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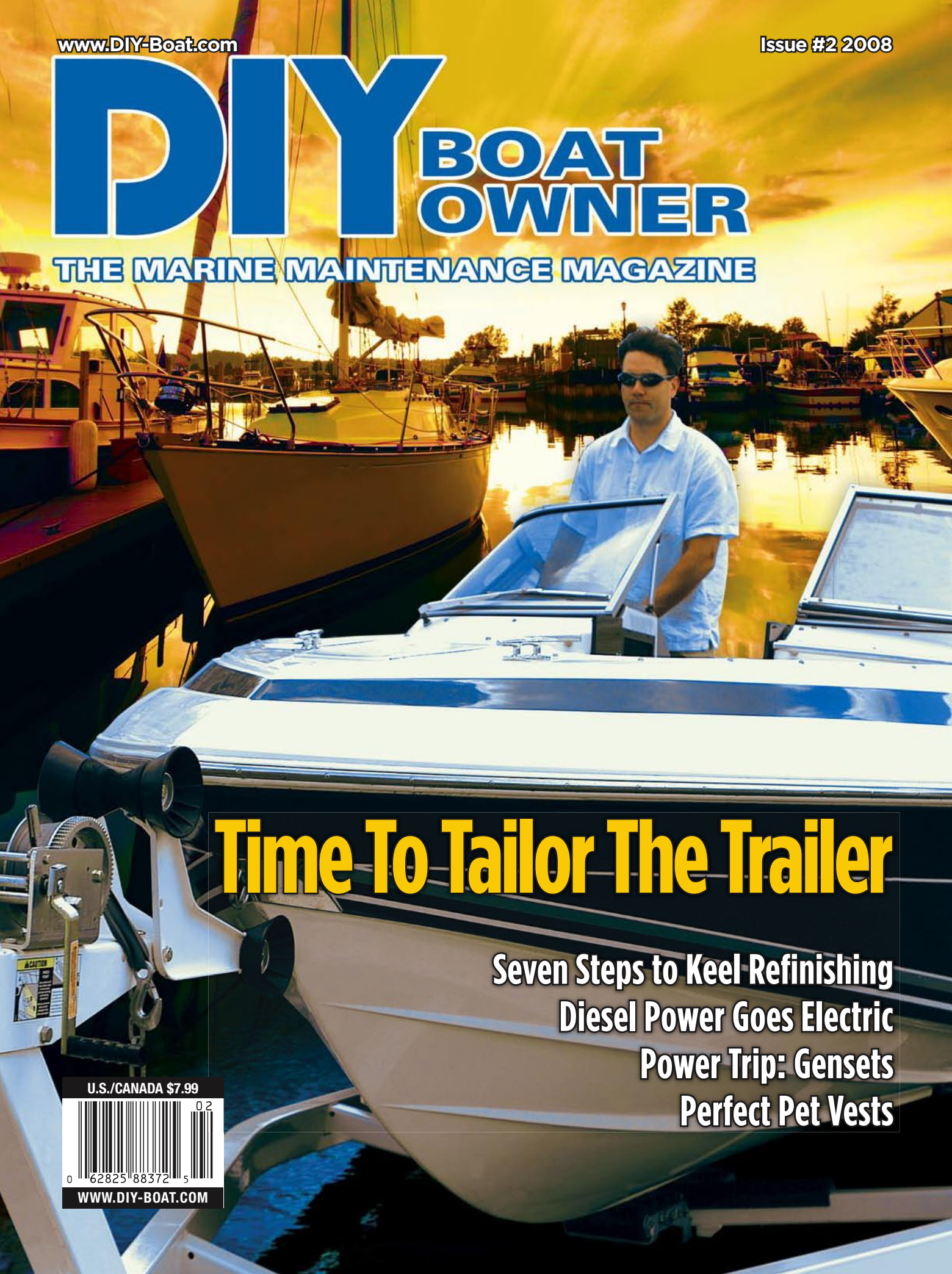
Issue #2 2008

DIY BOAT OWNER

THE MARINE MAINTENANCE MAGAZINE



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THE MARINE MAINTENANCE MAGAZINE
#2 2008

COLUMNS

DEPARTMENTS

Trailer Upgrades

Compiled by Jan Mundy

Bilge Pump Turn Off

In the article titled, "Bilge Pump Turn Ons," in DIY 2008-#1 issue, you missed a great opportunity to mention another major factor about bilge pumps. While Nick Bailey did a good job with his article focus on the pump switches, it's an even more important fact that bilge pump gallons per hour (gph) ratings are absolutely a joke. Being a certified electronics technician, I like taking things apart, seeing how they work, how they perform and why. I've taken a few bilge pumps apart and tested them and, while not 100% scientific, I have to conclude that most pumps would be lucky to actually deliver even one-third to one-half their rating when actually installed in a boat. The current process that I believe is now used to determine the flow rating is based on a pump's performance with no hose attached and there are no standards for the method of establishing the ratings. The realistic scenario is a pump connected to a length of smooth or corrugated wall hose that must lift the water from the bilge to the elevation required to exit the boat, all which reduce the output rating. Even the available voltage supplying energy to run the pump also reduces flow as the power supply diminishes. I didn't test every model but of the several I tested in the 750 to 1,200 gph range, all performed far below spec. If people want to spend $20 to $60 for a bilge pump that they may never need to use at full capacity, they need to understand that should they ever encounter a situation where they do need the rated capacity, they will never get even close to it.
Larry Erland, Reno, Nevada

Nick Bailey replies: The "nominal" bilge pump rating is just that, nominal. The rating is merely a name to identify the pump model. It is based on "open flow" rating of the pump, which is measured as the flow with zero lift of the water and with no hose restriction, in other words no hose attached. This is not in any way a realistic situation for a bilge pump but it is a reasonable way to rate a baitwell recirculation pump.

As recommended in ABYC Standard H-22, the pump manufacturers also publish two additional ratings for each pump and these are the ones to pay attention to: rated flow at 3.35' (1m) of lift and also at 6.7' (2m). These are the realistic ratings for a bilge pump installation and they are a lot less than nominal. Flow rates of approx 70% of nominal at 3.35' (1m) and around 50% at 6.7' (2m) are consistent with the manufacturer's own published data sheets. Various independent tests, including a landmark study of pump performance done in 1999 by Phil Cowley for West Marine, confirm the average centrifugal style submersible bilge pump loses between 5% and 11% of its nominal flow for every foot (304mm) it is required to lift the discharge water. Low voltage, in-line check valves, right angle bends in the hose and corrugated hose all contribute to making the pump's "real world" performance even worse.

In the real world, however, most bilge pumps are only designed to handle minor and routine dewatering. They are not designed to keep your boat afloat if it is holed. Even a 1" (25mm) hole lets in significant water, actually 44 gallons (166L) per minute if 5' (1.5m) below the waterline. Few but the largest, most powerful pumps can stay ahead of that and then only if human or battery energy is available to keep them running. A typical 1,100 gph pump just buys you a little time. If you need your pumps to do true emergency service, plan on installing more than one and big ones, at least 4,000 gph and larger. [Ed: For complete details on bilge pump selection, ratings and installations, refer to DIY 2000-#1 issue.]

Teak Restorer

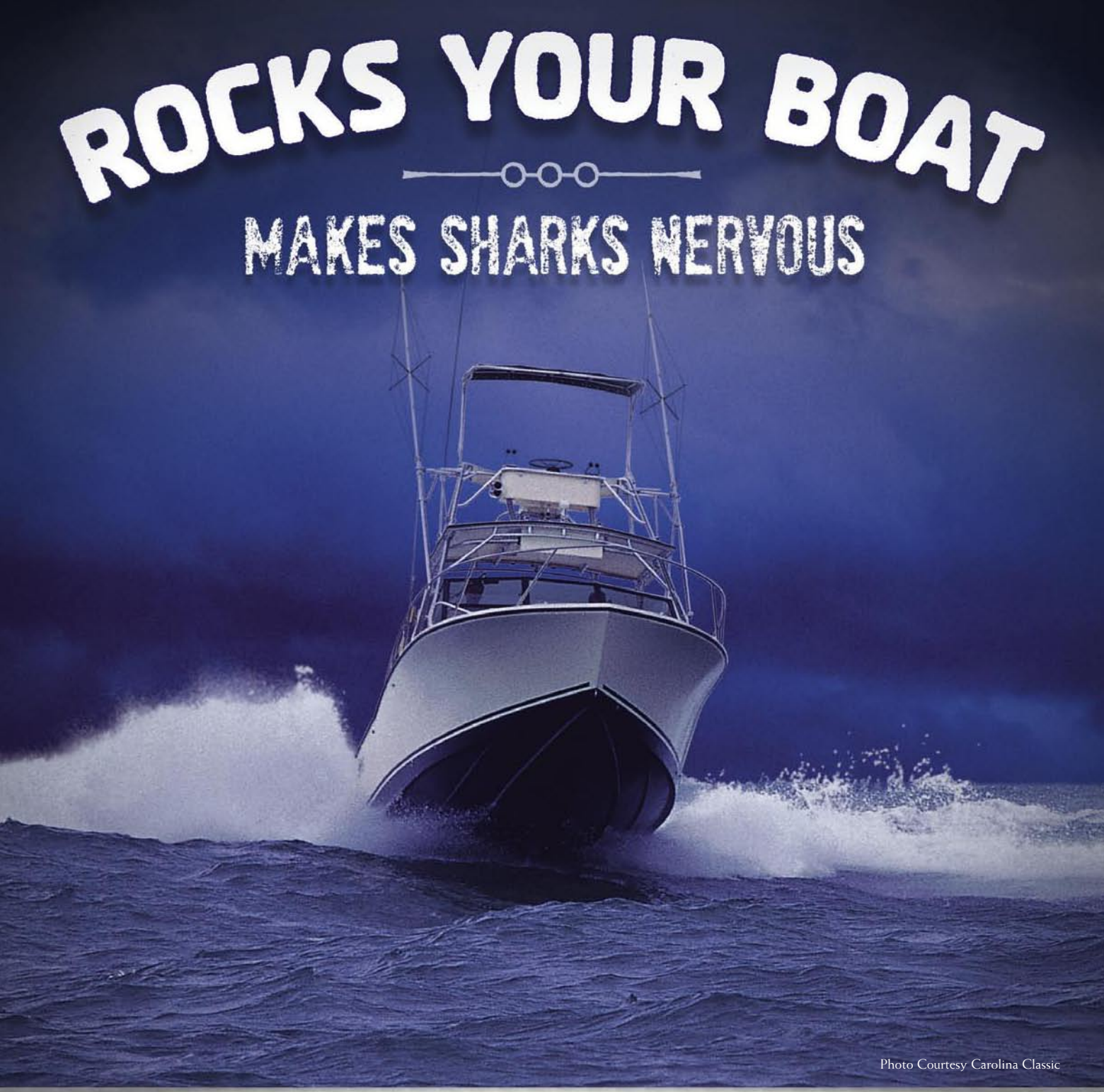
The favorite part of my job as editor is when I switch to my tester's hat to bench test the latest product offerings. Besides, a day in my workshop is the best therapy during our long cold and snowy winters in the near north.

Since reporting on teak cleaners in DIY 1999-#2 issue, I've been on the lookout for better solutions. I'm happy to report that Interlux Teak Restorer appears to outstrip its competition and also meet our DIY product mandates: most effective with the least amount of effort (a.k.a. elbow grease); will not harm other surfaces; and least harmful to the environment.

After washing with a boat soap to remove contaminants (**1**), just squirt some Teak Restorer over your teak and let "cure" for 10 to 15 minutes. Do this in the shade so the wood remains wet. The instructions on the label actually state that you should soak the wood first and then after the waiting time, agitate lightly with a soft bristle brush, scrubbing across the grain, before hosing off the surfaces. Exceptionally blackened and mildewed teak likely needs a second application.

This water-based product is safe for all surfaces, unlike the two-part, acid-alkaline cleaners that require you to rinse off spills immediately to prevent possible gelcoat damage. This teak cleaner restores the teak to its natural golden color (**2**), which I prefer over the two-part cleaners that bleach the wood to an artificial hue. If, however, you like the bleached look, then you won't like Teak Restorer.

When the wood has dried, apply your favorite oil or varnish. Interlux Premium Teak Oil, a honey colored, water-based formulation, is applied using a soft cotton cloth or brush (**3**). You can apply this oil over wet teak but it reduces absorption by about 20%. Containing fish oil and a rust inhibitor to protect deck fasteners from rusting, it is touch-dry in 15 minutes and you can walk on it in one hour. This oil does not raise the wood grain and two coats protects teak for one season in northern climes, four to six weeks in the south. As with the entire Interlux Boat Care line, both products are safe for all surfaces, especially painted ones. (What else would you expect from a paint company?)



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Auto Parts and Marine Uses: A Deadly Mix

We're always being warned about not buying components at the auto parts store for our boats but I incorrectly assumed a Gates fuel line would be okay. Placing a sensor for my Floscan fuel flow meter five years ago required replacing the factory fuel hose on the one engine on my 11 Meter Trojan. I purchased Gates M06272 (black rubber) fuel hose for the task from a local auto parts store. It is labeled as being made for fuel and PVC use, performing to SAE J30R7.

During commissioning this spring, I noticed some cracks in the outer cover of that hose. When I cranked the engine over to pull fuel through the hose, it began weeping gasoline into the bilge. Had I not been watching it, there could have easily been a catastrophe. I have since replaced it with Coast Guard-approved hose from West Marine but I'm shocked at the deterioration. There is no exposure to sunlight in my engine room. The boat is kept under a roof, so heat is not a huge issue. The engine room is clean and dry. I can't imagine what would cause such a failure. I guess it's just another case of "boater beware."

Darrell Gentry, Monkey Island, Oklahoma

Steve Auger replies: There are many different types of fuel hose available depending on the engine application. When you buy fuel or exhaust hose for a marine application, make sure that you verify that the hose (or any other part or component) has been tested to the U.S. Coast Guard (USCG) and/or the American Boat and Yacht Council (ABYC) requirements. In many cases, this means that the hose and/or other part will be marked as to its certification for a specific application. Also, the markings required may include references to Society of Automotive Engineering (SAE) and Underwriter's Laboratories (UL) standard compliance testing, both of which have marine divisions. You may see a hose for gasoline fuel service marked SAE 1527 and also be marked USCG Type A (A1, B or B1). Not marked? Not tested! Don't accept any less, even if the parts guy tells you, "It's just the same." It could be your life that you risk. The SAE J30R7 marking on the hose described by our reader refers to an SAE certification that has nothing to do with a marine application. Another area of important consideration is electrical equipment that is required to be ignition protected so that no sparks can escape and ignite any volatile vapors present. Do not substitute an automotive part for a marine part as automotive parts are not tested or approved for marine use.

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Seacock Service

The first item in the article titled, "Spring Fitting Out Checklist," on page 49 in DIY 2008-#1 issue, mentions the need to lubricate seacocks. How is this done?

Tom Sample, Parsonsburg, Maryland

To lubricate seacocks, the generic term for ball valves, too, while a boat is in the water, Forespar recommends the following procedure:

1. Close the valve.
2. Remove hose or tubing from the inboard side.
3. Drain any remaining water from the inside of the valve.
4. Swab some waterproof grease on the inside of the valve mechanism.
5. Reattach hose or tubing, checking clamps or fittings.
6. Activate the valve several times to spread the grease.

When the boat is hauled, perform steps four through six from outside the hull to lubricate the opposite side of the valve mechanism. Use winch, wheel bearing or water-pump grease. Avoid lithium or other metal-based greases, which may cause galvanic corrosion. Seacocks all too often suffer from "use it or lose it" syndrome. Regularly exercising them throughout your boating season is a good way to keep them fit for service. It's a good habit to close all valves at intake thru-hulls when you're away from the boat. Open them on your return. That habit translates easily to exercising the valves.

Buyer Beware: Boathooks

Costing $29.95, the Davis Team boathook was hooked over a dock cleat in strong seas and winds after the engine failed. The Davis Team held our 6,000lb (2,721.6kg) cuddy secure to the cleat. Davis offers a lifetime warranty against breakage of the Lexan hook.

Jan Mundy

Cost $10 and on the first use, the tip cracked and the hook buckled under the load while pushing the boat off a canal wall.

It always surprises me to see buyers lining up at boat shows to purchase $10 boathooks. Sure, it's a cheap price but what about the quality? Retailers often hawk these "loss leaders" to get buyers into a show booth where they will purchase other items.

Last year, I decided to join the crowd and I bought a $10 boathook. This was then stowed in the cockpit on the horizontal fishing rod rack alongside our reliable Davis Team boathook and a Bridgenorth Bailer. The former boathook has served us for 25 years and the latter is a new addition that promises to be just as good and does double duty as a bailer. We boat on the Trent-Severn Waterway in Ontario and this means traversing various locks to get to our favorite swimming holes. On one occasion, to push the boat off the canal wall while exiting a lock, I grabbed the cheap boat hook and the end buckled under the load. Toss that one in the garbage.

Fast forward to Labor Day weekend and our 150hp engine fails in heavy seas with the wind astern as we approached the marina entrance. Panic ensued but the 5hp kicker started on the first pull. I toss fenders overboard and grab the Team boathook. This small engine is no match for the seas and wind and, as we fly past the end of the pier headed for the beach, I have just one chance to grab the last cleat on the dock. I connect with the center of the cleat and watch in dread as the boathook end bent 25 degrees in the opposing direction and held until the boat came to a rest against the pier. The end deflected but it did not snap. Though we were in no peril, the Team saved our boat from an unintended beaching and possible boat damage and the hassle of refloating. Buy cheap sponges but do not buy cheap gear that you rely upon for safety.

— Jan Mundy

Liveable Cockpit

Winner of the Miami Boat Show Innovation Award in the Inboard and Outboard Cruisers category, the True North 34 from Pearson Yachts (www.tnyachts.com) features a convertible cockpit and hideaway transom. Moveable port and starboard forward seats move aft to create a U-shape complete with a stowable dining table. Best of all its unique, reverse transom design (also available on the 38-footer), incorporates a hideaway "tailgate" that disappears into the cockpit floor for easy access to the water and your water toys. An ignition lock prevents the engine from being started when doors are open.

1, 2, 3, 4, 5 and voila the cockpit becomes a hub for entertaining and water sports activities.

Extreme Heeling

Q: Sailing my 34' (10.3m) Pacific Seacraft hard on the wind in 8' to 10' (2.4m to 3m) seas and heeled to 25 degrees on a starboard tack causes water to leak into the port side. I can't actually see the water leaking but it settles into the port settee locker. I suspect it is getting in through the hull-deck joint or through the screws that fasten the teak caprail. How do I fix this? Do I have to remove the teak rail? Should I just live with the problem and keep my boat from excessive heeling?
Phil Littman, Stuart, Florida

A: Leaks that show up on the low side during hard upwind sailing with the lee rail under almost invariably originate from the hull-deck joint or any fasteners on the low side, such as the leeward genoa track or caprail. It would be a shame to mess up the varnish job by digging out all the teak plugs to rebed the caprail fasteners and it is certainly a big job to pull the caprail to access the hull deck joint. Instead, I would renew the exterior bead of caulking around the bottom inboard and outboard edge of the caprail and see if that helps. This is a Band-Aid solution and the leak source needs addressing in the future. Or reef the sails a little earlier.
— Nick Bailey

Slime Beater

Q: There used to be various anti-slime additives available for bottom paint but I no longer see these on the market. Some boaters recommend using pepper as an anti-slime additive for bottom paint. Can you recommend an additive to put into bottom paint to help with the reduction of the growth of slime and algae on my boat's bottom?
Michael Morelli, Kailua, Hawaii

A: StarBrite used to sell an antibiotic additive and they claimed it did some good. I've heard that cayenne pepper and grape seed work against slime but have never seen or read any hard data. Such materials, when added to the paint manufacturer's formula, don't usually stay in the paint film for very long so their long-term benefit is doubtful.

I know of some commercial fishermen in the Pacific Northwest (cold waters) that swear a coffee cup size of cayenne pepper added to every gallon of bottom paint helped but they generally use the cheapest soft antifouling available and they use their boats everyday so there isn't much build up anyway. The best advice is to use an antifouling paint with a biocide slime booster added, either Interlux with Biolux or Pettit with Irgarol. These paints were developed in a lab followed by real live testing and hundreds of thousands of dollars in R&D. You can't beat proven technology.

— Jan Mundy
Speciality formulated antifoulings are your best defense against slime.

Cleaning Off-Spec Stainless

Q: Does using an acid cleaner such as On/Off on stainless steel to remove rust stains cause the stainless to rust even more after use?
Frank Adshead, Falmouth, Maine

A: If stainless steel has insufficient nickel, etc, then brown oxidation is possible when exposed to an acid cleaner, such as On/Off. Stainless steel can corrode but the corrosion byproduct is not the telltale brown if the steel is manufactured to proper specs. Chemist Abe Kelly (former owner of Captain Phab Marine Products) recommends using a 5% to 10% solution of industrial or food grade phosphoric acid to remove rust and phosphatize any iron at the surface to prevent corrosion caused by atmospheric conditions. Phosphoric acid is a liquid and comes in different strengths. It likely would have to be diluted to the strength suggested. If you have difficulty in finding what you need, consider an aluminum boat cleaner that contains phosphoric acid. The presence of other acids won't interfere with the phosphatizing process. It forms aluminum phosphate, which reasonably resembles the color of aluminum when applied to boats, trailers, etc. Another product that contains phosphoric acid is Naval Jelly. Also note that phosphoric acid will turn rust (iron oxide) black.
— Jan Mundy

Sludge Sufferer

Q: For the six years we've owned our 1986 Ericson 32, we've serviced the 1986 Universal 25 engine per the owner's manual and articles in DIY magazine, bringing it up to temperature, no extensive idling, etc. The problem is that oil becomes black within minutes of starting the engine, so soon that I suspect a layer of sludge in the oil pan. The motor has a drain kit that extracts oil from the bottom of the oil pan. I've used Marvel Mystery Oil to loosen any sludge. I don't use oil additives but do use fuel conditioner. The engine with 760 hours doesn't smoke and there's no evidence of oil contamination. The oil is just black. I have not had the valves adjusted.
Chip Lohman, Woodbridge, Virginia

A: This is not a bit unusual. All your good work has not been in vain but the dirty job was unavoidable. Several things are happening and have happened. The engine is aging and the natural acids left from even the cleanest fuel consumption are digging away at cast iron and bearing surfaces alike. It would be really scary to take the pan off and see the shiny stuff at the bottom. The problem is that you replace the oil and filter and a few minutes later the oil is dark as tar. Even if you change the oil several times, the result is the same. This is comparable to a drop of black ink in a pail of water. The fresh engine oil is washing the "ink" off engine parts and colors very quickly.

There are several ways to clean up the situation. First and, by far the most draconian would be to remove the engine, tear it apart, send it out for an acid bath, reassemble and two years later have the same situation. Bad idea. You could rig an off engine system with an additional filtration element having a heater to evaporate moisture, which is a primary cause of engine corrosion and dirt. Not a bad idea, however, it's a trifle late in the game and a bit pricey. Good thought for future power, though. The easiest option would be a dilution cleaning of the engine. That means to change the oil and replace it with a lighter SAE rating that has been diluted with 20% kerosene. The engine is run briefly, 10 minutes max at idle. The oil is then changed and the process repeated. The oil is then changed twice more to remove any residual kerosene. Filters are also changed at each oil change. You will then have a very clean engine but that will not last.

Your diesel will continue to make soot and ash and stay dirty. It's the nature of the beast.

Let the engine oil do its job, change the filter four times a year and enjoy sailing. Be sure your fuel is fresh, no more than a few months (two to three) old at longest. Do not mix old and new fuel as then you simply make more old fuel. The air filter and breather tube must be kept clean and have the valves adjusted. If you are handy with feeler gauges, a valve adjustment can be a rewarding experience. Have a mechanic friend show you how to do it the first time, write down the procedure and you're good to go. If you can avail yourself of a very good Universal techician, have him check the engine timing. Timing is almost always outside the skill and tool sets of the usual boat owner but is critical to engine life and smooth running.

— Randy Renn

Rebuffing HDPE

Q: I coated my white StarBoard with a plastic primer. When I try to apply a polyurethane stain to produce a teak-like finish, the result is a very rough finish with the appearance of a non-skid paint. Do you have any recommendations or am I just spinning my wheels?

Daniel Sabado, Opalocka, Florida

A: We contacted King Plastic, manufacturers of StarBoard, and received this reply from Rick Butler: "Although I'm not sure what you mean by applying a plastic primer, I'm afraid that you are just spinning your wheels. The beauty and the curse of a high-density polyethylene (HDPE) plastic, such as King StarBoard, is that it is chemically resistant and not much sticks to it, which is why it is so easy to maintain and perfect for the marine environment. There are only a few adhesives that claim to stick to the material and no paints make that statement. Further, to my knowledge, there is no primer on the market that assists in any bonding process with polyethylene. These primers are mainly used with styrene plastics, PVC and especially with automotive plastics that are formulated to accept paint bonding."

Few adhesives and no coatings will stick to maintenance-free King StarBoard.

Drain Clearing

Q: I have a 2006 Mainship aft cabin trawler and the drain shared by the deck scupper and the aft-cabin shower is plugged and drains slowly. What do you recommend to use to snake out or pour down the drain lines to unclog?

Ron Jansen, Sarasota, Florida

A: Shower drains are notorious for clogging with hair and soap residue so I suspect it is the shower part of the drain that is slow as opposed to the deck drain. Although a harsh sodium-hydroxide (lye) household drain cleaner may be safe to use I would feel safer using gentler but slower acting enzyme-based drain cleaner. If you want immediate results, which might also positively identify the culpable section of the drain, loosen the hose clamps and disconnect the shower drain hose at both ends, remove any clumps of hair or debris and back flush the line with a dockside water hose fitted with a garden variety adjustable spray nozzle.

If the drain continues to be a problem, the flow restriction may be the result of a problem with the hose itself. Small diameter drain hoses often kink, so check the hose along its route for tight bends or kinks that are crimping the flow. If a kink or crimp is found, you may need to reroute the hose. Sometimes the hose has a "memory" and remains crimped even after straightening. In that case, hose replacement is usually recommended but, as an alternative, the hose can be cut and an elbow fitting spliced in to circumvent a crimp or kink caused by a tight bend.

If the larger hose to the cockpit drain is the problem, disconnect the lower end to clear any debris and back flush, if necessary. Note that the deck drain hose probably leads to a seacock below the waterline or possibly a thru-hull without a valve if it discharges above the waterline. Make sure you shut-off the seacock valve (if fitted) before disconnecting the hose. I would avoid using a snake. It might damage the inner wall of the hose and is unlikely to negotiate any tight radius bends.

— Nick Bailey

Dragging Blades

Q: Which is better on a sailboat, a two-blade or a three-blade fixed propeller? I am particularly concerned about power thrust in forward and reverse in docking situations. Is there any real difference in drag between the two when the boat is underway?

Bob Griffiths, Parry Sound, Ontario

A: The two-blade fixed has substantially and obviously less drag than the three blade. This is less of an issue if you can freewheel your prop when sailing and this depends on the transmission. The three blade offers better control, especially in reverse. You'll likely need a smaller diam-

Pat Kearns

Three blade prop provides better control but increases drag when under sail.

eter prop as the extra torque might be too much for the gearbox. On some boats, especially those with the propeller in an aperture, switching from a two-blade to a three-blade fixed prop gives tremendous control at low rpm and when powering through a chop in heavy seas. The trade off is increased drag, which makes the folding three-blade prop, though expensive, a better alternative. A prop supplier can run your engine, gearbox ratio, etc. specs through a prop calculator to determine the size of the three-blade prop needed.

— Jan Mundy

Charging from Twins

Q: I have a fishing boat with twin MerCruiser 454 engines. While fishing, we like to run one engine. My boat is equipped with three battery banks, one for each engine and a house battery bank. Each of the alternators has a sense wire. I need help in determining a wiring diagram so that a charge can be maintained on all three battery banks while running on either engine.

Kenny Sallee, Livingston, Texas

A: It is important to remember that it is always the house battery that requires constant charging unless you are drawing power from the start batteries. You have three main options. First, install a house battery bank on each engine and supply house power from whichever engine is running. This does give you some good redundancy as well. Of course this requires some work to install and if you do a lot of boating may be worth consideration. Secondly, install a switching arrangement that takes the house power supply from the battery and connects to either engine through a changeover switch. Lastly, install an automatic charging parallel device. This connects to the engine without the house power battery bank. When this engine is used, the rise in voltage when charging is detected and the automatic switch operates and starts charging the house battery.

— John Payne

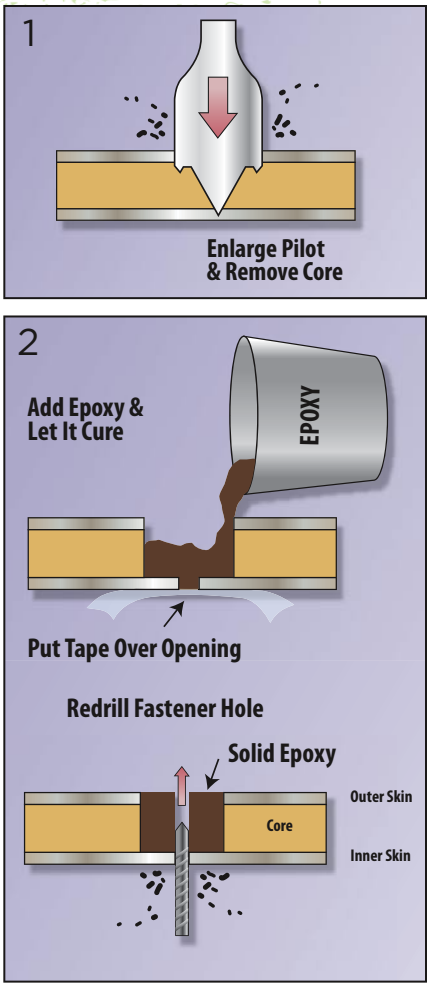
Jan Mundy

Options are available to those who need to charge multiple battery banks from twin engines.

Mounting Rod Holders

Q: I previously installed rod holders on the overhead in my 1999 Four Winns 245 Sundowner cuddy using very short screws. I am now replacing the rod holders with a more robust product. The overhead is carpeted and I'm guessing there is some kind of Masonite or similar product between the carpet and the fiberglass. What is the best fastening method?

Tom Smith, Rochester Hills, Michigan



Joe VanVeenen

Potting fasteners in cored laminates.

A: The carpeted overhead in your cuddy is likely either applied directly to the underside of the deck or to a molded fiberglass inner liner. Rap it lightly with a hammer. Does it sound solid or hollow? An inner liner is not really designed to have anything substantial fastened to it but fishing rods and holders are probably light enough you can get away with it. A liner is too thin to hold screws well and there may be little space between the liner and deck underside but a pop rivet should work nicely. If the carpet is glued to the actual underside of the deck and presuming the deck is cored, the overall deck thickness could be 1/2" to 3/4" (12mm to 19mm). Short screws are the only option in this case unless the item you are hanging is heavy enough to justify drilling all the way through the deck and thru bolting. Be very careful not to drill beyond the depth of the inner skin and core of the deck unless you plan on thru bolting. If you are thru bolting be careful to properly caulk or even "pot" the fasteners to prevent the possibility of water leaking into the deck core.

— Nick Bailey

Tankless Water Storage

Q: I need to replace my 5-gallon (18.9L) hot water tank on a 1991 Sea Ray and am considering installing an on-demand system. Does it provide enough hot water for showering and normal use? What are the pros and cons of this change? Are there special installation issues I should be aware of?

Lee Roach, Pennsaukin, New Jersey

A: Instant hot water without a storage tank is a nice idea and it is technically feasible to have enough hot water instantly available for a decent shower. It just requires large amounts of energy on demand. That means either propane or 110-volt AC power (220 volts is even better but harder to come by). Diesel fired heaters also exist but I am assuming you have gasoline engines. Propane is the traditional method of doing demand hot water on boats and relatively simple to add if you already have an approved propane system installed. Note that there are no American Boat and Yacht Council (ABYC) approved on-demand hot water heaters. However, propane and boats have a difficult relationship. Any installation should meet the relevant ABYC (U.S. Coast Guard does not regulate LPG on recreational boats) standards. A 110-volt AC power supply is always available when you are plugged in at the dock but underway or at anchor it can present problems. These appliances draw up to 30 amps at 110 volts AC thus requiring a decent sized onboard generator when away from the dock (assuming you don't mind turning it on each time you want hot water). Since you are dealing with high voltages, this installation may also require a professional marine electrician to keep your insurance company happy.

— Nick Bailey

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Water Access

Story and photos by Pat Kearns

"Water, water everywhere …," but getting to it, on it and in it is becoming more challenging for boaters.

The following is a quote from the book, *Unknown Florida*, by Florence Fritz: "1950 … people with modest incomes enjoyed … fishing and sailing (boating) … neat homes … a boat on wheels ready to launch where they pleased." In those days, it was pretty much the same in all regions where waterways, near and far, beckoned with the lure of family fun, fishing and cruising and other on-water recreation. In the 50 plus years since that time, the tide has turned on "modest income" boating access and the face of the waterfront is changing fast. The relaxed heartbeat of boating is becoming a highly stressed case of high blood pressure for boaters and the industry that serves them.

This distress is caused by the gradual but persistent erosion of our water access on every level from the traditional marina or boatyard dock to the simple act of slipping the canoe, kayak or skiff into the water from a beach. Owning a boat is just no fun if you have to go through political gymnastics and logistical gyrations to get the boat to and into the water.

Public access to water is rapidly being redeveloped and converted to exclusive private access and that's limited to those who have the initiation fee to purchase condo-style boat storage privileges, wet slips or racks. In my neighborhood in Southwest Florida, over 1,500 "hi 'n dri" rack storage rental units have been lost to private development in the last five years, a municipal mooring field has been closed entirely and most of the facilities, boatyards and marinas that traditionally form the working waterfront are in holding patterns, watching and waiting for their destiny. Sadly, only a single full-service, publicly accessible boat yard remains in Naples, Florida, and access to it is severely restricted due to draft limitations of its host creek. This is not the exception but rather the rule and it's a rule that is changing the game for the average recreational boater.

What has all this to do with boat owners? Everything! It's "everything" because gaining, protecting and regaining access to the water for boating is no small task. So far, boaters are the biggest losers in the competition for access to the waterfront. If we snooze, we will lose even more and lose it faster.

Water Access in Flux

Ten years ago, studies found that only 10% of boaters complained that access to their favorite waters was a problem. Regionally, very popular boating areas experienced a higher hassle factor but still it was not a consistent issue and boaters accepted fluctuations in access convenience. What they weren't observing was the widespread seeding of what we now clearly see as evidence of an emerging boating access crisis, as more publicly accessible facilities that create access to boating waters are acquired for development priorities other than boating access, including an increasing demand to set aside certain waters or wet lands as protected from any sort of activity, private or government, that would enhance or even preserve existing access facilities. Maybe none of this is obvious to you yet but the scenario is coming to your favorite boating access site soon.

Boaters are the first to be affected by loss of access, e.g., the sale of a popular local marina with rental wet slips and rack storage. The marina owners want to retire and their children are not in line to take over the operation, which has been family owned for decades. Local development has been booming and the site has been the apple of several developers' eyes. The owners could recover their original investment and more by selling to a developer who wants to create a waterside complex of luxury residential units, retail shops, restaurants and other attractions. The temptation is too powerful to resist. The marina owners need to make an exit plan. The marina is sold.

The developer's plan is to keep that maritime ambience even though the traditional marina will disappear. Short-term dockage will remain for visitors who come by boat but all the rental slips and dry stack spaces will be privatized. A percentage of both wet and dry storage is reserved for new owners of the waterside residential units. We have seen this dynamic in action everywhere navigable waters flow. Great idea for the developers and even the town council likes it because it creates a destination for visitors and adds to the municipal tax base. What is lost in the decision-making process is consideration of the jobs and revenue structure that is directly and indirectly produced by the marina. That's called economic impact and the marine industry is playing a catch up game to prove its positive impact everywhere that it exists.

Diminishing slip and rack space is pushing more boats to the launching ramps, clogging the flow of boats into and out of the water as the lines of tow vehicles and trailers grow longer. Even if you can get your boat into the water, you will face the same

How's this for a waterfront location? These boats have a bird's eye view of the mangroves below. Finding a berth for your boat is about whether you can find a slip or even a fourth story storage bunk in the sky.

More boats are taking to the road on trailers and this taxes the capacity of publicly accessible ramps. These rigs line up on a nearby roadside, risking the wrath of local parking enforcement, which, by the way, has been sympathetic to the boater's plight.

Fewer and fewer boatyards enjoy the luxury of being on the waterfront with enough ground space to bring boats ashore for their craftsmen's attentions. Olsen's Marine Service in Fort Myers, Florida, is holding fast in its commitment to provide traditional yard services to its customers.

This luxury residential high rise has slips only for its unit owners. It's a beautiful complex and will bring needed tax revenues to the municipality but the project displaced over 500 publicly accessible wet and dry storage spaces and a full boat service facility.

scarcity of places to park your rig while you are on your boat. Valet services for off site parking are now a reality in some popular harbors. Even bringing your trailerable boat home for dry storage is becoming a problem as your non-boating neighbors don't want to see a boat parked in your yard. Municipalities are developing ordinances to prohibit the storage of a boat (or RV) on residential property unless the "vehicle" is out of view. That means that you can't park the boat in your driveway if it can be seen from the street.

Environmental preservation interests are also colliding with the growing demand for public water access and that is a very tricky balancing act. I don't know a single boater who isn't interested in helping to maintain pristine waterways.

The challenge is to achieve balance for all vested interests. While boating continues to grow, the availability of storage space for the burgeoning population is not keeping pace. The marine industry's aggressive Discover Boating (to grow boating) mission conflicts with other interests who see uses of the waterfront beyond those of the boating public. It's a dilemma of determining the best use of the available property in the context of preserving public access to the water, while also planning for the needs of the environment and the economic needs of the community.

Join the Cause

When a public facility, renting slips, rack space and/or moorings goes away toward private development, what do those boat owners do? Where can they go? Boaters with boats too big for trailers but not rich enough for the new privately developed and owned facilities are caught in the middle. Does the boater who owns a $25,000 boat really want to or can afford to spend upwards of $100,000 for a storage bunk in the sky or the air between the pilings as a condo slip or rack space owner? What are the options for boat owners like this who are caught in the middle?

It's boaters' voices that need to be heard when local and regional planners consider new developments. Start with your local area. Watch for and monitor boating access issues in your area. Join in efforts to preserve and protect facilities and discuss options within your community as it faces water access issues.

BoatU.S. is now lobbying for a bill in Congress, the H.R. 3223, "Keep our Waterfronts Working Act," which would help preserve and expand water access in coastal and Great Lakes states. This bill would provide matching grants to support "water-dependent commercial activities" like working boatyards and public marinas. You can help be part of the access solution by contacting your member of Congress and urging them to co-sponsor the bill H.R. 3223. For more information or for help emailing a letter to your member of Congress go to www.BoatUS.com/gov/workingwaterfronts.

"Gently lapping waves and briny breezes wash away the troubles of the day." Without access to recreational waters, this lovely thought goes away along with fishing, watersports and "row, row, row your boat."

About the author: Pat Kearns is a National Association of Marine Surveyors certified marine surveyor (CMS) and she is DIY's technical editor. She operates Recreational Marine Experts Group, a survey and consulting firm in Naples, Florida. Her opinions are not necessarily the opinions of DIY magazine.

Tech Tips

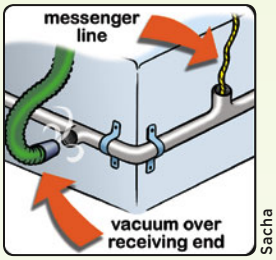
Mirror Finish

To restore the shine to chalked and faded acrylic (i.e., Plexiglas) lenses, ports, even compass domes, polish with Star brite Marine Polish using a J cloth or similar soft cotton rag and rub until clear. Follow with a coat of 3M Scotchgard Marine Liquid Wax. To shine and remove fine scratches on polycarbonate (i.e., Lexan), just apply the Scotchgard wax twice a year. Do a small test patch before doing the entire surface.

Mike Macdonald, "Mardi Gras," Toronto, Ontario

Best Wire Snake

A no-fail method to fish wires through tubing is to feed a messenger line into the start hole and place a vacuum hose end where you want the messenger to exit the tubing. Seal any unused holes openings with tape to increase airflow through the tube.



Sacha

Chip White, "Trinidad," Everett, Washington

Sensible Gear Stowage


Jan Mundy

How not to stow boat stuff.

Organize all goods stowed onboard by making a stowage checklist listing the item and where it's stowed and post it by the navigation table so that the entire crew can find any item onboard.

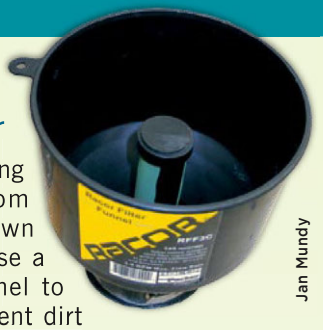
Author and DIY columnist Roger Marshall, from Rough Weather Seamanship for Sail and Power*; 304 pages, McGraw Hill.*

Ear Comfort

As a preventative measure against Swimmer's Ear, a painful infection caused by contaminated water getting into the ear when swimming, after swimming dry your ears then apply a few drops of one part white vinegar and one part rubbing alcohol.

Sheryl Shard, "Distant Shores," currently cruising the Caribbean.

Fuel Strainer


Jan Mundy

When filling tanks from an unknown source, use a filter funnel to help prevent dirt from getting into the tanks. It may slow the process but it is good insurance.

Footing is a Snap

Lay closed-cell, high-density interlocking foam panels over fiberglass or wood cabin floors to protect surfaces from impact and to provide a soft and cushioned slip-resistant walking surface. These lightweight panels install in minutes and provide a durable, fire-retardant, waterproof surface that also offers some sound dampening qualities.


Jan Mundy

Reefer Wipes

To provide some lasting protection against mildew in boat refrigerators, first clean hard surfaces and then wipe them with a disinfectant wipe, those packaged cloths that are pre-wetted with a diluted solution of quaternary ammonium chloride. Just pluck the wipe from the top of the dispenser, wipe surfaces, let dry and discard the wipe. Be sure to leave the door open when the reefer is not turned on.

Reed and Judy Whitten, "Filamingo," Cary, North Carolina

Mildew Remover

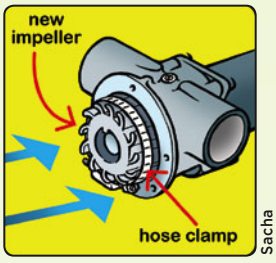
Spray on Lysol mildew remover with bleach, wait a few minutes and watch as mildew stains disappear from gelcoat surfaces. Do a test spot first before using. [Ed: Always rinse off and don't let any household cleaner dry on the surface or it might cause irreversible surface streaking. Mildew removers such as Lysol are toxic to the marine environment so use cautiously.]

Mike Wiseman, "Hawkeye," Mason Neck, Virginia

Although reader tips are accepted as submitted in good faith, DIY has not tested or proven those tips. DIY offers no guarantee or warranty as related to their fitness or suitability for service or application as reported.

Impeller Restraint

To install replacement impellers, first lubricate the inside of the pump housing and the new impeller with waterproof grease and then take a worm screw hose clamp just large enough to fit over the impeller when fully open and slide it over the impeller. Tighten the clamp, positioning the impeller blades in the proper orientation, until the impeller is slightly smaller than the housing. Lay the clamp over the housing and seat the impeller in the housing.



Sacha

George Hirsch, "Selah," Port Dover, Ontario

Drilling Tactics

When drilling holes for thru bolts or fasteners, rather than using a spade drill bit, which has a tendency to elongate the hole diameter larger than the desired fastener size, a better choice of tool is to use a serrated tooth holesaw, which produces a clean hole. Carbide tipped saws cost more but last longer.

Gene De Gennaro, Castro Valley, California

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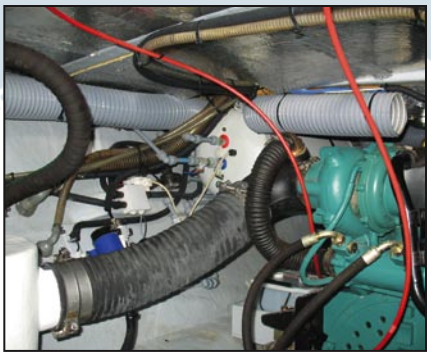
BREATHE EASY

Ever tried to sip a thick milkshake through a soda straw? That's what your diesel will experience without a constant and generous supply of combustion air. The result could be a very big headache in the process and the not-so-sweet taste of costly repair bills.

Story and photos by Randy Renn (exceptions noted)



Engine space ventilation hoses are mounted high in the space to pick up rising hot air. The purpose of the ventilation system is solely to dissipate heat and provide a continuous powered supply of fresh air for diesel engine combustion.

Pat Kearns

A system of corrugated vinyl hoses distributes the fresh air drawn into and blown out of the engine space by the inline blower motors (as shown by the arrow). The engine air intakes take care of pulling in the cooler air needed for efficient engine combustion.

Machinery space ventilation is very often overlooked as a maintenance function for your power plants yet it is critical to engine performance. When your boat was built, careful consideration was given to how much air equipment installed in the machinery space would need and the engineers had to determine how to deliver that air. In most cases, even careful planning left little room for additional equipment and made no allowance for equipment aging or restrictions.

Dilligent boatbuilders use the airflow and blower specifications formula taken from ABYC Standard H32, "Ventilation of Boats Using Diesel Fuel," for your engine space and maybe add in heat factors as supplied by the engine manufacturers for optimum engine performance. We can hope that builders also added factors for heat generated by exhaust parts, battery charger, refrigerator and air-conditioning compressors and all the other gotta-haves on the builder's option list. The end result is very often a fair but truly marginal equation and an installation that is barely on the edge of adequate for air flow and heat dissipation.

In the end, it's all about your engine's need for pulling airflow in and pushing heat out of the engine space. The engine is breathing hard and often perspiring before you put it in gear. Heat is really bad news for practically everything except making hot water. Your alternator, batteries, belts, fuel lines and hoses all have life spans and heat reduces that life by some measure. That's all bad but what is worse is the effect of inadequate airflow on your power plant's internal parts. Without the correct amount and quality of air your engine runs warmer, with less power and higher maintenance costs due to carbon build up and exhaust restrictions. This translates into big bucks and bad days in tight places.

Restrictions

Now, we add soundproofing, which is that wonderful thick insulation that keeps sound to a minimum and captures and retains heat to the maximum. Factory installed insulating systems are likely fine, as the builder took into consideration the myriad factors involved. Aftermarket or owner installed soundproofing may affect the needed airflow and heat rejection.

Following the installation instructions, the installer mounts thick insulation that makes the space smaller, uses tape to seal the edges of the engine space and sealer to seal up any open gaps. Correctly done, this is very good stuff but, if no thoughtful provision has been made, the engine could be getting much warmer than planned.

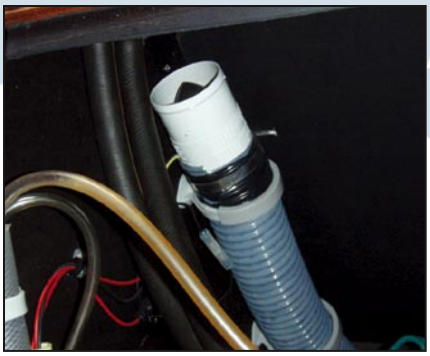
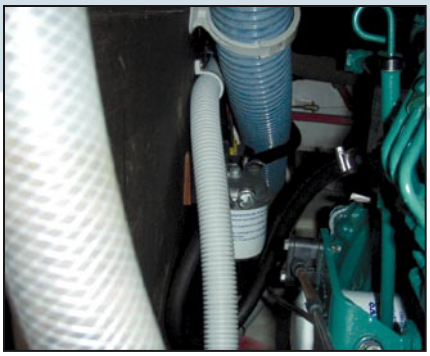
Why is all this so important? When your engine was designed to run at a given horsepower, it's combustion air need was measured under certain very strict criteria. Depending on the builder or year, it may have been rated at sea level with 17,800 BTU fuel at 60% humidity, running at 170F (76.6C) and at 68F (20C) ambient air temperature to produce whatever power. When temperature changes, the fuel quality is diminished due to a heated engine space and/or the ambient air temperature goes up and either condition can hurt engine performance. At some point, say 165F (73.8C) ambient air, performance falls very quickly.

An example is a sport boat that runs very well in the morning with a cool engine and engine compartment. By the afternoon, the now heated exhaust, engine block, heat exchangers and generator have now raised the engine space not just the differential 30 degrees but an exponent due to the growing nature of heat and resistance. The cooling system works harder, lubricants weaken, air is less dense so there is less power. The owner adds more throttle, less of the now excessive fuel is burned, carbon builds, exhaust temperature climbs and engine wear indicators spiral skyward.

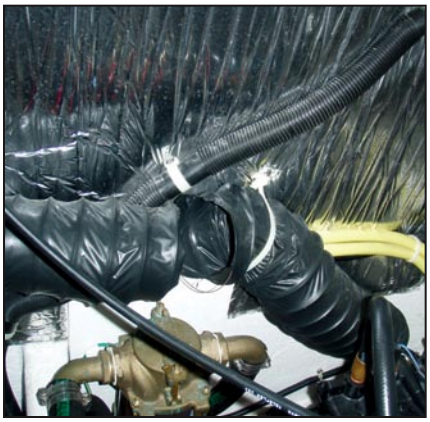
A space that is even close to being too airtight or restrictive costs you power, maintenance costs and perhaps many hundreds of hours of useful engine and machinery life. The effects are somewhat like running your car engine in stop-and-go traffic in August but, in the case of an air starved diesel, the condition exists all the time.

Maintenance Demands

A diesel engine ventilation system on a conventional pleasure craft is made up of deck or hull vents, perhaps louvers or


Bilge blower (left) mounted very high in the engine compartment is routed low into the bilge (middle) then to the transom where it was not attached to the exhaust vent (right). The engine smoked badly, ran warm and aged very quickly is less than 100 hours as a result of practically no ventilation made more deadly by a nearly airtight engine box. This was a factory installation on a new vessel from a very respected builder. Being new or used does not ensure a proper ventilation system.

(left) Aged and torn hose. (right) Hose crushed by installation from the builder caused flow restriction in a fairly new vessel with ABYC-approval plate installed.

This sport fishing boat was given to heavy spray and with the exhaust vent facing forward the ventilation hoses filled with salt after four years of use. Lack of engine space air flow caused the engines to smoke and lose performance.

grates, hoses and likely blower motors. These components were well placed and supported at installation but it's very possible things have changed a trifle since new. Below are a few items that can affect your ventilation system performance.

Crushed blower hoses are very common and, along with hoses that have droops or loops, make your engine struggle to breathe, loose power, overheat and develop the very bad sign of heavy smoking. Blowers work harder with drooped hoses that can fill with water and salt deposits. Hoses get occupied by birds' nests, mouse houses and general debris. Anything that slows or stops air is very bad. Torn hoses can be just as evil as they do not allow the blowers or natural ventilation to supply the very air your thirsty engine or system needs to perform properly.

So what's to be done? Remove anything from the machinery space that is not screwed down, strapped, bolted or glued. Remove the old outboard motor fuel containers and propane canisters (which shouldn't be in there anyway) first and then toss out fenders, fish buckets and extra line lying on or against ventilation hoses. Replace any torn hoses and get blowers tested and cleaned of debris. Also clean ventilation louvers and grates. Perhaps clean the engine air filter. Your local tech can calculate whether your engine has enough ventilation air exchanges or you can research it by subject in the ABYC H-32 standard but be sure to read all the way through to get the big picture. If you find your engine lacking, you may add more ventilation openings, smoother runs of hose or additional blowers that could have manual or thermostatically controlled switching should the engine space become too warm.

Symptoms

Soil staining on the carpet or deck edges adjacent to engine hatches or boxes, engine smoking that has become much darker, temperature that has been going up and a lack of the old zip the engine used to have are all signs that your engine is air starved. If your engine speeds up when you open the engine box, your engine is definitely in harms way.

A good and simple way to check if your space/engine is being abused is to use a laser pyrometer and shoot a static component, perhaps the air filter bracket. If it is above 140F (60C) you have a ventilation issue. The cure is to get the heated air out and encourage the cool air in. Correct it now before the unparalleled silence of an engine refusing to run alerts you to a problem.

As an "order of magnitude uncertainty," ventilation must not be ignored. Your engine will love you for the effort, your oil will stay cleaner, the engine will run cooler and overall engine life will benefit in a remarkable way.

About the author: James R. (Randy) Renn is a USCG licensed operator, avid sailor, sport fisherman and one of a few marine surveyors who is also accredited as an engine surveyor. He operates Marine Forensic Technicians in Stevensville, Maryland.

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POWER to Spare

Integrating a system of charging, storing and distributing electricity means that you can be certain of always having the required electric power at your disposal. In Part One, the author looks at considerations for choosing and installing a Mastervolt Whisper diesel generator.

The Whisper 3.5 kW delivers sufficient power to run an air-conditioning system, small washer-dryer, scuba compressor, electric heaters or a low energy watermaker and, at the same time, charge batteries quickly so you can switch back to silent inverter power for the remainder of the day.

Story and photos by Paul Shard

When Sheryl and I were making decisions about equipment for our new Southerly 42 sailboat, the question came up about whether we would be putting a generator onboard. Before we could answer that we needed additional design work to evaluate our boat's electrical needs and devise a system that worked with or without a generator.

When contemplating adding a generator, the first consideration is assessing power consumption. How much power do you need? How much is needed while sailing? How much is needed at anchor? What are the main power consumers on board? How much power is 12-volt versus AC (120-volt house current) power? The second consideration is how the power will be generated and stored. Are the engine alternator and/or auxiliary generator or wind or solar power the main power sources? What about the battery bank capacity?

Powerboaters need to store power for times when they are at anchor, otherwise, they run their engines. Rarely are they concerned about the power used underway since the engine alternator(s) are constantly restoring the power consumed along the way. Sailboats often need more power when underway under sail only to operate navigation equipment, lights etc., without running the engine.

Electrical Budget

If you have a boat, you can monitor your existing systems to plan additional charging and electrical options. As we were planning a new boat, I did a budget of both the 12-volt and AC power devices that we considered adding. Some would be the same as on *Two-Step*, our previous 37' (11.2m) sailboat, some would be new things we didn't have before. Power consumption for our stereo, Raymarine instruments and chart plotter, cabin lights and others all remained the same. There are a lot more cabin lights on the new boat, so I doubled the budget for cabin lighting. The hardest items to budget are the big consumers like refrigeration. So much depends on how efficient it is and a well-installed unit might use 30% to 50% less power than another similar model and tropical use means it runs more often.

My 12-volt electrical budget appears in **Table 1** on page 20. To make it more helpful, I have updated it with measurements taken from the new boat here in the British Virgin Islands where I'm writing this article. **Table 2** lists many of the common house current appliances found aboard boats, many of which we don't have onboard. The last column lists whether the appliance can operate from the vessel's batteries via a large inverter (2,000 watts). If you are planning to have any of the devices listed as "No" onboard, you'll need a generator to run these or run them only when connected to shorepower. If you plan to include any of the "Maybe" devices, then you could consider a generator, depending on the size of your batteries and whether you could possibly run them off an inverter. If you intend to run larger devices on an inverter, you need a large battery bank with 400 amp-hour minimum but larger than 600Ah is better. Remember, even if you have a large battery bank and inverter, you need some way to recharge it.

At the risk of oversimplifying, if you have any large power consumers onboard, you probably should consider a generator. Big power consumers include an air-conditioning system, clothes washer/dryer, microwave oven, scuba compressor, etc. Many boats have some form of inverter that powers 120-volt devices from the 12-volt batteries. This works great for small items but running anything with real power requirements needs too many batteries to be practical. Running a typical small vacuum cleaner for 10 minutes, for example, requires 25Ah from your batteries. Running a 120-volt watermaker for two hours would take 180Ah and even if you did have such a big bank of batteries, you still need to replace the power consumed. Neither the alternator, solar panels nor wind generator can produce this much power easily. So, as you decide on more 120-volt devices, you are increasingly pointed to a genset.

We considered a generator for a few reasons. First, it easily produces enough power to replace my budgeted 234 amps in just over two hours. It is quieter than the engine since. Best of all, a generator allows for our two dream options for the new boat: a washing machine and a scuba compressor.

Alternate Power Sources

For sailors in windy locations, a wind generator might make sense. We had one once and did not like the constant noise of the blades. We decided we would not have another one but that is a personal choice. Many cruisers love them and the manufacturers claim to make quieter versions.

We seriously considered a large solar farm to provide the electrical needs for the new boat. Finding an unshaded spot where the panels wouldn't be in the way is often a concern. We may have been able to

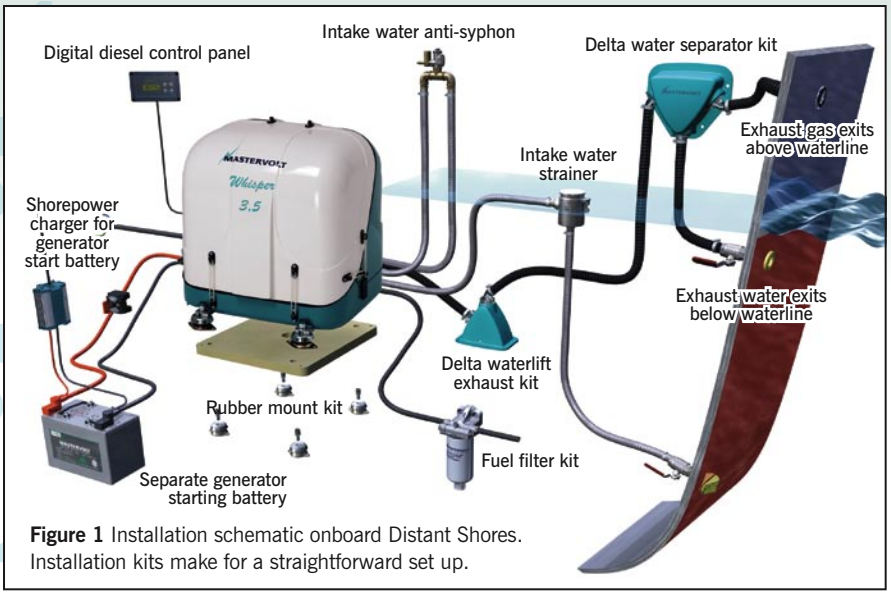
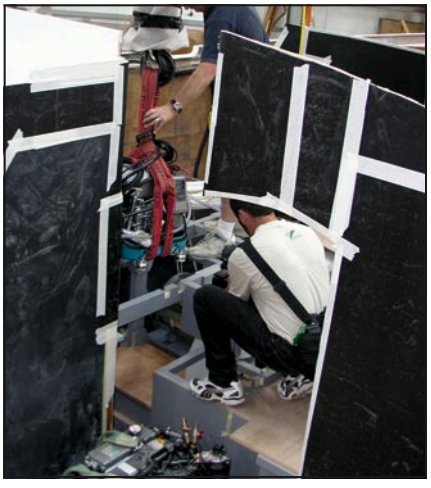


Figure 1 Installation schematic onboard Distant Shores. Installation kits make for a straightforward set up.

Extremely compact oil-cooled, one-cylinder diesel engine, the Whisper 3.5 has a sound shield of thick polyester.



Mounting the genset during construction, before attaching the deck, greatly simplified installation, though few have this advantage.

put an arch on the stern with some panels mounted on top but there were two big factors against doing this.

First, we needed a very large solar array to provide a significant addition to our power needs. I estimated a solar array that measures 5' by 7' (1.5m by 2.1m), cost more than $3,000 and generated 100Ah per day but not if it's cloudy. Including the arch, it would weigh over 100lb (45kg). The biggest factor working against a large solar installation for us was that we still needed a generator in order to run the big power consumers: the scuba compressor and washing machine. The plus was that the generator would allow the freedom to run power tools, even a portable electric heater if we wanted.

Design Integration

Figure 1 shows the system we designed for *Distant Shores*. Two large AGM batteries (capacity 450Ah) store enough power for one full day of sailing before reaching the 50% level and needing recharging. Charging is by a 2,000-watt inverter/charger capable of charging at 100 amps. A 3.5 kW generator provides AC to run all the big loads including the charger. All components are made by Mastervolt, since I was keen to have an integrated system with components that played well together. It appears as one of the biggest advantages that Mastervolt could provide everything, from the AGM batteries, battery monitor, generator, inverter/charger and isolation transformer.

System Install

Although I was quite psyched up to do the genset, in the end I did very little of it. There were a couple of reasons for this. First and foremost was the fact that the boat was built at the Northshore Yachts factory in England and we're located in Ontario, Canada. Being able to install components in an unfinished hull was much easier, especially for the generator, which would require dismantling in order to fit into the boat once finished. Of course, this varies considerably for each boat. It may be quite easy to get the genset into place if there is a good spot to position a generator in your boat but, if it needs dismantling, having a technician from the generator manufacturer involved might be a good idea.

Similarly, the inverter/charger was installed at the factory and connected up to the generator and the batteries. What I did do, however, was the systems' design and, in a way, I think the design phase was the best place for me to put in my DIY experience. After 18 years of international cruising with our old boat, a Classic 37, I knew how we would use the system.

Installation Considerations

Installing a generator is a fairly major job but within the ability of a competent DIYer. The problem is that if you do need to disassemble the generator to get it in, then you have a bigger job on your hands. After finding a suitable location, installation requires connecting the exhaust, fuel and water intake, mounting the control panel, connecting to the vessel's AC system and the generator starting power.

As generators are fairly large, there likely are only a few options for locating one. Our unit was located under the raised salon floor and accessed by climbing down through the salon seat. The Mastervolt 3.5 has a good sound shield built in but nevertheless it is good to have it under the salon floor to further reduce noise. Being able to locate it in an insulated engine room is even better.

Potentially, the most difficult job is mounting the generator. It needs a sturdy platform that will not resonate the vibrations from the unit to the rest of the boat. This generally means glassing in a platform to take the generator's soft rubber mounts. In our case, the builder bonded in a heavy sheet of plywood to which attach the rubber mounts. The Mastervolt 3.5kW unit is quite light, just 218lb (99kg). A larger unit needs a more substantial mounting structure.

Mastervolt sells complete kits to simplify the connection of exhaust, fuel and water intake. These include everything needed to do the connections.

We opted for the water separator exhaust option, which separates the exhaust into water and exhaust gases. Water is injected into the exhaust (as normal on marine wet exhaust systems) but this kind of exhaust

SYSTEM COMPONENTS

Generator

1 Whisper 3.5, 230V
1 50230201 Water inlet kit
1 50230202 Anti siphoning kit
1 50230251 Delta exhaust kit
1 50230261 Delta water/separator kit
1 50230205 Fuel kit universal
1 50230217 Rubber mount kit

Inverter System

1 Mass Combi 12/2000-100, 230V charger/inverter
1 70403105 Masterlink MICC charge controller
1 Ivet-D multi-tap isolation transformer
1 43212500 IVO 12-20 charger to charge engine and generator start batteries while on shorepower
2 62002250 AGM 12/225 (house bank)
1 AGM 12/90 (engine start)
1 AGM 12/70 (generator start)

TABLE 1 - 12-VOLT BUDGET

	Amps	Hours at anchor	Hours on passage	Daily Ah at anchor	Daily Ah on passage
Raymarine E120 plus instruments (Wind, speed, depth and graphic display)	3.6	0	24	0	86
Raymarine autopilot	2.0	0	24	0	48
VHF radio	0.3	2	24	.6	8
Masthead tricolor	2	0	11	0	22
Anchor light	0.3	11	0	3.3	0
Cabin lights at anchor	5	4	0	20	0
Cabin lights on passage	1	0	11	0	11
Fridge - Frigoboat	2.5	20	20	50	50
Stereo	.6	4	2	2.4	1.2
Pressure water system	4	.1	.05	.4	.2
Watermaker - Schenker	8	2	1	16	8
				92.7	234.4

TABLE 2 - AC APPLIANCES

120 Volt Appliances	Watts	12-Volt Amps equivalent per hour **	Hours per day	12-Volt Ah equivalent per day	Inverter
Microwave oven ***	1200	120	0.2	24	Ok
Hair dryer ***	1000	100	0.1	10	Ok
Small power tools ***	200	20	0.2	4	Ok
TV/DVD player ***	60	6	2	12	Ok
Big power tools	600	60	1	60	Maybe
120-volt desalinator	900	90	2	180	no
Clothes washer ***	1000	100	0.5	50	Maybe
Vacuum cleaner ***	1100	110	.5	55	Maybe
Air-conditioning	1300	130	2	260	No
Kettle	1000	100	.1	10	Maybe
Coffee maker	1200	120	.1	12	Maybe
Scuba compressor ***	1500	150	1	150	No

*** Rough calculation for running the device by an inverter. Calculated by dividing the watts by the voltage of the system (12V) and adding in the power efficiency of the inverter. A simple method is to divide by 10.*
**** Items we have installed or are planning for our Southerly 42.*

is quite noisy to neighbouring boats in an anchorage. So the idea is to separate the water out again and drain it out below the waterline and then just cooled exhaust gas is vented above the waterline, meaning the only noise is purring exhaust. When we are on deck, we can barely hear the genset running. The biggest job here is installing the two thru-hulls for the exhaust. This means hauling the boat since one of the thru-hulls is below the waterline. We used two Mastervolt kits: one for the exhaust, including a waterlift muffler and hose; and a second, which includes the water/gas separator. This kit also includes a seacock for the water to exit below the waterline (a noise reduction feature) and hosing and clips for all the connections.

A seacock for the water intake was added next to the one for the engine. An integral strainer mounts on top of the thru-hull and makes it easy to close the thru-hull, clean the strainer and then reopen. It also simplifies installation. Water intake must be low enough that the intake never rises out of the water while operating under sail or power.

Fuel runs through a separate filter with a separate shut-off for the generator. Since we were building this in to the original spec, we were able to add a separate pickup in the fuel tank with the level above the level of the pickup for the main engine. This way the genset will never empty the tank beyond the fuel level of the main engine pickup so we can always start the main engine. This project is much more involved if you are working with an existing tank. The Mastervolt kit includes the fuel filter, which is actually larger than the one Northshore installed for the main engine.

The Mastervolt generator comes with a fully automated controller module that mounts anywhere and connects with a telephone-style connector. We installed this in the nav center, alongside the controller for the charger/inverter.

We opted to provide a separate starting battery dedicated to the genset. Although some people choose to take power from the engine starting battery, we felt it was more robust to have a battery devoted solely to starting the generator. The builder had already made provision for the second switch in the main switch panel.

Connecting the generator to the AC system is through another Mastervolt box that automatically switches from shorepower to generator when it senses the presence of generator power.

System Testing

Firing up the system for the first time meant waiting until the boat was in the water. A cold November wind ruffled the grey water of Chichester Harbour on England's south coast. A weak sun was already dipping to the horizon by late afternoon as David Payne and technician Andy Drake of Mastervolt UK arrived to commission the system. That meant starting up the generator for the first time and

Mastervolt fully automated one-button operation generator controller module (right) mounts alongside the controller for the charger/inverter.

Mastervolt Whisper 3.5 kW fits snugly under the raised salon floor of this 40' (12.1m) sailboat. Service access is through a dinette seat locker.

checking all was okay with the integration of the shorepower, charger inverter and generator switch-over. It was a bit of a blur as settings were checked, dip switches dipped and then the "genny" fired up flawlessly. Despite being a small one-cylinder engine, it really doesn't make much noise. We were pronounced good to go.

Two days later we would put it to its first big test on a 24-hour run down the English Channel when we were quite literally freezing. The generator allowed us to run a couple of small portable electric heaters (equipped with tip-over switches for safety) and take the edge off the cold. Not a normal situation but a good example of the freedom of having lots of electricity. (Note: We didn't opt to install a heating system as the boat was heading for the tropics.) Having the luxury of hot showers during the 18-day passage from the Canary Islands to Antigua was worth every cent!

After living aboard our new boat for four months, I am happy to report the system is working well. We made very few errors in calculating the power needs. The generator is rather quiet and routine oil changes are easy. Our power use across the Atlantic was roughly what I had planned but the generator was easily able to top up the battery bank with two hours of running time per day, using very little fuel, less than .26 gallon (1L) per hour according to my calculations.

For years laundry was one of the negative issues we had with living aboard. The watermaker plus generator frees us from the tyranny of laundromats around the world. We have just a washer so we still pin clothes out on the lifelines. Freedom at last!

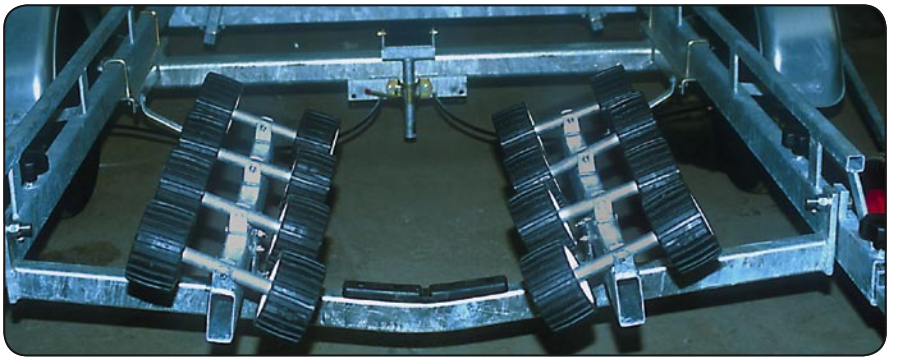
About the author: Paul and Sheryl Shard produce *Distant Shores*, a TV show based on their travels onboard a Southerly 42 of the same name that airs in more than 50 countries (distantshores.ca).

Ed: Part Two discusses inverter installation requirements and usage and follows in the 2008-#3 issue.

Time To Tailor The TRAILER

What to look out for when buying a secondhand trailer.

Story and photos by Peter Caplen (exceptions noted)



"Rollercoaster" wheels spread the load over a much wider area of the hull and the main weight is taken either on the keel or the hull area supported by the rollercoasters or a mix of both.

Jan Mundy

This broken and tied winch strap is sure to part under load and must be replaced before loading the trailer.

When the boating budget is tight, there are superficially compelling financial reasons for considering the purchase of a secondhand rather than new trailer. Unfortunately though, it is all too easy to buy a trailer that is not suited to the boat or under-specified in carrying capacity or just simply poorly built. Always remember that a trailer is a road vehicle and it carries probably your most treasured possession. If it fails, it not only seriously damages the boat, it may also cause a major road accident.

On the surface, a trailer appears to be a pretty simple piece of equipment, nothing more than a chassis on one or more axles with a set of brakes plus some supports for the boat. However, the design of a good trailer, as opposed to a bad one, is more complex than it first appears. Attention is given to the torsional stability of the chassis frame itself, the position of the axle(s) and winch post in relation to the weight distribution of the boat and the method of supporting the boat evenly along the length of the hull.

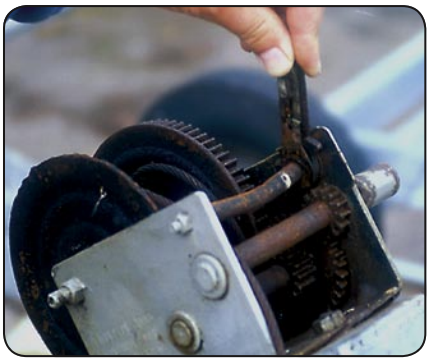
The first point to bear in mind when looking at potential trailers is how the boat will sit on it and the weight distribution once the boat is in its proper position. These are the factors that affect the tongue weight bearing down onto the tow ball of the towing vehicle. Acceptable tonque weight varies from vehicle to vehicle and should be checked with the manufacturer. If the tongue weight is too high, the front wheels of the towing vehicle have less road contact, affecting steering and vehicle stability. With too little tongue weight, the vehicles' rear wheels lose traction. Either scenario can cause snaking between the trailer and tow vehicle that, if not properly and quickly overcome can lead to total loss of control.

Modern powerboat trailers are generally equipped with "rollercoaster" supports that consist of rows of soft, small diameter wheels that not only make loading easy they also spread the load over a wide area of the hull. It is also possible to have additional supports along the length of the keel when extra support is required. The special requirements of other hull shapes, such as round bilge, are accommodated generally using keel rollers and chine supports rather than rollercoasters.

The second point to bear in mind is particularly important and this concerns the gross weight of the boat. If the boat is towed in cruising trim with all the equipment normally kept onboard then its all-up weight is significantly higher than the manufacturer's quoted displacement for the bare boat. Ideally, check the gross weight of the boat before purchasing a trailer, although in many cases this is impractical. Once the boat is on the trailer, it is easily weighed by driving to a nearby weigh station. The weight of the trailer as shown on the maker's plate can then be deducted. If there is no plate the trailer is either very old or an amateur-built job, which means you must then weigh the trailer empty. Of course at this stage it may be found that the trailer is under-specified for the weight of the boat in cruising trim. For this reason, when purchasing a used or new trailer, it is always best to err on the side of caution when considering the gross weight of the boat and therefore the capacity of the trailer required.

Once all theory has been worked out, it is then just a matter of looking around until a suitable trailer is offered and then examining it for the many obvious and not so obvious faults that are found with secondhand trailers.

The wheels and tires need to be of heavy enough construction for the capacity of the trailer but this is difficult if not impossible to check accurately. Additionally, the wheels should not show signs of excessive corrosion. This wheel looks relatively sound but two wheel studs are broken off indicating possible previous abuse and certainly a lack of proper maintenance. The remaining studs need checking to ensure the threads are sound before taking the trailer home and the broken studs need replacing before putting a load on the trailer. Similarly, the bearing housing covers are missing, which likely means that the wheel bearings are worn due to dirt and water ingress. Certainly, another sign of abuse. For safety's sake, renew the bearings and fit new covers before taking the loaded rig on the road.

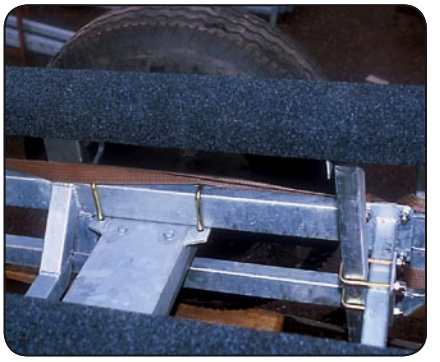


This winch has obviously been overstrained at some time and needs immediate replacement, as it is dangerous to use in its current condition. Rust and lack of lubrication mean early failure.

Check the condition of the bearings before taking the trailer home. Jack it up until the wheels turn freely, then rock each wheel from top to bottom and side to side. There should be a barely perceptible movement in each direction to show the bearings are properly adjusted with enough free play to prevent over-heating. Spin each wheel and listen to the bearings. They should spin with no appreciable noise. If there is a crackling, crunching noise from the bearings this indicates that the rollers or balls in the bearings have started to deteriorate.

Note the narrow tongue of this older trailer design (shown on the left). The modern coupling shown on the right is much wider and means the trailer needs modifications before fitting a modern coupling. The type of brake coupling gives a good indication of the age of the trailer. This old type over-run coupling, while still being legal for road use on older trailers, only works with matching older brakes. Modern auto-reversing braked hubs cannot be used with this coupling. Similarly, auto reverse couplings do not work with early over-run type braked hubs. While many old style parts are still available as spares, if any substantial part of the braking system needs replacing with modern parts, the whole system needs replacing.

This trailer is built of single run channel section, which has very little torsional strength and allows the trailer to flex and twist quite dramatically when loaded. This imparts stress on the welded joints and may lead to weld failure. Welded axles allow no opportunity for adjusting the balance of the trailer to suit a particular boat. A trailer built of single run channel section with no additional stiffeners is not a good buy.

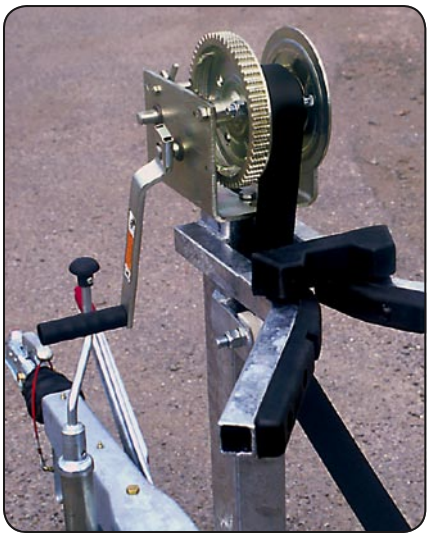


Box sections offer the greatest stiffness and avoid twisting while double or even triple run sections prevent flexing lengthways. When axles are clamp-bolted to the chassis, adjustment for weight distribution is simple. It generally only takes a small movement to provide the necessary adjustment.

Check the braking system to ensure it works. Test for free movement of all the brake components from coupling to hubs.

Corrosion anywhere on the trailer needs careful checking. The base of this winch support is showing signs of corrosion and needs removing and treating before painting and refitting. On this particular trailer, the central channel section on which it is mounted twists easily and offers almost no lateral support to the bow of the boat.

A rusted and kinked winch cable like this is an accident waiting to happen. The hook has been over-stressed and is permanently open and likely to break when loaded.



A modern winch is easy to operate and runs smoothly. It is also matched to the capacity of the trailer for hauling the boat into position.

Jan Mundy

A maker's plate displays the origin of the trailer, the vehicle identification number and its rated capacity. Without this plate, the capacity of the trailer can only be estimated and it is possible that the trailer was overloaded in the past.

Jan Mundy

The carpet that covers trailer bunks traps water and causes severe rotting at the ends of these wooden supports. Best to lift up a small area of carpet to check beneath for their structural integrity.

Buying a dodgy secondhand trailer could mean the end of your boat and your towing vehicle, a road accident that hurts others and/or their property. Is it worth the worry when new trailers cost a small percentage of the value of the boat? Easy to say I know, when a lot of us do our boating on a very tight budget and sometimes new is just beyond reach. There are good secondhand trailers about but if you want to achieve any resale value ensure your choice is a modern design with a proper maker's specification plate. This goes a long way to ensuring it has been properly designed for boat work and provides an unambiguous guide to its rated carrying capacity.

About the author: Peter Caplen is a specialist photojournalist in the marine field and also runs a boat repair business in Somerset, UK.

Trailering ESSENTIALS

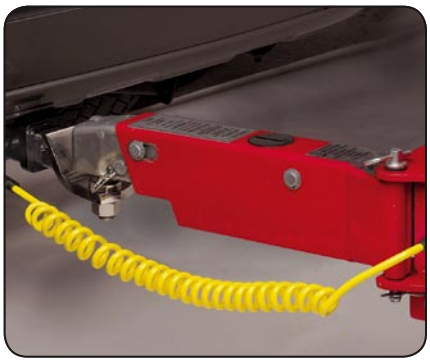
Innovative accessories that can turn even a jittery amateur into a confident performer at the ramp.

Story and photos by Pat Kearns (exceptions noted)

Jan Mundy

Jan Mundy

A simple two-piece device to line up the trailer and tow vehicle. One rod magnetically mounts to the trailer coupler, the other to the vehicle hitch, and the driver lines up both in the rear-view mirror (right).



JetConnex coiled cord with high quality molded connectors on each end replaces the loose flimsy wires that hang down and drag between the vehicle and trailer.

When you're all hitched up and ready to roll, are you humming that Willie Nelson "… on the road again …" tune? Are you anticipating a hassle at the ramp? While you wait in line to launch your boat are you observing a couple engaged in venomous verbal exchanges over lining up the hitch ball and the trailer tongue? Maybe your heart is racing with a bit of anxiety about your own competence with the haul, launch and retrieval of your own boat instead of feeling calm, cool and collected in anticipation of a day on the water. You're not alone. Depending on ramp conditions, wind and water depth, getting a boat on/off a trailer can be a snap or a struggle. As a DIY project, accessorizing a boat trailer is easy and the benefits instantly appreciable.

In search of advancing my own roro ("roll on; roll off" in ocean cargo shipping language) capabilities, I ventured into the showroom of a local RV dealership and service center. It's the superstore of the "stuff" that RVers covet and there is something for everyone and every size and style of things that tow or are towable. My local West Marine store (see the online catalog at www.westmarine.com.) has an excellent inventory of gear for boat trailers but this place was a boat towing heaven. It's filled with trailer "bling" that transfers nicely to trailering a boat. The Northern Tool and Equipment catalog (800/556-7885; www.northerntool.com) is also a treasure trove of equipment and accessories that can make you and your rolling boat happier and safer on the road and at the ramp. Add Cabela's (www.cabelas.com) and Bass Pro's (www.basspro.com) websites to your shopping spree and you'll soon be making a trailer upgrade wish list.

Trailer Tailoring

One of the most appreciated upgrades to the basic bunk-style trailer involves modifying the existing bunk boards to better distribute the boat load and help get the boat on and off the trailer more easily. There are several options for accomplishing this. While bunks are best for float off/on and are less expensive than rollers, rollers are better suited to circumstances that require you to drive a boat on/off the trailer and for larger boats with a deep-V hull form. There are also ways to combine both bunks and rollers to get the best of both worlds. In most cases, making these modifications involve bolt on hardware. A boat hull that is fully supported along its entire length is less subject to suffering the localized stresses of over the road transit and ramp activity that can damage the hull and its internal supports.

Aligners and load guides are, hands down, the best accessories you can attach to an existing trailer structure. There are various shapes and arrangements that, when installed on a trailer, guide the boat onto the trailer, getting it perfectly centered without the ramp jockeying that you might have to do otherwise. Vertical post guides are easy to install and some include lights and reflectors for ease in identifying the trailer slot during nighttime boat retrieval. If you're happy with the guides you have, you can still add the lights and reflectors, which are sold separately.

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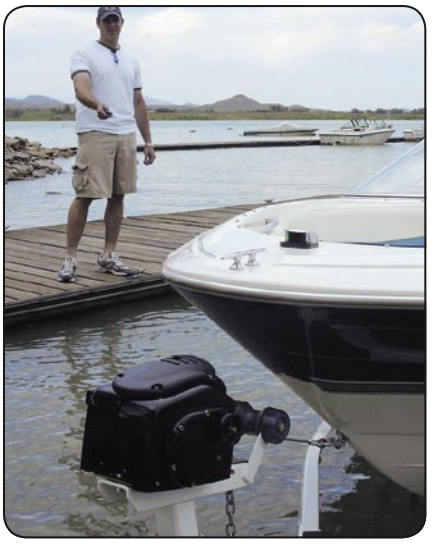

Powerwinch

Powerwinch RC 30 simplifies ramp duties with a power-in/freewheel-out operation controlled by a wireless remote and the added convenience of a light enclosed in the trailer winch casing.

Here's a tip. Make it easy to know when your trailer is immersed to the right depth for getting your boat on/off the trailer by marking your posts (at least one) with a line of red waterproof tape at the "waterline" of the post when the trailer is in the right position for the boat to glide on to the trailer supports.

Add plastic "slicks" to existing bunks to remove the friction of trying to slide a boat onto a wet, carpeted bunk. Installing the slippery, tough plastic slicks on my own trailer's carpeted bunks was a simple DIY job and the rewards for a half-hour's work with a screwdriver were immediate. Now, with minimal throttle, the hull glides onto and off the bunks without resistance.

Consider adding a tire carrier to your trailer frame to hold the spare tire that you hope you'll never need. Make sure to purchase a cover to protect the tire from the damage of UV exposure. Covers are available for the wheels as well and keeping them covered during periods of trailer storage contributes to a longer tire life.

One of the trickiest maneuvers at the ramp is winching the boat up to the bow roller. This often requires an acrobatic balancing act and extra muscle if the boat cannot be driven or floated fully onto the trailer. The fix? Replace that manually operated winch with a 12-volt DC electric one, which can make ramp time more efficient, safer and shorter. While you're at it, add a JetConnex electrical connector to provide electrical service to trailer accessories. JetConnex replaces the "spaghetti" that connects the vehicle lights to the trailer lights or other electrical equipment.

Because your trailer most likely spends more time standing still than rolling, don't skimp on wheel and jack chocks. Chocks made for the purpose are inexpensive and reliable and the plastic ones I chose can be locked to the wheels with a cable lock. Speaking of locks, consider a wheel lock available for that purpose. The steel PitBull Tire lock is designed to deter theft and immobilize the trailer wheel to prevent movement.

Some of the best things I've done to my own trailer have been inspired by a walk around the parking lot at my favorite launch ramps. One that is a favorite is the gear box that I have to hold "stuff" that I need when I'm on the road or at the ramp. It holds small supplies of cleaning materials and tools, extra lines, the helm and seat covers and other odds and ends for the boat. It's a heavy-duty, off-the-shelf all plastic (including hinges and latch) trunk-

style container and I installed it on the trailer with U-bolts forward of the winch stand. It can be locked but I don't leave anything behind that I can't afford to lose. It purpose is convenience, not security.

Hooking up

Getting the trailer and the tow vehicle connected and keeping them coupled is priority one for hauling any kind of trailer. Here is some of the gear I found to get the job done and keep things hooked up securely.

At the top of the list for price tag and high tech approach is the Swift Hitch, a wireless camera system with built in night vision. Mount the magnetic camera on your tailgate or trunk and the receiver inside your vehicle allows you to watch the action as you back up to hitch up.

For the rest of us who just need some simple assistance to align the couplers there is the Ball's Eye Quick Hitch, which installs on the trailer tongue. It aligns the center of the coupler with the center of the hitch ball. Simply back the tow vehicle until the "V" shaped guide bracket on the tongue comes into contact with the hitch ball guide bar. You have 7" (177mm) left to right, once contact it made and the guide bracket self aligns the center of the coupler. Once joined, lower the tongue jack and the coupler drops onto the hitch ball. There are variations of this device such as the award winning Couple-Mate. This is a clever device that attaches to your hitch ball mount and not only acts to help align the attachment points of the rig but also protects the towing vehicle from damage of the oncoming trailer tongue.

Other systems include the Align-Quik Hitching Guides and other similar devices. These bright orange guides are installed vertically or horizontally to transfer the locations of the two objects to be joined into your line of sight. The orange rods attach by their magnetic bases, one to the coupler and one to the hitch. Back up until you see the rods touching and get hitched. Remove the rods and stow for the next use. It's about as simple as it gets. The rods can be extended so you can see them in your rearview mirror, side door mirrors or by looking through the back window.

Heavy duty, weather-resistant poly box attaches to the trailer frame with U-bolts. Locking the box secures the U-bolt nuts and the box contents. The box is roomy enough to store all the odds and ends of boat gear and a full supply of cleaning supplies.

ADDITIONAL READING

For details on how to repair, replace and upgrade a sailboat trailer's running gear, brakes and hitch plus towing tips to ensure a safe road campaign, refer to "Making the Sailboat Trailer Road Ready" in DIY 2006-#1 issue.

The elegance of this trailer spare tire cover is hard to deny but the tire inside benefits from the practical protection against UV exposure and a sticky fingered tire thief.

This is a belt and suspenders lockup with locks at both sections of the trailer coupler; one at the tongue and one at the coupler ball lock.

This wheel lock won't get you a parking ticket but It will discourage thieves intent on stealing your rig.

If you want the hitch of all hitches, behold the all-aluminum Rapid Hitch. The Rapid Hitch offers a double ball system that is easily rotated to accommodate two different sized hitch receivers. The Rapid Hitch's adjustable height allows you to tow easily and safely by keeping the trailer parallel to the ground, maintaining a more stable tow.

After all is said and done, the best accessory may be an extra set of eyes of another person stationed between the tow vehicle and the trailer to guide you in the right direction and at the right speed to make a safe and secure connection. This "accessory" is free and requires no installation.

Plastic bunk covers make for slick bunks when running the boat back up onto the trailer. Several variations of bunk slicks are available from West Marine that screw to timber bunks or you can make your own.

The side guide ons plus the vertical guides plus the rollers plus the substantial bunks leave little margin for error in getting the boat properly aligned on the trailer.

Secure Fastening

Now that you have made the connection and loaded the boat, you want things to stay put. Don't forget the chains, tie downs, locks and pins you need to make sure what you have joined together does not go asunder. When I handled claims for marine insurance companies, there were calls about trailers that went missing, boats that leapt from their trailers, including the tow vehicle that sank at the ramp. All too often, the cry went up, "I was only going a few miles." That was a clue to the hapless boat owner's failure to use adequate tie downs to secure the boat to the trailer. Be sure to cross and properly secure the hitch chains.

BoatBuckle is a retractable tie-down system with a self-storing strap that extends to a full 44" (111cm) and it adapts to virtually any mounting angle. It automatically retracts and features a snugging ratchet with easy one-hand operation with a rubber coated handle and one-touch release lever. The protective, vinyl-coated top hook won't mar boat surfaces.

TIP

Trailering Smarts

Trailering a boat brings with it special considerations of equipment, equipment maintenance and the accessories that make bringing the boat to the water a less stressful exercise so be sure you are reading the latest in tips and checklists. See the BoatU.S. trailering guide (www.boatus.com/seaworthy/trailer/default.asp) and consider joining the BoatU.S. Trailering Club, with its 24/7 roadside assistance service, for extra piece of mind (www.boatus.com/Trailerclub).

— PK

Finer Details

Who hasn't worked around the back of a towing vehicle walked into the hitch ball mount? Ouch! The Towbar Safety Sock is a soft, washable neoprene cushioned cover for a standard hitch ball. It slips right over a hitch ball mount just like a sock and helps protect body parts from injury when a person bumps into the hitch.

Get a good grip when standing on trailer rails, fenders and tongue with 3M Marine's Safety Walk self-stick pads in a six-pad pack (#7639) for less than $10. Safety Walk comes in a variety of sizes, colors, and materials. Apply the pads to any surface for improved slip-resistance.

Protect expensive propellers with the lockable PropMate plastic clamshell cover. These high-visibility orange covers also protect props from damage by road hazards and accidental contact with the ground.

Equip your tow vehicle with a full width mud flap to divert road dirt, gravel and mud from the boat hull during towing on rough road surfaces or in bad weather.

With all the variables that affect your boat trailering experience, it's nice to know that there are so many things you can do to reduce the hassle factor of towing a boat. Now, add water and have fun.

About the author: When not squeezed into the lower depths of a boat conducting a survey, Pat Kearns might be found at the ramp launching her Angler 180 center console for a day on the Gulf in southwest Florida.

Building a DATA HIGHWAY

Interfacing electrical devices and electronics on a fully compatible data bus has come of age. Here's how to design and install a NMEA 2000 network.

Story and photos by Peter James (exceptions noted)

Many electronics manufacturers have recently launched products that use the NMEA 2000 networking standard: Airmar transducers, Floscan FloNET, Furuno NavNet 3D and the FI-50 instruments, Garmin 4000 and 5000 series displays, Lowrance displays, sensors and engine interfaces, Maretron displays and sensors, Raymarine SeaTalk NG ST70 instrument and autopilot control head and Simrad SimNet. To install any of this equipment, you'll need to understand the basics of how NMEA 2000 networks function, how to design and install them, and how to connect electronics to the network.

You may be familiar with NMEA 0183 and Raymarine's original SeaTalk network standard, both of which date from over 20 years ago. These standards were invaluable as a means of linking instruments together but are slow and inflexible, and not easily adaptable to today's needs. The National Marine Electronics Association (NMEA),

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Various NMEA 2000 devices communicating on one data bus greatly simplifies and hastens installation and reduces costs. Examples of NMEA 2000 compatible products are:

1 Raymarine ST70 display.
2 Lowrance LVR-880, the first NMEA 2000 VHF radio.
3 Award-winning Offshore Systems Fuel Deck Fill has a small display built in that shows the fuel level in the tank as it is being filled.
4 Floscan FloNET interface hub takes fuel flow information from single or twin diesel engines and offers it to the NMEA 2000 network for output on compatible displays.
5 Westerbeke's 5.7 kW and 7.6 kW D-Net diesel generators.

Figure 1

A minimal network with a short length of backbone, two tee-connectors, a power tee, two resistors and two drop cables. From left to right: Lowrance termination resistor; Lowrance T-connector (with attached drop cable); Maretron Powertap T cable (yellow); Maretron cordset; Maretron T-connector (with attached transducer drop cable); and Maretron termination resistor.

an association of electronics manufacturers, dealers and installers, saw in the late '90s that a new standard was needed. NMEA 2000 was the result. Early progress in adoption was slow but the standard took off in 2007 and is now in use by almost all the major manufacturers.

NMEA 2000 is a low-cost, moderate capacity, bi-directional, multi-transmitter, multi-receiver instrument network with a transmission speed of 250K bits per second. What that means is that it is a network that enables instruments on a boat to exchange information with one another in a format that is open and common and independent of the equipment manufacturer. At least, that's the goal. As we shall see later, some manufacturers have chosen to introduce their own proprietary variations on the standard.

The typical information that flows through an NMEA 2000 network includes data on depth and water temperature, engine readouts, fuel level, GPS position, heading and speed and wind speed and direction.

There's another type of networking that is increasingly seen onboard, one that is based on the Ethernet standard. This is used for high-speed data exchange, such as radar images, fishfinder data and chart data. NMEA 2000 does not handle these applications and there aren't any common standards for these networks yet.

Elements of a Network

An NMEA 2000 cable contains five conductors. Two of these carry power, two carry data and one is a shield. Two gauges of cable are defined in the standard and, as most recreational boats use the smaller (light) gauge, that is the only one I discuss here. The cables connect together and to compatible devices with five-pin plugs designed to make the network waterproof; however, connecting together two NMEA 2000 devices involves more than just running a cable between them. You don't connect the devices to each other. You must connect each device separately to the network. A complete network must be installed, however basic, and that network must have certain elements present or it will not work.

Those elements include: a backbone cable running the length of the boat that is the main transmission route for all network information and if often made up of multiple segments; drop cables to connect devices to the backbone; tee-connectors linking together two segments of the backbone and a drop cable and there is a tee-connector at each point where a drop cable meets the backbone; a power supply to connect the network to a 12-volt DC power source, usually through a special form of tee-connector; and terminators, which are special terminating resistors at each end of the backbone.

The need for a power supply is easily forgotten. It is best to think of the NMEA 2000 network as a system in itself, not just as a group of cables linking equipment together.

Powering the Network

Some devices, such as instrument displays, GPS antennas and transducers can be powered from the network. This greatly simplifies installation, as just one cable is needed for both power and data. Larger devices, such as chartplotters, take more power than the network can supply and so have their own separate power supply. Inside these larger devices, the NMEA 2000 network interface is optically isolated from the rest of the circuitry and is powered only by the network. Without power to the network, these larger devices may seem to function normally but are not able to send or receive information over the network.

Each device that takes power from the network is assigned a Load Equivalency Number (LEN), which corresponds to a draw of 50milliamps (mA). As an example, a device with a LEN number of 4 draws up to 200mA from the network. The light cable that most of us use has a capacity of 4 amps total (80 LEN or 80 times 50mA). You need to add together the LENs of all connected equipment to make sure it does not exceed the allowable total. If the power supply is connected near the center of the backbone, each leg can support up to a 4-amp draw.

In practical terms, plan to connect the power behind the main DC panel or at the helm and this is likely to be near the center of the backbone. If you have a high number of connected devices or a very long backbone, you need to engage the services of a certified NMEA network technician to calculate the optimal placement of the power connection. In some cases, he may recommend use of the heavier cable.

Network Layout Design

Now that we've covered the basics, we're ready to design a network for your boat. The first thing to consider is the route of the backbone. This has to go the length of the boat and pass close to all the devices that you wish to connect (and all the devices you will add over the next few years). There's a limit of 19.6' (6m) on the length of a drop cable so the backbone cable should pass within that distance of any device. However, you don't have to install the whole length of the backbone at once; it can be extended at any time to go further forward or further aft to connect to new equipment.

With the light cable, the maximum allowable length of the backbone is 328' (100m) so that shouldn't be a concern for most of us. Plan the backbone in segments, so that the joins occur at the

places where you may want to add T-connectors. It's important to create one continuous backbone. You cannot branch the backbone at a T-connector to create a Y-shaped or looped backbone as this just will not function correctly.

Detailed Network Planning

First list all the devices that you intend to connect to the network, including computers, displays, engines, GPS antennas, sensors, transducers and NMEA 0183 devices.

Create a diagram of the boat's layout and mark the location of these devices. You need to choose a route for the backbone that is both practical (in terms of pulling the cable) and which comes close to each of the connected devices. The backbone must be a single continuous length with no branches. Draw in the backbone on the diagram and mark the terminators at either end. Consider other devices that you might add in the future and allow for these in the backbone routing. Now mark on the diagram the proposed location of each of the tee-connectors in the backbone, allowing enough tees for drop cables to all devices. Think about future growth and where tees might need to go to accommodate this.

Choose a location to insert power into the backbone. The power cable should run to a DC breaker, so a good place for the power connection might be behind the nav station or helm where the backbone passes through.

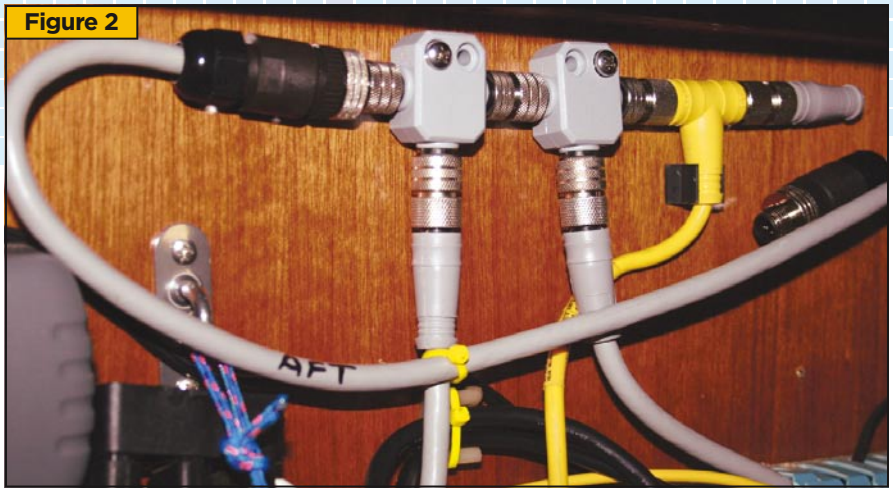
Estimate the length of each individual section of the backbone, from tee to tee, and the length of each drop cable up to an attached device. Some devices may have drop cables permanently attached, while some have just a port on the back. List the lengths of cable needed for the backbone and for drop cables, and the number of tees needed.

If you have devices on the network that are NMEA 2000 compatible but do not have standard NMEA drop cables or ports, note the adapter cables you will need for these devices.

Figure 1 shows a small but complete network. It has a short length of backbone, two tee-connectors, a power tee, two resistors and two drop cables. One drop cable goes to a multifunction display (not shown), and the other is shown connected to an NMEA 2000 depth/speed/temperature transducer. This network can be extended in either direction by removing one of the terminators, adding a length of backbone cable and another tee, and moving the terminator to the new end of the backbone.

The cables used for the backbone are identical to those used for drop cables, in a network where all cable is light cable. You can buy cables with the connectors already installed on each end (known as "cordsets"), or you can buy cable in bulk and install field-attachable connectors on lengths that you have cut to suit your layout. In **Figure 1**, the gray cable, tee-connector and right-hand termination resistor are by Maretron. The gray/red tee, cable and terminator are by Lowrance and the transducer is by Airmar.

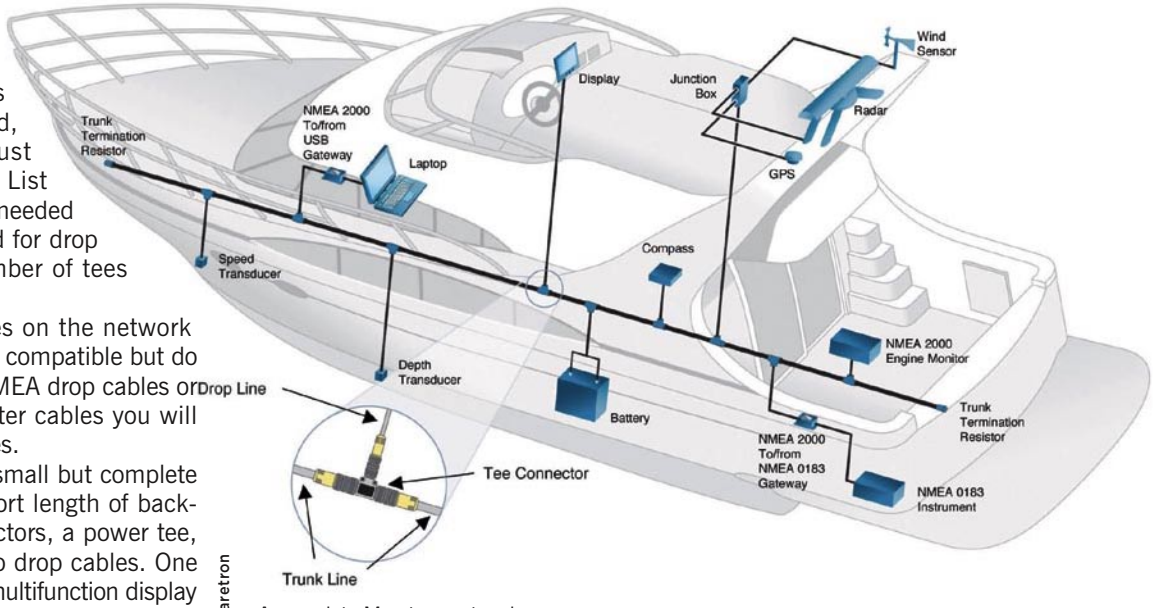
Figure 2



All NMEA 2000 components plug into a single cable, which supplies power and integrates all onboard data communication. Shown is a sample network installation.

Gender Matters

NMEA 2000 connectors come in male and female versions. A cordset has a male connector at one end and a female connector at the other. A tee-connector has a female socket on one side and a male on the other for the backbone and a female socket to receive the drop cable. NMEA devices that do not have their drop cables permanently attached usually have a male port, so that the female end of a cordset plugs into the device and the male end into a tee. This usually leads to a simple male-female-male-female sequence along the backbone with a male terminator at one end and a female terminator at the other end.



A complete Maretron network.

Manufacturers, however, differ in the structure of their power connectors. A Lowrance power connection comes into the backbone through a normal tee-connector and so does not upset the gender sequence. A Maretron power tee has female sockets on both sides and this means that the gender sequence has to be planned out in each direction starting at the power tee.

Figure 2 shows a section of a network being installed on my boat. This is behind the DC panel at the nav station. Two sections of bulk cable were used for the backbone, one running aft and one running forward. The ends of these sections of cable have Maretron field-installable connectors attached (the black plugs). There are two tee-connectors and a power-tee, which runs to a breaker on the DC panel. The drop cable from one tee goes to a Maretron display and the other is a spare used to connect equipment being tested or demonstrated. You will see that the forward section of backbone is not yet connected and a termination resistor ends the backbone at the side of the power-tee. The cables are not yet properly held in place.

Variations and Complications

The NMEA 2000 standard defines a number of layers, from the physical layer that defines the type of cables and connectors to be used, through the network layer that defines the administration of the network up to the application layer that defines the messages exchanged between devices. The physical layer has been liberally interpreted (i.e., disregarded) by some manufacturers, who have created their own cabling systems.

Maretron sells cabling with standard connectors. Lowrance sells their own design of cabling (the red version) that has standard connectors. Lowrance at first sold a blue version of their cabling that had non-standard connectors but has now switched to the red version. Both Garmin and Airmar have announced their own cabling systems with standard connectors.

Raymarine sells SeaTalk NG cabling where the connectors are non-standard. SeaTalk NG has color-coded backbone and drop cables and connectors and part of its design goal was to make it simple for boatbuilders and consumers to plug the various elements together correctly. Raymarine assures me that all the higher-level protocols and messages in SeaTalk NG are NMEA 2000 standard. However, it does not allow mixed SeaTalk NG and other cabling systems used in one backbone. If you are thinking of using SeaTalk NG, then you should either build a system that is all NG cable, with adapter drop cables to connect non-Raymarine displays and sensors, or one that is all standard cable with adapter drop cables for the NG equipment.

Simrad sells SimNet cabling, which also has non-standard connectors but can use an adaptor to connect to standard cable. One of the goals of the NMEA 2000 design was inter-operability across devices from different brands and it's disappointing to see both Raymarine and Simrad fail to meet that goal as far as the physical layer is concerned.

Furuno 3D, Garmin, Lowrance and Maretron displays have standard ports on the back. Raymarine and Simrad displays need adapter cables to connect to standard networks.

Sending and Receiving Messages

Any NMEA 2000 device connected to a network can transmit messages out to all the other connected devices and read the messages sent by all of them. There's no central controller and each device cooperates in ensuring that messages do not interfere with each other. All information on the network is available to every connected device so that, once a GPS antenna, for example, is connected then every display can read the position and speed information and use it for its own purposes.

In practice, connected devices fall into one of two groups: sensors and displays. Sensors detect environmental conditions (depth, engine rpm, level of liquid in a tank, position, temperature, etc.) and transmit messages containing their readings. Displays read these messages and show them in digital or graphic form, such as a depth reading or the position of a boat icon on a chart or a graphic engine gauge readout. Sensors, by nature, are limited in the type of messages they send, such as a fuel level sensor, which thinks only about fuel levels and can talk of nothing else. Some displays are also single-minded: the award-winning Offshore Systems Fuel Deck Fill has a small display built in that shows the fuel level in the tank being filled. It won't show GPS position information, even though it has access to that data on the network, because that is not what it is designed to do.

Multi-function displays made by Furuno, Garmin, Lowrance, Maretron, Raymarine, Simrad and others handle a wider range of messages. A typical unit such as a Raymarine E-Series display shows GPS information, speed, depth, wind, autopilot status and engine readouts. The decision on which data to read from the network and display onscreen is made by the software designers, and adding a new type of readout to one of these multi-function displays is as simple as loading a new software release into the display and no new hardware is needed. As new types of NMEA 2000 sensors are created, the manufacturers of the multi-function displays continue to update their software systems to keep pace.

This is the value of NMEA 2000. Once the network is in place and a multifunction display is connected, any sensor that you add to the boat just needs to be plugged into the network, anywhere along the backbone, and its data is instantly available to everything connected to the network.

Transducers

In the pre-NMEA 2000 days, thru-hull and transom-mounted transducers for depth, boat speed and water temperature, and masthead wind sensors were specific to an electronics brand and had to be connected to the appropriate control head of that brand. A Navman depth transducer, for example, had to be connected to a Navman depth display, as it would not work with a Datamarine display. That meant running transducer cables through the boat from the transducer location to the instrument location.

NMEA 2000 drastically simplifies that task. You can now install a "smart" transducer with an attached NMEA 2000 drop cable. Plug the cable into a convenient tee where the backbone runs through the bilges (remember the cables and connectors are waterproof) and you're finished. Airmar makes transducers for almost all electronics sold in the U.S. and the Airmar DST 800 NMEA 2000 depth/speed/temperature thru-hull and its transom-mounted equivalent are set to replace all existing manufacturer-specific variants. The transducer contains all the circuitry needed to format the sensor information into NMEA 2000 form and the network powers that circuitry.

For wind and weather data, Maretron sells a NMEA 2000 ultrasonic weather station, which measures true and apparent wind, barometric pressure, humidity and dew point. Airmar is expected to launch a similar unit soon (it already has a version that uses the older NMEA 0183 standard). With no moving parts, these units may soon replace the familiar vane-style wind sensor.

Once a smart transducer is installed, you are no longer dependent on a specific brand of electronics. Any display, from any manufacturer, should be able to read the information from the transducer. All the display sees is a standard speed, depth, wind or temperature message on the network.

Engines

Newer engines with electronic controls have network interfaces built in. These may be NMEA 2000 or a standard called J1939, which can be converted to NMEA 2000 through an interface adapter. These engines are then plugged into the network and capable displays now show the engine gauges onscreen.

Outboards made the last few years by Evinrude, Suzuki and Yamaha also have NMEA 2000 interfaces and Lowrance sells cables to connect the engines to a network. Engines from Mercury and Cummins Mercruiser that use the Smartcraft network standard cannot be connected to NMEA 2000 networks.

For older analog engines and for most diesels, there is no simple way to get data into a network. Maretron makes an interface module that works for some Yanmar models. What are really needed are general-purpose interfaces for tachometers, oil pressure senders and temperature senders. None of these exist yet.

Conclusion

Although NMEA 2000 has taken a few years to get into the market, 2008 is the year when many boaters will start installing these networks and basing their buying decisions for electronics on compatibility with the standard. Airmar, Furuno, Garmin, Lowrance, Maretron, Raymarine and Simrad have all made commitments to the new network. The question now is no longer when NMEA 2000 will take off but how it will affect boater's buying decisions?

Once a network is installed, equipment from any compatible brand is easily connected and buyers are no longer locked into a specific manufacturer. We may see more specialist companies focusing on specific types of sensors or displays. We may see more mixed systems, where boaters pick the best device for the application rather than choose just one brand for the whole boat. The power of the open network brings more competition and more functionality and that has to be a benefit to all of us.

About the author: Peter James is president of JackRabbit Marine (www.jackrabbitmarine.com), an internet retailer of electrical and electronics equipment and the author of Ask JackRabbit, a daily marine electronics blog.

ADDITIONAL READING

For a comprehensive discussion on the networks in common use today, refer to "Integrated Networks" in DIY 2007-#1 issue.

UPGRADE

Diesel Goes ELECTRIC

"Imagine motoring across the sea with almost no noise. It is possible."

Glacier Bay

No longer in its infancy, diesel-electric propulsion provides boaters with a fully integrated power package and offers a virtually silent and vibration-free alternative to conventional diesel engine and shaft-powered systems.

By John Payne

My professional marine electrical career has primarily been concerned with and still remains involved with electric propulsion on commercial ships and offshore deepwater oil drilling rigs. As a sailor, seeing these principles finally migrate into smaller pleasure boats is quite naturally of great interest to me.

While I became used to that familiar sound of diesel engines driving the boat forward, I am now also used to the low noise of electric propulsion systems. Imagine motoring across the sea with almost no noise. It is possible.

On larger motorboats and trawler yachts, the significant space savings will be a significant advantage as will be the large reduction in maintenance. Instead of possibly one large or two main engines and a generator set, you can simply have two properly rated generators to supply all electrical requirements in a lot less space.

System Designs

There are two main types of electric propulsion systems. One is the generator that directly supplies a switchboard that in turn supplies the electric motors that turn the propeller, which is the type of system used on large commercial vessels and is referred to as "diesel-electric." The second type is called "hybrid diesel-electric" and is not unlike the electric submarine, where a large battery bank is charged and powers electric drive motors. Although, when the generator is running, direct powering of the drive motors is also possible. Both methods involve the use of much higher electrical voltages. High voltages are essential for efficient electric propulsion systems and this is as safe as your shorepower system, if not more so. The term "hybrid" refers to propulsion systems that comprise both electric propulsion and diesel power generation and possibly other forms of electrical power supply.

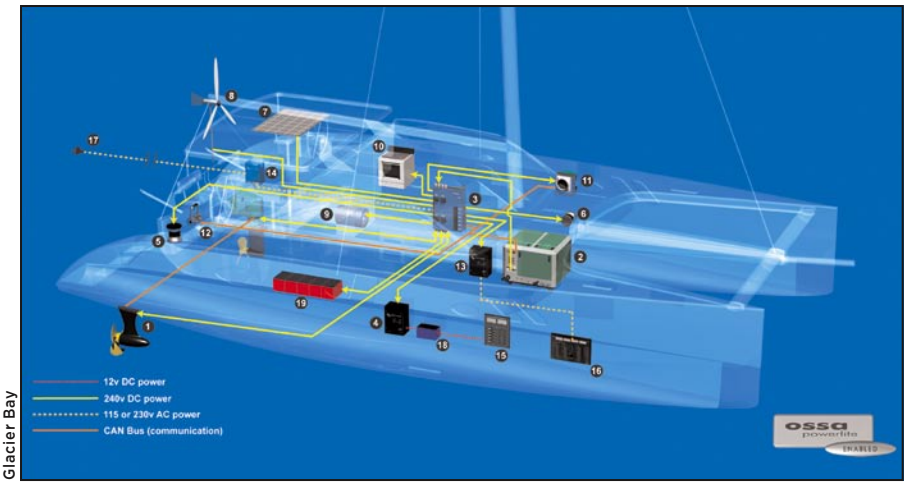
High voltage allows a significant reduction in the weight and size of the power generators, the propulsion electrical motors and also in the size of the electrical wiring and the battery banks. The buzz word in both commercial and pleasure boats in electrical and electronics design is integration and that means that all systems are designed to work with each other versus a collection of different equipment and systems that all have different agendas. The main generator supplies all vessel electricity needs and not just the electric propulsion system. An integrated system is important given the growing demands of high demand consumers, such as air conditioning, electric bow thrusters, electric deck winches, refrigeration and watermakers. It also allows the creation of a completely electric boat.

In simplified terms, an electrical propulsion system consists of a DC electric motor to turn the propeller shaft and this motor is speed controlled by a throttle controller or joystick. The DC electric motor is supplied either from a high voltage DC battery bank and/or directly from a DC generator. In an integrated power system, lower DC voltages supply various other consumers by stepping down the voltage or using a low voltage battery bank.

Power Generation

The two main players in electric propulsion systems are Electric Marine Propulsion or EMP (www.emotionhybrids.com) and Glacier Bay (www.glacierbay.com). Systems currently installed use DC (direct current) power, rather than AC (alternating current). Voltage has been significantly raised and is typically 240 volts DC in the Glacier Bay system and 144-volts DC in the EMP system. Generators are available from 6 kW up to 200 kW and in voltage ranges from 120 volts DC up to 800 volts DC, depending on the system configuration and design.

In an AC power generator system, the generator has to run at a constant speed that is based on frequency stability and the number of poles in the alternator. With DC generators, these are variable speed and, based on the DC generator design, can



Glacier Bay

Glacier Bay's OSSA Powerlite uses a diesel generator to directly power the motor with no battery bank.

1 Permanent magnet propulsion motor (pod or conventional)
2 Variable-speed diesel DC generator
3 Power distribution and safety system
4 Low voltage battery charger
5 Electric winch
6 Electric windlass
7 Solar panels
8 Wind generator
9 Hot-water heater
10 Stove
11 Air conditioning
12 Throttle and digital controls
13 DC/AC inverter
14 Isolation transformer
15 Low voltage panel
16 High voltage panel
17 Shorepower
18 Low voltage battery bank
19 High voltage battery bank

be run at the optimum speed. The OSSA Powerlite generator from Glacier Bay utilizes a neodymium permanent magnet generator and this is driven by a diesel engine. Neodymium magnets, also known as rare earth magnets, are very powerful for their mass, so that electric generators and motors can achieve real savings in weight and size. They can have reduced magnetic properties at high temperatures and for this reason the stator is water cooled.

Like many AC generators, the DC units have become very compact and also very quiet with improved noise suppression techniques. The DC generator also functions the same as any engine mounted alternator in that it must also charge the propulsion high voltage battery bank. These days, the choice is always AGM batteries as they require no maintenance and have high charge acceptance rates that suit this type of charging.

In this mode, the output of the generator must also match the optimum charge curve of the battery bank. Manufacturers have developed charging programs to get this right, otherwise the engine would run for long periods to attain a full charge. In addition, generators also feature automatic stop and start functions, which prevents unnecessary running of diesels on light load and also reduces fuel consumption and maintenance.

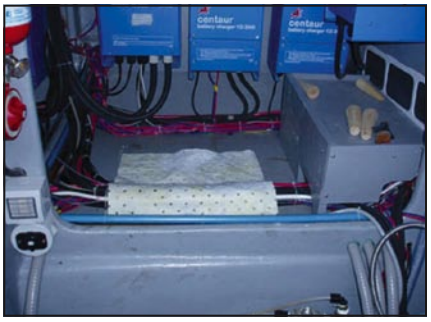
Propulsion Options

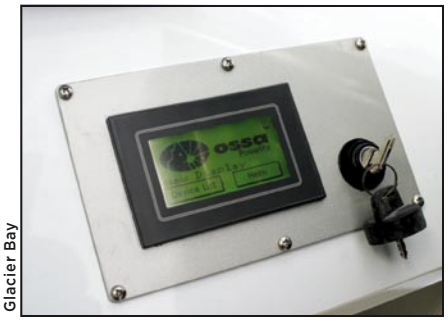
DC motor technology has evolved considerably over the years and the maintenance-intensive brush and commutator type motors have been superseded by brushless, synchronous, permanent magnet types that are nearly 99% efficient. These are designed for the relatively low propeller shaft speeds required and are also water cooled to ensure maximum motor efficiency. Motors are connected directly to the propeller shaft or incorporated into a pod arrangement.

There is also a wide range of propulsion duty-rated motors that spans from 20hp to 800hp that caters to boats of all sizes and displacements. They are very space and weight efficient and they do not need a gearbox and of course are continuously rated, unlike many traditional DC motors used on a boat, such as winches and windlasses that are intermittent service rated.

Motors in propulsion systems must be robust to be reliable. Those in use in the OSSA system are purpose designed and constructed and these are hand wound with the windings being encapsulated in a ceramic epoxy to eliminate water and moisture ingress.

The speed of the propeller is entirely controlled from the motor speed control. In the Glacier Bay OSSA system, speed control, signals are sent via the OSSA-



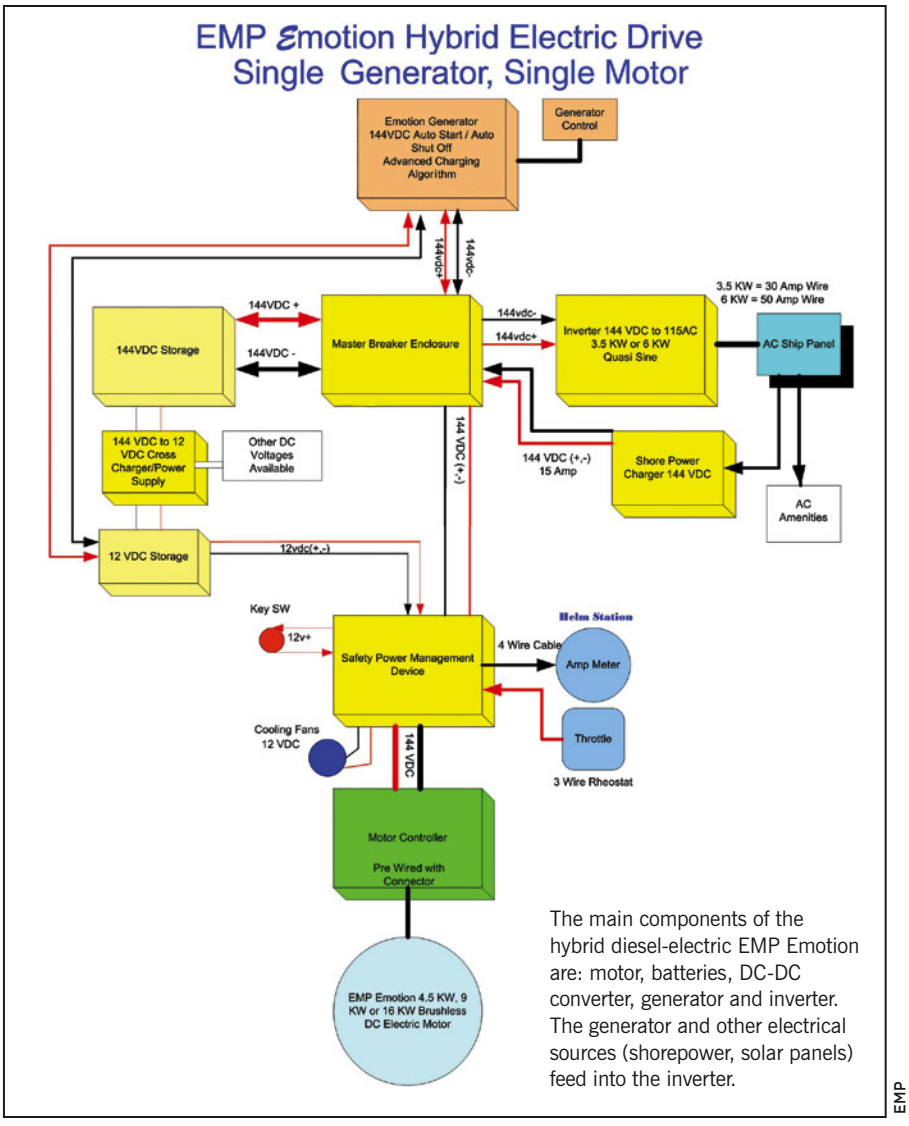


Glacier Bay

(top) Permanent magnet generators from 6kW to 200kW are the heart of the Glacier Bay diesel-electric propulsion system. (middle) This system easily accommodates both high and low voltage battery banks, adding increased load handling capability with no compromise in system performance. (bottom) Touch-screen display mounted at the helm provides information on the status of up to 50 devices on the OSSA-CAN network.

CAN network communications bus using standard NMEA 2000 cabling to the controller, which then controls the motor output. The system utilizes digital signal processing technology to optimize speed and torque control. EMP uses three phase permanent magnet motors using pulse width modulated speed control.

The permanent magnet DC motor is also able to provide full torque over the entire speed range, which allows efficient use when maneuvering at slow speeds. DC speed control was traditionally done by the use of a rheostat, which is, in effect, a variable resistance and this gave a relatively coarse control. Electronic control has



The main components of the hybrid diesel-electric EMP Emotion are: motor, batteries, DC-DC converter, generator and inverter. The generator and other electrical sources (shorepower, solar panels) feed into the inverter.

EMP

now superseded this with far greater accuracy and more precise motor control.

Power Management

All integrated power systems require a power management system for optimum control, distribution and protection; hybrid propulsion systems increase this requirement. This comprises several important elements.

High Voltage battery charging, power generation and distribution. The high voltage power generation system is used to charge the high voltage battery bank and also to power the propulsion drive motors. It must also be able to react to constantly changing electrical load conditions. The power management system, just like those in big ship systems, allows automated management of electrical loads and charging. In any electrical system, loads are coming on and off or increasing or decreasing current demand. The power generator must respond to these demands and provide a stable power supply. Like a diesel propulsion engine, speeds vary as the load changes, such as that from punching increased wave conditions to adverse currents, and the power management and generator systems must adapt to this to maintain constant boat speeds.

Low Voltage battery charging and power distribution. Using a low voltage battery bank requires control of charging and distribution. Low voltage battery banks are charged either from the high voltage source or from shorepower-supplied battery charger, wind generators, solar panels and fuel cells.

Circuit Protection. The protection of electrical circuits is a fundamental part of any circuit. Higher voltage DC circuits are protected against over-current and short circuit just as they are in 12 and 24 volt circuits. The protection of the supply circuits and the propulsion electric motor are critical. Any over-current situation, such as a fouled propeller applying large overloads, requires good protection to avoid damage and over heating of cables and the electric motor.

Ground Fault Monitoring. Higher DC voltages tend to look for easy paths to ground and potentially this is dangerous as well as degrading to the DC power system. Higher voltage DC tends, from my own commercial DC ship experience, to track to ground easier than AC and, for this reason, to ensure that circuit isolation integrity is maintained, these systems use very high precision ground fault monitors to detect even very low levels of leakage before they escalate to large values.

Electric propulsion systems use an ungrounded floating system, with no part of the system polarized to ground. Any large leakage of the DC system to ground, similar to AC systems, has the potential for causing a short circuit, overheating and even fire. Glacier Bay has named this important safety feature the GFS (Ground Fault Safety) system that interfaces with the control and monitoring system. It is a lot more reliable than the old ground fault lamps that were used on my first DC powered ships.

Monitoring and Control. It is a touch screen world, from mobile phones to computers, and this user friendly technology is also used in power management systems. Monitoring of system voltages, current demands and battery capacity have long been available in discrete metering devices; however, in any integrated propulsion and power system, knowing the precise values is essential. Like many instrumentation systems, Glacier Bay has incorporated networked, user-programmable parameter displays. Displays are also able to provide the system status of all networked devices and equipment.

Applications

It is not difficult to understand why the concept was initially applied to catamarans and trimarans. Total weight and weight distribution are of critical importance to the trim, stability and sailing performance. Catamarans normally have two diesel engines, one in each hull and, along with that, are duplicated house and starting batteries, electrical cabling

and so on. This adds up to a lot of weight, all of which is placed in less than optimum locations in the stern of each hull. In addition, the vibration in lightweight hulls can also be considerable when the engines in each hull are running.

Both the generator unit and battery banks are placed in the optimum mid-hull position for weight distribution. Generator sizes and weights have also shrunk considerably over recent years and they can also be placed in preferential locations, a positive feature for multihull use. Electric propulsion systems allow precise control of both propellers in a cat's twin propeller units and synchronization has always been a problem in diesel propulsion systems. Noise and vibration echoing in the hulls is now largely eliminated.

Battery Requirements

Determining battery requirements demands calculations similar to those you might do for a house battery bank installation. [Ed: For guidelines, refer to Tables 1 and 2 on page 20.] Calculations are based on the estimated time that you want to run in pure electric propulsion mode without the diesel generator running to supply power and charge the battery bank; amp hour calculation is based on motor current.

If you want to run silent for six hours, for example, base the battery bank capacity on this factor, with the usual margin for deep cycling. Battery bank size calculation also needs to determine the operating time needed for the generator to recharge. Obviously, the longer you run on battery supply mode, the larger the battery bank needed, allowing for consequential space and weight implications. The option of only limited battery supplied propulsion brings the battery bank requirement down and also cost and weight.

Installation Costs

A new installation has the advantage of being, in most cases, ideal for selecting the optimum locations for battery banks, generators and other system components so that the advantages of the best weight distribution are realized. At initial construction stage, the additional advantages of space rationalization are possible and all system components are selected and installed without the need to consider existing systems.

In retrofit installations, where electric propulsion is to be integrated with a traditional engine replacement, the costs are considerably higher. The existing engine space may not ideally suit the new configuration. Existing shafting, engine mounts, fuel and ventilation, as well as electrical systems, may all require complete replacement even though they are still viable in a traditional diesel installation. This means that the initial capital cost of the original engine is lost and all the subsequent construction activities have significant cost impacts. In many cases, existing boat layouts will complicate locating the new system components where they should be and major modifications will be necessary. In the end, this all comes down to budget and, on a straight cost basis, the cost of the electric system comes out significantly higher when its counted as part of a retrofit situation.

In most cases, a new hybrid installation (as opposed to a retrofit) also costs considerably more than a conventional one; however, this investment must also be looked at in the context of an overall system. When other components are added in, such as the traditional engine, batteries, AC generator and so on, the cost ratios start to level out. Viability further increases when there are plans adding other onboard electrically powered equipment, such as watermakers and air conditioning, and the power source is fully utilized.

Considerations

Integrated electric propulsion systems allow optimum use of electrical power generation and enable virtually silent and vibration free propulsion. These systems also offer real savings in both weight and space. Systems are simpler with considerably less moving parts and as generators are better utilized they also result in less maintenance. [Ed: Turn to page 18 for choosing and installing a Mastervolt Whisper diesel generator.] Generators are matched to load requirements and as a result are more efficiently used. The latest generation of compact generators use the latest diesel engine design technologies and have lower emissions, greater fuel efficiency and, within a boat environment, reduce the fumes from fuel and exhaust migrating into the boat.

More boat builders are now offering these systems as an alternative to traditional diesel engine and shaft-powered propulsion systems. It is a trend that is set to continue growing as the many advantages are realized.

About the author: John Payne is a professional marine electrical engineer involved in the commissioning of large mobile offshore deepwater electric propulsion drilling rigs. He is author of the *Marine Electrical and Electronics Bible* and a dozen other marine electrical and electronics books.

BELT SCRUTINY

Generally referred to as the "fan" belt and almost always ignored as a serious wear item, drive belts can cause large problems if left alone.

Story and photos by Steve Auger

Most gasoline engines employ the use of belts to drive engine accessories that are required to complete the marine engine package. Belts drive fresh and seawater pumps, governors on generators, compressors for turbo systems, power steering pumps and most commonly alternators.

In order for these peripheral components to perform their required tasks, the drive belt system must be in good working order. A failure of the drive belt system on an inboard engine can cause severe engine damage due to overheating as well as a loss of power steering and battery charging capability. Outboard engines use drive belts to operate alternators, distributors, compressors and the camshafts that control valve timing. A failure of the drive belt on an outboard can also cause severe engine damage.

As usual, I always recommend that you obtain a quality service manual for the engine you are going to service prior to starting any service procedures. Using a service manual safely guides you through the inspection and adjustment process for the specific engine you are servicing. Original equipment manufacturer (OEM) manuals are best and tend to be more model specific than generic service manuals that generalize service procedures for many similar models.

Belt Check up

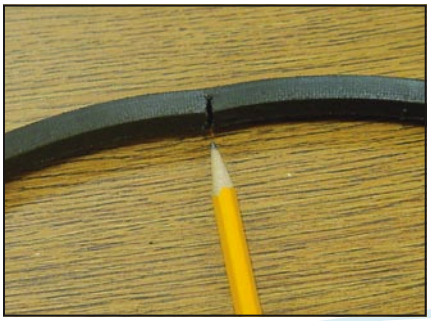
Drive belts are made of a woven fabric encased in a rubber jacket. The fabric makes the belt durable; the rubber makes the belt flexible. As engine hours add up, the rubber tends to lose flexibility and begins to crack. This, in turn, exposes the fabric in the belt core and the belt condition rapidly deteriorates. A simple inspection is really all that is required to prevent a belt failure from wear and tear.

With the engine shut off, inspect the condition of the rubber on the exterior and contact area of the belt. Any cracking of the rubber area of the belt indicates it is dried out and needs replacement. On vee-style belts, inspect the inside contact area of the belt for glazing, a shiny surface instead of the rough surface on a new belt. A glazed belt is either worn out or was incorrectly adjusted and requires replacement and readjustment. The vee belt contacts the pulley sheave on its sides only and does not bottom out in the pulley. If the belt rests below the surface of the pulley it is worn beyond use.

A drive belt wears out prematurely if one of the accessories it drives is failing. For instance, if the bearings in an alternator were to fail and start to seize, the drive belt wears out much sooner than one attached to a good alternator. Before ordering any replacement parts, ensure all belt-driven accessories are in good working order. Alternators, belt tensioners and idler pulleys should spin freely by hand. Inspect power steering pumps and seawater pumps if they are suspected of contributing to premature belt wear.

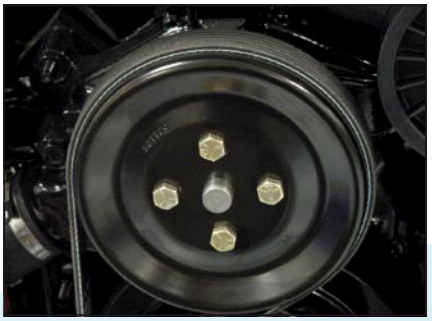
Under normal day-to-day operation, inspect vee belts every 100 hours or 120 days, whichever comes first. Inspect serpentine belt equipped engines every 300 hours or every three years, whichever comes first.

There is no actual replacement time frame for belts but it is wise to change the belts every five years or 500 hours even if they are not worn

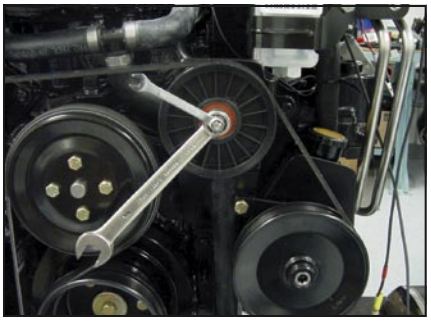


Inspect vee belts for wear and cracks every 100 hours or 120 days, which ever comes first. This belt requires replacing.

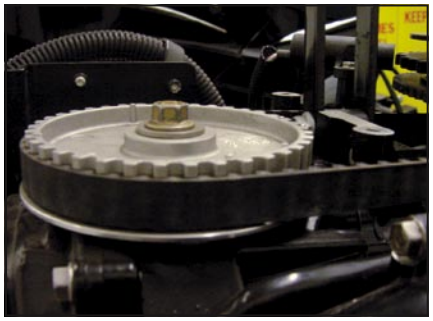
When adjusting or replacing a serpentine belt, spin the idler pulley by hand and replace if it makes any noise or has any play.



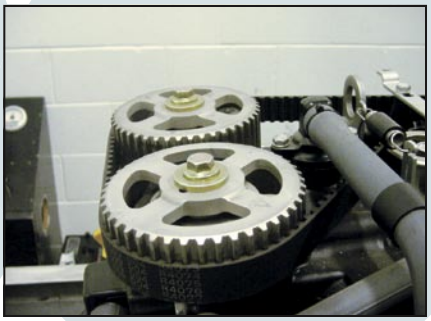
Serpentine belt is flat with many grooves and more closely resembles an automobile belt. This one is in good condition with no cracks or glazing.



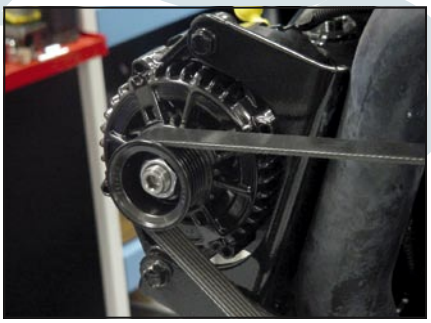
(top) 2008 model Mercury sterndrive uses a serpentine belt with a manual tensioner to drive engine accessories. (bottom) Manual serpentine belt tensioner requires only two wrenches to set belt tension.



(top) Four-stroke outboard with twin camshafts timed using a Gilmor or cog-style drive belt. (bottom) Single cam four-stroke outboard also uses a cog-style belt to keep the camshaft in the correct time with the rest of the engine.



Four stroke outboard uses a belt to drive a remote alternator.



The alternator requires a drive belt in good condition set to the correct tension in order to work correctly.

out or cracked. For engines that use a serpentine belt with an automatic tensioner, it is advisable to replace the automatic tensioner when replacing the belt.

Purchasing Tips

Have your engine serial and model numbers available when purchasing replacement parts. (Ed: Add these to your spare parts list.) There are literally hundreds of different belts that are available for all the different makes and models of marine engines. Having the correct model and serial number helps avoid getting an incorrect replacement part and saves you from making repeated trips to the dealer/parts supplier to obtain the correct belt or related part. Never replace a belt with one that is just “close” or switched from inch sized to metric.

Take the original belt and or part(s) with you to the dealer, if possible, to compare to the replacement part and to verify the replacement part is correct. Try to replace the belt with an OEM replacement belt, if available. Should your engine have two belts they must be replaced as a set.

Vee Belt Adjustment

Slipping creates heat and heat can wear a belt and pulley very quickly. Most marine engines that use one or more vee belts require that each one be adjusted individually. On a basic 7.4 liter sterndrive engine, for example, the alternator pivots towards and away from the engine by loosening the adjustment bolt/nut on the back of the alternator and applying side pressure to the alternator at 90 degrees to the pivot. Moving the alternator away from the engine increases belt tension and moving the alternator towards the engine loosens belt tension.

Never force a belt onto its pulleys and absolutely not tighten a belt like a bow string. Your engine manual has the suggested measurement of belt deflection along the longest open run of belt. Usually 1/2" to 3/4" (12mm to 19mm) with gentle thumb pressure.

Once the correct tension is achieved, tighten the adjustment bolt/nut. Now torque the alternator bolts to specification (usually around 30 foot pounds of torque). Repeat this process for the power steering belt, seawater pump belt and so on. Once the belt tension is correct for all belts, start and run the engine for five to 10 minutes and recheck belt tension again and readjust if necessary.

By the way, that black dust on the front of the engine is your vee belt’s signature goodbye and your engine really hates breathing it.

Serpentine Tuning

Modern marine engines use a serpentine belt system. This system uses one flat belt that ”snakes” around all of the belt-driven engine accessories. If the belt fails you will lose several systems in the same moment.

Replace serpentine belts once the rubber starts to show any cracking. Most modern marine engines using serpentine belts have a manual tensioner that uses a wheel attached to a rack and pinion. The tension on these belts is adjusted by loosening the retaining nut slightly and then using a small wrench to move the wheel up and down the tensioner rack and pinion. Lowering the tensioner typically reduces belt tension; raising the tensioner increases belt tension. Always refer to your service manual for complete details. Once the correct tension is achieved, run the engine for five to

This broken serpentine belt auto tensioner could have caused major engine damage if left undetected.

Serpentine belt "circuit" can be rather complex and the belt may drive several things at once. Most modern engines have a decal showing the correct routing.

10 minutes and recheck the tension and adjust if necessary. Some newer engines, such as the Mercury 496 Mag sterndrive, employ the use of a spring-loaded automatic belt tensioner that requires replacing when swapping the belt.

A serpentine belt uses an idler, a pivot pulley and sometimes an adjustment point in the belt run circuit. Idlers are self lubricating but do wear and when they fail they bring the party to a certain end. Carry a spare onboard and check the idler when adjusting or replacing the belt.

All belts must be considered wear items with relatively short lives. If you have not changed out the system in five years you are way overdue. Do not assume the correct belt is in place as a best intentioned mechanic may have switched out the belt with an incorrect width or diameter under the guise of good quick work. Clean rusted pulleys (never paint inside the sheaves) and replace, if pitted.

If you do not have a factory photo of the belt circuit make one yourself so you'll be prepared to change the belt or replace it in an emergency situation.

Follow these steps as part of your regular maintenance routine and you will spend more quality time on the water and less time down time at the repair shop.

About the author: Mercury Mercruiser master technician and DIY's engine technical advisor, Steve Auger, has more than 35 years experience in marine retail, manufacturing and training, mostly with Mercury Marine.

Picking the Perfect Pooch PFV

A flotation vest gives you peace of mind should your pet get in over its head.

Story and photos by Jan Mundy

During our too-few cruises last summer, I was surprised to see most boat dogs wearing flotation devices. What was even more surprising is that the dogs' owners were not as concerned about staying afloat themselves. Even for great canine swimmers, wearing a pet flotation vest (PFV) is akin to an insurance policy. When an unexpected dunking tosses your pet overboard, it keeps them safe until retrieved. Even legendary "water dogs" can panic or become exhausted, especially if they are trying to swim to a shoreline in cold water.

I've had dogs for as long as I've had boats and only in rough conditions did our furry friends wear PFVs when onboard. Three dogs make up our current "crew:" a 100-lb (45-kg) hound who abhors water; a smaller senior whose swimming years are behind her and a youngster who is the canine version of Esther Williams. It soon became apparent that the hound needed a PFV to save her should she fall overboard and the older one needed a flotation device to assist her in enjoying a favorite activity.

We purchased three inexpensive (read: cheapest) PFVs of the common and popular flat shell variety. Our in-water tryout, launched from a sandy beach, proved a failure. The instability of this PFV's design terrified the hound and its stiffness restricted the senior from swimming. Hence, my quest to find the perfect pooch PFV.

Three handlers from the Paus-N-Train dog training facility in Cameron, Ontario, volunteered their dogs as models. Our recruits were: Miss, a Border Collie, and Shelley, an English Springer Spaniel, both 7 years old; Sula, a 10-month old Portuguese Water Dog; and my dog, Tess, a 5-year-old mixed breed who competes in dog agility at the national level.

I invited seven manufacturers to participate but only three responded: Paws Aboard, Ruffwear and West Marine. We also tested the Fido Float, which was Tess' current PFV. Vests were tested on comfortability, durability, flexibility and wearability. For each dog, we examined label sizing versus actual dog size, considered dressing ease, ease of movement onshore and in the water, overall design and fit and preference rating by the dog's owner. Most important was how well the lifting apparatus served when a dog owner onboard a boat retrieved a wet dog from the water. We used a dock as our platform for this test.

Tests were conducted from a sandy beach on a sunny day last August. As all dogs were toy motivated, a floating toy was thrown about 50 yards (9m) into the water for the dogs to retrieve. We first observed each dog's swimming characteristics without a PFV then the dogs swimming while wearing each of the PFVs.

Selection

Vests are available to fit almost any breed from very small dogs less than 6lb (8kg) to dogs 90lb (41kg) and larger. All vests used in this test were either medium or large size. Paws Aboard (www.pawsaboard.com) comes in various colors and patterns that have a nylon back attached to a mesh underbelly and closed with hook and loop fasteners, bellyband and buckles. Ruffwear K-9 Float Coats (www.ruffwear.com) are made of "ballistic" red or yellow 1680 denier nylon shell and very stiff closed-cell foam. Side release buckles allow for easy clip in and release.

No one size fits all dogs within the manufacturer's sizing guidelines. Shown are the medium and large sizes of three test jackets. Note that the West Marine vests (bottom) vary marginally in size between the medium and large vests.

Sizing for this brand is based solely on the dog's chest girth and length. West Marine Deluxe Pet Vest (www.westmarine.com) comes in five sizes (no XXS) and is made of a lighter 500-denier nylon covering and soft PVC foam. The one-piece Fido Float (www.fidofleece.com) comes in seven sizes and has a durable orange or yellow nylon shell, mesh underbelly, soft PVC foam, an extra buoyancy neck cushion and a collar-to-tail back zipper closure.






(top left) Paws Aboard center-mounted handle enabled a straight, vertical lift. (top right) Handle placement on the West Marine vest offered the best single handle control for all our models. (bottom left) Ruffwear's handle is placed too far forward, which drops the dog's rear. (bottom right) Double handles on the Fido Float gave the best handler control and balance of the dog.

(top) Without a vest: True to her breed, Sula, the Portuguese water dog is a gallant swimmer. (bottom) With a vest: Flotation provides some extra buoyancy, though not as visible as with Shelley.



Ruffwear: (left) Large cutouts around the front legs provide good leg movement though very stiff closed-cell foam restricts movement on shore and in the water with smaller dogs. (middle) With straps fully tightened, the medium vest was too large for Miss. (right) This vest's bulkiness and stiff foam padding won't hinder larger dogs when swimming.

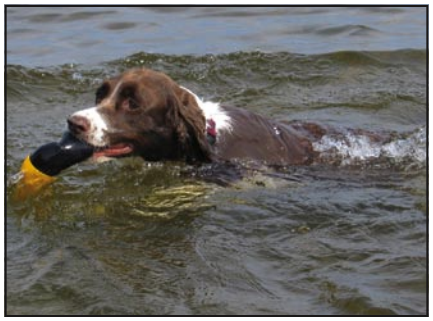
Vest prices for the large size range from $25.99 for the Fido Float, $44.99 for Paws Aboard to $69.95 for Ruffwear. All West Marine vests cost $29.95, regardless of size. All PFVs tested have lifting handles to retrieve the dog from the water and reflective trim for better visibility when illuminated with a light source in low light or at night.

Vest sizing is based on a combination of weight, body girth measured around the chest at the widest place, neck girth measured from back of neck to hollow in middle of throat and body length measured from back of neck to base of tail. All manufacturers have different sizing guidelines and no one size fits all canines. Size guidelines are printed on the manufacturer's label attached to each vest. You'll note from the test results on page 43 that though our models fit within the recommended medium weight range their varied shapes determined the actual best size fit. Rather than rely on the "guidelines," it is best to take your dog into the store for a fitting before purchasing.

Ratings

Surprisingly, all owners preferred the two strap-style vests for ease of dressing, albeit the two vests with the mesh underbelly appeared easy on, easy off. Fido Float has a nylon mesh bottom that the dog steps into and was difficult to slip into on the first try, especially with a puppy, as Sula proved. Dressing becomes easier once a dog gets used to it for this was now no issue with my dog. With only the full length zipper and no adjustable straps, the Fido Float was the most difficult to size. Though the Paws Aboard vest allowed for adjustment, its hook-and-loop fastened bellyband and snap together buckles proved just as challenging. Our models also seemed more comfortable and had better freedom of movement wearing the strap-style vests.

Oversize side-release buckles, wide and padded belly straps and all-around front leg cutouts gave Ruffwear unanimously top marks for fit despite its bulkiness. Stiff padding restricted movement on shore of our two smaller dogs and greatly impeded the swimming ability of Tess, our smallest model. We all preferred the soft flexible foam of the other vests. The highly visible brilliant yellow shell of the Paws Aboard and West Marine vests was a bonus and all vests provided adequate buoyancy, though the Paws Aboard lacked flotation in the neck region.



(top) Without a vest: Shelley possesses the enthusiasm and love of swimming typical of the English Springer spaniel breed. (bottom) With a vest: Added buoyancy provided by the vest is clearly apparent.

All vests had lifting handles to retrieve the dog from the water. Since grabbing the handle transfers the dog's full weight to the underbelly straps, we discovered that the number of handles and their positioning greatly affected the dog's comfort and balance. Fido Float was the only double handled vest, which gave it top marks for lifting. Of the three other vests, Paws Aboard gave the best support under the dog's belly and the center-mounted handle balanced the dog well when lifting. This vest was the best fit for our broad-chested spaniel. Ruffwear's handle is placed too far forward, which drops the dog's rear so it is lifted up by the neck. West Marine is better balanced with a handle mounted further back.

Not all pet flotation devices are created equal and no single vest fits every dog. I strongly recommend that you try various PFVs on your dog before buying. (Have plenty of dog treats to relieve your dog's stress while doing this.) Consider your ability to "dress" your dog, the ease of fastening closures and check for straps that pinch. Have your dog sit, lie down and walk around with it on to check the comfort level and pick up your pooch by the handle as you consider doing this from your boat. If any of these tasks are a struggle neither you nor your dog will be happy.

About the author: Jan Mundy is editor of DIY.

(Photos continue on next page)

POOCH PFV RESULTS

Miss, Border Collie (wearing Paws Aboard)
Height: 21"/53cm
Weight: 35lb/15.8kg
Girth: 25-1/2"/65cm

	Size	Fit	Dressing	Mobility Onshore	Mobility Water	Retrieval	Overall Rating*
Fido Float	L	Good	Good	Good	Poor	Very good	4
Paws Aboard	L	Good	Poor	Very good	Very good	Good	3
Ruffwear	M	Poor	Good	Very good	Very good	Poor	1
West Marine	L	Good	Very good	Very good	Very good	Good	2

Shelley, English Springer Spaniel (wearing Ruffwear)
Height: 20"/51cm
Weight: 49lb/22kg
Girth: 27"/68.5cm

	Size	Fit	Dressing	Mobility Onshore	Mobility Water	Retrieval	Overall Rating*
Fido Float	L	Good	Good	Good	Good	Very good	4
Paws Aboard	L	Good	Poor	Very good	Very good	Good	2
Ruffwear	M	Very good	Good	Very good	Very good	Very good	1
West Marine	L	Good	Very good	Very good	Very good	Good	3

Sula, Portuguese Water Dog (wearing Fido Float)
Height: 20"/51cm
Weight: 41lb/18.5kg
Girth: 26"/66cm

	Size	Fit	Dressing	Mobility Onshore	Mobility Water	Retrieval	Overall Rating*
Fido Float	L	Very good	Poor	Very good	Very good	Very good	4
Paws Aboard	L	Good	Poor	Very good	Good	Good	3
Ruffwear	M	Good	Very good	Very good	Very good	Poor	1
West Marine	M	Very good	Very good	Very good	Very good	Good	2

Tess, mixed breed (wearing West Marine)
Height: 17-3/4"/45cm
Weight: 33lb/15kg
Girth: 24"/61cm

	Size	Fit	Dressing	Mobility Onshore	Mobility Water	Retrieval	Overall Rating*
Fido Float	L	Very good	Very good	Very good	Very good	Very good	1
Paws Aboard	L	Poor	Poor	Good	Good	Good	4
Ruffwear	M	Very good	Very good	Good	Poor	Poor	3
West Marine	M	Good	Very good	Very good	Very good	Good	2

*Note: Results are based on preferences of our model's owner; 1 is best, 4 is just okay.



Paws Aboard: (left) double closure gave a secure fit but made it difficult to put on. Forward edge of bellyband rubbed against all our model's front legs. (middle) High-energy Border Collie, Miss, paddles aggressively with her front feet while her back sinks in the water. (right) This vest raises the dog's back to swim in a more horizontal position but lacks neck buoyancy.



West Marine: (left) Strap-style vest gives total freedom of movement and, if it had wider and padded belly straps, this vest would rate tops for fit, comfort, lifting and value. (middle) A natural swimmer, Tess' buoyant body floats high in the water. (right) None of the vests changed this dog's swimming position in the water.

7 Steps to KEEL REFINISHING

If your lead or cast iron keel is peeling paint and fairing compound, follow these steps for a long-lasting solution.

Story and photos by Nick Bailey

Keeping fairing materials attached to a keel is always a challenge. According to all the paint and epoxy manufacturers, using the same standard coating methods recommended for metal hulls below the waterline is the key to successful and durable adhesion of any coating to a metal keel. The procedure is pretty demanding and taking any shortcuts will result in premature failure of the coating or filler adhesion.

(top) On external iron keels, corrosion is always a problem. (bottom) Corrosion, precipitated by trapped moisture or galvanic activity, causes fairing materials to blister and separate from the keel.

Step 1

Remove all old coatings and fairing materials and either sandblast or grind the surface to expose bare bright metal. Be very careful to contain the highly toxic dust from a lead keel. Wear the best disposable protective clothing and a respirator.

When sanding or grinding any keel, especially a lead keel, wear full protective gear.

Step 2

A critical prerequisite of success is to make sure the temperature of the keel remains above the ambient dew point and no less than the minimum cure temperature of whatever epoxy coating and fairing materials you are using. This is usually 50F (10C) although "cold-cure" materials do exist. I find a 500-watt quartz light provides good heat and lots of light. If the weather or shop is cold, it may take a day or two of constant illumination to raise the keel temperature to a workable level. The keel should always be warmer than the surrounding air to prevent that dreaded condensation that produces the moisture that is death to coating adhesion.

Powerful 500-watt halogen lamps provide plenty of light and heat but may melt your extension cord if not careful.

Step 3

Once the keel is stripped and warm, remove dust from the surface with compressed air followed by a tack rag. Do not touch it with your greasy fingers! Immediately apply an epoxy anticorrosion primer, such as Interprotect 2000, Awlgrip 545, Bar-rust 245 or even plain epoxy resin. More than one coat is required to achieve the coating thickness that the paint manufacturer recommends. If applied during the specified overcoat interval, the additional coats are applied without prep sanding the previous coat.

Once the keel is stripped to bare metal, apply the primers recommended by the paint manufacturer's metal coating system. This primer system finishes with an epoxy barrier coat.

Step 4
The best time to apply the epoxy fairing compound is when the final epoxy primer coat has cured tack-free but while it is still within the overcoat window. You can choose from an array of fairing materials such as Awlfair, Interfill, VC Watertight or your own custom putty mixed from epoxy resin and powdered fillers such as micro-balloons. This "green-coat" application timing has the same adhesion benefits as outlined above when applying the primer coats.

Apply epoxy filler onto the barrier coat within the overcoat time window.

Step 5
Sand and repeat filling and fairing until you get the desired shape and smoothness. This could take a long time if you are a perfectionist.

Step 6
If your boat has a typical fin keel, you probably also have recurring problems with a crack developing at the keel-to-hull joint. Even the toughest fairing fillers become brittle and crack easily under tension and there is always some flex between the keel and the hull. First, torque your keel bolts to spec to minimize the potential for wobble.

The fairing at the keel-hull joint better resists cracking if reinforced with a band of fiberglass.

Next, apply three layers of 1.5 oz. fiberglass mat as a wide band, approximately 8" (203mm) or so overlapping the entire length of the keel-to-hull joint. Use epoxy as the laminating resin. After it has cured, sand off the rough edges and fair it in. There is one more worthwhile option if you are really determined to avoid fillers cracking. Once you have the overall shape correct but before you apply any paint, it is very effective to encase the entire faired surface of the keel with a single layer of 6oz or 8oz woven glass cloth. Drape the keel and squeegee the epoxy resin right through this cloth until well wetted. After this reinforcing skin has cured, trim the excess cloth followed by a quick sand and slick with epoxy putty to fill the weave. This process leaves only a minimum of final sanding to finish off the fairing process.

Step 7
Coat the faired keel with an epoxy barrier primer to seal the surface. As a general rule, all epoxy fairing putty must be "sandwiched" between epoxy

Always sandwich fairing materials by an epoxy primer, preferably a barrier coat. Underneath, it enhances the adhesion of the putty to the keel and it seals the open grain of the putty against moisture entry and provides the smoothest possible cosmetic surface on top.

(far left) Leveling of the cured filler is done with a sander set at low speed (1,500 rpm), using a foam pad and 60 to 80-grit sandpaper. Keep the tool nearly flat to prevent swirl marks in the finish. (across) Use a 3M Fairing Board to fair flatter surfaces.

(left) A Beneteau 36.7 keel barrier coated at the factory, faired, epoxy primed, sanded and ready for the application of racing antifouling. (above) A C&C 27 keel ready for combat after many hours of prep.

The author demonstrating that, according to a little known corollary of Murphy's Law, the more man hours you put into perfecting keel shape, the greater the likelihood of running aground just before a big regatta. That's cheap body filler going onto the keel for a last minute emergency repair.

primers. I like VC White Underwater epoxy for the final sealer coat because it is easier to sand smooth than most barrier coat epoxies. Sand the final sealer coat as smooth as possible with 120-grit paper and apply your choice of antifouling.

Very few people have the time or perseverance to do the keel job as outlined above but I can personally vouch for the effectiveness of "doing it right."

After years of struggle every spring patching the fillers on my cast iron T-Bird keel, I finally got it into the shop during the winter and carried out the work outlined above. After 10 years, with the only exception of those keel areas that have been aground, I have not had to touch it since. It took me around 80 man-hours but that was only because I was fanatical about achieving a template shape for one-design racing.

About the author: Nick Bailey is DIY Magazine's repair specialist and has spent 30 years in the boat repair business.

YOU CAN SEE CLEARLY NOW

(top) Before replacement. (bottom) After replacing the dodger window.

If things seem a bit blurry when seen through your dodger's clear sections, you can clear up the view with new window panels. Follow these steps to improved vision.

Story and photos by Jim Grant

After many years of exposure to the elements, dodger windows become cloudy, wrinkled, no longer soft and supple and may even be cracked and torn in places. Fasteners pull away from the fabric and the bottom edge of the dodger where it meets the deck becomes worn and its stiffness, which provided at least a partial water seal, is completely gone. These are all common problems. Fortunately, they are easy to fix.

Material Selection

Three materials are used to make windows in boat canvas structures: acrylic, Lexan and PVC (polyvinylchloride). The first two are relatively stiff. They do not fold compactly for storage nor are they easy to work with during installation. They do offer excellent clarity but the suppleness and flexibility of PVC makes it a more appropriate choice for use in canvas projects. It is also much less expensive, a nice plus.

Three grades of PVC are available and some of these are offered in different thicknesses. The three grades are: roll goods; sheet goods; and sheet goods with a polymer coating.

Plastipane is one brand of roll goods. Just .020" (.5mm) thick, it is light and supple enough to use in sailcloth windows and quite inexpensive, costing $5 per running foot (30cm) and 54" (137cm) wide or $1.11 per square foot (.09 sq. m). The downside is that it is somewhat fragile for cover windows and because it is stored and shipped on a roll, it is wavy and cloudy compared to sheet goods.

Crystal Clear and KalGlass are examples of sheet goods. They are both laminations that are pressed and polished to very high standards of clarity. Crystal Clear is available in two thicknesses, .030" and .040" (.75mm and 1mm). The KalGlass is available in .040" (1mm) only. Cost of these sheets range from $2.38 to $3.00 per square foot (.09 sq. m).

The third grade, Strataglass, is made in the same factory as Crystal Clear but is subjected to one additional operation in manufacture. A special polymer coating makes the material more scratch and UV-resistant so plasticizers, which keep the material soft and supple, do not migrate out so quickly. Its durability is roughly doubled as a result of this process. Available in .030" and .040" (.75mm and 1mm) thicknesses, pricing ranges from $3.96 to $4.20 per square foot (.09 sq m).

So, which do you choose? I clearly (no pun intended) do not recommend Plastipane except for the most temporary and unexacting work. Strataglass is the best choice for those who want the maximum in durability but, for most replacement projects, the Crystal Clear and KalGlass are good choices. The .030" (.75mm) thick sheets are best for smaller window expanses. There is a little more distortion because the material is more flexible than the .040" (1mm) thickness but that flexibility makes for more compact storage. I recommend the .040" (1mm) thickness for large windows in enclosures that are left in place nearly all the time.

Prep Work and Sewing

The key to a successful window replacement is to flatten the old window so the new one can be accurately secured over it (**Figure 1**). Then cut out the old window and finish the edges of the new one. If you cut away the old window first, it becomes very difficult to accurately spread the surrounding fabric and any diagonal misalignment results in wrinkles in the new window and a dodger that no longer fits the curvature of the deck.

Figure 1

The old window cannot be flattened without ripping stitches.

Figure 2

Having partially ripped two seams, the old window is spread flat and secured with awls.

Figure 3

Use a grease pencil to mark the new window panels.

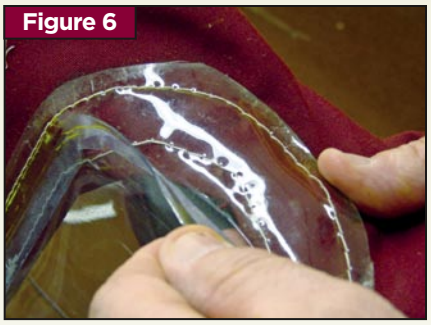
Figure 4

Scissors cut the window nicely.

Figure 5

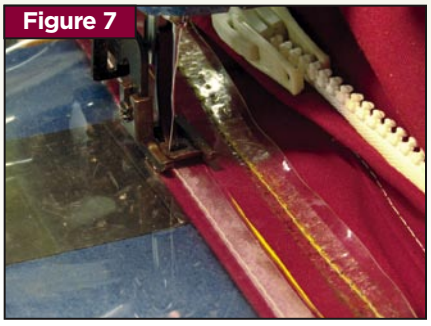
Turn the cut window over and apply basting tape.

Figure 6



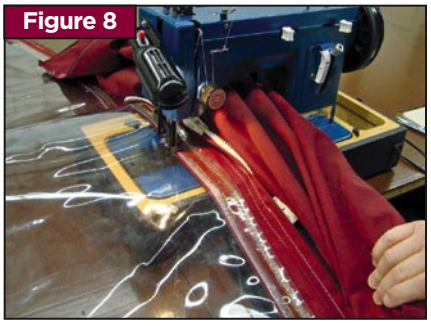
Adhere the new window on the inside surface of the dodger right over the old.

Figure 7



Sew right over the original inner stitch.

Figure 8



Roll the bulk of the dodger where necessary.

Flattening the window may require ripping out a few stitches that connect the front panel to the top panel around the curve of the first frame bow and down to the deck. Rip only as far as necessary so that the two panels remain connected at their center. Now, working on the inside surface of the dodger, remove any fabric trim along the edge of the window and then use awls to spike the old window panel flat (**Figure 2**). Lay the new window material on top of the old (**Figure 3**) and cut it to the same size as the old window (**Figure 4**).

To prepare for sewing, secure the new window material over the old (**Figures 5 and 6**) on the inner side of the dodger with double-sided basting tape (Sailrite part 129, $7.75; www.sailrite.com). If the old window is so stiff and cracked that it does not lie flat, trim away the problem spots. Use a more aggressive 3M Super Seam Tape if the new window still tends to pull away from the old in places (Sailrite part 1501, $24.65) or try stapling problem areas.

Sew all around the new window along its outer edge (**Figure 7**). I prefer the look of a zigzag stitch about 3/16" (4mm) wide by 1/8" (3mm) long but there is nothing wrong with a straight stitch (make it as long as possible). For durability, use medium weight polyester thread (such as V-69) with a number 16 or 18 needle. Rather than putting one continuous line of stitches all around the window, which entails turning the dodger all the way around through the small opening in the machine, it is easier to sew in straight or nearly straight lines with short reverse lock stitches at beginning and end and then reposition the assembly for the next nearly straight run and so on. Keep the bulk of the assembly outside the machine as much as possible (**Figure 8**).

Now, remove the old window using a seam ripper or scissors (**Figure 9**). If you are careful, cut under whatever trim was originally on the outer edge of the fabric. That leaves the dodger finished on the outside. On the inside, add a fabric trim strip made of 1" (25mm) wide prefolded acrylic binding, available in most colors, over the edge of the new window. Use a hot glue gun with special acrylic glue sticks (Sailrite part 102210, $1.95 each) to secure the trim in place (**Figure 10**). The glue eliminates unsightly extra rows of stitches on the outside of the dodger all

Figure 9

Use a seam ripper to cut away the old window.

Figure 10

Use a glue gun to trim the inside window edge.

Figure 11

Glued trim on the inside.

around the window. For a finished look, do this on the inside as well (**Figure 11**).

For the final step, match up the panel seams that were ripped to flatten the old window. Use double-sided tape to hold them accurately in place or you may prefer to staple the seam allowances together. Just be sure to remove the staples after sewing.

Canvas-Deck Join

For a good seal between the dodger and the deck, sew Xtreme Seal foam weatherstripping (available from Sailrite for $4.95 per foot/304mm) all along the underside of the dodger's front edge. Sew it in place with one line of straight stitches, making sure that the thicker bulge in the foam is aft and down (**Figure 12**). That accommodates the normal angle with which the dodger intersects the deck. Sew with the foam down, keeping the fabric on top, as it goes through the machine. In this way, the lower feed dog pulls it through. The foam is easy to attach even on curved edges but, as usual, the use of basting tape makes the work even easier (**Figure 13**).

Figure 12

Foam is sewn in place with a single row of stitches. With a walking foot machine, the foam is sewn on top like this; normally, it is sewn with the less sticky fabric on top.

Figure 13

Baste the weather-stripping foam in place.

Updating Deck Fasteners

A wonderful new low profile fastener called Pull-It-Up (Sailrite part 999100 for the button) does not release until the button on top is pulled up (**Figure 14**). Install them through the fabric and foam along the leading edge of the dodger. Use a number 2 hole cutter or a 3/8" (9mm) drill bit to open a hole for the button (drill with the foam over a wood backing scrap). Now, screw the button in place using a special clinch nut key, as shown in **Figure 15** (Sailrite part 999195, $3.95). Use a 3/16" (9mm) drill to open a hole in the deck for the ball key, which screws in place.

Protection Helps

Now that the dodger looks so good, how do you keep it that way? If your window material is Strataglass, there is just one preservative process that will not void the warranty. First, wash the dodger windows with boat soap, then apply IMAR "polish" (Sailrite part 100928, $19.95) and repeat at two to three month intervals. Always use IMAR cleaner (Sailrite part 100927; $19.95) for subsequent cleaning.

For all other window material use 303 Protectant every 30 to 45 days. This product is a cleaner and a "sun tan" lotion for all plastics with a 40 SPF. One proviso, however, do not let any solution get on any acrylic (e.g. Sunbrella). It makes the fabric leak badly until a coating of 303 Fabric Guard is applied to restore water repellence.

Figure 14

Pull-It-Up fasteners provide a secure deck attachment. Use four at critical points.

Figure 15

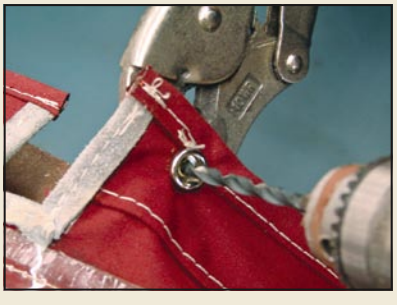
Pull-It-Up fasteners are screwed in place with a key.

About the author: Jim Grant founded Sailrite (www.sailrite.com) in 1969 and, with wife Connie, steered the business successfully until retirement in 2005. Jim and Connie gave legitimacy to do-it-yourself canvas and sail work.

TIP

Easy Snap Removal

Use a drill and pliers to remove old snap fasteners.



NAVIGATION by the Rules

Nav aids offer a handy reference check when you need information fast or to simplify plotting for novice and seasoned navigators alike.

Story and photos by Garrett Lambert

Long time purveyors of brass clocks, sextants and other traditional yachting appurtenances, Weems & Plath (W & P) has always evoked images of navigation performed in dim cabins on creaking wooden sailing ships. When I switched from sail to the dark side of diesel, fiberglass and high tech electronics some years ago, I also lost touch with the dreamy promise of W&P's products.

Imagine my pleasure to discover that the company has kept pace with technology and very smartly, too. I have two of their new goodies, one of which comes in several iterations, each representing an unbeatable combination of ingenuity, utility and value.

The first is the Light and Road Rules, a group of seven "recognition" aids (**Figure 1**). Each provides an almost instantaneous way to determine what a boat's light configuration, horn blast or an unfamiliar buoy is signaling or who has right of way in a particular set of circumstances. Each aid takes the form of a slide rule, but a big one, since so much information is presented using both sides. The devices are about 15-7/8" by 5-1/8" (403mm by 130mm) and sturdy, despite being quite light and thin.

Instructions specific to each rule are printed on the plastic storage envelopes that come with them; however, use is intuitive. The body has "windows" and a magnifying strip, while the slide, the meat in the sandwich, has an array of symbols representing whatever one is viewing (**Figure 2**). Put the symbol in the window and the magnifier describes it. The ratcheting slide makes registration easy.

In **Figure 3**, the image in the window and the Rule tells me that it is a "fishing vessel with gear extended >150m in direction of light making way." The obverse of the Rule shows the vessel's port and stern views.

The Light Rule could have been called the light and sound rule. Each face illustrates from all four possible viewpoints and describes the 60 different light combinations another vessel might display. Also printed on the faces of the rule are the maneuvering and warning signals for both horns and bells (**Figure 4**).

There are three versions of the Light Rule: COLREGS (English or Spanish) and CEVNI (Europe). There are four versions of the Road Rule: IALA Regions A and B (English or Spanish), USATONS and CEVNI. One face of the slide has full color illustrations of all of the buoys and markers as well as their associated lights and chart symbols. Put any buoy in the window and its related chart symbol is displayed immediately above, while the magnifier describes the information it conveys.

For the example shown in **Figure 5**, the magnifier provides the description: "East Cardinal Pillar Buoy: KEEP EAST OF MARK - May Show White Light." **Figure 6** shows lighted range markers.

Figure 1

Figure 2

Figure 3

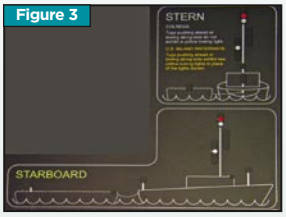


Figure 4

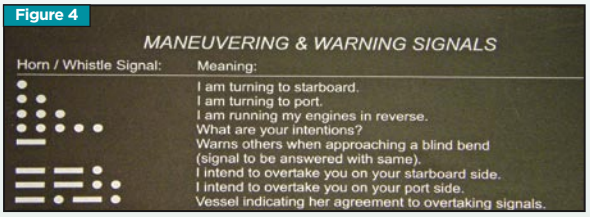


Figure 5

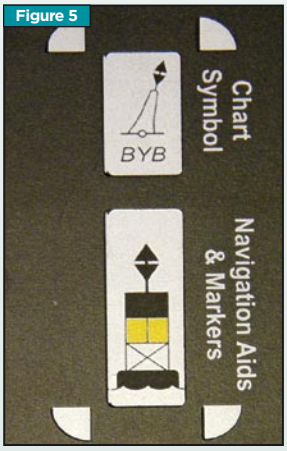


Figure 6

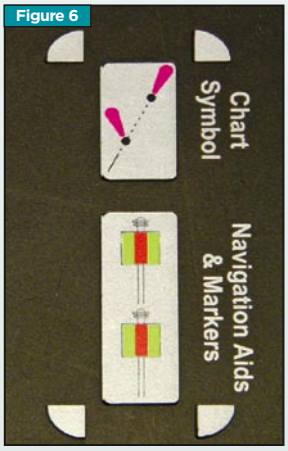


Figure 7

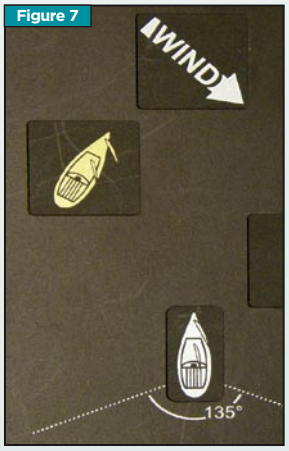


Figure 8

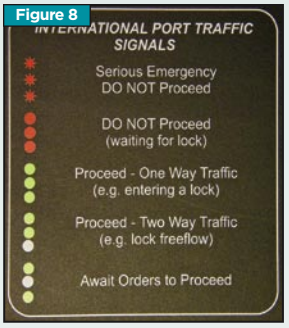


Figure 9

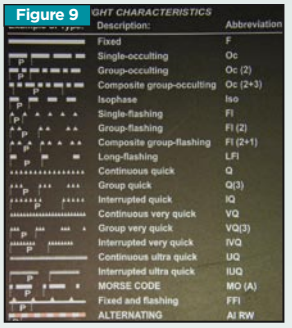


Figure 10

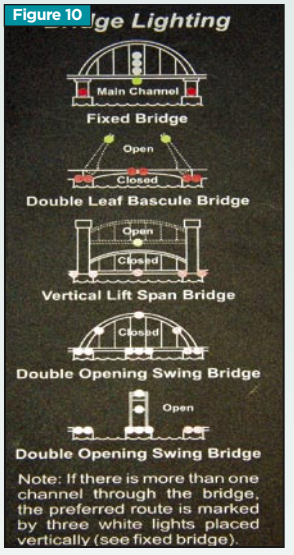


Figure 11

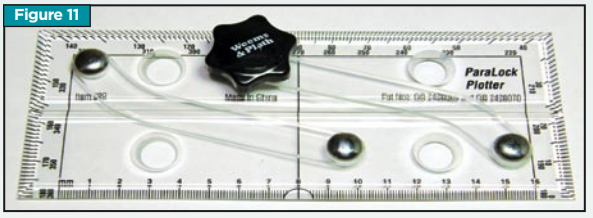


Figure 12

On the obverse of each Road Rule slide are illustrations of all Right of Way situations for both power and sail using boat icons colored yellow and white. Sliding any combination into the windows on the body immediately indicates the give-way boat (always yellow) and the stand-on boat (always white) as shown in **Figure 7**.

The IALA Rule body also shows International Port Traffic Signals (**Figure 8**) plus a table of Light Characteristics, illustrating the types and their chart abbreviations (**Figure 9**). For its part, the USATONS Rule includes bridge lighting (**Figure 10**) and navigation aids specific to the ICW. Both Rules also provide a list of the Horn/Whistle Maneuvering and warning signals.

These rules sell for about $25 each, a real bargain given the way they simplify what can be a bewildering array of information to the casual, part-time boater. Surely we are all supposed to know this information by heart and our reactions to Rule situations should be instinctive but the truth is most of us do not and anything that helps keep everyone properly informed keeps all of us safer. The Light and Road Rules should be on every boat. (Our guests love using them, too.)

The other new gadget is the ParaLock Plotter (**Figure 11**). W&P's Peter Trogdon told me that the parallel rule has been in use for about 3,000 years but that the ParaLock represents the first significant design innovation in centuries.

At just over 7" (451mm) closed, this rule feels really compact compared to its full-size brethren. As such, it's much easier to use with chart books and folded charts in the confined spaces of smaller boats. Although small when closed, thanks to its long and curiously shaped legs, in the fully extended position, it can project a 14" (355mm) straight line, a little more than a closed standard rule.

This device is also much easier to use than traditional designs because of a pair of finger holes that do double duty in each of the legs. Anyone who uses a parallel rule knows the beginner's frustration of trying to "walk the rule" from a course line to a Compass Rose or Meridian line and then tighten the clamps without changing the alignment. That's no longer an issue with the ParaLock. After tensioning the big black knob, the tips of the little and index fingers pressing through the holes onto the chart act as parking brakes to maintain the stationary rule steady while the other hand's finger tips use light pressure on the other rule to move it easily to a new position. The procedure is reversed to bring the rulers together again, then repeated until the destination is achieved. The pre-tensioning keeps everything in position. W&P's instructions recommend a finger and thumb, but I found the two fingers more convenient, not to mention that my thumbnail always got in the way. A metric scale runs along the bottom edge, while the other three edges are marked as a protractor with angles printed in both directions. The brief commentary on the plastic sleeve provides instructions on how to find a given GPS position on a chart as well as details for more traditional usage. An Internet search also turned up generic instructions, including a useful video at www.videos.sailingcourse.com.

I have to admit that the reason I spoke to Peter was because I thought my ParaLock was deficient. I inferred from the name that the knob should lock the two rules in position, yet I couldn't get it to do so. I also complained that the knob wasn't designed very well for the amount of pressure required. He listened carefully, then gently explained that a lot of design time had been put into the clamping mechanism, which is a matched pair of brass cones, to enable it to be tightened to a friction fit but not locked. In fact, each of the four pivots has a pair of very slippery washers to make movement smooth. For its part, the knob is sized and shaped precisely to prevent ham-handers (like me) from stripping the post. In an attempt to recover from my operator error, I suggested the name be changed to ParaSortaLock but I don't think Peter was amused. Priced at about $25, the ParaLock is another excellent tool.

And finally, if you're running at night, with your Light Rule close to hand and you are plotting your course on paper charts with your ParaLock, another must have is W&P's Night LED Dividers (**Figure 12**) for about $30. A red LED in each leg casts enough light for a chart to be read and marked without disturbing night vision. How cool is that? The pair I have on order hadn't arrived by the deadline for this article, so I can't comment on the basis of use, but W&P's reputation suggests that these dividers will be very well made.

About the author: Garrett Lambert is contributing editor of "Circumnavigator" magazine, editor for www.woodcentral.com and writes technical articles for boating and woodworking publications in Canada and the U.S.

Gasoline Alert

Spilled gasoline can be deadly. Follow these fueling procedures and know who to call for help should you discover spilled fuel in the bilge.

Story by Chuck Fort

In late August, a boat owner embarked on what was supposed to have been a relaxing cruise to Martha's Vineyard with his wife and a good friend. His boat, a handsome 35' (10.6m) Trojan was well equipped, with the exception of a few "small" details like an unreliable fuel gauge and malfunctioning gasoline fume detector. Since the boat's fuel gauge was not operating properly, the owner unscrewed the access hole in the tank and "sounded" the tank with a calibrated stick to gauge the fuel level. Throughout the trip, this method had enabled the owner to monitor fuel consumption.

Unfortunately, this procedure is fraught with peril. Opening the tank allows fuel vapors to escape to the inside of the boat during fueling and may permit liquid gasoline to spill if the boat is rocked by wake. Worse, if the cover is not sufficiently tightened, as was the case with this owner or, worse yet, left off accidentally, fuel could overflow from the tank's opening during refueling, puddle in the bilge, and immediately begin to fill the area with explosive fumes.

It was time to refuel and this skipper decided to fill the tank without unscrewing the access cover. Unfortunately, the last time the boat took on fuel, the access cover apparently was left off or not tightened. The boat took on more than 180 gallons (681L) of gas.

The skipper ran the bilge blower for several minutes after he finished fueling. Upon returning from the dock store to pay for the fuel, the owner's wife and their friend boarded the boat to assist with the departure. The skipper started the starboard engine but it quickly stalled. He then tried to start the port engine but only heard a clicking sound, probably caused by the starter relay chattering due to a low battery. He restarted the starboard engine to obtain electrical power from its charging circuit and pushed the start button for the port engine. The boat exploded. The blast injured all three people aboard and eight more on the dock, damaged the dock and several boats, blew out the windows of the two-story gas station and damaged several cars in an adjacent parking lot. As is sometimes the case, the explosion blew out any fires; there was almost no smoke or fire damage. Miraculously, no one was killed.

Gasoline vapor, when mixed with the right amount of air, doesn't burn, it explodes. After fueling, fumes from a leak in this boat's gas tank ignited. The power of the explosion blew off the bridge and fractured the hull.

The circumstances behind this accident are unusual, but the mechanics are not. Spilled gasoline can be deadly, no matter how it gets spilled. Proper fueling procedures are a must. A gasoline fume sniffer/detector/alarm is an important piece of equipment but don't trust your life to it. The last thing you should do before starting your engines is sniff the bilge. Open engine hatches and stick your nose way down inside. Nature has blessed humans with a nose capable of detecting gasoline vapors at far less than the lower explosive level of 14,000 ppm (parts per million). If you smell raw gas after fueling, something's wrong. Get everyone off the boat, notify the fuel attendant and call the fire department. Don't ever activate any electrical equipment. One spark is all it takes.

Gasoline Facts

Strange as it sounds, gasoline does not burn; it gives off highly flammable vapors, even in subzero temperatures, and it's the vapors that burn. One cup of gasoline has the same explosive power as five sticks of dynamite and all it takes to create a violent explosion is enough oxygen and a source of ignition.

Gasoline vapors have a higher density than that of its well-known cousin, propane, and, while most people know that propane gas vapor is heavier than air and it seeks the lowest spot in a boat, gasoline vapors, being even heavier, can spread faster and flow farther. Gasoline requires air to burn and a gasoline-to-air ratio of as little as 1.4:1 is enough to cause an explosion (propane needs 2.1%). At a ratio of over 7.6:1, the gasoline mixture is too rich

to burn and will not ignite; an engine may not start if vapors are too highly concentrated in the engine compartment. Anything between these numbers is a bomb waiting for a detonator.

Liquid gasoline can create explosive vapors as fast as a blower can exhaust them. Further, gasoline vapor ignites at less than 500F (260C). A cigarette, an open flame or a spark is all that is needed.

Managing Spilled Gasoline

Whenever gasoline is spilled in the bilge, anything more than a few dribbles, the response should always be to call the fire department. With the boat shown burning in the right photo, the new owners had refueled the empty tank from a portable gas can and got the engine running. The following morning, they returned to find about 20 gallons (75.7L) of gasoline had somehow found its way into the bilge. According to a bystander, the boat reeked of gasoline and the owners of nearby boats were all nervous.

Instead of calling the fire department, the owner called a mechanic. The latter shut off the electrical switch and began mopping up the gasoline. As he was finishing, something maybe static electricity or the bilge pump clicking on caused an explosion. Two people were airlifted to a hospital with severe burns. A third person was treated and released. By the time the fire was extinguished, five boats were destroyed and three others damaged.

Unlike mechanics, professional fire fighters are trained to deal with spilled fuel. According to Kenny Athing, a technician with the Fairfax County, Virginia Fire and Rescue, fire fighters would handle the same situation by boarding the boat (in full protective gear) to assess the situation. Like the mechanic, they would shut off the battery switch to reduce the chance of sparking. Unlike the mechanic, they would fill the bilge with foam to suppress the explosive vapors. The boat's owner could then contact a private salvor to clean up and dispose of the foamed gasoline. The latter often have a compressed air pump to safely remove the gas/foam mixture.

Spilled Gasoline in the Bilge

There have been at least four recent accidents involving wet/dry vacuums to clean up spilled gasoline.

The most recent was in Florida, where a boat owner first diluted spilled gasoline with cleaner and then, perhaps thinking it had been "neutralized," tried to vacuum it up. The vacuum cleaner burst into flames. The man grabbed an extinguisher and discharged it toward the burning vacuum cleaner, which was on deck next to the open hatch. The discharge sent flames toward the hatch, the vapors caused a second fire and explosion. Fortunately, the man was not seriously hurt, but the 40' (12.1m) boat suffered structural damage and was a total loss.

Gasoline vapors can't be eliminated with water, dishwashing liquid or any other home remedies. So, what should you do if you discover spilled gasoline in the bilge? If you're at the dock, larger quantities of gasoline should only be dealt with by professionals. Get off of the boat and call 911. Don't operate anything electrical, including the blower, even if it is ignition-protected. It won't eliminate spilled gasoline. Although you might be sorely tempted to disconnect the battery cables before leaving, don't.

Keith Emmons

When 20 gallons (75.7L) of gasoline spilled into the bilge the owner called a mechanic instead of calling the fire department. The resultant explosion injured three people and destroyed five boats.

Here's another example of what a few ounces of spilled gasoline can do to a boat. This boat caught fire after someone tried to clean up spilled gasoline with a wet/dry vacuum. As you would expect, there were injuries.

They could spark. If you just refueled the boat, the battery switch should have already be turned off.

If you're out on open water, the first order of business is to turn off the battery switch and open all hatches, windows, doors to help ventilate the boat and dilute the vapors. The safest way to summon help is with a cell phone. Call the Coast Guard directly or call the TowBoatU.S. at 800/391-4869. A VHF radio does not need to be ignition protected, which poses an obvious risk if the cabin is reeking of gasoline. If you decide it is safe, shut down all circuits except the one for the radio before turning the battery switch back on.

If you can't call for help with a cell phone or VHF radio, flares are obviously out of the question, unless you are well away from the boat in a dinghy. About the only other thing you can do safely is turn your ensign upside down and wave your arms to alert passing boats. If the situation is such that you decide to abandon ship, don't go far; someone happening along will have no idea your boat is a floating bomb.

About the author: Chuck Fort is the associate editor of *Seaworthy*, the quarterly loss-prevention news-journal of the BoatU.S. Marine Insurance program. Those not insured with BoatU.S. can subscribe to Seaworthy for $10 per year by calling 703-823-9550, ext. 3276 or at www.BoatUS.com/Seaworthy.

Beverage Cellar

7

A unique solution to storing difficult-to-transport beverages.

Story and photos by Bob Trenholm

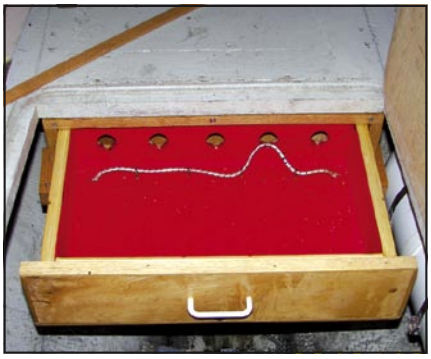
Like most boaters, I had a problem with storage space onboard and have resorted to looking in unused areas in my 11 Meter Trojan for solutions. The bilge forward of the water tank and up to the vee-berth was large, unused and accessible via a hatch. It's an ideal space for additional food storage.

Armed with the idea and a ruler, what began as a box developed into a wine cellar. The floor hatch to access this area was 25" (635mm) square. The space beneath was bigger but the box had to fit through the hatch. Checking dimensions with a framing square, a 24" wide by 28" tall (609mm by 711mm) and 16" (406mm) deep box would fit. I asked a cabinetmaker friend about the idea and he thought moisture-resistant exterior grade plywood, 3/4" (19mm) thick, assembled with screws and glue would do the job.

This cabinet has a top drawer designed to hold five bottles of wine and a large box on the bottom to hold two 12 packs. Wine bottles are secured by a second piece of plywood, drilled to cradle the necks, and a bungee cord stretches over the bottles. The drawer face, box and opening door are trimmed with thin strips of oak and all coated with polyurethane varnish. A crossbar locks into a piece of oak on each side to hold the drawer and door closed. Two pull handles and hinges completed the job.

With the wine cellar completed I took it to the boat. I checked the fit, marked the fastener placements on the floor and drilled six holes for 2" (50mm) screws to anchor the side panels to the underside of the floor. The box was lowered into the bilge and aligned before glue was applied to the top and screws installed.

— Bob Trenholm has owned powerboats for 35 years and his two-footitis ended with his current and ongoing project of 10 years, an 11 Meter Trojan that he cruises in Rhode Island.



Handy plywood beverage cabinet below the cabin floor in the cool bilge makes the idea wine cellar. Note crossbar (middle photo) to hold drawer and compartment closed.

Hatch Upgrade

7

Re-engineering the hatch design solves the problem of a leaky deck hatch on this '60s sailboat.

By Paul Esterle

My Columbia 26 project boat, like many others of the same age, came with a box-style forward hatch. Typically, this style of hatch has a wood, usually teak, frame and either a plywood or Plexiglas top. These hatches are hinged and close over a raised hatch opening in the deck molding. Keeping water out depends on a gasket-like seal trapped between the bottom edge of the hatch and the bearing surfaces.

Problems arise as the seals deteriorate, the wood frame rots and the top surface either becomes scratched, broken or delaminated. In fact, the one on my boat was so bad it was thrown away before I acquired the boat.

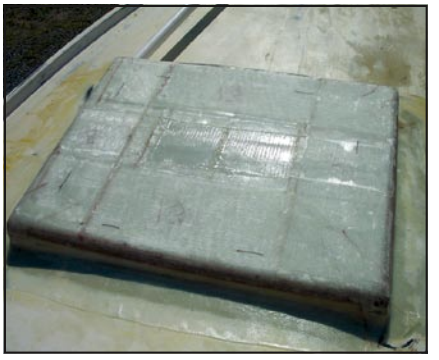
While other parts of the restoration proceeded, I reviewed the options for replacing the hatch. Replicating the original design would eventually lead to a recurrence of all the original problems, leaky seals and the need to refinish the wood on a regular basis being the prime ones. There must be a better solution.

Cross section illustrates how the new hatch mounting flange was laminated over the existing hatch coaming supported by the artist's foam board.

Artist's foam board cut to size, covered with plastic and wedged in place, ready for the fiberglass work to begin.

BLISTER FACTOR
INDICATES THE DEGREE OF DIFFICULTY WITH 10 BEING THE HARDEST AND 1 BEING THE EASIEST.

Bow hatch coaming shows the mahogany filler strips bonded in the recesses, rounded over, faired with epoxy filler and sanded smooth. The white tube is part of the cover support used to keep the boat covered and dry between working sessions.



Fiberglass lamination completed. The bulk of the build up is around the edges of the top surface, down the hatch sides and onto the deck. The center area wasn't covered with fiberglass.

A liberal amount of epoxy filler applied to the top surface of the new hatch flange. The center cut out area was not filled as it will be cut out for the new hatch.

I decided to level the recesses around the hatch coaming and then laminate a flat fiberglass surface over the opening. The new surface would form a flange to fit the hatch opening while keeping the strength of the coaming intact.

The next problem was to actually find a hatch that fit. I started by measuring the existing hatch coaming and made an accurate scale drawing of the side profile and overhead view of the hatch area. I then began looking through the catalogs of hatch suppliers. Unfortunately for me, most new hatches are square while my older hatch opening was rectangular.

I began looking at fabricated hatches on eBay and set up an automated search that emailed me any time a new hatch appeared on eBay. Many of these hatches were New Old Stock (NOS) and many were also rectangular. I was eventually able to buy a perfectly sized opening hatch at a very reasonable price.

With a hatch in hand, I proceeded with the actual installation work, starting with filling the recess around the coaming with pieces of mahogany. I first roughed up the surfaces of the recess with 80-grit sandpaper to provide a good bonding surface. The filler pieces needed a little work rounding the edges so they would fit snugly in the recesses. Once they fit well and were trimmed for length, I epoxied

A shelf, covered in plastic, pushed down into the soft epoxy filler to form a smooth and level surface for final finishing.

Another sheet of artist's foam board was used to make a template for the hatch opening. After centering, it was traced around to provide the cut marks for the jigsaw.

With the opening cut out, the full 3/8" (9mm) thickness of the hatch mounting flange is visible.

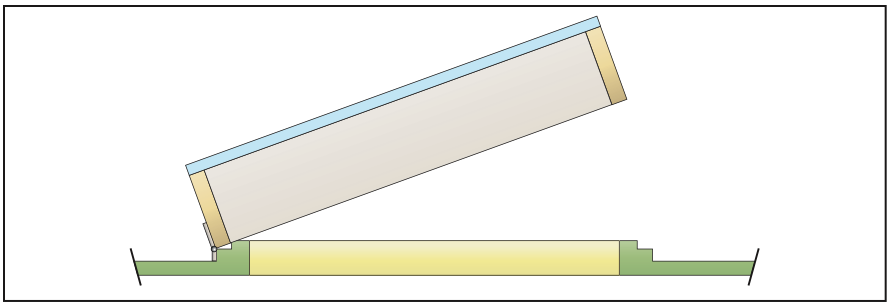
them in place with West System epoxy and high-density filler.

Once the epoxy had cured, surfaces were sanded smooth and corners of the filler strips radiused. This radius is critical in allowing the fiberglass to drape over the edge of the coaming without forming a bubble. Any remaining voids around the filler strips were filled with epoxy filler.

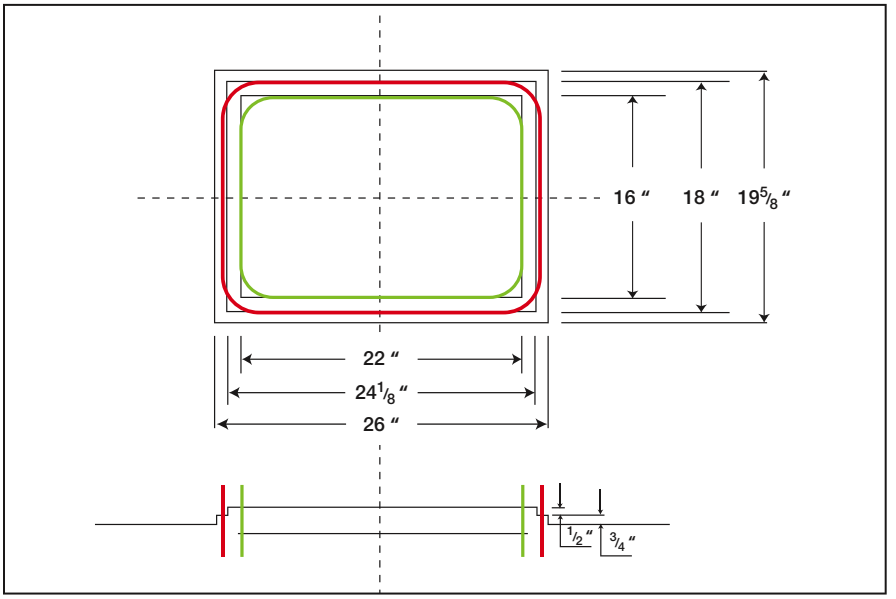
To provide a firm base to support the fiberglass laminations over the open center of the hatch area, I made a center filler piece out of thick artist's foam board. Sides of the filler piece were tapered slightly so I could wedge it tightly in place. It fit so well that it didn't need any additional support to keep it from falling through the opening. The board was covered with thin plastic sheeting before wedging in place to keep the epoxy from bonding to it.

The lamination consisted of alternating layers of 24oz double bias Stitchmat and 9oz fiberglass cloth. I minimized any overlaps of the Stitchmat as it would soon build up high spots in the overlapped area. Laminations ran down the hatch coaming side and across part of the deck surrounding the coaming. I varied the amount of overlap on the deck to form a feathered or tapered edge to make blending it into the deck contour much easier.

More epoxy was used for the laminations as epoxy gives a stronger mechanical or secondary bond than polyester resin. Five alternating layers of cloth and



This diagram illustrates the construction of a "box lid" style hatch. This example has a wooden frame with a Plexiglas top.



This scale drawing of the existing hatch opening was used to determine if a particular hatch would fit. The colored lines indicate the dimensions of a candidate hatch.

Stitchmat were applied. The resulting lamination was about 3/8" (9mm) thick solid fiberglass. It was probably overkill but I wanted the flange to be as strong as the rest of the deck. I didn't want a breaking wave to push the new hatch through the opening.

As careful as I was to keep the top surface of the lamination smooth, it did develop high and low spots. Instead of sanding away laminations and possibly reducing the strength of the flange, I applied a thick layer of epoxy filler round the edges of the top surface and then pushed an old shelf, covered in a plastic painter's tarp, into the uncured filler. When the filler cured, it provided me with a smooth starting place for my final finishing.

Most of the final sanding was done with a long board covered with 80-grit self-adhesive sandpaper. A long board is simply a long piece of wood with two handles on the top and sandpaper on the bottom. A long board spans many smaller imperfections and allowed me to work the surface down to a straight and level final finish.

The next step was to cut out the center opening. After marking the location of the cutout, I drilled an access hole for the jigsaw blade and proceeded to slowly cut out the opening. Fiberglass is rough on saw blades, so I used a slow cutting speed and changed the medium toothed metal cutting blades once during the cut. A few areas on the opening edges were sanded to get the hatch to fit.

Before final installation, I painted the deck and new hatch coaming, applying two coats of Interlux epoxy primer followed by two coats of Interlux Perfection two-part polyurethane paint.

Hatch installation began by drilling holes for the hatch fasteners. I was lucky in that the fasteners penetrated solid fiberglass, so I didn't have to worry about sealing a wood core. Since I had easy access to the hatch fasteners I elected to use machine screws and Nylock nuts to hold the hatch in place.

After drilling the mounting holes, the hatch was removed and blue masking tape applied all around the opening and on any surface I didn't want smeared with sealant. Liberal application of blue tape sped clean up and reduced sealant mess. I placed the hatch back in the opening and traced around it. After removing the hatch again, I cut away the tape under where the hatch flange would sit.

After painting the cabin top, the hatch was bolted in place.

Blue tape was also applied to the mounting flange of the hatch after placing the fasteners in the holes. A rubber washer was placed on each fastener on the underside of the hatch flange. These washers prevent over tightening the hatch and squeezing out all the sealant. A thin sealant layer is much more likely to shear and provide a path for leaks.

My sealant of choice for this hatch was 3M Marine 101 polysulfide sealant. [Ed: This was not a good choice as polysulfides should not be used for bonding PVC, acrylic (Plexiglas), ABS or Lexan plastics because the solvents in the caulking can leach the plasticizers from these plastics and cause them to harden and crack.] It is a good adhesive sealant yet not aggressive enough to make removing the hatch for rebedding difficult. I applied a generous bead of sealant on the coaming and the hatch flange, put the hatch in place and tightened the fasteners. I cleaned up the excess sealant that squeezed out and then removed the tape while the sealant was still soft. I find it much easier than trying to remove tape covered with cured sealant.

This hatch replacement project is one of a variety of options available to anyone restoring an older boat. I found it an easy process that could be broken down into a series of easily accomplished tasks and a reasonable cost. The end result provided all the benefits of a modern hatch in my project boat.

— Paul Esterle is a boating writer and editor when he isn't working on his fleet of old boats. Located at the head of Chesapeake Bay, he writes extensively about boat projects.

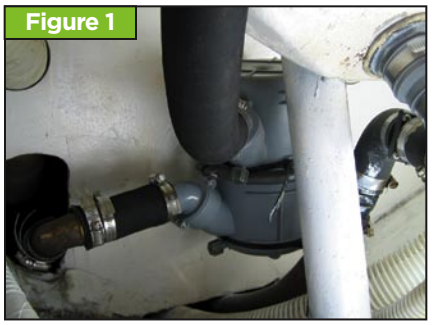
Installation of a Modern Exhaust

6

Concern for another exhaust system breakdown and potential engine failure, this boat owner replaced his 35-year-old system with a modern waterlock muffler and water temperature alarm.

Story and photos by Gary Gerber

Figure 1



Details of Vetus NLP waterlock. The top chamber and both the inlet and outlet connectors rotate through 360 degrees to greatly simplify installation, especially in confined engine spaces.

I purchased my second sailboat, a 1970 Morgan 33 fitted with an Atomic 4, from the original owner in 1975. Fast forward to 1990 and, after a 20-mile sail along the Connecticut coast to the Thimble Islands, I'm ready to drop sail in preparation to motor between the islands and drop the anchor. I turn the key and no engine! I made the decision to return to our homeport and sail into our slip.

Beginning work on cleaning the engine, I discovered that the double-walled 60" (152cm) exhaust pipe had corroded through allowing water to run downhill into the exhaust manifold. Foolishly, I blue printed the exhaust and had a new custom unit fabricated, which I installed myself and then sailed along blissfully for years.

It's now 2005. While considering the manufacturer's design of the double-walled exhaust pipe, I realized that a second failure in the pipe was only a matter of time so I elected to design and install a whole new system.

The waterlock muffler installation I undertook is a tried and true approach. Since all boats have different layouts, finding available mounting space for hardware is primary in addition to a proper safe performance installation.

In preparation for the installation I studied plans of the boat as to engine position, clearances, waterline and exhaust water outlet at the hull. The critical consideration is that, even with a failure in the exhaust system, no water makes its way back into the engine, e.g., when the boat is unattended for an extended period. Key here is having the engine cooling water join the exhaust riser on the down side of the exhaust pipe, with the elbow of the pipe as high above the waterline as possible to prevent water backflow into the cylinders.

Installation Steps

On the Morgan 33 the only space available to mount any waterlock muffler "pot" is in the lazarette. The typical waterlock muffler has fixed water/exhaust inlets and water/exhaust outlets, so this wouldn't work well for this installation. In researching available designs I discovered the Vetus NLP muffler, which offers maximum adjustment. The connection elbows are adjustable and the upper and lower body sections rotate (**Figure 1**).

In my installation, the Vetus unit mounts to the lazarette bulkhead as low as possible, only 6" (152mm) above the waterline. The water/exhaust outlet line rises up about 30" (762mm) to a vented loop (a.k.a. anti-siphon valve) in the lazarette prior to exiting the boat to prevent seawater surging into the hose and back flow into the muffler and possibly the engine when the boat is heeled (**Figure 2**).

Figure 2

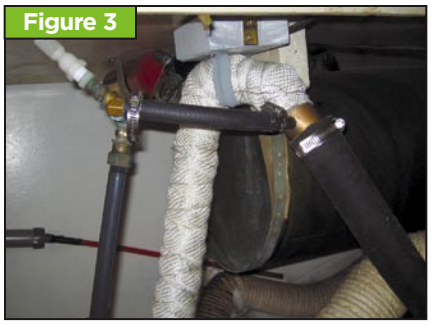
Exhaust water outlet line leads to a vented loop mounted at the highest point possible above the waterline. Hose on left exits to the exhaust thru-hull.

DIY BILL OF MATERIALS

Cost to install exhaust system in a 1970 Morgan 33. Although the installation procedure is an accepted method, variations in engine compartments and boat designs require individuals to adapt to their particular vessel requirements.

1 Vetus NPL Waterlock Muffler	$150.00
1 bronze "Y" with water input, 1-1/4" pipe thread to 1-5/8" hose, Moyer Marine part number EXHT_01.1_324	$41.00
8' (2.4m) Shieldsflex II Series 250 exhaust hose, 1-1/4" ID	$76.00
25' (7.6m) Hotshield fiberglass tape, 1/8" by 2"	$18.00
1 stainless-steel exhaust riser pipe nipple, 1-1/4" ID by 18"	$37.00
2 bronze 90-degree elbow, 1-1/4" pipe thread	$36.00
1 bronze 45-degree elbow, 1-1/4" pipe thread	$17.00
1 brass nipple, close, 1-1/4" pipe thread	$7.80
1 CPVC 90-degree elbow, 1-1/2" ID hose fitting	$5.00
1 Vented loop, exhaust water, 1-1/2" ID hose fitting	$25.00
Cost to install Aqualarm sensor:	
1 Aqualarm part number AQA-20064	$85.00
1 Anti-siphon Valve Kit, Moyer Marine part number KTAS_01.2_318	$56.00
2 Hex bushings, threaded 3/4" to 1/2"	$8.80
1 CPVC high-temperature pipe nipple, 3/4" pipe thread by 10"	$1.30
1 Brass short threaded nipple, 1/2" pipe thread	$2.40
2 Brass nipples, 1/2" pipe thread by 1"	$10.40
Total install costs	**$576.70**

Figure 3



Details of riser pipe joints, clamp securing riser pipe and Moyer anti-siphon kit.

A 90-degree elbow from the exhaust manifold connects to a stainless-steel pipe that rises as high as possible above the waterline in the engine compartment. This connects to two elbows, a 90-degree short connector and a 45-degree section that join to a bronze "Y" fitting where the cooling water joins the exhaust (**Figure 3**). Since the threaded riser pipe extends high in the engine compartment I elected to secure it with a U-shaped clamp and backing block to the overhead of the engine compartment. This prevents the possibility of movement in any violent motion of the boat. Marine wet exhaust hose directs the exhaust/water downward to the Vetus unit mounted in the lazarette.

Figure 4

(above) Aqualarm water sensor mounts to the exhaust water jacket on the manifold. Covered stainless-steel riser pipe connects to the exhaust manifold. (right) View of Aqualarm, riser pipe and connections. Black exhaust hose leads aft to Vetus muffler in the lazarette.

In my installation, I added an Aqualarm electrical sensor fitting that sounds an alarm if the water pump fails. This sensor, which reads water flow, mounts directly to the exhaust water jacket on the manifold (**Figure 4**) with a 3/4" OD pipe extending up as high as possible to an anti-siphon kit (Moyer Marine part number KTAS_01.2_318) to prevent water from siphoning. This device is simply added insurance. I was

concerned about attaching this CPVC plastic piece to the hot manifold so I contacted Aqualarm and learned there has never been a failure due to vibration or cracking. The cooling water now joins the exhaust at the "Y" fitting via a rubber hose (**Figure 4**).

To eliminate the Aqualarm and the anti-siphon valve simply connect a marine exhaust hose from the exhaust water manifold up to the exhaust "Y" fitting water input. All parts are made of either stainless steel, bronze or high-temperature plastic designed for the applications.

With all connections complete, the stainless-steel exhaust riser pipe is heat protected, wrapped with muffler wrap that is secured with stainless steel wire. I have sailed two seasons with this exhaust system and it has performed perfectly as has the engine itself.

— Gary A. Gerber has sailed the New England coastline, the Mediterranean and Caribbean extensively and, most recently, he crewed on leg six of the 2006 Volvo Round the World Ocean Race aboard Volvo's, *Life at the Extreme*. He and wife Joyce, sail *Captiva*, on the Chesapeake Bay.

See-through Hatch Boards

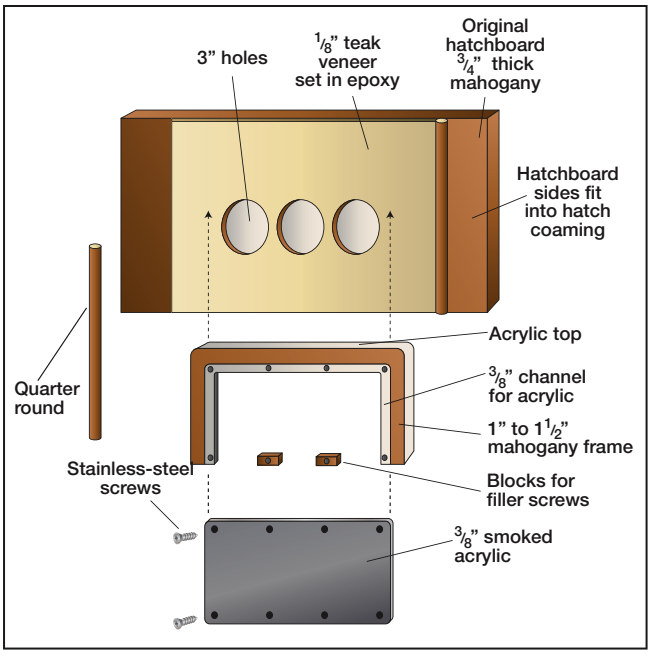
Easy modification to hatch boards brightens cabin interiors.

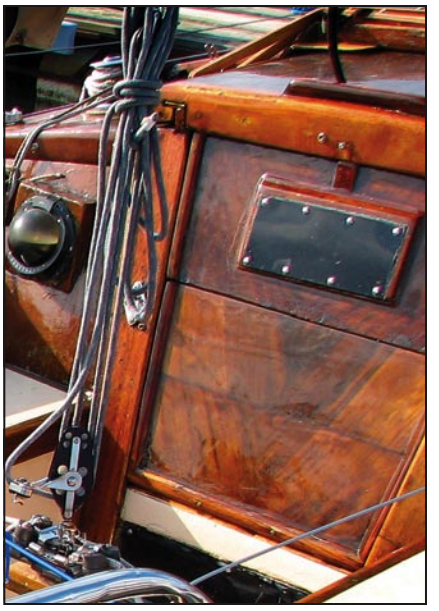
By Marlin Bree

To fix my companionway hatch boards, I decided to add a veneer over the existing wood and to add a custom port light with a vent. This was a fairly easy and inexpensive job that added strength, light and ventilation to my 20' (6m) custom sloop, *Persistence*, which I sail solo on Lake Superior. When I'm below at anchor, the upgraded hatch boards let me see what's happening in the cockpit and give me light in a traditionally dark cabin area. It also lets the cabin breathe a little.

To begin, I epoxied 1/8" (3m) thick teak veneers across both drop boards at a 45-degree angle to a centerline. This veneer is nothing fancy. I cut the veneers with a razor knife, letting the veneers run out to the hatch board's coamings. I wiped the teak with acetone to remove the surface oil. I also roughed up the teak's bottom section with coarse sandpaper to give it a "tooth" for the epoxy to adhere. I coated the hatch board with plain epoxy and buttered up the teak veneer with fortified (thickened) epoxy. Some ordinary bricks atop a plastic nonstick sheet weighed the veneers down. When the epoxy was dry, I sanded the project and finished it off with a quick coat of unthickened epoxy. I now had two beautifully veneered hatch boards.

The top hatch board would get the see-through treatment. To do this, I took a 3" (76mm) diameter drill saw and cut three holes in a horizontal line, leaving about 1" (25mm) of wood between the holes. I started from the veneer side, cut most of the way through, and then turned the board over to finish the cutting. This helped to eliminate splintering around the holes.





Marlin Bree/Joe VanVeenen

On the veneer side of the board, I added a three-sided frame of 1" (25mm) thick mahogany cut just a little bigger than a rectangular piece of 3/8"- (9mm) thick smoked acrylic. Nothing fancy here as the assembly was big enough to nicely cover the holes and be in proportion to the top hatch board. The wood frame overlapped the acrylic by about 1" (25mm) on the top and 3/4" (19mm) at the sides. I scribed a line around the edge of the wood and then trimmed the frames in a channel to fit the acrylic. Now I had a nice fitted, three-sided wooden frame in which the acrylic fitted loosely. The bottom of the wood frame was not enclosed so, to support the acrylic, I added two 1" by 1-1/2" (25mm by 38mm) filler pieces to screw into.

Next, I epoxied the three-sided frame to the hatch board to enclose the three 3" (76mm) holes. I also epoxy coated the inside of each hole. For additional storm proofing, I added quarter-rounds of mahogany trim to the veneer edges of both the top and bottom hatch boards. A slight angle on the top frame allows water to drain off easily.

To fit them, I inserted the hatch boards into the hatch's side coamings and scribed a line where the quarter round would face. Removing the hatch boards, I now epoxied the quarter round in place. This not only gave the newly repristinated hatch boards a custom look but also made the hatch a little more theft-proof, since you can't get a crowbar in there very easily, as well as a little more splash protection against the driving rain on Lake Superior.

After the epoxy dried, I wet sanded the finish and brushed on three coats of UV-resistant varnish with an amber tint to it. Next, I dropped in the smoked acrylic and drilled eight slightly oversize holes around the edges and fitted stainless-steel round-head screws. I dabbed a drop of epoxy into the empty wood holes to petrify them and then lay a ring of blue tape over the frame's wood edges. I squirted a thin rim of clear silicone in the beveled wood area including the oversized holes, then set the acrylic panel and drove the screws in place. [Ed: Do not use silicone with acetic acid (vinegar smell) as it can damage acrylic.] A little silicone came up through the oversized holes. On the bottom, I tucked nylon screen mesh between the wood and the acrylic and epoxied it in place. This screen would keep the north woods skeeters out.

I removed the protective blue tape and put the hatch boards into the hatch opening. They fit beautifully and the quarter round matched at the mahogany hatch side coamings. I polished the acrylic with a little bit of toothpaste and water (I was out of plastic polish and toothpaste works great). The shining plastic was beautifully set off by the varnished mahogany and the stainless steel screws.

Inside Persistence's cabin, I reinstalled the hatch boards and slid my hatch closed. The difference was immediately apparent. The previously dark cabin was now much lighter due to the little round windows I had in my hatch board. I moved forward to look out and I could see my cockpit just fine. No worries there, mate! The little bit of extra ventilation would help keep my small craft smelling sweet.

All in all, it was an easy, inexpensive and worthwhile addition to my boat. Anyone who wants to add light, visibility and ventilation would be well rewarded by trying my see-through hatch board. The process would also work very well for anyone who wants to reface old hatch boards that need resurfacing and strengthening. I've had this modification on my boat for about 12 years now and I've never regretted it.

— Marlin Bree has sailed his home-built epoxy-wood sloop, *Persistence*, many years throughout Lake Superior. His adventures are told in his books, including *Wake of the Green Storm* and *Broken Seas*.

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View from the Stern

The Good and Evil of Flotation Devices

A life jacket should keep you afloat and a dunk and swim experiment proved it so but, if you think you can swim back to your boat and reboard after slipping overboard, think again.

By Roger Marshall

During a recent summer, I emulated a drowning rat and tried out several lifesaving devices. My conclusions about their performance are at odds with the lifesaving authorities, mostly because I believe in the value of rescuing oneself, if possible, rather than lying in the water waiting for a rescuer. Of course, if I'm unconscious, I want to be rescued. With these biases in mind, I donned several inflatable life jackets and leapt into relatively cold water and, post spashdown, swam toward a waiting Zodiac life raft. Fortunately, the boat I jumped from was not sinking.

The first life jacket was a Mustang inflatable. I leapt from the Jamestown, Rhode Island fireboat and, as I was sinking, the vest inflated, pulling me back to the surface. Perfect! The life raft was about 20 yards (18.2m) away, so I thought I'd swim to it.

Wrong! This Coast Guard-approved Type V device does not allow you to swim on your chest. It is designed to roll you over onto your back and keep your head out of the water. The only way to get to the life raft was to lie partially on my back and backstroke toward it. Unfortunately, the raft was blowing downwind and I made like a berserk paddle steamer, with my arms flailing backwards to try to reach it. With a little help from the rescue boat, which towed the life raft back to me, I tried to climb aboard. It took six attempts before I could reach and climb into the life raft. The darn life preserver kept hanging up on the life raft tubes! I debated deflating the life preserver in order to climb into the raft but realized that I was getting tired and shouldn't do that. By practically capsizing the life raft on top of me, I managed to board it. Safe at last!

The second experiment used a Sospenders inflatable vest with the same result, only this time it took longer to get aboard because I was more tired. The third effort used a belt pack life jacket. I see these jackets worn by older folks who don't want the bulky inconvenience of an inflatable preserver. This preserver popped open as expected the moment I splashed down. I wore it at my back to see what would happen.

The crew on the rescue boat could see me easily. The life preserver and my butt (I wore red swim pants especially for the occasion) were sticking nicely out of the water. After swimming around for a few minutes, I arranged the preserver to a position on the front of my body. All I needed to do now was to get my head through the opening and I'd look like an airline flight attendant demonstrating how to use the onboard flotation device. Well, let me tell you, there's no way that you can get your head through an inflated preserver. Not hard to do when it's not inflated but, once it's fully inflated, forget it. I mentioned this to the manufacturer's representative and he said, "Most folks simply hold onto the jacket until they are rescued."

In my opinion, this response is a total contradiction to the purpose of the device. What happens if you want to swim or you get tired? I especially do not like the idea of having to duck my head underwater to get my body in the preserver, a personal maneuver even less desirable in cold water.

I tried a few other inflatables, one of which was the Stormy Seas vest-style inflatable. At the time, it was not U.S. Coast Guard approved but it's a wonderful design. Instead of inflating to 35lb (15.8kg) as the other models did when tested, it only inflates to 22lb (10kg). Because it's not so much the "Mae West" of bulk in the front, I was able to roll over and swim to the life raft and climb aboard. It took two tries but I did it. After these trials in 66F (18.8C) water, I decided that I'd done enough science for one day and needed a hot toddy.

My conclusions may be heretical but come from actually trying the gear. That I believe in inflatable life preservers is proven by the fact that I own all those tested and placed them at the top of my list. My favorite is the Stormy Seas vest. It looks like a red vest and few people realize that I'm wearing a life preserver. I can swim in it, which is a big plus for me. I also own a Sospenders lifevest with a harness because I believe that you shouldn't go overboard in the first place. This vest gets used on offshore trips. The Mustang will do equally as well but buy the one with a harness.

Before the next boating season begins, go to your local pool and try out your life jacket. I've often thought that this is a service that yacht clubs or marine associations should set up around the country. Setting up life jacket trials in a pool with your local chandlery ready with new igniters and inflators ready to replace spent ones goes a long way to promoting boating safety to say little of the good will of the sponsoring chandlery. Add some burgers and soda and you have a fun winter Saturday event. Put your jacket on and jump into deep water. Try to swim and see how you fare in the water. In summer, when the seawater is warmer, put your jacket on again and jump into the water alongside your boat. See if you can get out of the water onto your boat unaided. I'll bet you can't. These two exercises will change the way you look at your life jacket and your boat forever. If you do them, you may learn some important lessons that could save your life.

I have one final comment. If you regularly go on the water with your spouse or children, make sure that they all know how to handle the boat and how to call emergency services on the VHF radio. If you fall overboard, the life they save may be your own.

The Stormy Seas vest was the only inflatable that passed the author's dunk and reboard test.

About the author: Roger Marshall is the author of 12 books including, *Rough Weather Seamanship for Sail and Power*, a must-read for any coastal or inland boater.

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