Marine Lightning Protection Inc.

Latest news

The new **National Fire Protection Association Lightning Protection Standard** NFPA780-2008 is now available. The fundamental changes in its watercraft section in Chapter 8 represent a significant improvement over the old. The new concepts are those described below and in a recent ProBoat presentation. See also a shorter discussion of these changes in the October edition of BoatUS Exchange.

Our newly redesigned all-aluminum ZzapStrap TM is lighter, less expensive, and comes with a PVC handle.

New products we have recently developed include rail- and surface-mountable air terminals that can be lowered, through-topside connectors, specialized grounding strip connectors, main conductors, and connection studs, in both tinned copper alloy and aluminum. We are now very close to our objective to provide ***all*** components needed for a lightning protection system on vessels ranging in size from jon boats to superyachts. Our Products page gives our range of products and prices. Upcoming additions will be detailed information about the new components and an on-line storefront. Of course, as always, technical expertise is our forte.

Innovative lightning protection

Peer-reviewed science forms the basis

Lightning protection in the marine environment presents special challenges. As the ground attachment path for a 5-mile long spark carrying tens of kiloamperes, the protection system has the task of safely diverting this current around crew, sensitive electronics, and hull components. However, even when the current is flowing in the water, voltage differences can cause sideflashes, both inside the boat and between the boat and the water. These present a shock hazard to the crew, produce overvoltage in electronics systems, and can blast holes through the hull. Management of the sideflash problem is the fundamental issue in the design of an effective marine lightning protection system.
Our approach to lightning protection is based solidly on scientific theory and observation. The foundation was established in a paper published in 1991 in the peer-reviewed IEEE Transactions of Electromagnetic Compatibility. As a result of this paper, subsequent renditions of standards published by ABYC and NFPA upgraded their recommended sizes for down conductors from #8AWG to #4AWG and noted that a ground strip is a more effective grounding conductor than a square plate of the same area. In an attempt to find a solution to another fundamental problem revealed in this scientific work – that a one square foot ground plate is "hopelessly inadequate" to prevent sideflashes in fresh water – we have the sole license for a patent that can provide alternative techniques for grounding, and have contained to pursue the science. More recently, we have worked with the NFPA 780 technical committee to establish a new standard base on these ideas.

Sideflash prevention is the problem

An interesting feature of hull damage is the tendency for sideflashes to form around about the waterline. Apparently either the water surface or the waterline itself causes charges to accumulate, usually on internal conducting fittings, and initiate sparks through the hull. The effect is more pronounced in fresh water than salt.

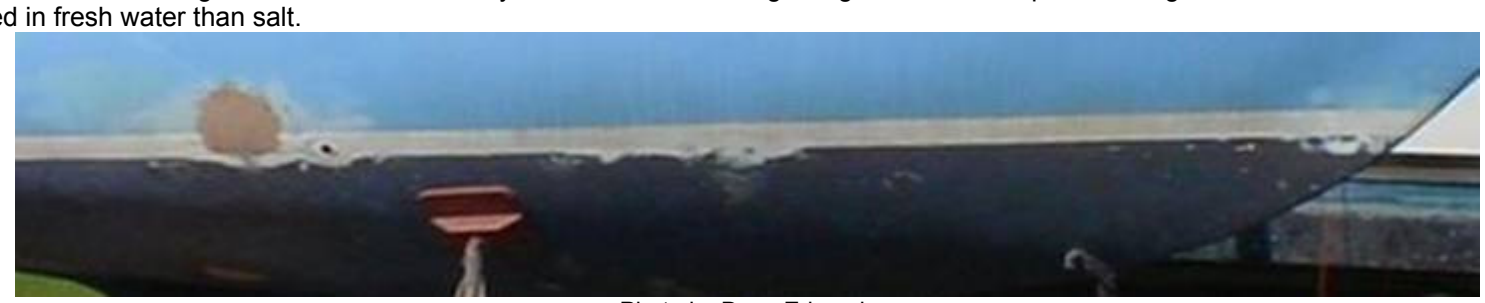
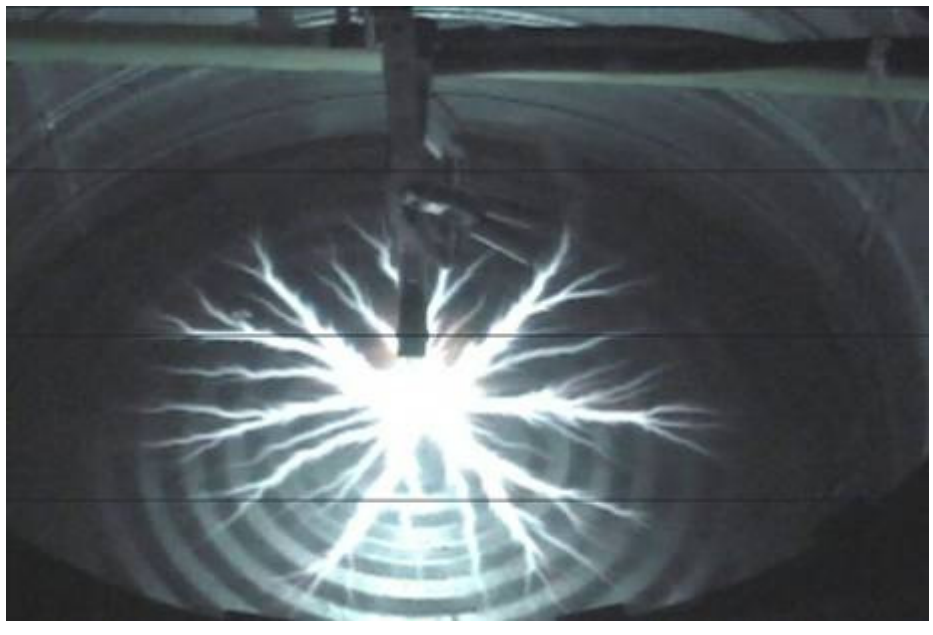


Photo by Dave Edwards

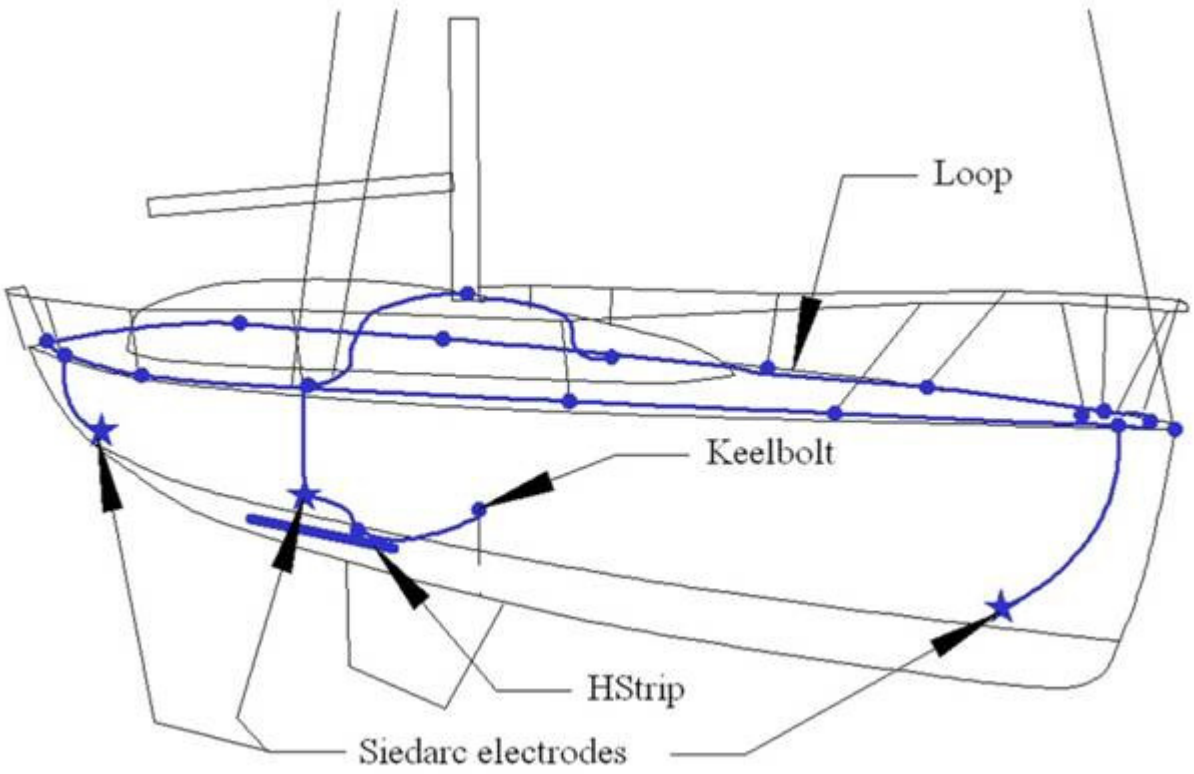
In lightning protection circles, the conventional solution to a problem such as this is to add conductors where the damage is observed. In the above case this means placing lightning conductors through the hull at the waterline. Since it is impractical to install multiple ground plates in a hull, we developed the Siedarc TM electrode to provide the necessary exit terminals. This is effectively an air terminal near the water. In fact, each one is designed to the same specification as a lightning air terminal. In order to investigate the effectiveness of this concept, we tested an electrode with a 10kV generator for both salt and fresh water at Kennick Inc. in St. Petersburg. Even though 10kV is much lower than what would be expected during a lightning strike, we obtained results that clearly indicated the promising potential for the method and further elucidated the best mode of operation. Specifically, in the photo below, with the electrode about 1/4 "above the surface of salt water, a spark of about 15" in diameter was produced. Clearly the sparking is contained very close to the water surface, perhaps even above it, showing the importance of the surface for current dissipation.



In fresh water, the spark connected all the way to the sides of the container, about 12" away. In contrast, when the electrode tip was immersed just below the water surface, a small (~$^1/_2$") glow was observed but no sparks. The conclusion is that an electrode can generate a spark that is orders of magnitude longer than the spark gap in air when placed above the water surface. Hence the optimum placement is just above the water surface.

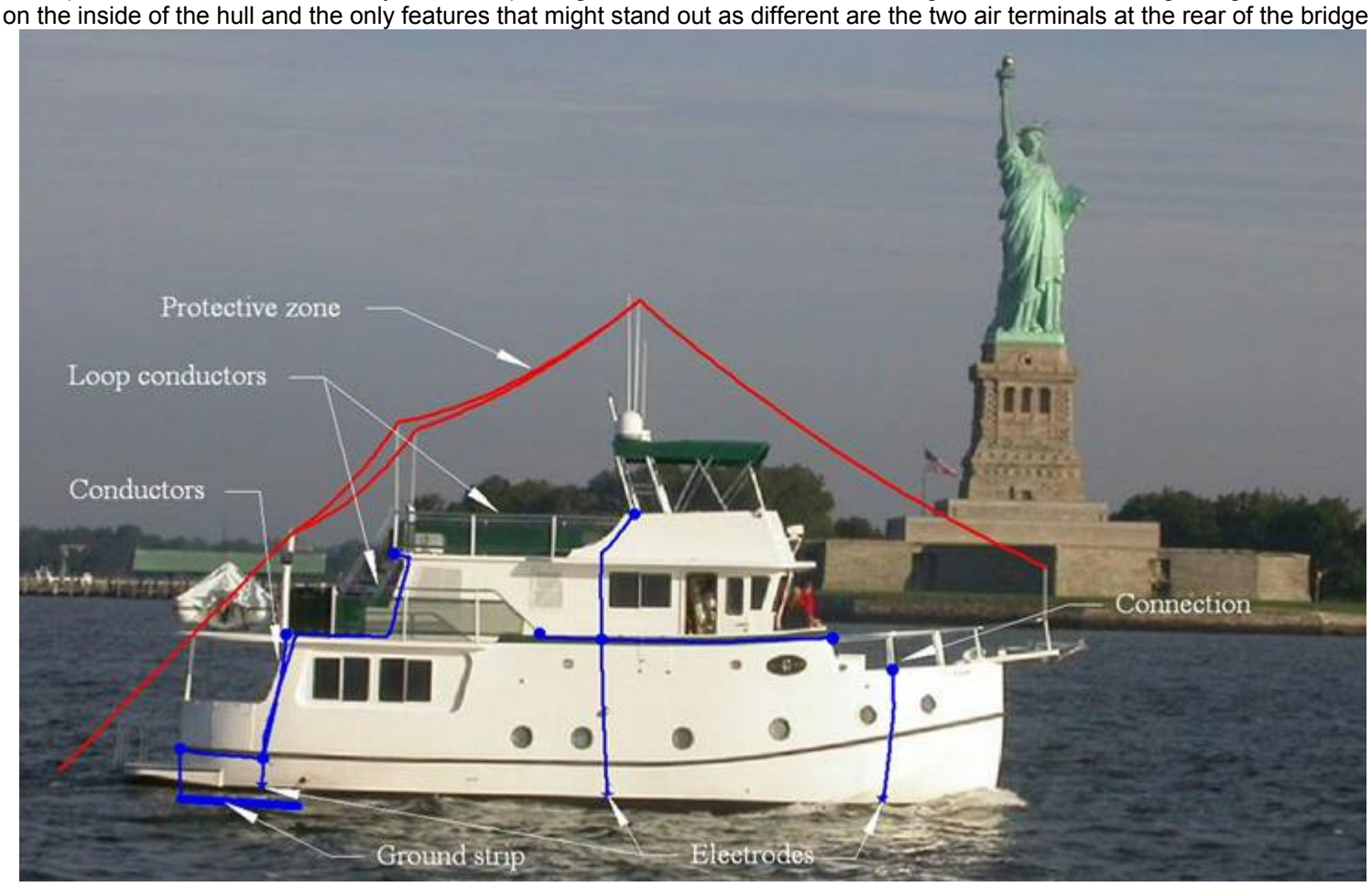
The ExoTerminal™ system is the answer

Providing exit terminals around the perimeter of the hull is the key to an effective system design since, in addition to dispersing the current more uniformly around the boat, it also enables the lightning down conductors to be routed externally to all wiring and conducting fittings. This is illustrated for a sailboat below. The lightning conductor from mast base connects to both the chainplate and the loop before passing down to a daisy-chain Siedarc™ electrode just above the waterline, and from there via an immersed HStrip™ to a keelbolt (and base of a keel-stepped mast). Siedarc™ electrodes at bow and stern provide more exit terminals from the loop to the water. This geometry is mirrored on the port side. Thus a conducting grid covers the interior of the boat and a total of nine exit terminals are distributed over the hull predominantly near the waterline.



Guiding the current on the outside rather than through the middle of the boat minimizes shock risk and emi. In addition, a bonding loop around the boat at about deck level equalizes potentials, provides additional paths for current flow, and can be used for bonding conducting fittings. NFPA (the National Fire Protection Association) is presently considering a revision of their watercraft standard (NFPA 780 Ch.8) to include the concepts of a loop conductor, external down conductors, and perimeter grounding electrodes. See our Standards page for details. With this new system the conductor layout more closely mirrors that found on the typical lightning protection system on a building. For a graphic demonstration of the shielding effectiveness of a metallic cage, check out this photo sequence from the Boston Museum of Science. We call this system of external lightning conductors and peripheral exit terminals the ExoTerminal™ protection system.

In the case of a powerboat, the external down conductors can be connected directly to air terminals that are around the perimeter. Placed using the rolling sphere model, these can be much shorter than a single air terminal that covers the whole boat using the "cone of protection" concept. The annotated photo below shows our first system on a passagemaker that was installed during manufacture. The lightning conductors (the blue lines) are on the inside of the hull and the only features that might stand out as different are the two air terminals at the rear of the bridge deck.



Lightning protection system on Mirage Great Harbor 47 *John Henry*

We can provide all of the components needed in a marine lightning protection system, including:

- RMAT™ & SMAT™ - air terminals with rail- or surface-mounted ratchet bases
- ThruCon™ – through-connector for stanchion-to-conductor continuity
- StudCon™ – attachment studs for connecting to strip conductors
- Lugs – heavy duty tinned copper closed-end lugs for cable terminations
- GapCon™ – tinned copper connector with integrated 1.5kV (nom) air gap for galvanic isolation
- Conductors – tinned copper insulated cable, tinned copper strip, aluminum cable, and aluminum strip

- Siedarc™ - spark-promoting grounding electrodes embedded in non-conducting through-hulls
- HStrip™ - 0.5 ft^2 tinned solid copper grounding strip, available with economical bolt connectors or state-of-the-art insulating connectors
- HStripCon™ – inboard coupling for combining two HStrips into the one square foot immersed area required by most standards
- ZzapStrap™ - bonding & bypass cable for boat lift, trailer or jack stand.

General information on these items and their integration into a lightning protection system can be found on the History/Problems/Solutions page, and specific details on these pages:

Item	Document	Contents
Siedarc™	Introduction	Introduction to the Siedarc™ electrode line
	Grounding guidelines	General guidelines for using Siedarc™ electrodes
	Grounding concepts	Physical basis for grounding electrode placement and type
	Prices	Product price list
Grounding strips	HStrip infomation	Brief description and prices of HStrip™ grounding strips and accessories
	Prices	Product price list
ZzapStrap™	Information	General description of ZzapStrap™ system
	Prices	Brief description and prices for ZzapStrap™ system

We also offer consulting services for:

- analysis and recommendations for specific systems;
- expert witness testimony concerning any aspect of lightning on or near water.

Please call or email if you have any questions.

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