated by an ABYC Certified Electrician.* Short of installing an isolation transformer, more on those here, there is no way to prevent your vessel from serving as a leakage conduit. Finally, while this sort of AC power leakage is a serious safety risk, it is almost never the source of corrosion.

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# Ask Steve

**Hello Steve,**

I found your website and contact while searching for more information about the bonding system for a sailboat. I have a 1977 Durbeck 46 ketch that was not finished by the producer, so no electric system was ever installed. I am having difficulty finding a clear answer… Do I need to install a bonding system at all? Some advise that you don’t need one for a sailboat, having in mind the long keel and heavy lead ballast, to just connect all ground to the mast base, but others say the opposite.

I am planning to put in electric propulsion, 45KW 96V DC 200 Ah, and the house electrical system will be based on 24V DC 600Ah plus a few 12V DC components, as well I will have 120/240V AC for a few devices. I certainly will add an isolation transformer, but having in mind the planned electrical system, I believe, will require me to make sure first that all metal components are well grounded for safety, and also well bonded, thinking of corrosion etc.

I would like to thank you in advance for your time and advice.

Cheers,

Krasimir Vatchinsky

**Krasimir:**

Within the American Boat and Yacht Council Standards, which are voluntary, compliance with E-2, the bonding chapter, is also voluntary.  In short, bonding is optional.

Having said that, most vessels are bonded for a variety of good reasons, including galvanic and stray current corrosion prevention, lightning mitigation, and electrocution prevention.  You can read more about common bonding system installation details here.

You can learn more about corrosion, and how it is affected by bonding, here.

The electric propulsion system is another matter, and my recommendation would be to ensure full compliance with the manufacturer's installation guidelines, including isolation/bonding connections.  The propulsion system should also comply with ABYC's E-11 AC and DC Electrical Systems, and E-30 Electric Propulsion Systems.

**Steve,**

I'm replacing my engine mounts this winter and noticed that one of the lag bolt holes securing the starboard rear engine mount to a stringer was stripped.

I've read your engine mount/alignment articles and understand that this isn't the preferred way (lag bolted) to attach an engine mount but that's the way the boat was built (the front engine mounts are through bolted to a heavy stainless bracket to the stringers).  I see two possible repair options:

1. Drill out the stripped hole, fill with epoxy resin (appropriate fillers added) and then re-drill for a lag screw
2. Drill out the stripped hole and epoxy a 3/8"-16 stud in

the hole. Leave 1-1 ½ inches of stud to accept the engine mount. There's a lot of depth in the stringer to accept a long stud (6 inches maybe). This would seem a much stronger attachment than anything a lag bolt could achieve. I'd use a 316 stainless grade 8 Grade B8M threaded stud which is good for ~100,000 psi tensile strength.

Boat and engine parameters as follows:

- 48' Custom Bruce Marek sloop
- Yanmar 4JH2-TE (62 hp)
- Kanzaki KBW20 transmission – 2.62:1 reduction
- 20-inch Max Prop

Appreciate any insight and advice you can offer either on the above options or another option.

I am a former (lifelong) power boater having purchased *Sola Fide* in 2013 as my first sailboat (to own). I used to subscribe to a lot of boating magazines but have narrowed it down to one – Professional Boatbuilder, were I read many of your articles. Please keep up the great work.

Best regards,

Ron Kraus

**Ron:**

Ideally, I would like to see something more substantial than epoxy filling the old fastener hole. If you can manage it, drive the largest, thickened epoxy-coated, ash dowel into the former fastener holes that will fit, let the epoxy cure then drill a pilot hole and install stainless (fine for a small engine, for larger engines and higher loads I'd use corrosion-inhibited mild steel) lag bolts.

Epoxying a metallic stud in place has some draw backs. Chief among these is, while not impossible, it's challenging to get

epoxy to adhere to the metallic stud's surface, particularly when one considers its small size and the torque loads. Preventing the stud from spinning when the fasteners is tightened will be challenging. Unless that stud can be threaded into an embedded metallic plate, or "wings" welded to it to prevent it from spinning, I don't believe it will work, and if it does spin, you'll have a hard time removing it.

**Steve,**

I have a 1977, 40′ sloop, an Aurora 40 from the Hinterholler yard. It has an odd (to me) setup for raising the centerboard. In the centerboard trunk is a bronze mushroom threaded to 1.25″ type L copper pipe, and that's it, no seacock. The pipe lasted approximately 20 years (replaced by me in Curaçao) but is showing signs of corrosion and I will replace it at haul out this month.

At the moment I plan to remove/replace the mushroom and install a proper seacock, and upgrade to slightly thicker type K copper pipe.

Other thoughts include:

- Copper-nickel pipe (suggested by engineer Leo Lindstruand)
- Fiberglass tube
- Kevlar tube

…Or something completely different that you would advise.

I would greatly appreciate your thoughts and suggestions before proceeding.

Thanks!

Glenn Sikes

**Glen:**

Is it possible the line is wearing away the pipe from the inside? Assuming it is corrosion, most copper pipe like this has some zinc content, often called ‘leaded red brass’. As long as that zinc content doesn’t exceed 15%, it can be used for raw water applications. If the pipe you have shows signs of a pinkish hue, then that’s an indication of a higher zinc content, and a phenomenon known as ‘dezincification’, explained here.

As for a replacement assembly, the seacock would only be useful if the line were to part or be cut, and assuming it fell free from the tube. It doesn’t hurt provided it doesn’t compromise the installation in any way. The copper pipe you used lasted for 20 years, using a thicker pipe can only help, but once again, ensure the alloy has a low zinc content, no more than 15%. Copper-nickel is a highly corrosion resistant alloy, however, if the issue is abrasion by the line, rather than corrosion, it may not offer any advantage (I’m not certain about the abrasion resistance of copper-nickel vs. common copper).