Striking Lightning Facts

An analysis of 10 years of lightning claims reveals which boats are most at risk

By Beth A. Leonard

LIGHTNING SEEMS LIKE the ultimate “act of God.” Unpredictable, capricious – it can come as a literal bolt out of the blue (or out of a glowing, black, anvil-shaped cloud). As the “Lowering the Lightning Odds” article in the July 2014 issue discussed, somewhere around one in a million people gets struck by lightning in any given year. Which means that someone must have it in for boats – two separate analyses of 10 years of lightning claims data from the BoatU.S. Marine Insurance files have found that about one in a thousand boats has a lightning claim each year.

When people get struck, it seems to be random. Yes, men get struck more than women (82 percent of lightning fatalities from 1995 to 2008 were men according to Popular Science), but that’s only because men spend more time outdoors and won’t stop what they’re doing for a little lightning. No one has yet suggested that tall people get struck more than short ones, or blondes are more at risk than brunettes. The same cannot be said for boats. The data shows that when it comes to lightning, not all boats are created equal. Certain boats are significantly more at risk than others. So which boats get hit, in which parts of the country, and how badly?

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AVOIDING WINTER GOTCHAS

I enjoy reading your articles and generally agree with what is written, but your advice indicating that tarps are not an effective way to protect your boat during winter storage has a few holes in it (pun intended). I do agree that, when properly vented, shrink-wrapping is the best way to protect your boat, but it is also pricey. I have been “tarping” my boats for over 25 years and save at least $200 per year, but there is definitely a right way and a wrong way to do it.

First you need to build a quality frame (I use PVC electrical conduit pipe for my ribs and strapping for the center ridge – photo above) and connect them with electrical tape. Then you need to pad any sharp corners that may create a friction point – old carpet is great for this.

Next I use two tarps, one old and one newer. Extra heavy duty (12mm) is key – blue tarps bought from your local hardware store will not work. The old one goes on first and helps protect the outer tarp. At some point the new tarp becomes the old. I purchase a new tarp every two or three years, which runs me about $100. It is important to tie the tarp down tightly and it may need to be adjusted over time. A ball or an old wadded-up rag can be used to give you a super strong tie-down point if needed.

I vent my 24-foot powerboat by leaving the stern open behind the outboard (like an A-frame tent), which gives me easy access and is far back enough to avoid water entering the hull. In the bow I use a section of flexible landscaping drainage pipe to create an airflow.

My boat is stored near the water and has been exposed to many winter northeasters with gusts up to 90 mph and snowfalls of over two feet at a time. The technique has never failed me.

Is it more work? Definitely. Does it work? Without a doubt, and over the years it has saved me thousands of dollars.

Sean King
Newburyport, MA

Thanks for the article on mast winterizing in Seaworthy. And many thanks to the link for frozenmast.com. I have a Beneteau 373 in fresh water since day one here in Arkansas and will be checking my mast drain capability immediately. Corrosion is not an issue, but we do have dirt dauber wasps, so dirt plugging the drain holes is a real possibility. I will also share this with other owners of in-mast furling boats here.

James Bockholt
Heber Springs, AR

REAL WORLD ANCHORING

Seaworthy’s recent article on anchor testing leaves out major essentials. First, experienced voyagers know that a long chain rode is the critical component of any anchor arrangement. Not only does the rode catenary absorb most of the wave-induced “shock load” but ensures that the force upon the anchor is nearly horizontal, save in storm conditions. Testing with just a short piece of chain has little useful information. Second, the ability of Danforth-style anchors in sand/mud was amply demonstrated during the War in the Pacific when 33-pounders were thrown overboard to stop landing craft from running full bore to the beach. But, and it’s a big but, those Danforths were made of forged steel. Modern copies typically made of aluminum/ alloys all too readily bend under load. We have a nicely bent 55-lb. Fortress to illustrate the point. Third, the experience of long-distance cruisers is that suitably heavy anchors plus ample chain rodes, plus proof-tested shackles are the key ingredients of a dependable anchor system – not the specific type of anchor.

Peter I. Berman
Norwalk, CT

Your article on the anchor testing is very interesting, especially since it kind of flies in the face of many other tests that have been done. There are two questions that it suggests to me:

1. In the case of the Fortress, is there a logical explanation for the tremendous variability in the anchoring strengths? My motto has always been that “good enough all of the time is better than excellent most of the time.” I don’t want to drop it and wonder if this is the time that it will perform poorly in a bottom that it was previously fine in.

2. It seems to me that keeping a constant scope and moving the boat is more realistic than holding the boat still and constantly changing the scope angle by reeling in the anchor. Was there some reason to do it this way? There will always be inconsistencies in the bottom as the anchor drags through it, but doing it this way puts two variables in the testing simultaneously, which seems like poor science to me.

What I think most of the larger boat owners are interested in is testing that would show what might be the best all-around anchor for all bottom types.

Ken Bloomfield
Knoxville, TN
The testers would have loved to have seen what was happening on the bottom with each anchor, but since we could not, we are left guessing. In the case of the Fortress, it may have landed upside down. With the flukes set, it would have skinned over the bottom “on its back” and the flukes would never have engaged. But it may also have found a particularly soft patch of mud where it could get no purchase, or gotten shells caught in the flukes so they could not grab. It all just goes to show the unpredictability of anchoring and to underline the need to make sure the anchor is set every single time you drop it.

As far as the testing protocol of pulling the anchor to the boat, the testers chose their method so that they could monitor the anchor’s holding power at various scopes in a short period of time. Even though the data is for a very specific kind of test in a specific kind of bottom, the tests took several days and consumed a huge amount of human and monetary resources. To determine the best all-around anchor for all bottom types would mean testing a large group of anchors in many different locations because most areas tend to have one bottom type. The Seaworthy editors would be happy to volunteer to test the anchors in fine Caribbean sand!

STILL MORE LIGHT

Having read the latest round of Dan Rutherford’s article and mail response, I would like to clarify a term misused and not clearly understood by many. “COLREGS” are the “International Rules for the Prevention of Collisions at Sea,” sometimes called the “72 COLREGS.” Thus they apply to waters outside the lines of demarcation. The rules Dan cited in several of his comments are called the Inland Navigation Rules Act of 1980. These rules apply to the navigable waters of the United States – those navigable waters INSIDE the lines of demarcation. Those waters may include lakes that cross borders between two states – otherwise state rules apply. Generally, most states use the Inland Rules as a basis for their statutes, but may add other rules. Many of these rules are identical but not all. For example, the term “Vessel Constrained by Draft” ONLY exists under the International Rules or COLREGS. “Privileged” and “burdened” are no longer used, because the term “privileged” gave mariners the idea that they had right-of-way privilege under conditions that are properly deemed to be “stand on” situations.

Right of way exists ONLY for downbound, power-driven vessels with a following current, on the Great Lakes, Western Rivers, and other specified waters. Regardless, even a vessel that is stand-on must do everything in its power to “avoid the risk of a collision,” not necessarily the collision itself.

Kenneth R. Babick
SR Division Commander, USCGA
DIV 7—SO-OP/MT
Gresham, OR

We thank all of our readers for the many comments on “Light Up The Night” from the July issue. That article was not first and foremost meant to cover the nav rules, but rather to focus on the importance of navigation lights for nighttime safety. Clearly this has sparked a much larger discussion, and we intend to follow up with an article on the navigation rules later this year.

SAFE FUEL FILLING

On page 15 in the October issue, there is an article about Seaworthy reader Cort Schult watching his neighbor put gas into his boat using a five-gallon plastic fuel jug and a plastic funnel. The article states “three things to avoid: not grounding the fuel jug on the funnel …” The use of a double negative leaves me confused: Should you not ground the fuel jug on the funnel or should you ground the jug on the funnel when fueling? Ken Pagliugh
Millvale, NJ

Sorry for the ambiguity. Yes, you should have the fuel jug in contact with the plastic funnel to prevent a spark from leaping between the jug and the funnel, and igniting the gasoline.

Would grounding a plastic fuel jug to a plastic funnel really make any difference? How about putting the key to the gas cap on the same key chain as the ignition key? That way you cannot open the gas fill pipe without removing the ignition key from the switch.

R. Withington
Clayton, NY

Static charges can build up on either surface, but if they are touching, there’s no chance for a spark to jump. Fuel fills on boats are required to be grounded, so there can be any buildup of static on the fill side. Keeping a fuel nozzle in contact with a funnel in the fill pipe or with the fuel fill itself eliminates any possibility of static charge building because it would simply go to ground. If your boat has a lockable gas cap, keeping the key attached to the ignition key is a great idea to prevent the engine from being started while the fill is open.

RECALLING ALL EMAILS

We always try to answer every email we receive, and to do so within a few days. However, the Seaworthy email inbox crashed right when we started receiving letters about the October issue. We were able to recover most of the emails, but if you didn’t get a response to yours, please resend it to Seaworthy@BoatUS.com
WHICH BOATS?
While any boat can be hit – BoatU.S. Marine Insurance has even had some lightning claims for personal watercraft – lightning is most likely to go for that tall, tree-like metal pole sticking straight up toward the sky. The taller the better. That’s why sailboats have significantly more lightning claims than powerboats (Table 1), and almost certainly why larger boats have more lightning claims than smaller ones (Table 2) – overall size is closely correlated to mast height, which is probably what really matters here. And as far as lightning is concerned, two hulls are better than one. Multihull sailboats are almost twice as likely to have a lightning claim as monohulls. But that’s only true if that big, pointy thing is in the middle of the boat. The frequency of pontoon boat lightning claims is well below the average.

According to Martin Uman of the University of Florida’s Lightning Research Group, the average lightning bolt is an inch wide and five miles long. On the face of it, it seems unlikely that 20 or 30 feet more height – roughly the difference between the mast on a 35-foot and 45-foot sailboat – would almost triple the odds of the boat being hit. But understanding how the electrical charge that passes through a lightning bolt moves between the clouds and the ground makes lightning seem just a bit less capricious.

Lightning is a direct result of the electrical forces built up in the clouds during a thunderstorm, where the bottom of the storm cloud becomes highly negatively charged. Only 20 percent of lightning strikes actually reach the ground – the rest are cloud-to-cloud strikes. A typical cloud-to-ground lightning strike occurs in less than 1/100 of a second but actually proceeds through four distinct phases. The following is an abbreviated version of the National Weather Service’s JetStreamMax Online School for Weather’s lightning discussion.

1 Development of the stepped leader from the cloud base. A very faint, negatively charged channel emerges from the base of the cloud and propagates toward the ground in a series of small steps about 150 feet in length and 1 microsecond in duration. The stepped leader carries about 100 million volts of charge relative to the ground. It usually branches out as it approaches the ground, pausing between each step and “looking” for an object to strike.

2 Development of streamers from objects on the ground. The strong, negative charge of the stepped leader attracts vast amounts of positive charge. The attraction is so strong that the stepped leader induces electric channels up from the ground known as streamers, most readily from tall, pointy objects. When a cloud-to-ground strike occurs, one of these positively charged streamers connects with the negatively charged stepped leader, at 100 to 300 feet above the ground on average.

3 Negative charge flows downward. When that connection occurs, the negative charge from the cloud starts flowing down the established channel.

4 Return stroke shoots up the channel. Once the channel is open, the return stroke flows up and produces a ground current that peaks in about 1 microsecond at an average of around 30,000 amperes. The return stroke produces 99 percent of a lightning bolt’s luminosity, and, though it travels from the ground up to the cloud, to the unaided eye the opposite appears true.
Sailboat masts, like tall trees, seem to be at just the right height and of just the right shape to develop streamers that the stepped leader can reach when it’s “looking” for a place to touch down. That doesn’t explain why one mast in a particular marina wins the lightning lottery, nor does it mean that the highest object will always be struck. But when looking at probabilities, the claims data suggests that sailboat masts must make better lightning rods than other appendages on other types of boats.

Understanding why multihulls get hit so much more frequently than monohulls is more problematic. Several theories have been put forward including the lack of a keel, the increased wetted surface area, the larger footprint, the location of catamarans at the edges of marinas, the overall size of catamarans, and the average height of their masts. Unfortunately, we do not yet have enough data to be certain of what is driving this finding.

WHERE?

Not surprisingly, boats get struck where there is a high density of lightning and a high density of boats. The frequency of the BoatU.S. lightning claims by state fairly closely resembles the incidence of cloud-to-ground lightning strikes. If an area has a high incidence of strikes, that includes a lot of masts, it’s not too unlikely that one of those strikes will find its way to ground through a boat.

Six of our top 10 states in terms of the frequency of lightning claims – Florida, Mississippi, Louisiana, Alabama, South Carolina, and North Carolina – are part of the big “hot spot” in the Southeast and midsection of the country. Maryland ties for second with Mississippi, which might surprise you. But there are a lot of sailboats there, and anyone who has boated on the Chesapeake Bay in the summer has experienced the fast-moving and violent thunderstorms that sweep through the area several times each month from June through September.

At the other end of the spectrum, the frequency of lightning claims is about 1 in 10,000, or one-tenth the average, along the Pacific coast. That doesn’t mean that BoatU.S. Marine Insurance doesn’t ever have lightning claims there, only that if you are the one with the claim, you’ve been very unlucky indeed.

WHAT TYPE OF DAMAGE?

Yes, the old wives’ tales are true. Lightning can blow a thru-hull right out of the boat, but more commonly its passage through a metal fitting damages the surrounding fiberglass. This can be severe enough that the boat sinks. Boats on the hard often fare even worse than those in the water – the lightning will find its way to the jackstands or chains, often leaving a visible track across the hull. But extreme damage from lightning is the exception, not the rule.

More than 75 percent of lightning claims in the BoatU.S. Marine Insurance files over the past decade were for less than 30 percent of the insured value of the boat. And nearly all of those claims were for damaged electronics. Here’s how it normally goes. Joe and Jane Boater arrive at the marina looking forward to a lovely weekend on the water. They begin loading all their stuff onto their sailboat. Jane goes down below to put things away and says, “Joe, did you leave the breaker for the fridge off?” A bit later, Joe tries the chartplotter but it won’t fire up. Then the microwave won’t work. It takes awhile before the penny drops. One of them looks at the other and says, “Remember that big thunderstorm last week? Maybe our boat got hit.”

If this ever happens to you, don’t assume the damage
is limited to the electronics. To make sure your boat is safe, you should do the following:

1. Unplug the shorepower cord and turn off all battery switches. You don’t want a short circuit to start a fire.

2. Check the bilge and make sure it is dry. If it is not, arrange a haulout immediately. This will probably be covered by the insurance company, but even if it isn’t, you need to make sure everything is OK below the waterline.

3. Call your insurance company. Tell them what is happening, and don’t forget to discuss a haulout if you are taking on water.

4. Once you’re sure the boat isn’t sinking or you have hauled it out so it can’t, your insurance company will assign a marine surveyor to do a damage assessment, inspecting the electronics and all electrical panels to figure out what does and does not work. Electronics may need to be bench tested to establish that lightning was the cause of the damage. If you haven’t been hauled out and the damage appears extensive, the insurance company may require a haulout now to ensure there is no below-waterline damage.

5. Don’t throw away any damaged equipment unless your insurance company says it’s OK to do so.

So, if you have a sailboat in a lightning hot spot, especially if it has two hulls, you are more at risk than average. What can you do about that? The general consensus is, you can’t do much to keep your boat from being struck. The ultimate act of God, remember, though God seems to have it in for sailboats and doubly so for multihull sailboats. But lightning protection systems can help to minimize the damage if your boat does get struck, so we will be looking at those later this year.

WHAT TO DO IF YOU’RE CAUGHT OUT ON THE WATER

“When thunder roars, go indoors.” If there is time, return to shore and take shelter in an enclosed building (not open-sided) or your car. They are not impervious to lightning, but the lightning is less likely to do damage.

But if lightning has already begun, getting closer to shore may bring you close to trees and other objects that could be lightning targets. In that case, stay on the boat and do the following:

- Go indoors – go down below. Stay in the center of the cabin if the boat is so designed. If no enclosure (cabin) is available, stay low in the boat. Don’t turn yourself into a lightning rod!
- Keep arms and legs in the boat. Do not dangle them in the water.
- Discontinue fishing, waterskiing, scuba diving, swimming, or other water activity when there is lightning or even when weather conditions look threatening. The first lightning strike can be a mile or more in front of an approaching thunderstorm cloud.
- Disconnect and do not use or touch major electronic equipment, including the radio, throughout the duration of the storm.
- Lower, remove, or tie down the radio antenna and other protruding devices if they are not part of the lightning protection system.
- To the degree possible, avoid making contact with any portion of the boat connected to the lightning protection system.
- On larger boats with an oven or microwave, putting electronics inside should prevent them from being damaged as the oven or microwave will act as a Faraday cage, allowing the charge to pass harmlessly through the metal around the devices.

From University of Florida’s “Boating-Lightning Protection” by William Becker
If you’re a Seaworthy reader and you keep your boat on a covered dock in the winter, you’re probably well aware of the potential risks from fire and snowload. But you may not be aware of recent innovations that help reduce those risks. If your marina is the old-fashioned type and you have multiple covered marinas in your area, consider scouting out the others to see if any have adopted these construction techniques. If you can’t move your boat, sharing this article with the marina management might result in safer docks when the time comes to replace the existing dock buildings.

**SNOW PROTECTION**

Last December, a storm that dumped heavy snow and ice on a covered marina on Lake Lewisville, Texas caused part of the marina to collapse, damaging dozens of boats and sinking several. One owner who was sleeping aboard had to be rescued from the mangled metal roofing that once covered the boats.

Wet snow – the kind that’s typical in places that aren’t in the frigid North – is heavy. A one-foot by one-foot section three inches thick of the wet white stuff can weigh five pounds. Multiply that by thousands of square feet of marina roofing and you can see why many structures just can’t handle the weight and collapse.

For fixed docks, there’s a way to prevent even the worst storms from collapsing the roof and damaging the boats underneath. After the wicked back-to-back snowstorms in the mid-Atlantic in 2010, several covered marinas collapsed in the Chesapeake Bay area, including Bohemia Bay Yacht Harbour in Chesapeake City, Maryland. The owners decided that an engineered, extra-strong roof system offered the best protection for the money. The system uses a heavy galvanized steel pipe foundation, driven into the seabed, along with a heavy-gauge galvanized steel roof structure. Much stronger than traditional timber construction, this approach virtually eliminates snow and wind load concerns. The substantially heavier equipment needed does increase the cost, but the structure will outlast conventional roof systems – and protect the boats under them – for many years.

**FIRE PROTECTION**

A marina fire is the stuff of nightmares, but it can be even worse when docks are covered. Once a fire gets going, the heat trapped under the roof turns the whole place into a super-heated oven that will ignite anything under it. That scenario actually happened at a marina in Gig Harbor, Washington a few years ago, and dozens of boats were destroyed. One innovative solution is to install polycarbonate panels in 50 percent of the roofing. That way, if a fire starts, the panels quickly melt, allowing heat to escape and greatly lessening the chance of the entire marina going up in flames. In some parts of the country, those melting panels are now required by local law. The polycarbonate panels offer another terrific side benefit: Because the panels are clear, the normally gloomy covered marina feels light, airy, and welcoming.

**ONE MORE THING WORTH MENTIONING**

One of the lessons learned from both of these incidents is the value of proper insurance. Not all marinas are built to withstand huge snow loads or fires. If your boat causes the fire, you may be liable for a staggering amount, so don’t be caught short when it comes to liability insurance. Some people mistakenly believe the marina’s insurance will cover damages to boats, too, but in most cases it won’t. You don’t want to end up like the people who weren’t properly insured and found themselves wishing that was a risk they hadn’t taken.
Bilge Pump Basics

They’re your last line of defense against sinking, so give them some respect – and a little love from time to time

By Frank Lanier

Due to the lack of maintenance they receive from the average boat owner, I often refer to bilge pumps as the Rodney Dangerfield of boat equipment, meaning “they just don’t get no respect.” It’s a funny but also troubling statement, particularly because bilge pumps are often a boat owner’s first and only line of defense against sinking. To prevent you from being that proverbial scared sailor with a bucket, here’s a look at bilge pump basics – from what they do, to selection, installation, and maintenance.

What They Are (and Aren’t)
The primary job of most bilge pumps on most boats is to clear nuisance water from the bilges (packing gland drips, spray from an errant wave, etc.). The one that came with your boat may be up to that task, but a bilge pump should also be able to provide crucial extra time if your boat is taking on water, allowing you to find and deal with the source of a leak or, in extremis, to don life jackets and hopefully keep your boat afloat long enough for help to arrive. Most people upgrade to a larger bilge pump or add a backup bilge pump to give them time to deal with an emergency. Even that pump should not be confused with an emergency pump, which provides much greater dewatering capacity. If you plan on fishing the Canyons or sailing offshore, then you need a true “crash” pump, one that can move hundreds of gallons per minute.

This article will focus on the middle of these three options – the bilge pump meant to remove nuisance water but also to give you time to deal with an emergency. See our Online Extra to figure out how much pumping capacity you need.

What Type of Bilge Pump Do You Have?
The most common types of bilge pumps (and the primary focus of this article) are centrifugal and diaphragm electrical pumps. Centrifugal pumps move water by kinetic energy using a rotating, solid impeller, similar in design to a turbine. Water enters the pump, picks up speed as the impeller rotates, and is then forced out by its own momentum. Centrifugal pumps are submersible but not self-priming, meaning they must be sitting in water in order to pump it.

Centrifugal pumps are relatively inexpensive and can move a lot of water. Other advantages include low maintenance, excellent reliability, and the ability to pass small amounts of debris without clogging. They can also run dry for extended periods without damage, although this does wear the bearing and will cause it to fail eventually. Disadvantages include their inability to self-prime and their loss of effectiveness the farther they have to push water vertically.

A diaphragm pump acts like a little wet-vac to suck out bilge water. Water is pulled in through an intake valve, then pushed out through an output valve. Diaphragm pumps are self-priming (meaning they develop suction and prime themselves when dry), can be run dry without damage, and are better able to push water uphill than centrifugal pumps. As to downsides, they can’t move as much water as a comparable centrifugal pump and most can’t tolerate even small bits of trash or debris, which can lodge in the pump’s valves, causing leaks or failure.

Nothing beats the simplicity and pumping power of a centrifugal pump. However, diaphragm pumps can be a better choice where water has to be pumped more than a few feet uphill, and they can be installed in a drier, more convenient place than the bottom of the bilge. Adding a filter before the pump to remove debris reduces the risk of failure.
**DO YOU HAVE ENOUGH CAPACITY?**

Now that you know how different bilge pumps work, the next step is determining how many and what size your boat should have. The first thing to understand when shopping for a bilge pump is that just because a pump is rated to pump 1,000 gallons per hour (gph) that doesn’t mean it will. See the Online Extra to figure out how much a bilge pump is likely to actually move when installed on your boat compared to its rated capacity.

So how much pumping capacity should your boat have? It’s a good question, but one with no clear or easy answer, mainly because boats are so different. Any compartment that’s essentially watertight (i.e. where water can’t drain into another area) should have its own pump or two. While the American Boat and Yacht Council (ABYC) hasn’t set requirements concerning bilge pump capacity, the American Bureau of Shipping recommends one 24-gallon-per-minute (gpm) pump – or about 1,440 gph – and one 12-gpm (720 gph) pump for boats under 65 feet. To me, it’s a simple case of bigger is better – within reason, of course. Based on size alone, I’d recommend a minimum of 5,500 gph pumping capacity for a 40-foot vessel, divided among a 1,500-gph primary pump and two 2,000-gph backup pumps. I’d also throw a high-volume manual pump in the mix for good measure, since all that pumping capacity will be useless if something happens to your batteries.

Based on this, you’ll probably find you don’t have enough pump capacity. If you decide to install more, make sure to follow tips below. And if you are happy with what you have, take a look to see if your current bilge pump needs a bit more respect.

**ARE YOUR BILGE PUMPS INSTALLED TO MINIMIZE PROBLEMS?**

The first step on the path to bilge pump nirvana is making sure your boat’s bilge is clean and free of trash and debris. Routine bilge cleaning is a fact of life for older boats, but even that new boat you’re purchasing can have a bilge littered with pump-clogging bits of construction material – wood shavings, bits of fiberglass, and gobs of epoxy. Oily bilge residue should also be cleaned up and disposed of properly. In addition to the ecological concerns of accidentally pumping it overboard, oil combines with dirt to form a gooey sludge that can clog pumps and prevent float switches from operating properly. In addition, some newer bilge pumps are designed not to pump automatically if they sense oil in the water, so keep those bilges clean!

Use smooth-walled marine-grade hose for pump discharge runs and secure them at each end with marine-grade stainless steel hose clamps. Hoses should be routed as directly as possible to their discharge thru-hull and should also be properly supported (approximately every 18 inches) to prevent chafe and excessive movement. Speaking of discharge thru-hulls, they should be situated well above the waterline to prevent water from siphoning back into the bilge. Siphon breaks and riser loops are also recommended and should reach at least 18 inches above static waterline where possible.

If your bilge pump uses a flapper style automatic float switch, it must be securely mounted and installed so that the floating-arm is clear of wires, hoses and other obstructions that could impede its operation. Orient the switch fore and aft, with the flapper pointed toward the stern. This is especially important on powerboats – during jackrabbit takeoffs, surging bilge water can damage the flapper mechanism. Installing them close to a bulkhead or frame also helps protect the switch from a torrent of water. Enclosed switches eliminate this worry, but they’re difficult to inspect and test. Regardless of the type you choose, make sure each pump has a manual switch as well; none of the automatic systems are failsafe.

Make sure all bilge pumps not only have intake strainers or strum boxes installed, but that they can be easily reached and cleared of debris. As a marine surveyor I often see centrifugal-style pumps mounted beneath engines...
and completely inaccessible, even to simply clean the strainer – if your boat has similarly inaccessible pumps, relocate them for better access.

ABYC standards require circuit protection for each bilge pump. You can do this by powering them through the primary DC circuit breaker panel, but then you’ll have the potential problem of someone inadvertently killing power to the pumps by turning off the primary battery switch. To prevent this, you can also wire each through a dedicated fuse to the “all” or hot terminal of the battery switch (the one that’s always energized) or even directly to the battery itself. The battery switch option ensures the pump can draw power from both batteries, rather than limiting them to one. An even better option is installing a small, dedicated bilge pump breaker panel (which has the added benefit of keeping all bilge pump fuses and breakers together and easily accessible). This panel would then be wired directly to the battery switch, bypassing the primary DC circuit breaker panel.

When wiring your bilge pump, ensure all electrical connections are located well above normal bilge water levels (to reduce corrosion issues) and properly terminated with marine-grade connectors – leave those wire nuts and electrical tape joints at home! Finally, while it’s fine to go with oversized wire, don’t upsize the fuse. The BoatU.S. Marine Insurance claim files include many fire claims caused by centrifugal bilge pumps that overheated when something got caught in the rotor assembly and the fuse didn’t blow because the installer thought a slightly bigger fuse would be better. When it comes to fuse size, follow the manufacturer’s recommendations exactly.

WHAT MAINTENANCE SHOULD I BE DOING?
Problems with centrifugal pumps typically involve clogging, defective automatic float switches (if installed), or corroded electrical connections, a common problem with any electrical gear installed in corrosive environment of a vessel’s bilge. Maintenance is generally limited to clearing the strainer (centrifugal pumps have one built into the base) and waterproofing all connectors. When it comes to repair, with the exception of the larger, rebuildable units, most centrifugal pumps are so inexpensive that it usually costs less to replace a damaged pump than repair it.

Maintenance and repair of diaphragm pumps typically involve opening up the pump body, clearing the pump chamber of debris, and checking the diaphragm and valves for damage or deterioration. Other than clogging, most problems will be caused by torn or damaged check valves. The diaphragms can also fail though they will typically outlast several valve changes. Pump disassembly for maintenance is normally straightforward; however, some are more complex than others (multi-chambered units, for example), so be sure to read all instructions carefully to avoid common mistakes, such as improper orientation of check valves during installation.

So give that bilge pump a little respect, and it will keep your bilge dry and maybe even keep your boat afloat long enough for you to figure out where that water’s coming from!

**KEEP YOUR BILGE PUMP PUMPING**

- Test and verify operation of all bilge pump systems at regular intervals (monthly at a minimum). Testing should verify the actual pumping of water overboard, rather than (in the case of electric pumps) simply switching the pump on and listening for motor operation.
- Disassemble and inspect pumps periodically for worn or damaged components. Pay particular attention to neoprene or other soft parts such as diaphragms, check valves, etc. This is not only good preventive maintenance, but also lets you learn the ins and outs of disassembling and reassembling before an emergency occurs.
- List bilge pump by type, location and size for future reference and make sure there are spare parts or complete rebuild kits onboard for each. If you really want to go the extra mile, pack a complete spare pump assembly. Being able to swap out a defective pump lets you quickly bring the system back up, while giving you the option of repairing the damaged pump later at your convenience.

Common bilge pump problems include physical damage, loose hoses, and failure to securely mount the pump to ensure proper orientation.

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**Captain Frank Lanier** has over 30 years of experience in the marine and diving industries, holds a 100GT master’s license, and is a SAMS-accredited marine surveyor.
Plugging For Safety:
Two new shorepower cords designed to reduce the risk of electrical fires at the inlet

By Charles Fort

As Seaworthy Readers know, 55 percent of electrical fires on boats originate in the electrical system, with the shorepower inlet being one major source of fires in the 120-volt AC system. Fires often start at the inlet connection because of corrosion or damage to the metal connector blades. Once blades begin to corrode, there is less contact area for current to flow, which causes heat buildup. Arcing also damages the blades when a connector is disconnected under load and electricity leaps from the connector to the tip as the plug is removed. Eventually, the heat from arcing and corrosion can melt insulation and cause a short in the wiring, which can ignite anything flammable nearby. Seaworthy has always recommended cleaning the connectors and avoiding making connections with shore power on. But in the past few years, new shorepower cord designs have been introduced that have the potential to reduce the number of fires originating at the inlet.

**Marinco EEL**
EEL stands for Easily Engaged Lock and has a new clamp-type locking mechanism instead of the old-style locking ring. Marinco says it creates a watertight seal, which should keep corrosion at bay. The EEL also has LEDs on both ends to show that power is flowing, which will hopefully remind you to turn off the power before disconnecting, eliminating arcing. The EEL comes with a cord light at the boat inlet side, which acts like a flashlight, making it easier to find the inlet at night. But since Seaworthy still recommends turning the power off before connecting the cord, the light won’t be very useful. The EEL system meets UL safety standards and costs about $100 for a 50-foot cord.

**SmartPlug**
The SmartPlug inlet and connector kit, designed to replace the current AC inlet on your boat and the connector that plugs into it, has straight, rather than curved blades, which have more contact area and make it easier to plug in. There’s no danger of damaging the blades while you’re trying to twist them in on a dark night. The cord connection is weatherproofed with two separate seals to keep out moisture and salt air, and it securely snaps into place so you know when you’re connected. Finally, a thermal cutoff shuts off the power if it senses a temperature over 200°F and restores it when it has cooled.

The challenge, of course, is the need to replace your boat’s shorepower inlet. SmartPlug Systems says its inlet can be installed in about 30 minutes. For a 30-amp service, you can buy the inlet and the connector end and refit your existing cord for about $225, or you can buy the complete cordset and the inlet for about $300. Fifty-amp connectors are also available for a bit more. Eventually, SmartPlug plans to have inlets and connectors for the dock pedestal, too, though the installation for that is not for the do-it-yourselfer and must be performed by a qualified electrician. The SmartPlug does have one potential safety issue: If the thermal cutoff trips and the power goes out, anyone working on the AC system might get a nasty surprise when the thermal cutoff restores the power. The SmartPlug is not UL listed, but has been tested to recognized standards by another independent facility (ETL).

While neither of these solutions is perfect, they both offer the promise of reducing fires due to shorepower cords and extending the longevity of the connectors and inlets. We’ll keep you posted as we get real-world data through our claim files, and we’ll let you know as other products come to the market.
LPG WATER HEATER HAZARD
Several marine surveyors have recently told *Seaworthy* that they’ve come across boats with LPG (propane) on-demand, tankless water heaters installed. While these water heaters are fine in a house, they’re not safe installed in a boat, and installing one is almost certainly contrary to American Boat and Yacht Council (ABYC) standards.

Here’s why: Any LPG appliance produces deadly carbon monoxide (CO), including, say, an LPG stove. What makes LPG tankless water heaters dangerous is that they’re designed to turn on automatically. Stoves, on the other hand, are attended, require frequent attention by the operator, and can’t turn themselves on while someone aboard may be sleeping or unaware. ABYC standards require that any unattended LPG appliance must have a combustion-sealed chamber that draws in air from the outside, not the cabin, and also exhausts the combustion products outside. LPG tankless heaters don’t have a room-sealed combustion chamber, which means when they are on, a leak or even a strong downdraft could cause carbon monoxide to collect in the boat. Most often, surveyors say, these appliances are mounted in the head, which has precious little air – it doesn’t take much CO in a small space to build up to dangerous levels. Leaking CO into the head from tankless LPG water heaters has already caused several close calls. Don’t take the risk – install only a marine-rated, tank-type water heater in your boat.

FLUXGATE FLUMMOX
*Seaworthy* would never recommend using an autopilot when passing under a bridge due to the potential for boat, ship, and barge traffic, and to the likelihood of changes in wind and current near such a large obstruction. But if that won’t convince you, maybe this will. Operating under autopilot while passing under the Route 50 bridge on the Severn River near Annapolis last spring, a Sabreline 36 suddenly turned hard to starboard and drove right into the bridge abutment. The boat was traveling south at about 7 knots with 10 knots of northerly breeze, and she was about 70 feet from the bridge abutment when she turned. The incident happened so quickly that her captain had no time to react. Similar cases have been reported elsewhere when captains relied on autopilots to pass under bridges. The metal in the bridge structure can easily disturb the magnetic fields that the fluxgate compass uses to determine the boat’s heading and keep it on course. When navigating under bridges or in the vicinity of natural magnetic anomalies, usually noted on charts, do not rely on the autopilot. Hand steer until you are well beyond any potential disturbances.
HAIR-RAISING ELECTRICAL SYSTEMS

What’s wrong with the picture at bottom left? At first glance, the ground wires on the back of this ground stud look OK – properly crimped and securely fitted. Sharp-eyed readers, though, will see red – as in the red wire that’s arcing over a big black ground wire. That red wire is a positive, current-carrying wire. If it chafes through (which it probably will over time, even with a bit of chafeguard on it), it’s going to contact the ground wire. In the blink of an eye, the wires will get red hot, easily hot enough to start a fire. Even if it doesn’t start a fire, it’s possible that everything connected to the ground lug is going to get a burst of electricity the wrong way that could easily destroy sensitive electronics. An additional problem is the number of wires that are connected to the ground lug. American Boat and Yacht Council (ABYC) standards call for a maximum of four wires per lug – this one has five, the last one likely added by a well-meaning but uninformed do-it-yourselfer.

If you’ve read this far, you’ll be able to spot the problems on the picture at bottom center. While it pretty much has the same problems – too many wires on the lug and, in this case, a ground wire ready to chafe its insulation against a positive wire – note that the lone black ground wire is actually zip-tied to the positive wire, which will likely accelerate chafe. In this case, if the two wires chafed through, there would be a direct short from two 8D batteries – with enough resulting heat to ignite anything nearby. Positive and negative wires have to be separated so they don’t have any chance of contacting each other if they chafe through. If you’re not positive about how to work on your electrical system, hire a pro.

OK, if it was a bit tricky to spot the problems on the last one, this one ought to be pretty easy. The photo below right was sent to us by marine surveyor Greg Group and shows a boatyard outlet. Most people would be smart enough to leave this alone, but the surveyor says it was still available to anyone to plug into. Not only is the outlet broken and the connections corroded, the metal box was actually shorted to the wires, making an electrocution all too easy. One more thing is the extension cord in the left side of the photo; it’s missing its ground plug, which, ironically, is designed to prevent a dangerous shock in case the outlet is faulty.

While you can’t know if every outlet in the boatyard is safe, you can protect yourself by using an extension cord with a built-in ground fault interrupter (GFI). That way, if there is a problem with the outlet, the GFI will trip before you can get hurt. And if you see an outlet like this lying around your boatyard, treat it as you would a poisonous snake – stay away and tell your boatyard manager about it.

REPOWERING OR UPGRADING YOUR BOAT?

Let your insurance company know. Most BoatU.S. Marine Insurance polices are of the agreed value kind – that is, you and the insurance company agree on a value for the boat, motor, and equipment. This is the amount that would be paid to you if the boat were stolen or destroyed. If you buy a brand-new engine or make substantial upgrades to your boat, the value will likely increase. But if you don’t tell your insurance company and raise the agreed value, the old value is what could be used if your boat is lost, which may be thousands less than what you invested. If you need to report a repower or upgrade, call a BoatU.S. underwriter (1-800-804-2628). If you’re asked to send in documentation to substantiate the work, don’t put it off.
When it comes to life jackets, even the most well-educated and diligent of sailors often find themselves scratching their heads. The Coast Guard carriage requirements specify that boats must carry one properly-sized life jacket for every person aboard. But there are four types of life jackets: I, II, III, and V – with different buoyancies and recommended uses. In addition, boats over 16 feet in length (except canoes and kayaks) are also required to carry a Type IV throwable device. While Types I, II, and III need not be worn but be immediately available – except for children under a certain age (as dictated by state law, or federal law if the state does not have a requirement), some Type V life jackets must be worn to meet the carriage requirement. The Coast Guard recommends, but does not require, that certain types of life jackets be worn for certain activities like waterskiing or riding a PWC. But many states do require wearing a life jacket of a certain type for these activities. Confused yet? You’re not alone.

On October 22 last year, the Coast Guard announced that they would be doing away with the type coding on life jackets. The move is designed to pave the way for life jacket labeling that is easier to understand, more directly relates to safety, and is more in line with international standards. It is also expected to lead to the introduction of new life jacket designs and help reduce prices as life jackets are introduced from other countries. While doing away with the type labeling is a positive step, it will take some time for new labels to be developed and for life jackets with those new labels to reach the market. In the meantime, life jackets marked with the Type I, II, III, and V labeling will remain legal for use, and boaters must still abide by the current standards when using them. So how do you know what type of life jackets you have and whether they meet existing standards?

BoatU.S. Foundation President Chris Edmonston has been working on issues concerning life jackets for nearly two decades – he was involved in the early 1990s when the Coast Guard contracted with the BoatU.S. Foundation to study inflatable life jackets, and the findings from that study helped to pave the way for inflatables becoming legal for use by American boaters. Currently, he works with Underwriters Laboratories on standards, and he’s on the USCG “Tiger Team” for life jacket use. “Unfortunately, there isn’t any way to determine what type a jacket is unless you look at the label. But, by law, the conditions for legal use must be listed on the life jacket label – everything you need is right there. Simply put, if you follow the label, you’re following the law,” said Chris.

To understand the variations of jackets and the conditions for which they may be used, Chris recommends the USCG document, “A Boater’s Guide to Federal Requirements.”

“But stay tuned,” Chris said. “In a year or two, you won’t see new jackets being sold as a Type I or II, or V, or whatever. They will simply be ‘wearable devices’ and you won’t have to worry about many of the things you do today.”

Tired of that pesky old drain plug? Frustrated with trying to install it when your hands are cold in the early morning or with getting it out at the end of a long day? Well, the photo below isn’t the solution. Seaworthy has often warned against using household plumbing fittings in boats. There are lots of reasons for that, including lower-quality metals and plastic parts that don’t stand up to the marine environment. But we were a bit taken aback by this photo of a novel approach to the whole concept of the drain plug sent in by surveyor Steve Mason. “Never in 27 years have I seen
This one," he wrote. And, yes, it failed. Here’s a better idea: The Flow-Rite Remote Drain Plug allows you to open and close the drain plug right from the helm station. Forget to put the drain plug in? No more fumbling around underwater. Simply turn the switch at the helm station and – presto! – the drain plug closes. These remote drain plugs have been under development for a couple of years and have undergone some design modifications and upgrades after being used in the real world. They haven’t been around long enough for us to know how well they are going to perform versus conventional drain plugs, but we’re willing to bet they’re a better option than a $2 spigot.

None of the above. The Lewek Constellation is an ice-classed, dynamic-positioning, pipe-laying vessel (whew!) with a gigantic heavy lift crane designed to lay rigid and flexible pipes in really deep water. Think you’ll never see a ship like this? You just may. The Lewek Constellation is heading to the Gulf of Mexico to begin work for Noble Energy in the first quarter of 2015.

O NE OF THE FRUSTRATING things about watching crime shows like “NCIS” on television is the ease with which the investigators can track everything from cell phones to DNA. Just push a button or start a computer search and – voila – you know everything you ever wanted to know about a suspect. The crooks just don’t stand a chance … unlike in the real world. But now fantasy meets reality in a new product called SmartWater CSI, a clear traceable liquid which contains a unique forensic code that is guaranteed to last a minimum of five years in any weather conditions. SmartWater helps the police identify stolen property and locate the original owner.

The nonhazardous, patented, traceable liquid leaves a long-lasting identifying mark that is invisible except under ultraviolet light. Only a minuscule sample of SmartWater from the stolen property is necessary for scientific analysis by the SmartWater Forensics laboratory to identify the owner. The product has been on the market in the U.K. for several years and there are numerous testimonials to its crime-fighting abilities. It was introduced in the U.S. a year or so ago, and it has already garnered endorsements from half a dozen police departments in Florida.

For $99 you can get a kit that will protect your entire boat. Yes, it sounds too good to be true. But at that price, what have you got to lose? Check it out at www.smartwatercsi.com

NOW FOR SOME nautical trivia. “Mayday, mayday, may-day...” Someone’s in trouble, right? But do you know where the term “mayday” came from? It’s from the French, “M’aidez” (pronounced “mayday”), which means “aid or help me.” A mayday call should only be issued if the vessel and crew are in grave and imminent danger. If the danger is not that severe, then the correct call is “Pan-pan” (pronounced “pon-pon”). “Panne” (pronounced pon) in French means “broken” as in a breakdown or mechanical failure. A good memory aid for pan-pan is “Possible Assistance Needed” or “Pay Attention Now.”

KEEP LOSING your insurance cards? Don’t worry – now you can print them whenever you want right off our website. All you need to do is to log in to the BoatU.S. Policyholder Service Center at www.BoatUS-insurance.com/selfservice

Keep losing your BoatU.S. login? Don’t worry – all you need is your policy number, last name, and zip code. In addition to printing out your insurance cards, you can set up automatic payments, download policy documents, and change policy information including the lienholder.

S O THERE YOU ARE, far out at sea, on watch aboard your sailboat. After reading for 10 minutes, you look up from your book, and you see this on the horizon. What would you think? A floating Jules Verne amusement park? A hamster-powered cruise ship? A hallucination from lack of sleep?
The Afterdeck: Seamanship Stories

WHAT WOULD YOU do if you suddenly had water pouring in through a shaft stuffing box? One couple in our claim files reacted with speed and ingenuity when they put their 1982 32-foot Sea Ray in gear and heard water. They went below and found the ocean gushing into the engine room from the starboard propeller shaft packing gland assembly. Thinking fast, they grabbed a large, heavy-duty plastic bag and secured it over the shaft boot with hose clamps to slow the influx of water. The boatyard was closed, but the dockmaster was able to arrange an emergency haulout at another yard, where they were hauled out that night.

Sheila Schwede, the claims surveyor who inspected the boat, sees all manner of botched do-it-yourself work (see Alert, page 13) and is not easily impressed. But after seeing the quick-fix, she wrote, “It is the professional opinion of the undersigned, that the assured acted as a prudent boat owner, following discovery of the vessel's torn stern tube. His quick action of applying a plastic bag with hose clamps surely prevented additional damages from being occasioned.”

Seamanship is defined as the skill, techniques, or practice of handling a ship or boat at sea. At its broadest, it encompasses everything from the care and maintenance of the vessel to the judgment of the skipper in deciding whether or not to leave the dock in less than perfect conditions. Part and parcel of seamanship is dealing with the unexpected. The ability to react to a changing situation quickly and decisively can prevent the loss of the vessel, as was the case here. And as is the case with all good seamanship, this is a story we can all learn from, one that just might save another boat in a similar situation someday.

Seaworthy is looking for stories of how quick action saved the day with lessons learned that can help others. Write in with your jury rigs, troubleshooting, and on-the-spot repairs. Tell us about what went wrong and what you did to deal with the situation. Send us a photo if you have one. We’ll share the stories in coming issues in hopes that others will benefit from your seamanship.

Striking Lightning Facts

The afteDeck:

Seamanship Stories

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Letters to the editor can be emailed to Seaworthy@BoatUS.com or sent to Seaworthy. We reserve the right to edit for clarity and brevity.

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