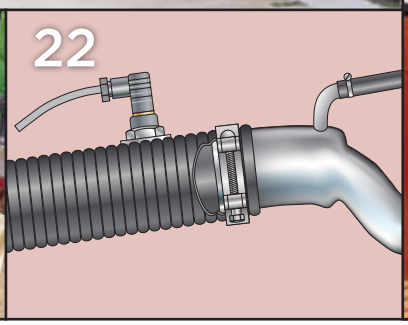
#4 2007

DIY BOAT OWNER

THE MARINE MAINTENANCE MAGAZINE



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Edited by Jan Mundy

Cable Sizing Correction

We heard from many readers regarding the error in the article titled, "Engine Electrics," in DIY 2007-#3 issue. Under the subhead, "Cable Guidelines," we overstated the general guidelines for determining battery cable size and, in fact, reversed the sizes. AWG cables sizes get larger as numbers get smaller, i.e. 6 is bigger than 18 until you get to 0 or 1/0 and then sizes increase.

It should read: "As a general guideline, for a gasoline engine, start with a minimum of a 4 AWG cable when the distance between the battery and the engine measures 3' to 4' (91cm to 121cm). For every increase in length of 1.5' to 3' (45cm to 91cm), increase the gauge (size). For example, a 3.5' (106cm) length requires a 4 AWG cable; a distance of 6' (182cm) needs a 2 AWG cable and a 7.5' (228) length calls for a 1 AWG cable. Diesel engines require a heavier gauge cable so they start at a 3' (91cm) cable being 2 AWG and increase on the same relative scale as gasoline engines."

Clarification of Wire Nuts

The idea for the galley blower in DIY Projects column in the DIY 2007-#3 issue is a good one but the picture on page 53 captioned: "Blower installed in shelf area above stove. Metal screen filter covers the blower compartment;" shows wire nuts used in this installation. The use of wire nuts is prohibited by the USCG and isn't approved by ABYC for marine use. Editorial review of the illustrations as well as text by a real expert would make your publication a first-class tool for boaters.

Jim Bonnett, Wavetop Technology, New Bern, North Carolina

Ed: ABYC standard E-11 does specifically prohibit "twist on" connectors but the U.S. Coast Guard (USCG) code does not address these fittings at all, much less prohibit them. Although the ABYC standard is voluntary and it exceeds the USCG minimum requirements for electrical systems on some boats, it's the higher level of safety that we encourage DIY readers to achieve. It's very important to note that ABYC standards are performance based and, with few exceptions, do not prescribe or prohibit methods or materials if they can be determined to meet the performance requirement. In the case of wire connections, the standard says "Conductor, conductor to connectors, and conductor to terminals must be able to withstand a tensile force equal to at least the value shown in Table XVI (e.g., 10 gauge wire must survive a 40lb/177 Newtons tensile force) for the smallest conductor size used in the splice for a one minute duration, and not break." If a wire nut could be proven to withstand those forces and to meet the other requirements of the standard, they might be acceptable. Wire nuts are widely used successfully in land-based connections that are not subjected to the same atmospheric and dynamic assaults as exist on a boat. The only other reference in E-11 to connector types is to specify that they be ring or captive spade types. Friction type connectors can be used under certain circumstances.

Biohazards at Pumpout Stations

I was talking to a customer last week about his waste holding tank and how he cleans it. Prior to pump out, he fills the tank to capacity by flushing the head repeatedly. Immediately after pump out, he uses the dockside water hose to fill the tank and pumps out again.

I tried to impress upon him that this is a very dangerous practice. During the "fill" action, there is a great possibility of the hose contacting a sewage-contaminated area. When the hose is next used to top off the potable water system on his boat or the next boat in line, it can contaminate the water tank and result in some very sick people. He reports this is a common practice, but was unaware of the potential for causing illness.

John Cly, Groco (groco.net)

Nick Bailey responds: Gas dock safety and environmental regulations are very specific about refueling but they don't say much about safe pump out practices. As long as there is no physical contact between the hose nozzle and the contaminated deck fitting there should be no danger of E. coli contamination. This means that you don't jam the hose into the fitting but hold it a foot or two above the deck fitting. As gas dock duties are often handled by youngsters on a summer job, common sense may not necessarily prevail. Don't turn your back if you ask for that extra flush. Fecal contamination by careless use of a water hose is a biohazard.

Parquet Refinishing Alternative

There is an alternative to using a chemical stripper on a parquet floor as advised in the "Ask the Experts" column on page 6 in DIY 2007-#3 issue. I know because I refinished the floor (and replaced some of it) on a 1984 Europa model that had sunk.

The problem with strippers is the chemical (usually a mixture of organic solvents that require the handler to use a respirator) can penetrate the small cracks and loosen the mastic used to adhere the parquet tiles to the sole. You end up having to reglue some tiles and sometimes replacement is necessary.

A better method to remove varnish is to use a variable temperature heat gun, (the best is made by Milwaukee), and a scraper, which I purchased from Jamestown Distributors along with a selection of blades. Wear leather gloves and start working in a corner. Three-quarter heat is all that is needed and, as the varnish starts to blister, work the scraper toward you. Take your time and repeatedly sharpen the scraper using a diamond sharpener available through any good tool supply. Vacuum up the varnish flakes with a shop-vac. Replacement parquet is available through thaiteak-marine.com.

Curtis Edwards, Olympia, Washington

Quality in a Hatteras

I currently have a 1971 Hatteras Sport Fish with twin 350 Chev raw-water cooled gas engines. With the coming of ethanol and having fiberglass fuel tanks,

I considered alternatives, including new metal tanks or conversion to diesel engines. Pricing for the diesels seems to be way high for the value of the boat and new fuel tanks do not fix a low cruise range.

Based on your articles in DIY 2005-#2 and 2007-#2 issues, I'm considering selling what I currently have and looking for a Hatteras 34 DC (1964) or possibly a Hatteras 36 Sedan Cruiser (1986). Are there any significant difference in the quality levels between the early Hatteras, i.e. 1964 to 1966, and the later models (1986), assuming that the subject boats survey well? Also, are there other models or brands that might be considered for cruising and possibly extended travel? Speed desired is a cruise of 10 to 12 knots with top speed of 18 knots.

Sally Weir via email wsweir@yahoo.com

Pat Kearns replies: Hatteras, despite several corporate transitions, has consistently produced high quality yachts throughout its production. Sure, there have been a few duds in terms of models but that has been more a matter of model design popularity. There is also the tremendous advance of technology that has been a part of the evolution of Hatteras yachts. Fiberglass laminating techniques have resulted in stronger, lighter and more efficient boats and the technologies of mechanical systems have similarly evolved. Otherwise, a Hatteras is a Hatteras is a Hatteras. What is your budget? Where will you cruise? What kind of layout do you seek? So many variables affect the approach to narrowing the field of available boats. My general advice, in connection with looking at preowned boats, is that it's always better to target higher quality in an older boat than to accept the lesser quality of a later model. As you are already a Hatteras owner, you are accustomed to the assurances of high quality.

Freshwater Anode Advisory

I have been boating for more than 35 years in both salt and freshwater and

While visiting friends in Nova Scotia this past summer we found this classic schooner tied to a wharf in Indian Point. Local boatbuilder, Bill Lutwick (Tel: 902/624-9008), was putting the finishing touches to a complete restoration of "Atlantica," a 48' (14.6m) Tancook-style schooner. Now 40 years old, this boat was the star attraction at Expo 67 in Montreal, Quebec, where boatbuilder David Stevens and crew built this all-wood yacht in the Atlantic Canada pavilion in a record six months.

Jan Mundy

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So you think you're an expert?

A guideline to becoming an accomplished DIYer.

Why is it that almost everyone that has been boating for a few years and has a technical background thinks they are an expert? Having an engineering degree in plastic injection molding or possessing an aircraft mechanics license does not mean one is qualified to work on a boat.

Let's start by informing you of my day job. Since 1990, I have been a product support specialist for a major marine engine manufacturer and I spend my spring, summer and fall on the phone assisting dealer technicians and consumers with their technical problems. Every winter I'm a service-training instructor responsible for preparing dealer technicians in order for them to reach the different levels of technician certification. Needless to say experts of all levels surround me.

This occupation has presented me with the opportunity to converse with many self-proclaimed experts that are looking for help after they have had some type of catastrophic failure on their boat. I often find their experiences amusing but, to be quite frank, once a boat stops operating correctly it usually turns a great day on the water into an emergency situation.

If you decide to perform repairs on any boat, you must be willing to accept the responsibility that goes with the job. That responsibility is that you are putting the lives of everyone that uses that boat in your hands and this is a responsibility that cannot be taken lightly.

Some individuals may also believe they do not need a service manual due to their technical background. I have obtained Mercury Mercruiser Master Technician status and have been repairing marine pleasure craft for almost 40 years and I still use the correct service manual for the product I'm working on to ensure the job is done to the highest standard possible.

The number one reason for using a service manual is the ability to capitalize on those manufacturers' years of experience that most self-proclaimed experts do not have. A quality service manual provides you with a step-by-step, tried and true process that takes into consideration the safety of the repair person, the occupants of the boat and the marine equipment itself.

Below are some tips that will allow you to complete repairs safely.

1. Know your limitations. It takes a marine technician at least four years, five training courses and a certified technician test score of 85% to become a basic certified technician and another six years of training and a passing grade of 90% to become a master technician. Chances are you won't reach this level of expertise in your spare time. Start off with simple projects and work your way up to the more complex repairs. Be smart enough to know when you are in over your head and hire a professional for those jobs that are beyond your present repair skills. I can fix most mechanical things with a service manual but I can't cut a piece of wood straight if it meant saving my life so I always hire a pro for my woodworking jobs.
2. When you are looking for advice, seek out a professional. Always check for the proper credentials of the supplier of your information. "Docktalk" can prove hazardous to your boating pleasure. Note also that the Internet is not always an accurate information supplier.
3. Always obtain a service manual or procedure guide before you start any repair projects. As a contributor to DIY magazine, I always start my technical articles by advising the readers to get the correct service manual. A manual usually costs less than the parts you ruin by not having a one.

Finally, perform repairs right the first time because it will cost you more money to do the repair over.

— Steve Auger, DIY's engine "expert"

currently cruise extensively on the Great Lakes with my homeport located on Lake Erie. I was always under the impression that the traditional zinc anode could invariably be relied on to protect the various underwater metals from galvanic corrosion in any environment. Last year I learned that this is simply not the case.

The Nibral props had, over the years, become pitted despite my regular use of zinc shaft collars, which curiously had always remained essentially pristine. To improve performance and fuel efficiency, I decided to change propellers.

The new Nibral props were installed, again supposedly protected by the commonplace zinc anodes. When the boat was hauled at season's end, I was stunned to see that these new props also had begun to pit. I decided it was time to learn more about galvanic corrosion, a process of one metal's loss of mass that occurs whenever two dissimilar

DIY BOAT OWNER
THE MARINE MAINTENANCE MAGAZINE

DIY Boat Owner™
The Marine Maintenance Magazine™
P.O. Box 22473
Alexandria, VA 22304

Publisher: Michael G. Sciulla

Executive Editor: Elaine Dickinson

Editor: Jan Mundy

Associate Publisher: Steve Kalman

Technical Editor: Patricia Kearns

Circulation: Susan Clark

Designer & Illustrator: Joe VanVeenen

Cover Photos by: Jan Mundy

Contributors:
David and Zora Aiken, Steve Auger, Nick Bailey, Jim Grant, Garrett Lambert, Roger Marshall, John Payne, Randy Renn, Paul and Sheryl Shard.

Director of Advertising:
Steve Kalman
888/658-BOAT (2628)
e-mail: stevek@diy-boat.com

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Call 888/658-BOAT (2628)
weekdays 8am to 6pm EST or log onto DIY ONLINE @ www.diy-boat.com

Subscription Rates:

1 year (4 issues)	$25
Canadian residents	add $5
Foreign residents	add $25
EZINE (web version) 1 year	$15

Payable in U.S. Funds only

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Periodicals pending postage paid at Alexandria, VA, and additional mailing offices. POSTMASTER: Send change of address to DIY Boat Owner, P.O. Box 22473, Alexandria, VA 22304.
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metals are immersed in an electrolyte solution and their differing electrical potentials react to each other. To prevent this corrosion of vital underwater metals, a third, less noble (more active) metal is introduced into the system. This method of cathodic protection has traditionally been provided by the well-known zinc anode, which works quite well in saltwater. What I now know is that zinc has no place in freshwater.

In freshwater, zinc quickly forms an insulating oxide that seals it and renders it useless as a sacrificial anode. A quick glance at the galvanic series of metals reveals that magnesium is the most active (least noble) anode with a greater driving or protecting voltage and, as such, offers the best protection from corrosion in freshwater.

At the beginning of last season, I purchased and installed two new Nibral props (keeping the previous pitted set as spares), behind which I installed a set of Martyr magnesium prop nut anodes. When the boat was hauled at season's end, the propellers revealed absolutely no evidence of corrosion while the magnesium anodes were extensively wasted, as one would expect from an appropriate sacrificial anode. In short, the magnesium anodes did their job and corrosion was held at bay.

The message is clear. Use the anodes most suitable and effective for the environment in which your boat is operated. In freshwater, that anode is ideally magnesium.

K. Spano via email

Ed: You are correct that magnesium can be used in freshwater but never in salt or brackish water. But it you move your boat from fresh to brackish, even saltwater, the most widely effective anode used these days is aluminum since it can last up to 50% longer and remains active in all waters. How, you may ask, does an aluminum anode protect an aluminum outdrive? It's because the anode is made with an aluminum alloy that is significantly different (more anodic) than the alloy used on an outdrive.

Jan Mundy

Too few sailboats have comfortable cockpit seating and this custom arrangement is top drawer when in a calm anchorage or at the dock but a perilous perch when sailing.

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Consumer Recall Alert

Federal laws require marine manufacturers to issue defect recall notices when boats or related equipment contain "defects which create a substantial risk of personal injury" or when they do not comply with boat manufacturing regulations. The U.S. Coast Guard recently published the following defect recall notices.

For more information about these campaigns, contact the manufacturers directly or go to the Coast Guard's web site, uscgboating.org, or call 202/372-1073. New recalls are listed monthly at the BoatU.S. National Recall Alert Registry at BoatUS.com/recall.

Volvo Penta (Tel: 757/436-5100) became aware of several incidents where QL 12-volt CT600 and CT900 bow thrusters and 12-volt SP60 and SP900 stern thrusters that were installed on various makes of boats between December 2004 and March 2007 have overheated during operation. At least one incident on a boat in Europe resulted in an electrical fire but the manufacturer is not aware of any injuries. Volvo's investigation revealed many deviations in the installation of the thrusters, including location, cable length and material, lug nut size, order and torque. The design itself does not support continuous operation and can overheat when the installation is not done according to instructions. Volvo will replace the thruster control box, check the system installation and connections and provide revised, detailed operating instructions for use.

If recall repairs must be delayed, thrusters can be used safely by operating only in short bursts of time, not to exceed four operating periods of 30 seconds each within a 25-minute span of time. When not in use, boat owners should make sure the main circuit breaker for the thruster is in the "off" position.

Two life raft manufacturers, BFA Marine and Viking Life-Saving Equipment, recently announced recalls of their products. BFA Marine has identified some failures of over-pressurization valves on leisure life rafts manufactured between 1997 and 2006. An incorrect assembly process caused these failures. Life rafts must be checked to determine the integrity of the valves. In the event that both over-pressurization valves of the two independent compartments fail simultaneously, the life raft will sink. Owners of the identified life rafts should immediately return their rafts to the nearest BFA-approved service station in order for the over-pressurization valves to be inspected. Defective valves will be replaced. Additional information about this recall program and about approved life raft service stations is available at bfa-marine.com. This recall does not involve any commercial life raft.

Yachting and fishing life rafts RescYou (UKL) and RescYou Pro (UKSL), sizes 4, 6 and 8 persons, in either container or valise from Viking Life-Saving Equipment (Tel: 877/848-1057) may have potential problems with their Thanner type OTS 65 valves, which may prevent the life raft from inflating properly. In the unlikely event that both valves are affected, the life raft will sink. As a precautionary measure Viking recommends that all Thanner type OTS 65 valves be inspected and replaced if necessary. Owners should check their raft type and serial number with those posted on the company's website (viking-yachting.com). This information is found on the life raft's Certificate of Compliance or on the registration label on the bottom of the life raft container or, if packed in a valise, on the end of the valise. Owners of life rafts affected by this recall should contact a Viking-approved servicing station for a valve inspection. Contact details of applicable servicing stations are available on the company's website. Valves will be replaced free of charge.

Sacha

Crusader Service Gets Five Stars

Longtime subscriber, James Munley of Budd Lake, New Jersey, contacted DIY's Technical Helpline about ongoing problems he had with his twin 2000 Crusader 350 Vortec engines. The right-hand rotation engine apparently came from the factory with the wrong ignition wires, wrong distributor and it lacked an ignition resistor. Four distributors later solved the problem of these grinding into pieces but engine idle still continued to fluctuate with a hot engine and it would stall when throttling down, causing the Borg Warner transmission to chatter. He had the carburetors rebuilt; the engines tuned precisely and he swapped the carbs but all to no cure of the inconsistent idle on the right hand rotation engine.

On James' behalf, DIY contacted Pleasurecraft Engine Group, manufacturer's of Crusader engines, and received a detailed reply from Max Bazen who suggested some possible fixes and parts. James ordered the replacement parts but the engines would not start after their installation. Upon hearing of this development, DIY again contacted Crusader and this time Max referred us to a service technician for James to call directly. James spent a day performing numerous ignition tests, all the while communicating with the Crusader tech via phone, and he learned that the parts he had received were faulty and new ones were subsequently shipped.

DIY Technical Helpline can make a difference in getting the attentive ear of a manufacturer or supplier. That, in combination with Pleasurecraft Engine Group's commitment to providing Crusader engine owners with the technical support they need to get the best performance from their engines, is a win-win for James and Crusader.

Painting Underwater Metals

Interlux

Final coat of Interprotect 2000E applied to running gear.

Q: What can I do to stop the barnacle growth on the propellers, rudders and just about all the stainless steel and bronze underwater equipment on my 47' (14.3m) trawler? The antifouling paint I use works very well on the fiberglass hull but it seems to do nothing on the metal.

Wendy Miller, Cranston, Rhode Island

A: Painting shafts, struts, props, trim tabs, thru-hull fittings and even stern thrusters requires special attention to initial surface preparation in order to improve adhesion. The idea is to isolate the copper in the antifouling paint from bronze components because the cuprous oxide in the antifouling paint is less noble than the bronze in the strut. If you don't prime them properly, underwater metals become fouled or burn back may occur, which appears as though the paint has been burned in concentric circles emanating from the strut, thru-hull, strainer, etc. Excellent results have been obtained using the following steps, though the longevity of this system does not equal that of the coating on the boat bottom due to the abuse of the service speeds (rpm) these parts undergo. First, degrease the metal surface with Interlux Fiberglass Solvent Wash 202 or Special Thinner 216. Next, bring metal to a uniform bright finish by sandblasting with non-ferrous blast media, such as clean silica sand, or grind using coarse to medium emery cloth. Solvent wipe to remove blast or sanding residue. Immediately, apply one thin coat of Interlux Vinyl-Lux Primewash 353/354 thinned 25% with Vinyl-Lux Solvent 355. If this is not done within 24 hours of blasting or sanding, you'll need to reblast or resand with coarse emery cloth. Primewash is a metal etcher containing vinyl butyral resin, phosphoric acid and a little bit of zinc chromate. The acid cuts through the oxidation, the vinyl resin gives the primer something to hold onto and the zinc chromate adds some anticorrosion protection. Metal etchers are the weak link in the chain and instructions must be followed very carefully. Allow Vinyl-Lux Primewash 353/354 to dry a minimum of one hour but no more then 24 hours and then apply four coats of Interprotect 2000E/2001E, following dry times on the label. If fairing is necessary, fair between first and second coats of Interprotect. If dry times for Interprotect cannot be followed, use the following alternate system. Apply four coats of Primocon YPA984 over the Lux-Lux Primewash 353/354. If you don't want to prep the gear down to bare metal, coat the surface with two to three coats of a single-part primer, such as Primocon, and then apply the 2000E. Apply two to three coats of a non-vinyl antifouling paint. Hard antifouling paints work best, such as Fiberglass Bottomkote or Ultra, for this application. Finish with at least three coats of antifouling paint.

— Jan Mundy

Determining Voltage Drop

Q: What criterion guides the choice of battery cable size? I'm completely rewiring my Pearson 323. Using Don Casey's formula for wire size in "Sailboat Electrics Simplified," if I use 1 gauge battery cable I will have a 3.3% voltage drop in the primary starter circuit and a 3.9% drop in the secondary/emergency circuit. Using 0 gauge the numbers are 2.6% and 3.1%. It seems that, for this type of circuit, the voltage drop is not as critical and the 1 gauge would be fine. There is a significant difference in expense but also in the ease of working with the smaller wire.

Geoff Kloster, Galesville, Wisconsin

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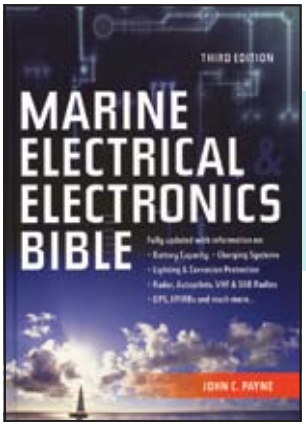
A: The issue of voltage drop in starting circuit wiring is absolutely critical as voltage drops cause less current to the starter and this can lead to slower engine cranking speeds and the longer the cranking period, the more power used. The 1 gauge cable is satisfactory for a starter on a boat your size. I always aim for overall 5% volt drop no matter what the circuit. There is one point I raise in my book, "Marine Electrical and Electronics Bible," and that is battery cable duty cycle. Heavy current carrying cables, such as those used on windlasses, winches, thrusters and starter motors, are in fact only used for very short durations. As there is a time factor in the heating of a cable, smaller cables can often be used. A 1-gauge cable at 60% duty cycle is rated at 320 amps so you have a good margin for safety and effectiveness. On a practical note, the negative conductor to the engine should also be the same rating as the positive cable and I recommend you fasten the negative as close as practical to the starter motor to minimize the voltage drops on that side of the circuit that often are unseen when calculating circuit resistances. In addition, run a negative cable equivalent to the alternator output cable directly back from the alternator case or negative terminal to the battery to significantly improve the charging system and eliminate an approximate voltage drop of .5 volts, usually found in charge circuits.

— John Payne



"Marine Electrical and Electronics Bible" by DIY columnist John Payne, now in it's third edition, is a complete guide on how to select, install, troubleshoot and repair a boat's electrical and electronic systems. (Sheridan House)

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Fusing the Positive

Q: When attaching or installing an hour meter to either a tachometer under the dash or to the ignition coil positive side, does the hot lead to the meter need to be fused? My boat dealer installed a Teleflex hour meter and did not install a fuse.

Brock Barnes, Westmount, Illinois

A: All instrument power supply wires (regardless of their function) must be protected by a fuse or circuit breaker. Often, this is the same fuse that protects the ignition switch that supplies the power to the helm instruments and usually is a 15 or 20-amp fuse or breaker. Installing a stand-alone gauge typically requires a 5-amp fuse; Teleflex specifies a 1-amp fuse.

— Steve Auger

Leaking Tank Treatment

Q: I have a 1973 Allied Princess with an 80-gallon (302L) stainless-steel water tank that has developed a slow leak. Is there a product that can be added to the tank to seal it? The only other solution is to lift the entire floor to repair the tank.

Brian Bishop, Goderich, Ontario

A: Unfortunately there is no miracle cure for a leaking stainless-steel potable water tank similar to automotive radiator "leak stop." Most leaks in stainless tanks occur due to pinholes caused by internal corrosion at the welded seams or at a location originating on the outside of the tank where the tank surface is in constant contact with a wet environment. The tank should be removed and repaired, or if extensively pitted, replaced. It may be possible to coat the interior of the tank with a tank liner epoxy but this can only be done in situ if you have a large access port in the tank top. The interior of the tank must be thoroughly cleaned and wire brushed (or sanded) for the epoxy to have any hope of long-term adhesion. It's a good idea to paint the outside too. Ameron (formerly Devoe Coatings) sells Bar-rust, a food grade epoxy coating suitable for tank liners.

— Nick Bailey

A Power Boost

Q: My boat has 30-amp service and this requires operating certain AC devices separately. For example, I'll run the microwave but not before turning off the air-conditioner or heating system. I would like to rewire the AC system and upgrade to 50 amps to run bigger loads. What is involved in the upgrade? Does it require a new shorepower cord and/or connection? A new panel?

J.K. Iverson, Mt. Pleasant, South Carolina

A: If the entire AC power system is rated to 30 amps any upgrading to the new load of 50 amps requires increasing the cable size from the shorepower inlet to the switch board, possibly upgrading the shorepower inlet itself if not rated and a new shorepower cable. It's possible, and it requires checking, that the panel needs replacing if the circuits are much lower than 50 amps. A panel for a 30-amp system has a main circuit breaker that requires an upgraded main switch or main circuit breaker. In panels with an ammeter, the meter range may also be lower and require upgrading.

Care must be taken when working with AC and should only be performed by or under the guidance of a skilled and preferably ABYC certified marine electrician. In virtually all of North America, regional and national codes govern electrical systems and for good reason. Similar codes protecting boats and boaters from explosions and fires related to electrical systems onboard are largely a boat manufacturer's responsibility and there is a limited body of Federal law to address that, along with voluntary standards from ABYC, NFPA, SAE, UL and other groups who work with boating safety standards. Make sure you know the risks inherent in working with marine electrical systems and that you are armed with the standards' savvy needed to work on them safely.
— John Payne

After Grounding

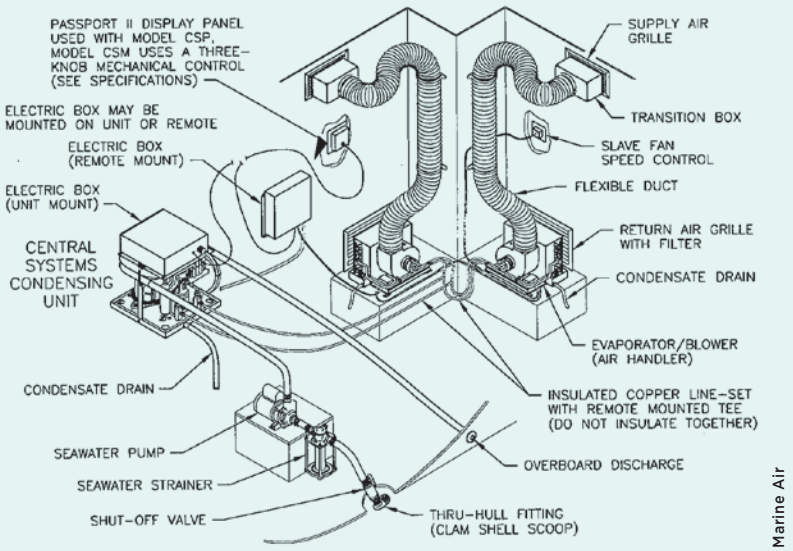
Q: We have a 40' (12m) power cruiser with twin 454 inboards. Last season, we barely touched a shoal at idle speed just before haul out and dinged both four-blade props. There are slight (about 1/2"/12mm) deformations on the blades of both props. Last winter, the marina sent the props out for repair and reinstalled them before spring launch. This year, when operating the boat, it doesn't track straight with both engines in sync (as indicated by a separate sync meter) but continually veers to port. This isn't too noticeable at displacement speeds but, at cruising speed (18 knots), the boat continually tracks to port with the rudder indicator reading 0°. While on a five-hour cruise, mostly with the autopilot on, the rudder indicator on the autopilot continually showed the helm about 2° or 3° degrees to starboard, regardless of wind or sea conditions. I made numerous adjustments to the trim to rule that out also. The boat's fuel, water and load were all much as usual. I'm now wondering if the props could be delivering unequal amounts of thrust caused by the repair work. If so, can/should they be redone and should the marina be responsible for the cost? In my 10-plus years of boating, it's the first time I've hit anything so I don't know if shaft warpage can result from such a low-speed impact. Also, wouldn't the prop repair shop, when working on two props from the same boat, check that they were identical after the repair?
Jeff McNab, Richmond Hill, Ontario

A: Either the props are now not equal in pitch after the repair or you have one or more twisted rudder shafts. This is referred to as a corkscrew effect and is common after grounding. As far as who is responsible for any compensation for this situation, that is an issue for you and your legal representative to decide. Most repair shops perform the services requested as outlined on a work order. No more no less. Both props should match on a dual prop repair; however, after 35 years in this business, I have found that, if something can go wrong, it will happen at least 25% of the time. Prop shops have mixed up shipments before. Unfortunately, the boat needs to be hauled and blocked to perform a proper assessment of the situation. For now, I would continue to offset your ballast and trim tabs until you haul the boat at the end of your season's use

Removing A/C Odors

Q: What routine maintenance should I be concerned about relative to our boat's air-conditioning (A/C) system? The A/C unit on our 2001 Cruisers 3075 cools just fine but we are concerned about the cleanliness of the system. For instance, should there be a filter on the air intake and one also on the supply-side (we have two supply diffusers, one in the center cabin, the other aft). Is there any chance that there is standing water in the system anywhere causing bacterial contamination? My wife can smell a faint mildew odor and without a systems manual, I don't even know where the intake strainer is located.

Tom Lawless, Crofton, Maryland



Components of a central air-conditioning system.

A: Most air-conditioning units have a replaceable (or at least cleanable) air filter incorporated into the return-air grill. If yours does not, it should be easy to adapt a common furnace filter to fit. Clean (or replace) this filter at least once a season. Marine Air Breathe Easy anti-allergenic air filters (marineair.com/airfilter) are promoted as seven times more effective at capturing airborne micro particles than ordinary foam filters. Additional filters on the supply-air side are redundant and would be less effective as they would not keep the evaporator grill clean. The evaporator is located in the return-air side of the system. The steady stream of water being pumped over the side while the unit is running is the used coolant water exiting the system. This water is not a health hazard as it's completely contained within the pump, compressor heat exchanger and system plumbing while inside the boat. There are maintenance issues relating to the cooling water circuit, particularly if the boat is located in an area prone to seaweed. The intake thru-hull or sea strainer frequently clogs with weeds cutting off or limiting the water flow, which, in turn, causes the A/C to shut down due to lack of heat exchange. This problem requires closing the seacock and dismantling the sea-strainer to clean out its filter basket. Standing water that may occur at your A/C unit results from condensation dripping from the evaporator grill onto the drip pan below. The drip pan of most marine A/C units usually has a drain fitting designed to connect to a hose that leads the condensate water to the bilge (and the auto bilge pump) or a self-contained gray water sump box complete with its own discharge pump as is typically used for shower sumps. If you are noticing moldy smells coming from the A/C unit check that the condensate drain is not plugged causing the water to overflow the drip pan and collect at some weird location below the floorboards in a stagnant swampy pool. Odd odors also indicate the return air screen and/or the evaporator grill may need cleaning. It's also a good idea to occasionally clean the drip tray (and drain fitting) integrated into the lower chassis of the A/C unit.

— Nick Bailey

or try adjusting the port rudder angle to a minor toe in setting until you can perform a proper survey of the props, rudders, shafts and struts. Any of these items could cause your performance problems. Whenever you hit bottom, for any reason, notify your insurance company. It costs nothing to bring your insurance company into the loop and could save you big money in the long run, whether the damage is covered or not. The insurance company usually sends its preferred surveyor to inspect the damage, a process that includes not only confirming the cause and nature of it but also the extent, something that is not always noticed by service technicians. It's possible that, in your case, it's not too late to bring the insurer in for a look. Tell the insurer what happened, when it happened, what you did (and didn't do) and what is going on now. A diligent surveyor can gather all the clues and help solve the puzzle, oftentimes in favor of the insured.

— Steve Auger

Diesel Fuel Fitness

Q: I have a 32' (9.7m) Helms sailboat with a 25-gallon (94L) diesel fuel tank. Do you recommend periodically emptying the tank and refilling with fresh fuel? It's been over 12 years since the tank was emptied. I always use one of the recommended fuel additives when adding fuel and have had no problems with moisture, sedatives, gunk, etc.

William Majors, Columbia, South Carolina

A: The dilemma here is one of "if it ain't broke ...." Here are some factors to consider in making your decision. You can wait until there is a fuel quality problem or you can be proactive. That you are asking the question tells me you are the latter. Diesel fuel loses cetane rating (how easily the fuel ignites and how fast it burns), lubricity and calories as it ages. Valves and piston rings might stick, lube oil becomes diluted and injectors seize or worst stick open. If you do extract the old fuel, make sure to dispose of it properly and prepare for filter fouling as the new fuel may dissolve some of the residue in the tank. Run the engine to move fuel through the system and continue to add fresh fuel and change filters. The tank may be original equipment (Helms ceased operations in 1990 so your tank, most likely made of aluminum, is at least 17

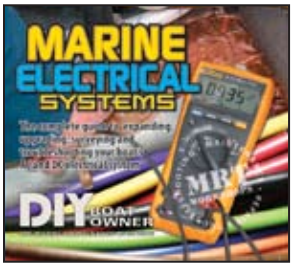
years old) and, as such, it may be at or near the end of its expected useful life; certainly, the fuel tank sender gasket has. Before going to the trouble of fuel transfer and replacement, consider the age of the fuel tank and its supports. Do an inch-by-inch inspection of all the fuel hoses, looking especially for leaks, permeation or hose casing cracks and replace any suspect hose. Replace all washers and system gaskets. This is also a great time to plan and install a bypass system so you can change filters while underway. This may all seem like a big answer to a relatively small question but you wouldn't ask your doctor to just listen to your heart and "fix it" without doing the related "system" checks. On the other hand, "if it ain't broke …." It's your call.

— Randy Renn

More than Wires

Q: When installing an autopilot on my sailboat, I ran a 12-volt wire from a spare accessory switch on the back of the distribution panel. Is this enough amps for the autopilot or should I connect straight to the battery?

Russ Traina, Kiln, Mississippi



Refer to DIY's MRT Series "Marine Electrical Systems" CD-ROM, for step-by-step wiring installations and ABYC standards relating to wire size and circuit protection.

A: The first thing to look at is the current or power draw rating of the autopilot. Based on this, run the proper gauge wiring to the autopilot, allowing for voltage drop. [Ed: To determine wire size and length per ABYC E-11 Standard refer to DIY's MRT CD "Marine Electrical Systems."] Always install a fuse or circuit breaker to protect the electrical supply wire to the autopilot (or any other equipment for that matter). If the wiring specified, typically, 10 amps, you would need the same size circuit protection. It's difficult to say whether you have enough amps without seeing the panel. If you do connect directly to the battery, you still must consider the wire size and protection issue, and never place more than four terminals on the battery stud. Also, make sure any power cable to the autopilot is routed well clear of radio aerial cables.

— John Payne

Alpha Changeout

Q: I have a 5.7L Mercruiser with an Alpha One drive. I want to replace this drive with a pre-Alpha one. Any problems doing this?

Glen Foster, Quincy, Massachusetts

A: The main difference between a 1983 to 1991 Alpha One drive and its predecessor, the 1976-1982 MC-1 drive, is the gearcase design. The Alpha One drive is designed to take more horsepower and boat weight than the MC-1; specifically, up to 260 hp and around 5,000lb (2,268kg) boat weight, compared to 200 hp and 4,000lb (1,814kg) for the MC-1. If an MC-1 is installed on a heavy boat with a strong 5.7L engine, it could suffer a pinion gear failure due to the excessive load, hence the introduction of the Alpha One drive.

If you have a light boat and are easy on the throttle, the MC-1 drive may survive but there certainly is no guarantee on how long it will last.
— Steve Auger

Bonding Issues

Q: All I've ever read is that a boat's negative DC wiring system and bonding system should never meet. Yet, they do on my boat. The negative DC cable goes via the engine mount to the negative battery terminal and the engine is part of the bonding system too. What is the explanation to this seeming contradiction?
Frank Minelli, Austin, Texas

A: Your boat is not so different than most others but your confusion is well founded. The negative DC that goes from battery to engine is in fact a polarizing conductor. In most arrangements, it carries current to the starter motor and also carries DC charging current to batteries from the alternator, which grounds out on the engine. Some boats have a cathodic protection bonding system that connects underwater metals and anode to ensure all these are at equal potential. Usually, the engine is bonded into this system as it's connected to the propeller shaft via the shaft coupling. As the engine is effectively then at zero potential, the battery is also polarized to this as well so no current actually flows in the bonding system. Ideally, engine and cathodic bonding systems should be separate; however, in practice it's hard to achieve. If you are not experiencing any underwater corrosion issues, everything is probably okay.
— John Payne

Terminal Corrosion

Q: I have some dielectric grease that I was thinking of using on spade and ring terminals as a corrosion inhibitor. The grease is apparently non-conductive, which sounds like it would be a bad thing to apply to a connector. Should I use something else such as Vaseline?
Bob Griffiths, Parry Sound, Ontario

A: You're absolutely correct to not use dielectric grease. My best advice is to use nothing; connectors should be clean and dry without any substances applied. It's actually rare to see marine-grade terminals rusting as they are tin coated. If the distribution panel is enclosed at the rear, throw in a large bag of silica gel to keep things dry or alternatively use one of those corrosion inhibitor products that ensures all remains dry.
— John Payne

Zerust foam capsules from Dr. Shrink contain a non-toxic corrosion-inhibiting vapor that's applied by peeling away the adhesive backing and affixing to any surface to protect electrical and mechanical metal components to keep things dry.

Gate Keeping

There are many ways to provide a path through handrails and lifelines for getting on and off the boat. The key is having a system that ensures everyone onboard stays onboard.

Story and photos by Pat Kearns

A gate, according to the World Book dictionary, is "a movable frame or door to close an opening in a wall or fence. It turns on hinges or slides open and shut." The thesaurus suggests that synonyms for gate include opening, entry and access.

When we think of "gates" on boats, we usually visualize an opening in a handrail or lifeline. This gate has traditionally been an opening section that allows us to board or leave the boat without having to precariously straddle a fixed railing or continuous run of lifeline.

The interruption in the system that allows the gate to be installed often includes additional, vertical sections of railing (stanchions) that support each end of the opening and are the points to which hooks or hinges or some other device that permits separating the fixed components are attached. This is usually at the side decks but boat designs have evolved and, as the form versus function design issues emerge, we have seen the gate evolve, too. We now see the gate function appearing at transoms, bow and stern rails, through the forward bulwark of a flying bridge molding and other places as the designer's imagination sees utility.

In doing the research for this article, I found that there are many new ways to provide for passing through handrails, lifelines and other areas of a boat. The term gate, as used in the context of this article, is intended to embrace all forms of gating an opening through which persons onboard can pass when moving laterally to and from the boat or onboard from one area of the boat to another.

Standards Savvy

There is only one factor to consider in evaluating the function and safety of a lifeline or handrail gate and it's contained in the ABYC standard H-41, Reboarding Means, Ladders, Handholds, Rails and Lifelines, which states that: "Gates shall be fitted with latching devices that, when closed, cannot be accidentally disengaged." The design or type of latching device is not prescribed and therein lies a great deal of latitude in determining whether these devices meet the intent of the level of safety dictated by the standard.

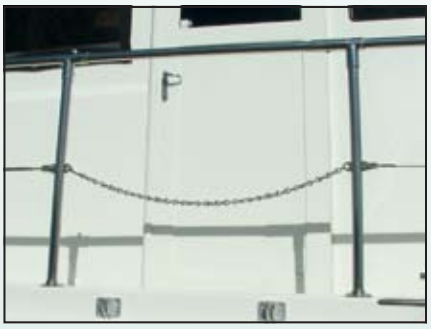
What can't you use? What should you use? It's really up to you (or the boat builder) as long as it cannot be accidentally disengaged. In fact, you don't have to provide a gate at all but, if you do, it must comply with the standard. While the standard is voluntary, it's accepted as a minimum level of safety performance whenever there is an accident and an investigation of what should have been done to prevent the accident. These requirements are greatly expanded for boats that carry paying passengers.

The standard goes further to say that all "assemblies listed in H-41.6 (including gates) shall be mounted in such a manner as to withstand a 400lb (181kg) static load at any point, in any direction, without failure such that they no longer perform their intended purpose. If the system includes a gate, the system must pass the test with the gate open." This can be interpreted to mean that the gate, in its closed position, must also meet that test.

In the less than 70 words quoted from the standard above, there is quite a mouthful and failure to comply can be an off the boat gateway to a liability nightmare. Otherwise, how you get to that level of safety performance is limited only by your engineering and fabrication imagination. Remember, too, that the standard sets a minimum level of performance. It's only the floor of safety thinking. Anything that exceeds that is a matter of good, better or best.

This gate is provided to allow the launching of a dinghy from the upper deck. The gate is opened and the intermediate stanchion removed temporarily during dinghy lifting and launching operations.

A simple, effective gate that opens inward is much safer than an outward opening gate or transom door that can dump into the sea the unwary leaning on a gate/door that is not securely latched.



The upper rail gate is secured with a latch activated by a small knob that permits the rail to lift vertically and fold over, via a hinge, onto the fixed section. It's a good arrangement but the light chain at the lower lifeline would not survive the load test.

Faulty Closures

A failure at any point of attachment of a lifeline or handrail system can cause the section that separates to unintentionally become a gate through which a person goes overboard. Whether such a fall occurs at sea or dockside, an unplanned overboard event is traumatic.

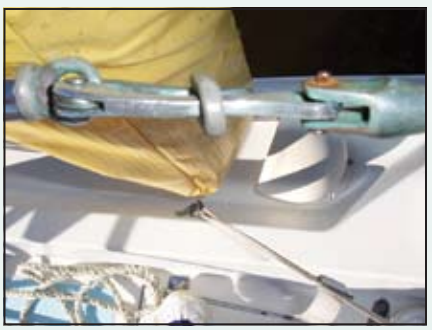
"Old reliable" lifeline gate design with upper and lower, vinyl-coated wire lifelines and gates fitted with pelican hooks. As long as this system is maintained, it should do its duty. Rust is the biggest enemy of coated lifelines and uncoated wire, which doesn't suffer hidden corrosion issues, is a better choice.

What's wrong with this picture? A high-quality pelican hook is compromised by a split ring that is easily snagged by a sail sheet or crew clothing, resulting in unintentional opening of the latch. The tension adjustment nut is not threaded tight to the fitting.

Swage at the lifeline (shown by the arrow) gate wire is cracked. The good design and condition of the pelican hook will not save this gate when the swage fails and the gate opens under load.

This pelican hook arrangement on a sailboat lifeline gate has stood the test of time as a good design, well installed.

The section of railing in hand slides out of the fixed tubing of one end of the railing and has a nut that threads on to the other end, which is threaded to accept the nut. The resulting closure is effectively bolting the gate closed.



A well-designed gate terminal arrangement with a fairly goof-proof pelican hook if it stays connected to the toggle. Clevis pin in toggle is missing the cotter pin to secure its position as the key connection to the toggle.

The one constant that is the weak link in gate design is the method or device used to secure the gate closed. The protections implied in the lifeline or railing system are only as viable as the weakest point and that is often the gate's latching devices.

On sailboats, the forward and aft ends of the lifelines, where they connect to bow and/or stern rails, are often adapted as gates to allow passage through the lifelines. Lifeline gates on sailboats often resemble an unrelated collection of make-do fittings after a few years of service. Cotter pins break and split rings come adrift and are replaced with assorted swaged fittings, forks and studs, bolts, clevis pins, eyes, hooks, shackles, swivels, toggles, even light line and wire.

Handrail systems on houseboats and pontoon boats have historically been notoriously light duty and gates in these railings are often closed with small lengths of chain and some of them are, worse yet, plastic linked chain secured with snap hooks or carabiners intended for use as key rings.

Powerboat handrail gates seem to fare better as they are integrated into a solid railing of stainless steel or aluminum with welded sections and stanchions. When the handrails are stretched or deformed from overloads of serving as places to tie docklines or they are bent by forceful contact with fixed objects, the gates separate. Other gate closures such as those that rely on a sliding or threaded section seize up and often in their open positions.

DIYers installing new lifeline or handrail systems or repairing or upgrading existing systems must be diligent in their choice of gate closure hardware. If it can vibrate loose, it will. If it can be snagged on clothing and come open, it will. If it can deform and lose its grip, it will. If it can corrode, it will. Stock fittings and wire are available for boats using lifelines and boat builders can usually provide replacement railings for late-model powerboats. When custom work is needed, work with an experienced rigger to be certain you meet the required load calculations and the fittings used will withstand those loads.

In the final analysis of strength and suitability, testing is the only way to ensure that a gate closure meets the standard's requirement for resistance to unintentional release, which leads to opening the gate, possibly under load, at the worst possible time. The idea is to avoid that test occurring unintentionally. Since testing is impractical for the DIYer, using the right fittings is the way to go. A mish-mosh gathered from an assortment of spare odds and ends will surely lead to getting somebody wet or hurt.

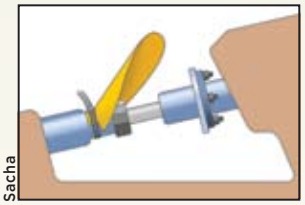
Every boater should know what to do when someone goes overboard but it's a far better thing to make sure everyone onboard stays onboard.

About the author: Pat Kearns is a NAMS certified marine surveyor and DIY's technical editor.

Tech Tips


Jan Mundy

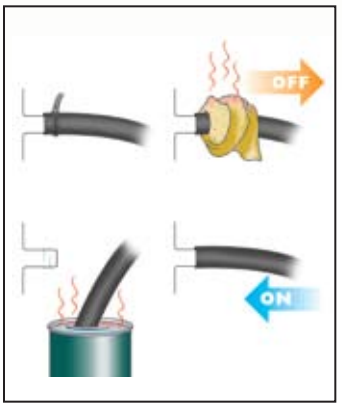
Engine Flush Bucket: A better alternative to engine flush ears (a.k.a. ear muffs) when winterizing outboards and sterndrives, is to purchase a plastic container of the appropriate size to fit the lower unit, fill it with water and while operating the engine always at idle keep a water supply handy to refill the container.


Sacha

Rust-proof Shaft: If your engine shaft stuffing box doesn't have a spray shield to keep the nuisance seawater mist from rusting adjacent parts, add one by shaping a piece of plastic from a laundry soap bottle and attach it to the box with hose clamps or wire ties.
Randy Renn, Stevensville, Maryland

Dinghy Safekeeping: Sailboaters who need to stow the dinghy, either for security reasons or to keep it clean, might consider rigging a four-part hoist with the one end attaching to the main halyard and the other ends to lifting eyes on either side of the dinghy's bow and transom. This works for putting the dinghy on deck or on the dock for transport to a dinghy rack in the marina or boatyard.


Jan Mundy



Sacha

Hose Helper: To remove old hose from its hose barb, unfasten the hose clamp, wrap a dish towel around the hose end, pour hot water on the cloth and let it sit for a few minutes then simply pull off the hose. Reinstall or replace the hose with a new section the same way or dip the hose end into hot water for 15 to 30 seconds and slide it on.
John Cly, Groco, Maryland

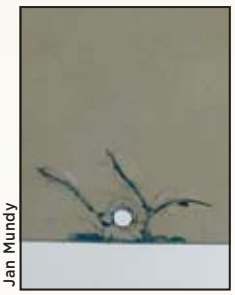
Amazing Clean: To remove black streaks, stains, tough dirt and even cosmetic scuff marks, take a Mr. Clean Magic Eraser, wet it with water and gently rub the eraser on the surface.
Alan Jones, executive editor, Boating World


Jan Mundy

Dockline Control: Rather than leave the excess dockline on the dock, drop the dockline loop around the dock cleat, run the line onto your boat and cleat it off on your deck cleat being careful to set the length correctly. Neatly lay the bitter end of the dockline on deck then do this for all lines, and you may not have to adjust them again for the entire season.
George Hirsch, "Selah," Port Dover, Ontario


Jan Mundy

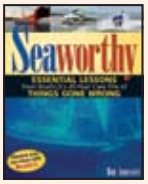
Noodle Guards: Pool noodles made of soft flexible foam in myriad colors are ideal for use as lifeline backrests or slip them over wire shrouds and they offer chafe protection for headsails.


Jan Mundy

Drilling Plex: Plexiglass and other acrylic glass and Lexan expand or contract with temperature changes. When drilling holes for fasteners, always drill oversize to prevent the holes from cracking and crazing. The rule of thumb for Plexiglass is to increase the hole size by 1/16" for every 1' of surface length. Never countersink drilled holes, which causes stress loading at the screw area and cracks radiating from the hole.

Torque Helper: Next time you need to extract corroded and seized fasteners and they won't budge, try using an impact driver. *Graham Collins, Halifax, Nova Scotia*

TECH TIPS WANTED



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High-Tech Interior Refits

Cored composite panels offer a lightweight, high-strength alternative to solid marine plywood when refitting interiors.

Story by Nick Bailey

The interior of any boat large enough for an overnight stay will inevitably be a compromise between structural performance and "livability," that elusive amalgam of function, convenience, beauty and comfort. The choice of materials for a new or refit boat interior is also a compromise between strength and weight with the attractive surface often a superficial benefit.

Traditionally, the material of choice for bulkheads, flooring, berth tops and cabinetry has been marine plywood, either with a beautiful wood veneer or covered with fabric, paint or topped with a laminate like Formica. Although solid marine plywood is an excellent and economical boat building material and is still the performance standard by which all others are judged, many high-performance cored alternatives are available for applications where saving weight is the priority over low cost.

Forty years ago, the use of lightweight core sandwich construction brought greater stiffness combined with less weight to fiberglass hulls and decks. The same engineering breakthrough led to the ready-to-use flat panels available today. When a lightweight core of honeycomb, end-grain balsa or PVC foam is bonded to outer skins of wood, FRP (glass, carbon fiber, Kevlar) or aluminum, the rigidity of the panel is equivalent to a solid material of the same thickness but weighs much less (refer to **Table 1**). At the same time, the thin but tough outer skin backed by

REFIT CAUTION

Today's fiberglass boat construction techniques are changing the traditional trade-offs between form and function. The primary purpose of a bulkhead may once have been to support the hull but, in many new boats, that role is carried out by a molded one-piece FRP grid structure either bonded to the hull or infusion molded together with it as a single unit. Compared to older boats, the bulkheads and intercostals in these new boats may not have much structural significance and may, in fact, be merely cabin dividers and furniture. Once the bulkheads are free of structural requirements, the modern boat designer has much more flexibility with interior layout.

Caution is required when refitting an older boat, especially if you want to modernize and update the interior layout by cutting out and relocating bulkheads. There are too many examples out there of enthusiastic but misguided DIYers cutting out critical interior structure while remodeling.

Chances are if a bulkhead is 3/4" (19mm) thick marine plywood and fiberglass is tabbed to the hull, it's probably there for a good reason. Don't be in a hurry to remove it unless something equally substantial takes over the same job in approximately the same location.

— NB

Jan Mundy

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core provides surprisingly good resistance to puncture by point source loads.

As is usually the case with emerging technologies, these products were first developed for the aircraft industry and then began appearing about 30 years ago in "cost-is-no-object" custom racing boats. Today, many high-tech panel manufacturers are still primarily aircraft industry suppliers. Unfortunately, from the standpoint of price, the products they sell to aircraft manufacturers are government certified eight ways to Sunday, must meet stringent fire and smoke regulations and come with a long ISO 9000+ quality-control paper trail. These "true" aircraft panels can cost more than 10 times the price of marine plywood which qualifies them as "unobtainium" for most marine applications.

Recently, less expensive panels with similar performance have become available and they are even beginning to find their way onto production boats. The yacht sales person at the boat show may say, "… that dinette table really is genuine black granite," but they might not mention the granite portion is only 0.125" thick overlaid on a featherweight honeycomb core. They might also say, "This galley counter-top is solid half-inch Corian," but the builder knows that, to make up for the weight of that monolithic slab, all the beautifully varnished cabinetry around it is balsa-cored plywood.

Cost Versus Performance

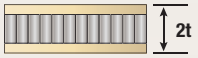
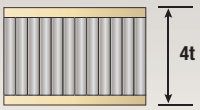
You might be thinking: Why use expensive lightweight aircraft technology on a boat? A boat doesn't need to fly, it just needs to float. However, like anything else that has to move, weight is a primary factor in overcoming inertia and getting to a boat's best potential for performance and this is especially so with that of a planing powerboat, so anyone interested in better performance might beg to differ. For the powerboater, 1,000lb (453.6kg) saved here or there can make a significant difference in fuel economy and acceleration, quicker planing and longer range. For the sailor, it can mean the performance advantages of a stripped-out racer combined with a luxurious interior suitable for cruising.

Nonetheless, even when the cost of a lightweight panel is only two or three times that of marine plywood, the added cost is a significant factor. The cost versus performance balance must be weighed carefully when considering the use of these new materials. For example, when a professional yard undertakes a major refit on an older yacht, the complete package usually involves exterior refinishing, new engines and a lavish new interior. A rough rule of thumb used in the industry is that the interior of a luxury yacht is often 30% of the overall weight so it's important that a heavier interior does not cancel out the increased performance promised by the new engines. For a small premium in the overall cost of the project, the careful choice of materials can help keep speed–robbing weight to a minimum.

In a case like this, the use of fiberglass and honeycomb bulkheads and flooring at half the weight of the same thickness of plywood and comparable strength makes sense. When building cabinetry and furniture, where maximum strength is not required, even greater weight savings can be gained using pre-finished teak or mahogany veneered, balsa core panels that weigh 80% less than the equivalent thickness of plywood.

The price premium for lighter materials may not be that significant in a project where the largest single expense is labor. In fact, most of these products can make use of simplified "cut, fold and bond" (see below) assembly techniques that can actually reduce labor costs.

Table 1

	Solid Metal Sheet 	Sandwich Construction 	Thicker Sandwich 
Relative Stiffness	100	700 7 times more rigid	3700 37 times more rigid
Relative Strength	100	350 3.5 times as strong	925 9.25 times as strong
Relative Weight	100	103 3% increase in weight	106 6% increase in weight

Hexcel

A comparison of the panel stiffness, strength and weight versus core thickness of steel to a honeycomb composite.

Selection

There are many types of composite panels now available from many different manufacturers. The best-known U.S. manufacturers offering prefab composite panels for marine use are Nida-Core and Tricel. Nida-Core primarily uses thermoplastic

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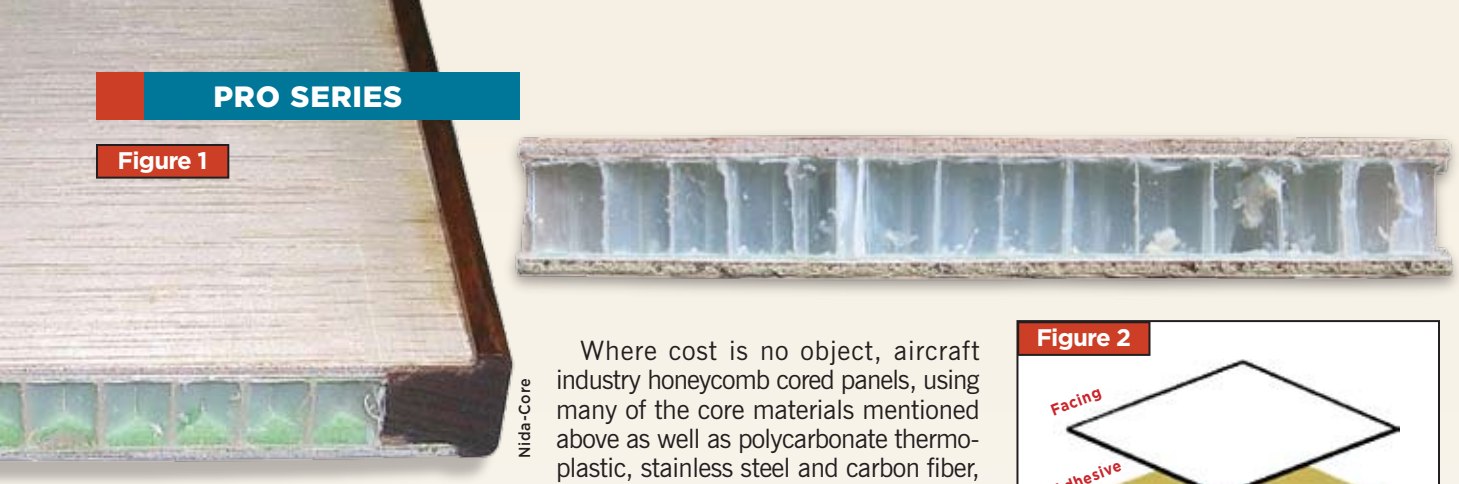
Figure 1



Nida-Core

Nida-Core prefab composite panel with wood veneer skins and polypropylene honeycomb core and user installed edge trim.

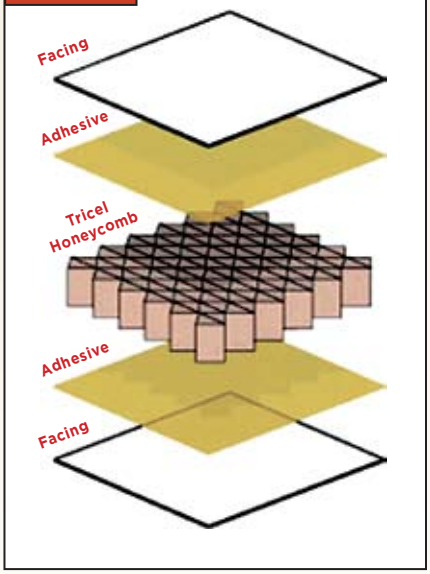
polypropylene (PP) core (**Figure 1**) and Tricel is known for their phenolic impregnated paper cores (**Figure 2**). Plascore also provides a variety of honeycomb-cored panels using aluminum, PP, Nomex and Kevlar (aramid) papers. Besides honeycomb core, more conventional end-grain balsa and foam core panels are also available from these manufacturers and others including ATL Composites (distributed by RevChem Plastics in Tacoma Washington).

Where cost is no object, aircraft industry honeycomb cored panels, using many of the core materials mentioned above as well as polycarbonate thermoplastic, stainless steel and carbon fiber, are available from Hexcel, M.C. Gill and Cattco, to name just a few.

The panel manufacturers may not be interested in selling in quantities smaller than full skid loads (10 sheets or more) so it's necessary to find a retailer. Most retail suppliers of boat-building materials stock lightweight composite panels. A quick Google search turned up Jamestown Distributors and Core Composites in Rhode Island, Boat Builder Central in Florida and Noah's Marine Supplies in Toronto, Ontario.

Stock panel sizes are usually equivalent to plywood but many are available as half sheets and also in sizes larger than the standard 4' x 8' (122cm x

Figure 2



Tricel

Tricel honeycomb panels use a phenolic resin impregnated Kraft paper core.

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Figure 3

Jan Mundy

Shown is an onyx-faced, aluminum honeycomb cored panel for lightweight galley countertops. Granite, quartz and marble skins with corrugated (most popular) or fiberglass cores are also available.

243cm). Available thicknesses typically range from 1/4" to 1" (6mm to 25mm) but some panels can be obtained upwards of 4" (101cm) thick. The basic panel for a marine application has an unpainted fiberglass/epoxy or fiberglass/polyester skin. Panels are also available with almost any conceivable type of decorative veneer, ranging from machined metal to exotic hardwoods and genuine marble or granite (**Figure 3**).

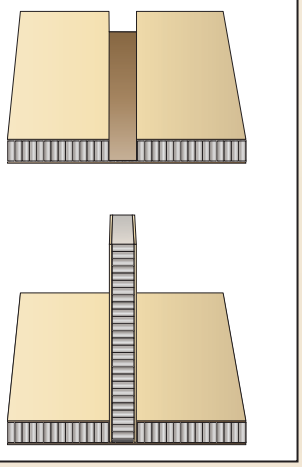
The fundamentals of construction using lightweight cored panels are not much different from working with plywood. Bulkheads and stringers attached to an FRP hull are bedded into thickened resin (usually epoxy) and tabbed in place with fiberglass secondary bonds. To ease the fiberglass over the right angle transition between the hull and the panel, a rounded fillet of thickened epoxy is recommended. At an exposed bulkhead to sole joint, use the second method for a splined joint, as outlined below.

Cabinetry Joints

There are several short-cut methods of joining cored panels to each other. Right angle "T" joints use one of two methods. The first method dadoes a recess through the one skin and core (leaving the other skin uncut) and simply glues the end of the joining panel into the recess with epoxy thickened with colloidal silica, cotton fibers or sawdust (**Figure 4**).

The second method glues a wood spline of the same thickness as the core onto the surface of one piece. Prepare the edge of the joining piece by removing the core (use a router)

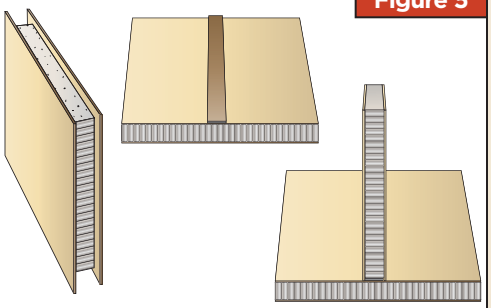
Figure 4



Nida-Core/Joe Vanveenan

Method 1 for creating a "T" joint: Dado a recess through one skin and the core, leaving the other skin uncut. Glue the end of the joining panel into the recess using thickened epoxy.

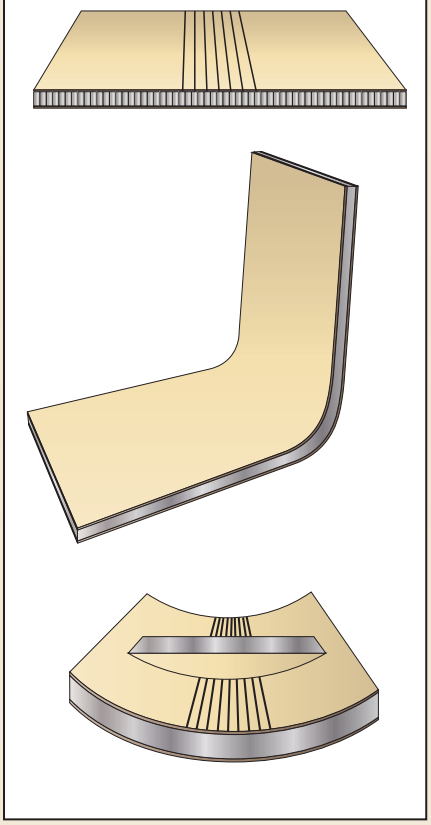
Figure 5



Nida-Core/Joe Vanveenan

Method 2 for a "T" joint: Glue a wood spline to the surface of one piece and then remove the core from the adjoining piece to create a recessed edge, apply thickened epoxy to the recessed edge and then fit the recessed edge of the spline and clamp.

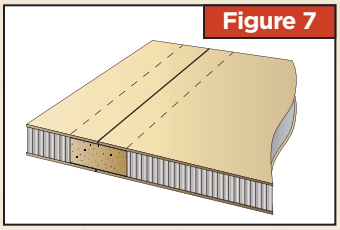
Figure 8



Nida-Core/Joe Vanveenan

To create a rounded corner, kerfs (slots) are cut through the back face and core that allow the panel to be folded and bonded to make the curvature permanent. A reinforcing gusset bonded to the backside of the curved panel is optional but adds strength.

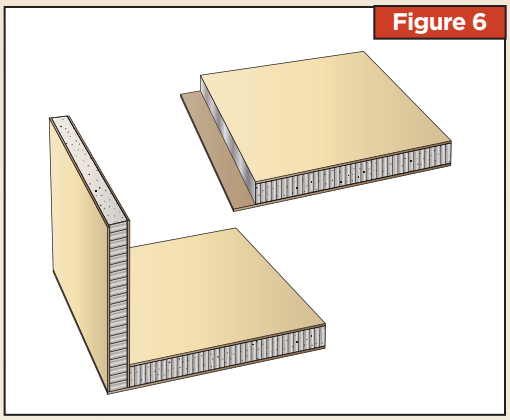
Figure 7



Tricel/Joe Vanveenan

Joining two panels end-for-end is done with an overlapping wood spline, epoxied in place of the core along the joining edge and clamped.

Figure 6



Nida-Core/Joe Vanveenan

To make a corner joint, remove a section of skin and core to create a rabbet and glue the end of the joining panel in place over the exposed rabbet.

so that it fits neatly over the spline and the assembly is glued together with thickened epoxy (**Figure 5**). This style of splined joint also helps prevent water absorption by plugging the exposed core and provides a convenient cleat to help fix the bulkhead in place while the epoxy cures.

Outside right angle corners are easily done by cutting or routering away one skin and a section of core the same width as the joining panel. This leaves behind the ledge of uncut skin for use as a rabbet. The joining panel is epoxied in place over the rabbet neatly capping the exposed edge of core (**Figure 6**).

Joining two panels end for end is also straightforward. The core is removed from the adjoining edges of each panel and a wood spline is epoxied into the recess in place of the core creating a solid link (**Figure 7**).

Cut, Fold and Bond

Sharp right angle corners are not usually preferred in a boat interior. Because the thin outer skin and decorative wood veneer is flexible enough to bend, hollow cored (honeycomb) panels are well suited to creating radius bends and rounded corners.

To allow the rigid panel to bend, kerfs or slots are cut using a table saw through the back skin and deep into the core (**Figure 8**). Each cut allows the panel to fold or bend a fixed amount before the kerf closes. Each additional kerf cut into the backside increases the bend by the same additional fixed increment. For example, if the first kerf allowed a 10-degree bend, a total of 9 kerfs will allow a full 90-degree corner. The distance between each kerf defines the size of the bend radius. To make the bend permanent, the bent panel is straightened enough to open the kerfs and thickened epoxy is brushed into the openings. The panel is then bent to close up the kerfs and clamped into a jig until the adhesive cures. For additional strength, a reinforcing gusset can be bonded to the backside.

Edge Treatment

The raw panel edges of cored panels are even less attractive than plywood so it's important to plan on using decorative wood moldings, veneers, borders, fiddles, etc. These are either inserted into the end of the panel or slipped over the end like a sleeve and are then bonded in place with thickened epoxy. In cases where the edge trim is inserted into the panel, the core must be removed with a router or table saw to make room (**Figure 9**). Various edge treatments and trim are necessary to finish and seal the core edge ranging from a U-shaped molding to simply inserting and bonding a wood spline to cap the edge.

Potting and Blocking

As with plywood, it's also important to seal the exposed edge of any core that could be exposed to water, particularly balsa or impregnated paper cores. Although most plastic honeycomb and foam cores are immune to water damage, it's still a good idea to keep them sealed and dry.

Any raw unfinished edges that are not already epoxy encapsulated, splined or capped with trim should have the core removed within 1/4" to 1/2" (6mm to 12mm) of the edge and potted with thickened epoxy.

Most honeycomb, hollow core panels are vulnerable to crushing the core at fastener locations. For this reason, they are best suited to be chemically bonded (glued) rather than joined by mechanical fasteners. In cases where the panel must be removable, i.e. floorboards, bunk-tops, etc., or when hardware must be fastened to the panel, screws or bolts may be necessary.

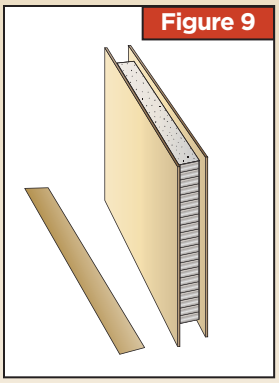
To provide a hard point for a single bolt or screw, use a variation of the traditional potting method for hardware fastening in a balsa-cored deck. Drill an oversized hole, approximately 1/2" (12mm), in the face skin and core. Enlarge the core recess below the face skin to approximately 1" (25mm) in diameter with a router or die grinder (e.g., Dremel) and then fill the cavity with thickened resin and allow to cure (**Figure 10**). Drill the resulting plug to the correct size for the fastener.

An alternative technique used in the aircraft industry is to employ specialized epoxy bonded metal core inserts or adhesive bonded surface mount fasteners. Where multiple fasteners are required in one location, the blocking technique is appropriate. In this case, use a holesaw or router to cut out a section of the face skin and core, leaving the inner skin in place. A matching solid wood plug of the correct thickness is then bonded in place with epoxy to provide a hard point for fasteners **(Figure 11)**.

As professional yards begin to make routine use of these new materials, it may also make sense for the DIYer to consider them while pondering an interior refit.

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

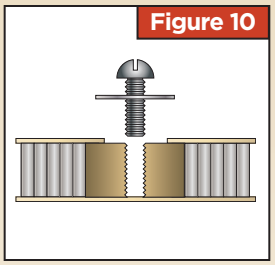
Figure 9



Tricel/Joe VanVeeenan

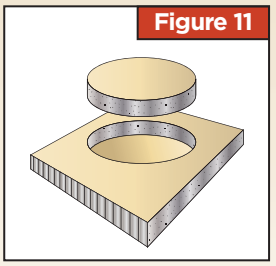
Removal of the core from the panel edge to provide clearance for a spline, joint or edge finishing trim is done with either a table saw using a straight blade or a dado set to the core width or with a router. The trim is then bonded to the edge.

Figure 10



Potting technique for a single fastener where the core is replaced with thickened epoxy and redrilled (and tapped if appropriate) for the fastener.

Figure 11



If several fasteners need to go in a small area or high compressive loads are expected, use the blocking technique to replace any hollow core with solid wood. In this case, the outer skin and core are removed with a holesaw or router and a slightly undersized wood (or plywood) block is bonded in place using thickened epoxy. All fasteners go into the wood plug.

EFC International

The new TwinDisk from EFC International provides a rapid fastening point anywhere in a composite panel. A hole drilled in the panel removes the core, adhesive is applied and TwinDisk pushed into the cavity. The bottom disk bonds to the bottom skin, the top disk to the top skin, to form a secure fastening mount.

Jan Mundy

Countertops installed in many top-end yachts are actually lightweight cored panels.

AN EXHAUSTIVE JOURNEY

Attention to maintenance tasks ensures a trouble-free exhaust system.

By Randy Renn

In the course of many years of pleasure and commercial boating, I have replaced lots of manifolds, metal boxes, barrels, risers, standpipes and hoses but never a modern muffler. So, why do I now address a subject with such a low failure rate and high durability rating?

The exhaust system, whether it's a simple barrel muffler or a complex system with required dry sections, is a dynamic thing. Metal units rust, fiberglass fatigues, exhaust hoses cycle their contents millions of times. Systems get hot, expand and are repeatedly cooled by seawater in an extremely hostile service environment.

Most boat exhaust layouts are designed and engineered exhaust percolation arrangements. In such a system, exhaust gasses and water are fed into a barrel-type muffler and pressure builds to a point where it's higher than the weight of the water in the muffler. Water and exhaust are then "percolated" out of the boat via pipes and hoses. While this is a tried and true method, there are a couple of drawbacks. First, the system is constantly loading and unloading the exhaust line (turbos, in particular, do not care for this). Second, these systems can be noisy, particularly when in a quiet harbor with a generator whooshing and burping while the boat's occupants snooze in air-conditioned comfort.

Enter the newer kids in the business. Bypass, Halyard and Soundown systems are fairly new on the market and they are appearing in large numbers. Bypass systems divert some water flow and exhaust to a terminus on the boat's side or to an underwater outlet where exhaust discharge is kept to a minimum as the exhaust by products are dumped directly into the water without the splash from a gravity discharge above the waterline. Halyard and Soundown systems and other similar versions separate water and exhaust after the exhaust gas is cooled and send the cooling water overboard below the waterline, also considerably moderating the exhaust cooling water splash and pulse noises of a traditional above the waterline discharge. On a late model, midsized powerboat so equipped and at anchor, we turned down the stereo and could barely hear the generator exhaust output. Another newer system is the vertical dry stack, similar to those found on commercial boats, but the system starts out wet, separates the gases and sends them out well above the boat's top deck.

Made of composite fiberglass, Soundown's Classic WaterDrop silencer discharges the cooled, dried exhaust gas from the silencer side housing and the raw water to a thru-hull fitting below. Extremely quiet, separating the gas and water silences the engine's combustion noise and creates minimal backpressure.

These days, mufflers, tubes and connections come in a wide variety of configurations of standard shapes for fiberglass and roto-molded plastic types. The combination of available sizes and shapes allow the skilled weekend warrior to assemble a custom system with little trouble and without undue expense. Stainless steel systems or combinations that use flexible steel tubes should be left to professional fabricators and tend to be painfully expensive and too complex for a sensible DIYer. Always use materials that conform to your situation as prescribed by the engine manufacturer and that are certified to conform with SAE Standard J2006, a Society of Automotive Engineers standard that is incorporated by reference into ABYC standard, P-1, Installation of Exhaust Systems for Propulsion and Auxiliary Engines. Flexible plastic/rubber hoses vary considerably in price and temperature ranges. Select only NMMA, SAE or UL certified hose or Coast Guard accepted hose.

Maintenance 101

Your primary concern must be safety. There must be zero tolerance for exhaust leaks. That means no seeping riser gaskets so change gaskets at first signs of rust streaks. If water is leaking at exhaust system joints, gasses are also leaking out into the spaces.

Hose clamp and tee bolt failure from over tightening, external corrosion, dissimilar material attack or physical damage can result in several conditions that do not seem obvious on the surface. Over tightening clamps deforms hoses and greatly shortens their life span. If you can see surface rust or wire coming through the hose or the hose's external casing is cracking, it's time for replacement. There is no practical way to see inside every inch of hose but cracks on the external plies are symptomatic of breakdown of the hose compound. Leaking hoses can very rapidly lead to flooding so even the smallest leak should not be ignored. Replace any metal union or fitting found to be weeping water or creating a rust trail. Concern over the seep would be one item but complete

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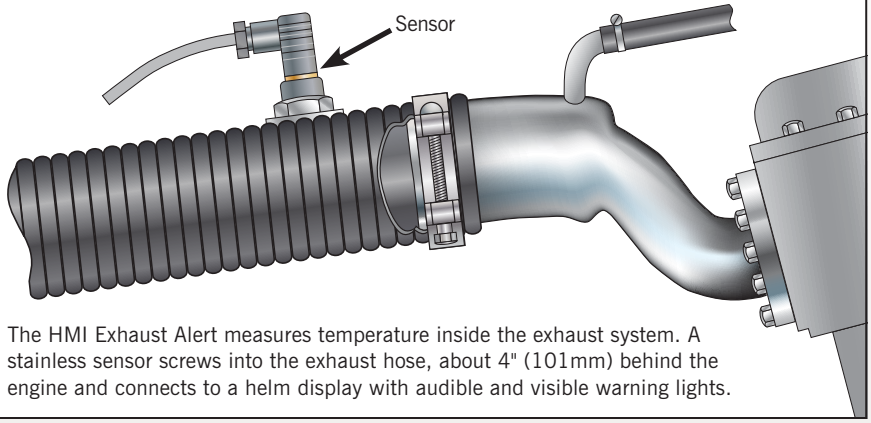
Vetus

union failure due to internal corrosion can ruin more than a few days of your boating season and the consequences can deliver a big hit on your boating budget.

Home or shop-made systems of iron pipe are generally unsuccessful in the long run and usually problematic to engineer and install. If you have an older iron standpipe system, consider a proactive system redesign. There is never a good time to endure a catastrophic exhaust system failure but it's always a good time to plan to avoid one. Any part of the system that is bolted, clamped or welded to the engine must be securely supported to avoid loading hard bolted components with weight and subjecting them to damaging vibration. Adjustable, stainless-steel braces are suggested as a midsized diesel exhaust section can easily weigh 90lb (41kg) and larger units very much more.

Machinery space must be properly ventilated to control the maximum temperatures that affect engine performance. Some boat's engine compartments are so airtight that closing an engine hatch reduces engine rpm or causes an overheat condition, which is very harsh on hose and electrical component life. Crushed vent hoses, poorly designed runs and weak blowers all contribute to performance loss.

No matter what your system design, components or materials, adding an alarm, either in the seawater pickup line or near where seawater enters the exhaust stream, provides an early warning of seawater cooling loss. Marine diesel exhaust systems depend on a free flow of cooling water from the engine to keep the exhaust components at their designed operating temperature of around 248F (120C). When any obstruction cuts off water flow or a water pump fails, exhaust gases can exceed 932F (500C). Loss of cooling water quickly overheats the system, causing damaged or igniting a fire. In most cases, an add-on seawater alarm warns you before the engine alarm alerts you to an overheat condition and serious damage occurs.



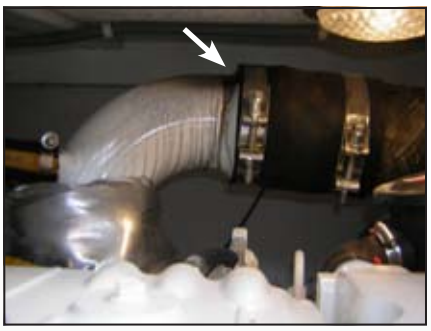
HMI/Joe VanVeenan

The HMI Exhaust Alert measures temperature inside the exhaust system. A stainless sensor screws into the exhaust hose, about 4" (101mm) behind the engine and connects to a helm display with audible and visible warning lights.

Percolating mufflers are divided into two sections. A vertical baffle divides a muffler into two sections from the top to just above the bottom. The mixed water and exhaust gas enters the muffler, the water falls to the bottom and the gas escapes around the bottom of the baffle and through the outlet. A rising water level blocks the outlet side and traps gas in the input side. Increasing exhaust gas pressure (back pressure) "lifts" some of the water up the outlet side through the outlet port, pushing the "percolated" water through the exhaust system to the overboard terminus.

Randy Renn

If your engine came with an exhaust outlet flapper (flexible or rigid), do not remove it and routinely check that it remains closed on all edges when the engine is not running. Flappers are wear items and sometimes curl or break with age. Most systems can benefit from this attachment to avoid a water backflow situation when backing down the boat.

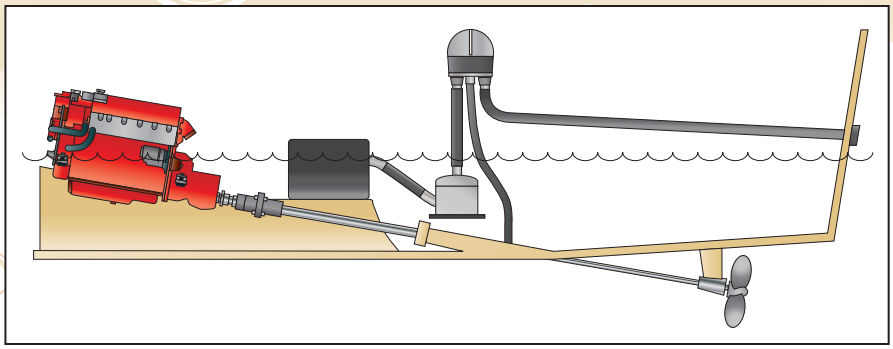


Randy Renn

Leak at an exhaust elbow from over tightening the hose clamp.

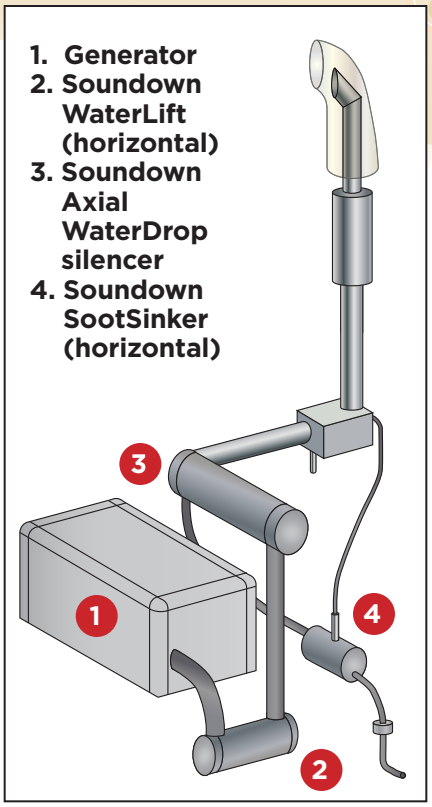
Pat Kearns

Cracking is evidence that this exhaust hose is long past its serviceable life.



HMI/Joe VanVeenan

An HMI exhaust water separator replaces the gooseneck and removes the cooling water, draining it below the waterline thus minimizing backpressure. Ideal for gen-sets, by eliminating the splashing noise out of the exhaust, it reduces noise up to 90%.



Soundown/Joe VanVeenen

A typical dry exhaust system sends exhaust gases aloft. This eliminates exhaust fumes, reduces sooting on the hull and provides quiet, splash-free operation.

Vetus

Vetus XHI exhaust temperature alarm provides a visual and audible warning when temperatures inside the exhaust hose or the muffler exceed an acceptable level. The sensor mounts onto the exhaust hose immediately after the mixing elbow.

While carbon monoxide (CO) is not normally a threat on diesel-powered boats, it has been known to migrate to such a boat when a nearby boat with gasoline engines is operating in atmospheric conditions that allow its CO emissions to flow into the innocent boat. This exact situation has been observed on boats that are rafted up or moored or berthed in close proximity to boats with gasoline engines running, especially at very inefficient idle speeds. It also occurs when using a generator and exhaust vapors migrate and intrude into the accommodation spaces of other boats. It's highly recommended that diesel-powered boats be equipped with CO sensors. It might be overkill but it may keep someone from being exposed to this invisible, odorless, colorless, killer vapor.

Pressure and Performance

The major concern in system design is restriction of the flow of exhaust gases, known as backpressure. This is where many boats get their owners into difficulties. Backpressure is the measurable entity, in the form of pounds per square inch or inches of mercury that your engine creates in an effort to evacuate exhaust and cooling water. How much can this be? Let us say you have a 150 hp diesel that rests 2' (609mm) below the waterline. A straight line from the back of the engine to the transom is perhaps 14' (4.2m) and, with all the twists and turns, the total exhaust run is 25' (7.6m), plus add a muffler and 3' (914mm) of rise in the system. Given that several times a minute the system is at least partially filled with water, how much pressure will the system need to pump the water out? This figure is recommended by the engine manufacturer and can be as low as 3 psi or, in simple terms, not much. This means exhaust system runs must be smooth and large at times. Too much backpressure affects engine cooling, creates smoking, shortens turbo life, impacts cruising speed and engine longevity in general.

How can you measure backpressure and why would it change? Readings are taken at basically any point in the system, close to the engine, that can be tapped and a fitting added. Many diesels come with pressure taps, not to be mistaken for pyrometer taps, although they may be in the same location. (Some mufflers have a usable tap point as well.) A pressure change from readings at the time the boat was built occurs for several reasons. Mufflers and hydro lifts become clogged with residue or rust, hoses collapse internally, vermin build nests, a metal muffler can scale and fiberglass mufflers lose internal baffles. These are muffler maintenance items frequently overlooked when considering performance issues. Your engine is not as strong as it once was so additional resistance dynamics can multiply within the system.

ABYC standard P-1 speaks to outlet terminus, backpressure and maximum system temperature in relation to structure and numerous system parts descriptions. A useful tool for reading engine temperatures is an infrared pyrometer available for about US$30 from an auto parts or air conditioning system supplier.

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

ADDITIONAL READING

DIY Mechanic Articles discussing the proper exhaust system installation complete with schematics per ABYC P-1 and additional maintenance tips plus how to CO-proof your boat appear on DIY's MRT Series "DIY Mechanic" CD-ROM (US$19.95)

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Carburetor Check-up

A well-tuned carburetor increases performance and delivers better fuel economy and lowest possible exhaust emissions from your gasoline engine.

Story and photos by Steve Auger

Is your carburetor giving you the best engine performance possible? Carburetors, like many engine components, might require service to be sure they are working at peak efficiency.

In order to produce optimum power, with reasonable fuel economy, your gasoline engine requires an air/vaporized gasoline fuel mixture of approximately 14 parts air mixed with 1 part of vaporized gasoline. The least expensive way for engine manufacturers to accomplish this is with a carburetor.

Carburetors come in various styles depending on the vintage, displacement and application of the engine. The service procedures outlined in this article are general and are for reference only. With all the different makes and models of gasoline-powered marine engines, there are procedures and specifications that apply only to your engine. For this reason, you need to obtain a service manual prior to servicing any system on your engine. Following the procedures as outlined in the service manual is the only correct way to diagnose and repair any system. A service manual is also a safety related document. It advises the user of any special equipment required, along with procedures that reduce the possibility of damaging the engine or boat to ensure the safety of the person servicing the engine and those passengers who use the boat after any repairs are completed. Always read the service manual and make sure you understand the entire repair or adjustment process completely prior to attempting any repairs.

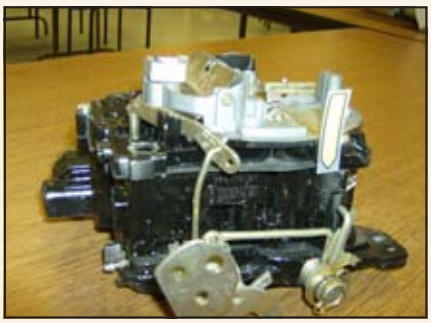
Always use marine grade, U.S. Coast Guard (USCG) accepted replacement parts. Never substitute marine parts with automotive parts as these are not ignition protected, may not comply with the USCG fuel system requirements for fire retardency nor be liquid and vapor tight and could cause a fire or explosion if a malfunction of the fuel system occurs.

Before heading to the store for replacement parts, record the part and/or model number of your carburetor. This information is stamped on the carburetor. Give this information, along with your engine model and serial number (in writing) to the parts person. Parts departments don't like returned open carburetor repair kits, filters or gaskets and may not be required to refund your money once the sealed package is opened. Having all your information together helps avoid ordering the incorrect kit or replacement part. Check the part information against your own list before you leave the store.

Gasoline is highly flammable when in its vaporized state. When compared by weight, gasoline has 10 times the explosive power of dynamite. If you're a novice DIYer, you may want to leave the major fuel system repairs to the pros until you are comfortable with your knowledge of the safety standards and practices related to working on these systems. Never perform fuel system tests or repairs without taking the proper precautions to ensure the area in which you are working is well ventilated and there are no sources of ignition, such as automotive battery chargers, heaters, lamps, pumps, etc. that are not ignition protected. Always disconnect or disable the battery(s) and shorepower before working on the fuel system.

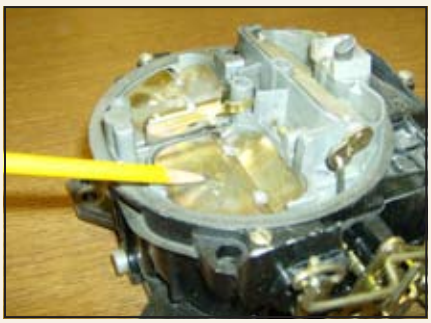
Carb Basics

The basic theory on which a carburetor operates is that atmospheric pressure, which is around 14 pounds per square inch (psi), is higher than the pressure in the intake manifold of your engine, which is around 7 psi when the engine is idling. By placing the carburetor in between the atmosphere's high pressure area and the intake manifold's low pressure area, air flows through the carburetor where the air is mixed with the correct amount of gasoline for proper combustion in the cylinders.



Part number location stamped on the body as identified by the arrow.

Choke plate closed on a modern two barrel carb.



Secondary air valve on a Rochester four-barrel carb opens the adjustable rpm.

Modern turn key start carburetor doesn't require a choke plate due to its fuel enrichener system (shown by yellow arrow). Red arrow points to the fuel filter on this two-barrel carb.

Jets that are drilled to a specific size and placed in front of tubes that are connected to the barrels control the amount of fuel mixed with the air. The process of fuel being drawn out of the carb works like a drinking straw. The high pressure in the carb fuel bowl is the same as atmosphere (14 psi) and the pressure in the carburetor barrel is the same low pressure as in the intake (7 psi). By changing the jet size, you are changing the amount of gasoline being supplied to the engine. A smaller jet decreases the amount of gasoline and a larger jet increases the amount of gasoline. The number of jets is dependant upon how many barrels a carb has. The component that pulls the fuel into the venturi or barrel is called the venture cluster.

The amount of air flowing through the carburetor is typically measured in cubic feet per minute (CFM). Carburetors are classified by either their CFM and the number of venturis or barrels or, in smaller engines, the carb is usually classified by its center bore diameter in millimeters. The displacement and application of the engine is the main factor that determines the size and style of carburetor that is utilized.

For instance, two-cycle outboards up to 1.5 liter displacement tend to use multiple one barrel carburetors that are adjusted individually to extract the greatest amount of performance out of a small displacement engine. Larger displacement outboards use multiple two-barrel carburetors.

Moving up in displacement to a 3.0 liter, four-cycle engine, the carburetor is usually a one or two barrel, 350 CFM. Because of its increased torque and horsepower, the carburetor does not need to be as finely tuned to achieve acceptable performance. For a 5.7 liter engine, a four-barrel (two primary barrels and two secondary barrels), 600 to 700 CFM carb was the normal set up until the late '90s where most new carbureted 5.7 engines use a two-barrel carb in order to meet tighter emission standards.

A current two-barrel carb engine is likely equipped with non-adjustable idle mixture screw, which has been adjusted by the manufacturer to meet emission regulations, and a turn key start system that eliminates pumping the throttle twice and holds the throttle open one-quarter to cold start older carbureted engines.

Larger displacement engines, such as the GM 8.2 liter big blocks, use even larger four-barrel carburetors from 600 CFM for standard production engines to as large as 1,050 CFM for high performance applications.

Idle mixture screws on a four-barrel carb.

Green arm is the adjustable accelerator pump on a two-barrel carburetor.

Marine-approved decal on body.

Electric choke on a two-barrel carburetor.

Carburetor

Before you remove and disassemble a carburetor, there are several basic checks to perform to ensure your performance problem is actually the carburetor.

1. If equipped with a choke, does the choke close completely before a cold engine start-up?
2. Does the choke open completely once the engine is up to operating temperature?
3. Is the idle mixture screw adjusted correctly? (Remember that some engines require the ignition to be "locked out" in order to adjust the carburetor.)
4. Does changing the idle mixture have an effect on engine idle speed? If not, you may have a vacuum leak.
5. Is the engine idle speed set correctly by rpm?
6. Is the venture cluster discharging fuel at 2,000 rpm (primary barrels only on a four-barrel carburetor).
7. With the engine off, is a good stream of gasoline being discharged through both discharge holes in the venture cluster when the throttle leaver is pumped?
8. Does the carburetor flood at idle speed?

If you answered "yes" to questions 1 to 7 and no to question number 8, it's possible the carburetor is not the problem.

Idle Adjustment

Before working on the carburetor, verify that there is no water in the fuel and that the fuel filters are in good condition. Modern fuel contains alcohol and additives that can increase the amount of water in the fuel. These additives act as solvents that clean fuel tanks and plug fuel filters and jets if the engine is not run for a period of as little as two weeks. This is why I advise you to add fuel stabilizer to your fuel each time you add gasoline to the fuel tanks.

Many modern carbureted engines built after 1990 have intelligent ignition systems that work with the carburetor to achieve maximum performance. These ignition systems need to be placed in base timing mode by a specialized procedure prior to adjusting the carburetor. Refer to your service manual to determine if you have this feature on your engine and read through the base timing process prior to any carburetor adjustments.

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If your engine stalls or runs poorly at idle the idle mixture may be incorrect. Follow the steps below to service the carb (remember to lock out your ignition system if required).

1 Disconnect the throttle cable from the carburetor.
2 Using a tachometer, set the idle speed to the specification in your service manual.
3 Adjust the idle mixture screw to the specification in your service manual.
4 Adjust your engine idle speed to the specification in your service manual.
5 Adjust your throttle cable and reconnect the throttle cable on to the carb, ensuring that the idle rpm does not increase once the cable has been reinstalled.

Poor Acceleration

If your engine bogs or backfires during acceleration, the accelerator pump may be the culprit.

With the engine off, pump the throttle and look down the carb. You should see two streams of gasoline being injected into the venturi. If there is little or no fuel, the accelerator pump needs replacing. Most modern carburetors have adjustable accelerator pumps. By changing the location of the linkage in the accelerator pump arm, you increase or reduce the amount of fuel discharged into the venture by approximately 0.5cc.

Four-barrel carburetors do not engage the secondary barrels until around 2,400 to 2,800 rpm. When the secondary barrels open too soon or too late, this affects the high speed performance of your engine. This opening of the secondary barrels is adjustable. Refer to your service manual for the correct procedure for your four-barrel carburetor.

Flooding at Idle

Flooding at idle can be caused by several conditions. Most of the time, the fuel inlet needle and seat are jammed with a small bit of debris. An ignition system that causes the engine to run rough at idle, incorrect float level or float drop settings or a fuel pump that is producing too high a fuel pressure are other causes.

Altitude and Performance

With an increase in altitude, the combustion air is a lower pressure than at sea level and the result is decreased engine performance.

If you do your boating in waters at elevations above 5,000' (1,524m), you should adjust the set up of the engine to increase overall performance. If you are vacationing for a short period of time, you can install a lower pitch prop only. If all your boating is done at high altitudes, you may want to reduce the jet size and advance your ignition timing by 2 degrees. Refer to your service manual for jetting and timing specifications by altitude.

After servicing your carbureted engine, your boat engine may achieve increased performance and better fuel economy. As always, a well-tuned engine decreases the exhaust emissions, making boating a more pleasurable and an environmentally responsible experience for all of us.

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.

ENERGY AUDIT

Performing a DC load calculation is the first step to upgrading your boat's DC electrical system or adding additional electronics. Here's how you do the math.

By John Payne

Regardless of your boat size, achieving a well-balanced and functional onboard electrical system requires that you assess how much power your boat consumes. Perform a DC electrical load audit to determine how much power is consumed under a variety of scenarios so that you can plan the size of the battery bank required to comfortably provide the needed DC energy source. Once the overall load is calculated, audits can also derive the alternator charging requirements. The overall load calculation also determines the size and electrical power rating the main switch panels require. An audit also helps to verify all the primary electrical wiring sizes and ratings along with related circuit protection (fuses or circuit breakers) ratings.

Load Types

Deep cycle, service or house power loads are those loads that draw electrical current over a long time period. Equipment in this category includes autopilots, cabin lights, electronic instruments, entertainment systems, inverters, radios, radar, refrigeration and trolling motors, among others.

The deep cycle battery is normally used to supply these load categories. Load calculation is based on the maximum power consumption over the expected longest period between battery recharging. This can be a day or more for cruising yachts to a few hours for powerboats.

Starting loads are those that require large current levels for relatively short time periods. Some of the electrical loads in this category include the anchor windlass, electric deck winches, electric thrusters, electric toilets, engine starter motor and preheat circuits or glow-plugs. The starting type battery is normally used for these applications. The battery rating should allow for worst case starting scenarios, such as very cold temperatures that can extend the length of time required to start the engine, also factoring in several start attempts. Very cold temperatures lower the battery efficiency and engine starting requires much

TABLE 1 CONVERTING WATTS TO AMPS

Watts (W)	Amps (A)
6 watts	0.5 amps
12 watts	1.0 amp
18 watts	1.5 amps
24 watts	2.0 amps
36 watts	3.0 amps
48 watts	4.0 amps
60 watts	5.0 amps
72 watts	6.0 amps

TABLE 2 DC LOAD CALCULATION TABLE

Equipment	Current (A)	Consumption Actual (A)	Consumption 12 hrs (Ah)	Consumption Other hrs
Radar- Transmit	(4.5A)			
Radar – Standby	(0.5A)			
VHF – Receive	(0.5A)			
SSB Radio Receive	(1.0A)			
HAM Radio Receive	(1.0A)			
Sat Com Standby	(1.0A)			
Autopilot (full load)	(5.0A)			
GPS	(0.5A)			
Navtex	(0.5A)			
Chart Plotter	(0.5A)			
Fishfinder	(1.5A)			
Instruments	(0.5A)			
Stereo/CD Player	(1.0A)			
Inverter Standby	(0.5A)			
Tricolor Nav Light	(1.0A)			
Anchor Light	(1.0A)			
Chart Table Light	(0.5A)			
Refrigeration	(4.0A)			
Cabin Lights	(4.0A)			
Compass Light	(0.25A)			
Computer	(2.5A)			
Television	(2.0A)			
Video/DVD	(1.5A)			
Trolling Motor	(15A)			
Livewell Bait Pump	(3.5A)			
Watermaker	(15A)			
DC Air Conditioning	(25A)			
TOTAL LOAD 1				

CONTENTS PREVIOUS NEXT

TABLE 3 INTERMITTENT DC LOAD CALCULATION

Equipment	Current (A)	Consumption Actual (A)	Consumption 12 hrs (Ah)	Consumption Other hrs
Bilge Pump	(3.5A)			
Water Pump	(3.5A)			
Shower Pump	(2.5A)			
Washdown Pump	(3.5A)			
Electrical Toilet	(15A)			
MSD Unit	(25A)			
Cabin Fans	(1.0A)			
VHF Transmit	(4.0A)			
Spot Light	(3.0A)			
Spreader Light	(1.0A)			
Courtesy Lights	(1.0A)			
SSB Transmit	(5.0A)			
Satcom Transmit	(6.0A)			
HAM transmit	(5.0A)			
Cabin Light 1	(1.0A)			
Cabin Light 2	(1.0A)			
Cabin Light 3	(1.0A)			
Cabin Light 4	(1.0A)			
Cabin Light 5	(1.0A)			
Deck Winch	(30A)			
Inverter Load	(40A)			
Anchor Windlass	(80A)			
TOTAL LOAD 2				
TOTAL LOAD 1				
TOTAL LOAD				

greater power due to the increased oil viscosity.

In many cases, these loads may be connected to the start battery and can be eliminated from the house battery power calculations. This is good practice as it removes equipment that causes large voltage surges on the house system that can damage equipment. If you decide to transfer these items to the engine start battery, you should consider a small calculation on your start battery to avoid too many loads that drain down your start battery and possibly affect the battery charge levels. In this case, you may have to consider a larger start battery.

Finding Equipment Ratings

The ratings of each item of electrical or electronic equipment can usually be located on the equipment nameplate or in equipment manuals. This small identification tag is usually located on the back of the equipment case and includes the voltage and the rating in either current in amps (A) or power in watts (W), along with serial and model numbers. Where watts are used for calculation purposes, it's recommended that you convert this rating to current in amps. To do this, simply divide the power rating in watts by the operating voltage, 12 or 24 volts. **Table 1** gives the basic conversions.

Time Period

For most sail or powerboats, the best measure is calculating the electrical power consumption for a 12-hour period while in port or anchored. The calculation should assume that the engine is not operated and that no generator or shorepower connection is energizing the onboard battery charger. When it comes to smaller boats, such as trailerable fishing boats and powerboats or small sailboats that often have an outboard engine, the time period may be calculated in one to four hours. However, in the case of many fishing boats, the actual recharge time is quite small as a boat moves to a new location and the smaller alternator outputs of an outboard engine do not have the capability to provide large charging inputs to the battery.

Load Calculation Table

A load calculation table lists and carries out the electrical calculations. To calculate the total boat electrical system loading, multiply the total current values by the number of operating hours to get the amp-hour requirements. If equipment uses a current of 1 amp over 24-hour period, then it consumes 24 amp-hours (Ah). **Table 2** shows many typical power consumptions. There is space for insertion and calculation of your own boat electrical data.

List all equipment on the boat along with the power consumption ratings in this table. Insert your own equipment current values into the current column where typical values are shown in brackets. Calculate the power used over 12 hours. To convert power in watts to the current in amps, divide the power value by the system voltage. Add up all the current figures relevant to your boat and multiply by hours (12) to determine the average amp-hour consumption rate. Consider equipment that is operational when sailing, anchored or moored. Equipment used when motoring or when shorepower is connected is not relevant as much of that load is restored to the battery by the engine charging system (alternator output). For example, using the electric windlass to retrieve an anchor is usually done with the boat's engine running. The engine alternator is putting the energy consumed by the windlass back into the battery(s). Depending on the elapsed time between charging periods, select the column that best matches your boat activity.

The most typical scenario exists when the boat is moored or anchored

and the cabin lights, entertainment systems, some radio or navigation equipment and an electric refrigerator are being used during that time. For those with good computer spreadsheet skills, this exercise is easily done and, if suitable macros are written, the sheet automatically calculates the values.

Calculating Intermittent Loads

Some loads cycle on and off periodically, such as bilge pumps or water pumps on a pressurized water system, and these use battery power for relatively short time periods. It's difficult to quantify actual real electrical current demands with intermittent loads. I use a baseline of 6 minutes per hour, which is .1 of an hour, as it makes calculations simpler. Enter these loads into **Table 3**.

Bottom Line

Now that you know your boat's total load calculations, you can determine whether you have enough battery capacity to meet the anticipated demand. If the battery capacity is not at least double the calculated value, then it's possible to discharge the battery more than 50%, which reduces battery life. If the battery load is greater than the nominal battery discharge rating (usually quoted at the 20 hour rate), the actual capacity will be less than that quoted. In both cases, you may have to consider adding greater battery capacity.

Also, use the calculated numbers to determine the alternator rating required to replenish the discharged current within a specific time period. While this also needs to factor in the battery bank size, it allows you to make additional calculations and decisions on both alternator output ratings and whether to use a fast charge alternator regulator.

About the author: John Payne, DIY's electrical consultant, is author of "The Marine Electrical and Electronics Bible," now in it's third edition, and "Motorboat Electrical and Electronics Manual" (Sheridan House).

JUST RELEASED

Making the Electronics Connection

Whether you are equipping a new boat or just want to upgrade here's how to select, install, operate and troubleshoot marine electronics.

Articles written by marine professionals and previously published in DIY BOAT OWNER Magazine provide the information you need to consider when purchasing, installing, operating and troubleshooting marine electronics for most any layout or equipment and budget in a step-by-step approach with clearly detailed photos and illustrations. (US$19.95)

Easy-does-it Dinghy Storage

Weaver davits deliver a simple and affordable system for storing the dinghy on a swim platform and an adept boat owner should be able to accomplish their installation easily.

Story and photos by Garrett Lambert

Can you color between the lines and drill 1/4" (6mm) holes? If so, you can install any and all of the components that make up the extensive Weaver Davit system.

I had installed Weaver Davits for a Livingston hard dinghy on my previous aft cabin boat and liked them: simple and quick to launch and retrieve, with safe and stable boarding. I bought a very different boat a year ago with a Zodiac stowed on the upper deck, where it's secure and out of the way. There have been many times when it would have been fun to drop it into the water for a spin but the 20-minute sessions getting it in and out of the water definitely depressed my enthusiasm for short pleasures. Since it's much less time in either direction with Weavers, having both options on the boat would give me the best of both worlds.

I contacted Weaver industries and included a photo of my boat for reference. Weaver offered to supply the system on condition that the installation be done in Anacortes, Washington, so that Mike Engstrom, Weaver's west coast installer, could assist to ensure the job was done right. Someone else to do the work? I swallowed my DIY pride without difficulty.

It's unusual to go into a marina without seeing Weaver systems on boats. In fact, when I was tying up in Cap Sante Marina after the five-hour trip from Vancouver Island, I noticed the boat across the fairway from me had an Avon RIB and 15-hp Yamaha on almost the same Weaver setup I was about to install. When the owner launched the Avon the next morning, I had a chance to chat with him. He said he'd done the installation himself, had been using it for years, and hasn't seen anything that would compare for ease of use and cost.

Fixing Dinghy Components

The installation usually begins with the aft davit pad because it's always opposite the dinghy's stern. However, we'd be installing a Weaver Transom Arc to support the engine weight, so Mike started with the forward davit pad and traced its outline on the lower tube and then did the same thing for the winch eye-pad on the upper tube (**Figure 1**).

DIY BILL OF MATERIALS

Here's what went into my boat because of the dinghy weight with list pricing from Weaver's website at weaverindustries.com or actual. It looks like a big number until the pricing for alternative dinghy stowage systems is fully known and then, it looks like a bargain.

Davit kit for inflatable dinghies	$358.85
Transom Arc	$169.44
Weaver Leaver	$580.37
Leaver Rod (stanchion)	$113.00
Leaver swim-step pad eye	$33.20
Push pin	$39.84
36" (914mm) stand-offs	$93.26
Adhesive kit	$27.36
Weaver winch	$241.76
2 Inspection ports	$30.00
Extra fasteners	$10.00
Total	**$1,697.08**

CONTENTS PREVIOUS NEXT

Figure 1

Figure 2

Figure 3

Figure 4

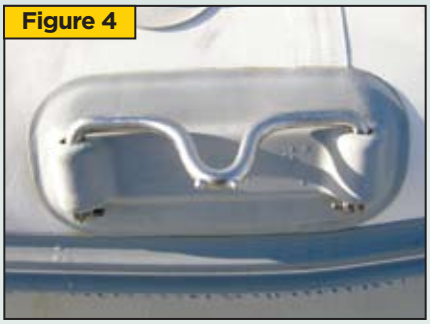


Figure 5

Figure 6

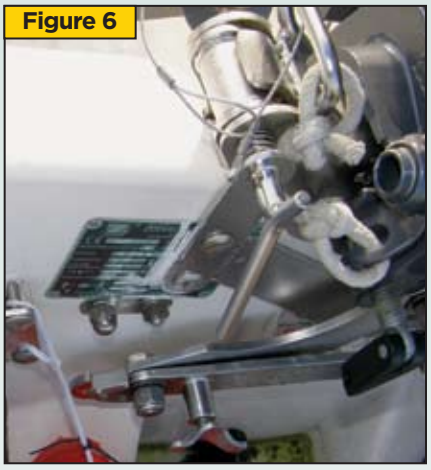


Figure 7

Figure 8

The marked areas were then cleaned with solvent to prepare them for the welds (the materials are actually melted together). Inflatable tubes are made of either Hypalon or PVC. For Hypalon, the preferred cleaning agent is Toluol. If it's PVC, use methyl ethyl ketone (MEK). Weaver packages and sells the special two-part glues and solvents in kits (**Figure 2**). Most marine stores sell the glues, too, and the solvents are available from Ace Hardware for about US$8 per quart (946ml).

While it's better to use the solvent and adhesive specific to each material, acetone and PVC adhesive will work on both. Chemicals can be hazardous, so be sure to read and follow the directions on the labels. Wear a respirator and protect eyes and skin from contact when using.

It's important to do the adhesive work on a dry day, because moisture in the air could compromise the welding process. Mike mixed the two-part glue and applied a light coat to both the pads and the tubes and let them dry for 30 minutes (**Figure 3**). Tip: To apply the cement evenly and cleanly, cut all but 3/4" (19mm) of the bristles off the applicator brush with a sharp chisel and keep the brush in solvent when not using it.

Half an hour later, he applied a second coat, waited about 5 minutes until the glue was dry to the touch (not at all tacky) and put on a third thin coat. He then pressed the pads firmly onto the tubes (**Figure 4**). The forward davit pad is on a seam, a practice Mike prefers to avoid but will tolerate when other factors make it the best compromise.

Leaving the welds to cure overnight (they reach maximum strength in about six days), Mike installed the Weaver Leaver on the dinghy's transom. The first step was to remove the small aluminum clamping plate (three screws). However, two small obstacles prevented the Leaver from dropping all the way down. One of the U-bolts for the stern straps that tie the dinghy to the deck cradle was in the way, so it was moved sideways. Another five minutes to cut away two small, triangular pieces of the transom's aft ledge, and the Leaver was now in the proper position (**Figure 5**). The transom is 11° off vertical. Nonetheless, standing behind it and using the Leaver as a template, Mike unerringly eyeballed and drilled four holes through the transom from the front to exit through the holes on the back side of the Leaver.

To compensate for variations in transom thicknesses, Weaver includes several machined plastic spacers in the Leaver kit (**Figure 6**). They match the Leaver's brackets, and prevent any possibility of it being warped when the bolts and nuts are cranked tight. To forestall any water ingress and the development of rot, ample quantities of 3M 5200 adhesive sealant were squeezed into every one of the holes we drilled during this installation.

The Leaver, as delivered, opened the wrong way for my needs. Since I prefer to tie to port, the side where my transom door is located, the dinghy's engine should be to starboard. Simply moving the pivot bolt from the starboard to the port side fixed that issue (**Figure 7**).

The Yamaha 15 hp, two-stroke weighs 80lb (36kg). To support that weight, Mike installed a Transom Arc

Figure 9

Figure 10

Figure 11

adjacent to the Leaver (**Figure 8**). This eliminates the pad eye on the dinghy transom. The Leaver covers the information plate but I had already ordered a new plate.

Only the Arc's receiver is fixed in place with bolts through four holes that were drilled, using the plate as a template. The Arc itself is removed and stowed by simply pulling the big pin. A rubber puck cut to an 11° wedge is included in the Arc kit and is inserted between the plate and the transom to bring the Arc to the vertical position. **Figure 9** shows the Arc inserted into the receiver. The extra backbone rod ensures it cannot be bent.

Other than a couple of stand-off pads to be glued on later, that completed the work on the dinghy, so we winched it down to the stern of the boat, leaving the engine behind.

Attachment Points

Mike first hooked a pair of snap brackets onto the dinghy's eye pads to ensure they didn't get dropped overboard. With the dinghy parallel to the boat's stern, he traced the outline of the bracket bases on the swim platform. We had a problem. My boat's swim platform is an extension of the hull, and each corner contains an auxiliary tank, one for diesel and the other for fresh water. One of the brackets had to go over the water tank.

Weaver had sent a pair of extended bracket heads normally used for a curved platform or to clear a ladder and all we had to do was drill a couple of new holes in each one. Tip: To drill stainless steel, use a cobalt bit, not titanium plated one, available from any hardware store and keep it cool with a lubricant. Use restrained pressure and let the tool do the work. We also needed longer bolts because the overhang is quite thick. A quick walk to the hardware store, and the brackets were bolted in position (**Figure 10**), with lots of 3M 5200 in the holes, of course.

To tip up the dinghy when it's attached to the brackets, the puller has to be as far above it as possible and able to generate a lot of energy at the start. The ratcheting Weaver winch does that. Attaching the quick release shoe, which is included in the winch kit, to the underside of the cockpit overhang was a simple matter of drilling another four holes plus one for the quick-release pin, injecting 3M 5200, and bolting it on (**Figure 11**). The shoe allows the little winch to be removed and stowed when not required.

About 7 hours of pleasant (for me, anyway) work and chatter had passed quickly and since the pads needed to continue to cure before we could actually put the winch to use, we tied the dinghy alongside and called it a day.

TIP

CLEANING PVC

When the Weaver rep prepped the tubes with MEK, the result was a shock. I had just scrubbed the dinghy for the photos with an expensive cleaning agent specifically for PVC, but the MEK brought out a white that made my result look gray. I asked him if I could use it on the rest of the PVC. He advised strongly against it because MEK dissolves and removes some of the plasticizers that keep the PVC flexible. Using MEK, especially on dinghies left uncovered, would shorten the tubes' life span. Instead, he suggested Soft Scrub, available in supermarkets. — GL

Figure 12

Figure 13

Figure 14

Figure 15

Set Up

Mike returned on Sunday morning to finish the few remaining tasks. We hooked the dinghy to the brackets and winched it up (**Figure 12**) to the inverted position, still without the engine because the welds were not yet fully cured. The first part of the pull is at a very acute angle and poses a real test of the bond between the pad and the dinghy (**Figure 13**).

With the dinghy up, Mike opened the Leaver and used a slip pin (with a safety wire) to attach the stanchion that supports the engine. To adjust it for length, he loosened the upper and lower clamps, shifted the two parallel rods until the open Leaver was horizontal and then secured them (**Figure 14, shown with the engine mounted**). That's a one-time task.

With the stanchion hanging as a plumb bob, we drew the outline of its small floor plate and then used it as a template to start the now familiar routine of drilling and caulking. This time, however, we used heavy 1" (25mm) screws as fasteners because these holes were directly over the water tank. The plate is always in compression, so bolts are unnecessary. Mike gave me the "honor" of drilling these holes and driving the screws home. I used a piece of tape on the bit to mark what I sincerely hoped would be a safe depth and went for it. No spurts.

Meanwhile, Mike used the adjustable stand-offs to mark their brackets' positions on the dinghy and on the boat's transom. Another problem. The transom is about 8" (203mm) thick without any access from the cockpit side. Mike knew what to do and a marine store supplied a couple of 6" (152mm) inspection ports/deck plates. A 4-1/2" (114mm) hole saw cut the openings and these were mounted on the transom (**Figure 15**). Now we could reach in and put washers and nuts on the bolts.

Adjustment Anomaly

Except to finish the stand-offs, the work was completed. I winched the dinghy back up to the boat deck and onto its platform for the return trip.

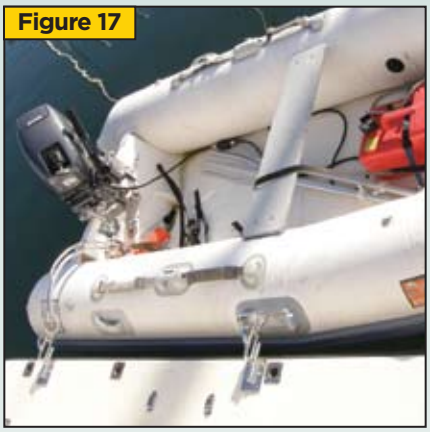
Before setting off, I mounted the outboard. The Leaver is heavily built and getting the engine on it was a bit unnerving. Even with the transom clamps screwed all the way out, I had to whack the Leaver plate a few times in order to persuade the engine to drop down into position. When I later asked about the squeeze fit, Weaver replied, "Yamaha is a unique engine, deeper seated than others, and their

Figure 16

clamps do not open quite as far. We usually have a worksheet filled out on the Leaver so we know what engine we are dealing with. We did not realize you had a Yamaha and sent you a regular Leaver. For Yamahas we weld a 1" (25mm) tab where the motor clamps are located so the deeper-seated clamps have something to clamp to. If yours is giving you a problem, you can take just the top part off, send it back and we can weld some tabs onto it for you."

Weaver notes that it's important to bolt the motor to the Leaver (**Figure 16**). Otherwise, vibration might wiggle it off the bracket. The plate has several square holes for carriage bolts and I found a pair that lined up with the holes in the engine's mount. One bolt secures it but, since two sets of holes lined up, I used both.

Figure 17



Launch and Lift

My boat was now "Weaverized" and, after waiting a week for the glued welds to cure fully, I finally had an opportunity to try the system with the engine mounted. It works well but requires some muscle because of the angles and the weight. However, the lift would be a lot easier if my boat had permitted a higher attachment point for the winch. I'm going to make a simple gin pole to improve the geometry and that should significantly reduce the effort involved. As always, it's a trade-off. Custom-made motorized systems are available but cost about five times the price of Weavers.

To use, bring the dinghy parallel to the stern, line up the brackets, and let them snap and lock (**Figure 17**). The dinghy is now not only secured, it's also stabilized. After the passengers disembark, tilt the engine all the way up. Install the winch and the Arc (if it was removed). Snap the winch line onto its eye pad and haul up. Rated for 400lb (181kg) on a 1:1 ratio, the Weaver winch does

Figure 18

a good job but impatient people like me will find it slow going and might prefer a small block and tackle. When the dinghy is upright snap on the stand-offs, open the Weaver Leaver and attach it to its stanchion with the drop-nose pin (**Figure 18**). Check that the dinghy doesn't obscure the stern navigation light. Sometimes it's necessary to relocate this light after installing davits.

The Leaver's advantage over other devices is a combination of four factors: 1) it stands the engine upright without having to remove it; 2) it retains the engine in its original position on the transom, avoiding a most undesirable weight shift to the rear; 3) it's simple; and 4) it's cost effective. On the downside, it adds some weight in the stern and pivoting the Leaver/motor combo involves some lifting effort. My fiberglass Livingston and 6 hp engine on my previous boat were much easier to manage than my now far heavier Zodiac and 15 hp engine.

Implementation

This installation required about 15 hours. (The Livingston installation followed the same routine but was done in a single day because no gluing of pads and, in particular, no curing time was involved.) Although a modicum of care is required, most of what has to be done is intuitive but, as with all projects, there is lots of potential for error and you'll be much happier with the result if you read, understand and follow instructions for each step before gluing or drilling.

Mike did almost all the work but I could have done it without difficulty, especially since I had easily managed

King Plastic

Custom Build Deck Davits

These unique deck brackets support a 14' (4.2m) Boston Whaler. Constructed of 3/4" black King StarBoard it's assembled with stainless-steel screws and Lord Corp. adhesive #7540-AB. Davits were then bolted through the deck using 3/4" King StarBoard as backing plates that were flame treated before sealing with the same Lord adhesive.

CONTENTS PREVIOUS NEXT

the earlier installation with its own share of challenges. The only tool we used that the average boat owner might not have is a 4-1/2" (114mm) hole saw and very few installations would require it. Had it been necessary, I can think of several ways to make those holes without the saw. None of the tasks are onerous, especially if you have solvent and a lot of rags handy. We were careful and didn't lose any parts or tools overboard but that's an omni-present danger. Use inexpensive tools and do this project near a hardware store during normal business hours. You will almost certainly need something.

Weaver's products are very high quality, perform well and offer good value for money. With a lightweight outboard, a basic package plus stand-offs with no Leaver, no Arc and no winch, would do the job for under US$400 for a hard dinghy, US$500 for an inflatable.

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

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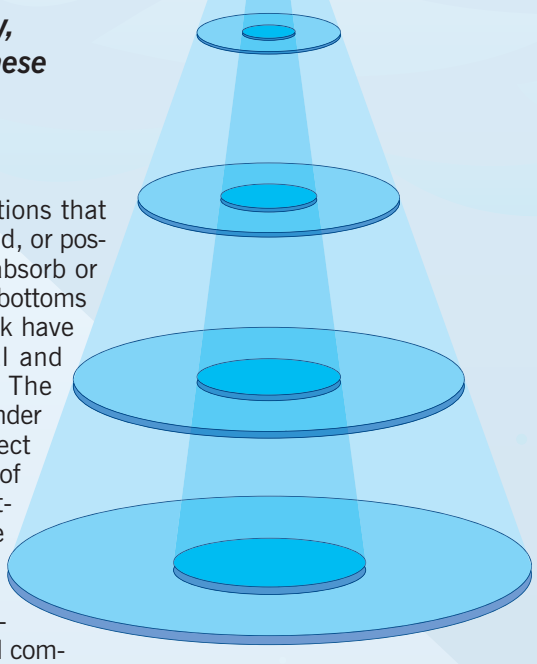
Troubleshooting Sounders

When your depth sounder or fish finder isn't up to its duty, you are well equipped to make a diagnosis if you follow these straightforward procedures.

By John Payne

The depthsounder or echo sounder, as it was once more commonly known, is one of those "don't want to do without" items of marine electronics. Modern electronics have significantly improved the performance and reliability of sounders (and fish finders) but sometimes they do fail and before troubleshooting you need to understand some basic principles.

The majority of depth sounders operate at a frequency of 200 kHz. The lower transmission frequencies, such as 50 kHz, give much greater depth capability. It's important to understand that acoustic signals are affected by propagation delays and attenuation as the seawater and various bottom formations cause signal absorption, scattering, refraction and also reflection. In addition, biological material that includes algae and plankton and suspended particulates such as silt, dissolved minerals and salts also contribute to this. The actual water density and salinity levels, as well as water temperature, all affect signal propagation. Bottom formations that are made up of sand and mud, or possibly large beds of weeds, absorb or scatter signal, while harder bottoms such as shale, sand and rock have a tendency to reflect signal and give strong return echoes. The power output of a depth sounder unit is important with respect to the range and resolution of the unit. The higher the output power, the greater will be the depth range and signal return.



Lowrance/Joe VanVeenan

Depth transducers are normally constructed of a crystal composed of various elements that include lead, zirconate, barium, titanate and conductive coatings. It's the crystal or a piezoelectric element that converts an electrical signal to an acoustic signal.

No matter what failure mode you are experiencing, before troubleshooting your depth sounder, read the manufacturer's operating manual. Verify that the various settings are correct, as straying fingers are the main cause of sounder problems. Depending on the sounder or fish finder, go into the settings or options menu and ensure that settings are selected on an auto setting or default to the factory settings.

Problem: Malfunctioning Display

If the display has faded or is flashing or just blacks out, follow the steps below to check the wiring, check for electrical interference and cavitation or restore the unit to the factory default settings. If the display is foggy and shows signs of condensation, the unit requires servicing.

1 Electrical system checks.

Verify that the battery supply voltage is normal, around 12 volts. If too low, the battery charge level may be low and, if too high when the engine is running, it might indicate an alternator regulator problem.

It's common to see displays black out if the sounder is connected to an engine start battery. Start the engine and there may be a voltage surge or a dip. Connection problems are a major cause of voltage drops and this can be at the distribution panel or at the battery. Use a multimeter to check the voltage level at the depth sounder plug with the engine both on and off. If the voltage level at the battery is much higher than at the sounder, then there's likely a connection problem.

Check that all power supply connections are properly coupled. Verify that the electrical plug connections on the back of the unit are tight and that the pins are straight and also there is no evidence of corrosion.

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Check both the fuse and fuse holder and verify that the fuse is still intact and that the fuse holder shows no signs of water or corrosion. The end caps are a favorite failure area. If the unit is supplied from a circuit breaker, check the terminations at the breaker and also operate the breaker several times.

2 Interference tests. Checking your system for electrical interference initially means turning off all other electrical equipment. In many cases, interference is caused by the engine, in particular outboard engine ignition systems and charging systems. Power down all other systems and then progressively start up the engine and then, one at a time, turn on the other equipment to determine the interference source. If interference still remains when all other systems are off, the depth sounder or fish finder may have a malfunctioning automatic noise rejection function. In some cases, when you have done everything to eliminate interference sources, you need to run the power supply through a noise suppression unit.

Always ensure that cables are installed well clear of heavy current carrying cables to engines or anchor windlasses, refrigerators, etc. or radio aerial cables. Never install sounder cables next to speed log cables, as the interference problem can be significant. Interference may also be due to cavitation (see point 3 below).

3 Cavitation checks. Cavitation is caused by water turbulence passing over a sounder transducer head and can significantly affect transducer performance. At slow speeds, the laminar water flow is relatively smooth without any interference. When the boat starts to travel at speed, air bubbles are created over the face of the transducer and these affect both acoustic signal transmission and reception. This causes interference with the transmitted acoustic signals, which reflect back off the air bubbles, and this causes noise and masks the acoustic signals. Underwater turbulence is caused either by the boat's hull form or from underwater obstructions, as well as the actual water flow over the transducer, and turbulence resulting from propulsion.

Transom-mounted transducer units must be properly sited and mounted to avoid turbulence from either outboard motors or the water flow coming off the transom. The greater the boat speed, the greater the possible turbulence. Riveted alloy boat hulls can create turbulence off each of the rivet heads.

Various equipment manufacturers have designed transducers with improved hydrodynamic shapes that do work better at higher speeds. Transducer installation is crucial and it must be installed in areas of minimal turbulence or well clear of the main hull flow areas. If a depth transducer is obstructed, angled or placed in the wrong location, performance is severely affected. When not located properly, there is a good chance that random interference will be visible on the display.

4 Factory reset. If your sounder has a hard factory reset capability, do this to restore the sounder to all factory default settings. If all of these actions fail, you may need to have your depth

sounder or fish finder checked by an authorized repairer.

Problem: Power, No Display

If the depth sounder powers up but there's no display, there are four elements to check.

1 Perform the basic electrical system checks above.
2 Inspect the connectors and pins of the display unit and the transducer, checking for corrosion. Check that both the connectors and connector pins are not damaged and that they are straight. Use caution when straightening a bent pin as they are relatively brittle and there is a risk of breaking them and all you're left with is a pin stump. Connectors are often not inserted properly or the connector is not tightened and this leads to saltwater ingress and subsequent corrosion.
3 Perform a check of fuses and circuit breaker connections.
4 Disconnect the plug to the depth transducer and verify that the sounder unit powers up. You need the manufacturer's assistance if it doesn't.

Problem: Display Freezes

If the sounder display freezes, check the following.

1 Perform the basic electrical system checks above.
2 Disconnect the plug to the depth transducer and verify that the sounder unit powers up.
3 Check that two sounders or fish finders are not operating at the same time. Two boats within close proximity, both using sounders, can cause mutual interference if using similar acoustic frequencies.
4 Perform the basic interference check above.
5 Check all cables for damage, cuts or fatigue. The transom mounted depth transducer cables are very prone to damage and on some smaller boats, the transducer hull cables may be damaged in normal trailering activities.

If the display is still dark, you will need manufacturer's assistance.

Problem: No Bottom Readings

If the sounder operates but has no bottom readings, perform the following tests.

1 If a new installation, verify that the transducer positioning is correct.
2 Perform the basic electrical system checks noted under the heading "Malfunctioning Display."
3 Inspect the transducer for marine growth, damage or any other obstructions that are on or around the transducer face. Inspect the transducer for signs of physical damage or paint coating. Clean off the transducer face surfaces using warm soapy water. Never use heavy abrasives or any sharp objects or scrapers to clean the transducer face. Never strike a transducer or apply any impact to the surface as this may cause crystal damage. Don't apply antifouling paint to the transducer surface. Small voids and air bubbles in the paint reduces sounder sensitivity. If you think you must protect the transducer from marine growth, smear a very thin layer of paint on the surface with your finger.
4 Inspect the connectors and pins of the display unit and the transducer, checking for corrosion.
5 Verify that your sounder is not trying to read a depth beyond its nominal depth range. Check the sounder upper and lower limit settings, as it's quite common to have the display set to indicate a region where there is no sea bottom.

Also check that the sensitivity settings are properly set. Consult your operator's manual for the unit's sensitivity specs and check that the settings on your unit are correct. The sensitivity control tunes the receiver to tune in or tune out returns. If the unit is set with low sensitivity, it will not detect bottom details. If high sensitivity settings are used, it returns signals on everything and clutters the screen with spurious returns. Most sounders and fish finders have automatic sensitivity adjustment, which compensates for ambient water conditions and depth.
6 Verify that the transducer is not being affected by excessive propeller cavitation. Also, nicked or bent props on high-speed boats can aggravate this condition.
7 Where the boat has a transducer switch, unplug each of the transducers and plug into the sounder. Switches may cause problems.
8 If your sounder has a hard factory reset capability, do this to restore the sounder to all the factory default settings.

If all of these actions fail, you're outside the DIY zone and you need the help of an authorized repairer.

Problem: Incorrect Depth Readings

If your sounder is indicating the incorrect depth readings, do the following.

1 If a new installation, verify that the transducer positioning is correct.
2 Perform a basic transducer inspection. Inspect the transducer for marine growth and damage.
3 Verify that there are not two sounders operating close together.
4 Inspect the transducer connectors and pins for signs of corrosion.
5 Perform a basic cavitation check. Verify there are no excessive propeller cavitation problems.
6 Verify that the upper and lower depth limit settings are properly set.
7 Inspect the transducer cables for damage.
8 Perform a hard factory reset if available.

Problem: Erratic Depth or Bottom Readings

For a sounder or fish finder indicating erratic depth or bottom readings, perform the following tests and refer to previous troubleshooting tips for expanded details.

1 If a new installation, verify that the transducer positioning is correct.
2 Verify that there not two sounders operating close together. Check that you are not still selected in this mode.
4 Perform a basic interference check.
5 Inspect the transducer connectors and pins for signs of corrosion.
6 Perform a hard factory reset, if available.

About the author: John Payne, DIY's electrical consultant, is author of "The Marine Electrical and Electronics Bible," now in it's third edition, and "Motorboat Electrical and Electronics Manual" (Sheridan House).

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OLD BOAT Syndrome

Though each generation of boat design and construction has its Achilles' heels, they all share common ailments and foreseeable problems. If you own or are thinking of buying a pre-owned boat, it's time to take a closer look for symptoms of old boat syndrome.

Story and photos by Patricia Kearns

According to recreational marine industry market reports, the sales of used (pre-owned) fiberglass boats has been exceeding new boat sales for many years. This presents buyers with an opportunity to buy a late-model used boat that is tried and true and more affordable than a new boat. No doubt, we'll soon see pre-owned boat certification and extended warranties offered in a manner similar to what car dealers have been doing for more than a decade.

While there is no nice, neat Consumer Reports reference equivalent for boats, there are track records of boats and their problems lurking in marine surveyors' files and in other databases, such as that maintained by the BoatU.S. Consumer Affairs department and by the U.S. Coast Guard division of Boating Safety. Both of these resources are easily accessed at boatus.com. Once you know the boat brand and its age, it's possible to identify a predictable set of conditions related to a particular breed of boat.

In my survey practice, defining an older boat is not always related to chronological age. A boat's real age is more about exposures, service life and the level of maintenance it has enjoyed or lacked.

A chronologically 10-year-old boat can be suffering the same aliments or worse than its 20-year-old counterpart but, for our purposes here, let's work with boats that were built before 1995. This is not an arbitrary time but rather one that represents fiberglass production boatbuilding technology of that generation and takes into consideration the accumulated maintenance issues of boats of that age or older.

The important issues are in a boat's genes and its medical history. With some of the clues offered here, you can identify which things are the colds and sniffles and which ones are the debilitating conditions that diminish a boat's ability to continue to provide safe conduct to captain and crew. So get out your brightest flashlight, strap on your kneepads and have a digital camera handy to record what you see.

Metal Decay

Corrosion is by far the most prevalent deterioration seen in mature boats. It's an insidious disease that impacts the structure and function of virtually every onboard system. Seawater is the vehicle that carries the corroding offender and wherever it goes, so goes the damage potential.

Seeing if your boat or the one you are thinking of buying is suffering from corrosion issues requires that you insert yourself into places no homo sapien was ever intended to go (after the boat was built). You'll need to find every metal thru-hull fitting and its valve, locate and get your eyes and hands on seawater strainers, shaft and rudder stuffing boxes (packing gland), metal rudders, props, bonding wire connections, strut bolts, chainplate attachments, any pump or other metal fitting though which seawater passes.

The shaft rotation has been slinging water and spray has rusted stuffing box hose clamps and coupling. Even the cleverly devised shield cannot deny an excessive leak at the shaft stuffing box. The leak will soon become uncontrollable and possibly sink the boat. BoatU.S. Insurance does cover a sinking related to conditions like this.

Localized corrosion of swim platform supports and fasteners is an example of the boat builder's choice of stainless steel that is not suited to this application, which exposes the metals to constant immersion in seawater.

Shaft strut mounting bolts in a trawler yacht built in Taiwan. The bolts are wasting away inside the nuts. Later, the bolts were removed and found to have dissolved to half their original diameter. Zincs were totally wasted and the bolts were sacrificed to the cause.

In a boat with a bonding system, the sight of powdery green or white residues, wet or dry, on metals or fittings that are in common contact with seawater, indicate corrosion. Before taking any action, you must

"Out of sight, out of mind." One of a pair of rudder bearing/stuffing boxes on a 41' (12.5m) motoryacht. Notice adjusting bolt at left is bent from persistent attempts to control leakage. Water was flowing from these fittings and the owner could not find the source. Visual access was difficult enough. Physical access for service requires orangutanian flexibility.

Corrosion makes for a high-resistance connection that can cause overheating and start a fire.

Cracks in outer ply of hose compound are external symptoms that the hose is degrading. The real story is unfolding within the inner plies. When will it fail? Replace now. Ask the question later.

investigate the source of the problem, which means testing for stray current. [Ed: An article on such testing procedures appeared in DIY 2003-#1 issue and is available on the 1995-2006 Hands-On Boater CD-ROM.]

Of course, there are other types of corrosion, e.g., galvanic and pitting and other forms of localized corrosion, including cavitation erosion. Testing

Easily identifiable problem hose that is suffering from extreme bend radius sickness. In many cases, this kind of hose damage is not visible since the inside radius is not readily visible. You'll need a lighted mirror for the inch-by-inch inspection of the underside of hoses and clamps.

finds the culprit with relative ease and this testing is within the DIYer capabilities; although, for a one-time test, the cost of acquiring the right equipment can be nearly as much as having the testing done by an expert. Once that is done, all the affected fittings must be cleaned of corrosion residues, carefully inspected for damage and serviced or replaced as needed.

Metal fuel tank corrosion is almost always the result of installation problems, primarily originating in areas of the tank panels that are bearing on a water-absorbent material. Tanks mounted on wood support braces or cradles are the first to get weepy prematurely. Discovery almost always requires destructive activity.

Wherever water, even the smallest molecules of it, is trapped between a metal tank and a porous material, corrosion is inevitable. This is known as poultice corrosion and is seen in the form of tiny pinholes in the metal. By the time liquid fuel is visible, the damage has already progressed to a highly dangerous hazard level. Even in the absence of liquid fuel, gasoline vapors are deadly in the presence of an ignition source.

Older powerboats with metal fuel tanks encased in foam are also highly suspect. Inspection and discovery of tank condition are complicated by the industry-wide proclivity of locating tanks in boat cavities that render the tanks inaccessible without dismantling or destroying boat structure to gain access. A replacement tank itself is cheap relative to the time and effort required to get to it, which, sooner or later, is an inevitable necessity.

In older trawler yachts of Asian origins, where saddle tanks are installed outboard of the engines, the tops of the steel tanks (a.k.a., "black iron," a misleading nom de steel) are often wet from water leaking though the sidedecks. That water stands on the top of the tank and/or runs over and down the tank surfaces, which are often not visible behind a perforated insulation material. The clearance from the top of the tank to the underside of the deck is often only a few inches and none of that space is visible without considerable determination (some even destructive) to gain access.

Water: The Silent Killer

Unless it's over your bunk, a leak often goes unnoticed or is ignored. Water that goes in and out is not much of a problem, except for inconvenience and discomfort. Water that goes in and stays in is analogous to a cancer.

As a boat ages, its connected parts start to detach as the glues, sealants, bolts and nuts, screws and other connecting materials start to react to the normal stresses of service life. Water is the great separator of laminated materials and it corrodes metal fasteners and parts. It breaks down sealants and other chemicals and it rots wood. Once in and unable to escape, it's inevitable that what once had been joined together will eventually come asunder.

Leaks are often the first clues to this process and, to complicate the cause and effect, anywhere that something is attached to the boat or its parts is also a place for water to enter when that attachment begins to detach itself. It's the classic vicious circle.

Other leaks, like those at shaft entry points, stuffing boxes (shaft and rudder) or hose connections to thru-hull fittings can be fatal to a boat if not discovered and eliminated. These may develop gradually, seeming to be only nuisance leaks, or they develop spontaneously and cause catastrophic damage. Don't count on your insurance company to pay for flooding damage caused by a leak that resulted from a failure to maintain your boat. One exception is BoatU.S. Insurance — it won't pay for the part that failed but will pay for subsequent damage.

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Hose Scrutiny

Hoses of all sizes and lengths are the arterial system of every boat. When they fail, they often do so without any hint of impending failure. When inspecting older boats, I often suggest that the boat's owner invest time and/or money in an inch-by-inch inspection of every hose on his boat and all their connections, particularly the clamps. I advise this when I've seen enough evidence myself that hose is degrading or is otherwise symptomatic of future unreliability that the inchworm exercise is mandatory.

Power Impulses

You may find this hard to believe but the electrical system that has not been upgraded is often the one with the least problems. Original equipment AC and DC systems that have not been subjected to add-ons and modifications never considered by the boatbuilder are rarely the cause of serious electrical hazards. Notable exceptions are many of the yachts built in the Far East, primarily Taiwan, in the 1970s and through the '90s, depending on the builder. Even on decent domestic production boats, Saturday morning electricians and the local dockside buddy who does electrical work on the side have installed inverters and chargers, added circuits, enlarged battery banks and otherwise increased the original system's capacity in ways that create nightmares of wiring, sometimes leaving old wiring in place "just in case," and are lacking critical circuit protections.

Any boat showing evidence of messing about with electrical systems should be put through a thorough electrical system survey. This sometimes leads to going back to square one to rectify errors and hazards that have evolved and grown over time.

Suspect Transoms

Plywood was (and is) used to reinforce many boat transoms so they can support the load of outboard or sterndrive engines. Transoms are usually fabricated as a sandwich with inner and outer fiberglass skins that wrap a core of plywood. (In newer boats, other non-wood based materials are often used to core transoms.)

Keep the plywood dry and there are no problems. Herein lies the challenge and as often is the case, water eventually makes its way between the machin-

Degraded plastic thru-hulls are something easily seen, even by the casual observer. Non-fiberglass reinforced plastic fittings were common in older boats. Today's boatbuilders use reliable and durable reinforced plastics like Marelon with confidence in their performance above and below the waterline.

The bonding system connections had corroded to the extent that merely touching them separated their connections. The bonding system was there but, with only one broken connection, it was useless.

Multiple waterlines in this bilge tell a story of several bouts with high bilge water levels. Worse news is found in the fuel-laced bilgewater. A boat owner or buyer cannot ignore the obvious evidence of fuel and water leaks.

Everything still works but for how long? These fittings and the pump should be cleaned of rust and treated with a corrosion inhibiting formula to extend the life of all affected parts. A drier operating environment may not be possible but more corrosion-resistant materials should be considered for use here.

"Look behind the drapes." This leak damage is typical of water finding its way in through window frames. The problem is most often seen in older Far Eastern built trawlers. Interior symptoms are easy to spot but the leaks often find paths between the outer fiberglass skin of the cabinsides and do serious damage to the laminate structure.

ery mountings and transom laminate, wicking its way into the transom core where it degrades the wood inside. Finding this condition begins with percussion sounding and the judicious use of a moisture meter both on the outer and inner skins. Any suspicious structure should be opened for a more complete examination.

Backbone Integrity

Engine beds and stringers are the backbones of every boat and, in older boats, they suffer water intrusion in much the same way and for the same reasons as do transoms. Water gets it and can't get out. It enters via the unsealed perimeter of bilge limber holes, through loose engine mounting brackets and mounting openings that have developed microscopic water pathways.

Problems with water logged "backbones" can dash even the most optimistic DIYers hopes for an older boat. As the backbone weakens, so goes the hull's ability to withstand the normal stresses and strains of wave action.

Risk Aloft

For older sailboats, rigging is the most common vulnerability because old standing rigging, shiny and bright as it may present itself and contrary to testimony of light use, is still old rigging. Even without being put under sailing loads, installed standing rigging fatigues from static load cycling and no one can say how old is old or when something in the rigging will break. One thing is sure: A failure never happens at a good time.

Rigging is not limited solely to the wire. Rigging includes any and every part, small and large, that is attached to another part for the purpose of supporting a mast. A rigging survey finds what is broken but it won't tell you when the next problem will occur. The rigging on boats sailed exclusively in fresh water or where seasons are short and on boats never raced and those whose rigging has always been taken down for storage should last 20 years or more. Sailboats in tropical waters, sailing the year around in saltwater environments, and those that are raced, may need rigging changes much earlier in their lives. There are no rules of thumb on rigging life. The only accurate measurement for the lifespan of rigging is knowing the cycling rate under all conditions, which is not easy or practical data to gather.

Pressure Points

Surveyors often see localized evidence of stress or strain present in older boats but they rarely see a high rate of hull failure under normal use over time. Hull-deck joint failures are the exception. Boats don't die from hull bottom blisters and few keels fall off without the help of a sudden impact on a rock.

What surveyors do see are boats that have managed to reach middle age showing the usual and expected signs of deferred maintenance, hard service or neglect and abuse, much of which I have cited here. Surveyors also see those wonderful exceptions to average condition that represent good breeding, skilled construction and the TLC of knowledgeable owners.

On the other hand, surveyors also see boats from less than accomplished builders and those that are on the very low end of the quality scale, many of which have defied predictable cautions and are still afloat and operational, all being testimony to the effects of the work of passionate ownership and the miracles of boat repair and service that extends the lives of the unlikely.

There is a saying that "old soldiers never die, they just fade away." Old boats don't seem to die either but they are not fading away. You can fix the stuff that breaks and polish the stuff you see, the rest awaits detection, either in a proactive quest to stem the tide of age related failures or in reaction to things that go bump in the night or emit those gasps that beseech our attention.

About the author: Pat Kearns is a NAMS certified marine surveyor and, as DIY's technical editor, she is the undisputed Standards' Keeper.

Off with the Wire, On with the Rope

In the old days, halyards were made of wire to minimize stretch but, with modern low-stretch rope, an upgrade to all-rope is a change for the better.

By David and Zora Aiken

For years, wire "rope" was the material of choice for sailboat halyards. Only wire could keep a sail luff truly taut, enabling the best control of the sail's set. Wire's small diameter also kept windage and weight aloft to a minimum as these, too, could diminish performance. The daysailor or coastal cruiser isn't concerned about minor slowdowns caused by imperfect sail set but, if the racer can make enough small adjustments, the total can translate to the elusive competitive edge.

Wire had some drawbacks too. Wire winches were cranky, the obvious pun intended. Accidents occurred when a winch brake let go unexpectedly, rotating a winch handle in a rapid and unstoppable motion until it met an unmovable object. Never mind that the handle should not have been left on the winch; it was an all-too-common mistake that broke many arms and wrists, cracked the ribs and a few jaws of the careless or sailors ignorant of the hazard as a painful punishment for a lack of vigilance. That danger aside, the twisted wire used for halyards can and does wear and unlay in tiny sections, leaving burrs or slivers (a.k.a. "meathooks") to snag at the masthead sheave or give a crewmember a nasty cut. Wire can chafe anything it contacts, notably the sheave itself. A rattling wire halyard chips paint off a mast or mars its anodized surface and has driven more than a few sailors into sleepless frustration as they tried to keep the halyard slap to a minimum at night.

There are alternatives. With the manufacture of low and virtually no-stretch rope, the sailor has other options. Many older boats converted to furling headsails long ago but, if the main halyard is still wire, an upgrade to all-rope would be a notable improvement. At first glance, the switch seems straightforward: replace the wire winch with a rope winch and add a cleat; replace the wire halyard with a low-stretch rope halyard and change the masthead sheave to accommodate the larger diameter halyard. Voila. A more efficient, easier-to-use, safer way to hoist the sails. With a few add-ons, you can handle it all from the cockpit.

New England Ropes

(top) Double-braid Sta-Set has a braided core and a braided cover. (bottom) Parallel core Sta-Set X has a unidirectional fiber core with a braided cover.

SHEAVE REPLACEMENT

Narrow, high-load sheaves in mastheads improve sail handling and allow the use of smaller, lighter halyard winches.

Shown in the photo is a Harken 691 aluminum sheave that combines sideload-carrying balls with a Teflon composite bushing for radial loads. When retrofitting, the sheave requires some minor modifications when mounted.

According to Syd Millman of Harken, the sheave's inner race must be secured on the crosspin so it doesn't turn on the pin. There are two ways to do this. The first is to use shims next to the inner race and sides of the sheave box to keep it from turning. Mylar makes a good shim. Syd has also used plastic from milk jugs trimmed to fit just the inner race. This is not a good long term solution because the material has no UV resistance and dissolves.

The other method is to drill and tap a small hole, say 1/4" x 20, in the sheave box close to the crosspin. This keeps the fastener away from the bearing race. Then insert a 1/4" x 20 fastener to apply pressure to the sideplate of the inner race and force it against the opposite side of the sheave box. There should be a shim between the sheave and box to help cut down on corrosion. It's also highly recommended to use Tef-gel on all stainless-steel to aluminum contacts surfaces; i.e. 1/4"x 20 fastener, crosspin and even the sideplate of the sheave to the sheave box.

Wire winches still in use on a 35' (10.6m) Hallberg-Rassey.

David and Zora Aiken

The cover is sometimes stripped from portions of a halyard in order to minimize weight and windage or to reduce its diameter. In this case, stripping was done so the core of the rope halyard would fit in the groove of the existing sheave.

Before you start comparison shopping, take a good look at the top of your mast, a place called the "truck" by riggers.

Not Just a Sheave

The problem area concerns the masthead sheave. You must replace the old sheave, which has a small vee-shaped groove for wire, with a new sheave, which has a larger diameter, U-shaped groove for rope. Hold it. That groove is only one consideration.

Ideally, the new sheave fits in the existing space with the same diameter, same width, same diameter center pin and access is easy to make the switch. In addition to the obvious difference between rope and wire diameter, there are so many masthead configurations that the ideal may not be found, particularly with older boats. This aspect often takes the halyard-changing project out of the do-it-yourself category. It's not impossible but it depends greatly on the individual's knowledge and technical skills. It may also depend on that person's willingness to do the necessary research. This can be a dicey judgment and, if you do tackle the job yourself, make sure to have a competent rigger review your work before you close up shop. Safety cannot be guaranteed but getting expert eyes on the job will be a step in the right direction.

Companies do manufacture replacement sheaves but, if a good match is not found among existing sheaves, the next step is to contact the mast manufacturer for a source of a suitable replacements. Depending on the age of the boat, that could mean any mast manufacturer, as the one that made your mast may be out of business. You may already know that the sheave box in your mast does not have space to accommodate a new rope sheave. In that case, you need to have a new box installed, perhaps even fabricated. Thus, the simple switch can grow in difficulty and cost.

Once you've resolved the sheave question, trace the entire route the halyard travels to be sure rope fits through exit holes in the mast and in clutches or line-stoppers.

As for the sheave itself, a new one is a great improvement over the old. Original sheaves for wire halyards rotated by turning around the center pin. The new sheave likely has stainless steel or Delrin ball bearings, which preclude troublesome snags and make the sail much easier to hoist. Be sure to follow the manufacturer's installation instructions to ensure that the sheave functions properly.

Rope Selection

Rope choice is easy compared to the problems associated with sheaves. The large selection of rope appears confusing initially but specific materials are used for specific applications. Compare rope recommended for halyard use but also consider the type of sailing you do.

All the new ropes are strong enough to replace wire. While eliminating stretch may seem to be the goal, it's the most costly option and is practical only for those serious racers who have already spent serious dollars for high-tech sails. Most sailors, whether cruisers or weekend racers, have no need for no-stretch rope. Ordinary Dacron sails stretch slightly regardless of the halyard material.

Polyester is the most popular fiber for halyards. Not only is it strong, low stretch and UV and abrasion-resistant, it's also easy on the budget. Higher-tech and higher-cost halyards are made of polyethylene (Spectra and Dyneema), Technora and Vectran. Blends are used often, combining a core of one fiber and a cover of another. Some high-tech fibers are less resistant to UV, so polyester covers provide that protection. Some new fibers have a smooth, slick surface making them more difficult to grasp.

Winch Changeout

Recommendations for the halyard winch can be found based on boat and sail load specs and rope size but an equally important factor is who will use the winch. Which crewmember will be hoisting the sail most of the time and how much assistance do they want or need? Look at size, material, one or two-speed and self-tailers. Talk to friends with similar boats, talk to boat manufacturers and dealers, learn what's standard on comparable models.

Wire/Rope to All Rope

If the halyard on your boat is a combination wire and rope, you won't have the

David and Zora Aiken

With so many different masthead configurations, replacing the masthead sheave may not be easy, particularly on an older boat. (left) All-wire sheaves. (right) Stepped-down sheave for wire and rope.

same problems as those changing from all wire. You already have a rope winch. The masthead sheave is large enough to accommodate the proper diameter rope, so a replacement is likely easier to find. Though the sheave seems usable based on size, you may choose to replace it for two reasons. A sheave with a double groove, vee-shaped for the wire, U-shaped for the rope, may chafe the new rope. Plus you'll like the improved function of a new ball-bearing sheave.

For a cost estimate on changing the halyard(s) on your boat, contact your rigger or fill out a quote request at westmarine.com/rigging.

About the authors: David and Zora Aiken have been liveaboards for more than 20 years and are authors of "Good Boatkeeping," and their newest release, "Cruising: The Basics."

Webbing Savvy

A helpful guide to selecting the correct webbing for onboard use.

Story and photos by Jim Grant

Webbing is a length of woven fabric tape with selvedge edges i.e., it is woven in such a way that there are no yarn ends along the sides. It is generally highly flexible and strong and durable. Common uses are as slings and straps. Webbing is as flexible as rope, even more so along its flat axis (it can be rolled into a smaller bundle than rope of comparable strength). Because it is flat, it distributes stress across a broader area and causes very little abrasive damage and because it's flat, it is less prone to tangles and, although knots do not hold well, it can easily be sewn to increase its length or to create loops at its ends. Buckles and ratchet winches work well with it to make snug fits possible.

First, and probably perfectly obvious, there are limitless variations in the way webbing can be constructed. Not only can the weave be varied to create thicker or thinner cross sections (some flat, some tubular), the yarns used in the weave can be made larger or smaller and, finally, they can be made of different fibers. For marine use, we can limit our consideration to webbing with strength ratings of 7,000lb (3175kg) or less and to only those made of synthetic fibers.

Fiber Choices

Four synthetic fibers are used to make webbing for marine applications: polypropylene, nylon, polyester (Dacron) and ultra high molecular weight polyethylene (Spectra). Each of these yields a finished product with different characteristics that may or may not be helpful in a given application (refer to **Table 1**).

Polypropylene has a very low specific gravity (it floats) and it takes dye readily so it's available in a wide range of bright colors. It also has very good modulus ratings; that is, it stretches relatively little when loads are not extreme (relative to its breaking strength). On the other hand, polypropylene does not resist exposure to ultraviolet radiation well and it becomes brittle and eventually turns to powder. Even its initial strength is far inferior to other webbing fibers and constructions.

Nylon is the most ubiquitous fiber found in marine webbing. Because it stretches the most of all four fibers, loads are distributed evenly over its entire length, giving it an extremely high breaking strength. It can be dyed, though the colors are not as bright as they are for polypropylene. Many maintain that the darker dyes help increase its resistance to UV. There is no doubt that nylon has a much better resistance to solar rays than polypropylene, no matter the color, roughly two times the durability. Nylon shortens with exposure and gets more and more brittle but turns to powder very slowly. The strength of nylon decreases and its length increases (both only slightly) when it is water soaked. It returns to its original length and strength when dry.

Polyester stretches very little yet has roughly 70% of the strength of nylon (in similar constructions). It also holds up best in exposure to ultraviolet with roughly two to three times the durability of nylon. Downside? It costs quite a bit more than similar nylon and polypropylene webbings.

Ultra high molecular weight polyethylene (known as Spectra) stretches the least of all four fibers and has strength surpassing that of nylon. Its UV resistance is better than that of polyester. Unfortunately, this fiber is extremely expensive, about US$5.25 per foot (304mm) for webbing rated at 7,000lb (3175kg) breaking strength so its use is limited to only the most demanding applications, such as reinforcement straps at the corners of large sails. It has a low melting point and when sewn, keep sewing speeds slow so the needle heat doesn't weaken the webbing.

WEBBING USAGE

Nylon: Ideal for sail corners. The extra heavyweight nylon is perfect for safety straps, tethers, jacklines and wherever maximum safety is required.

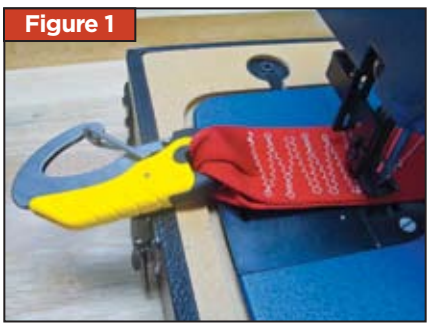
Polyester: Rugged and best to use outdoors. Use for sail corner reinforcements, tie downs, trampolines, etc.

Polypropylene: Thinner construction, the UV resistance is not as good as other webbing. Use for bags, sail ties, utility work, etc.

Spectra: Excellent in all ways but extremely expensive. Use sparingly.

Tubular (nylon and polyester): Thicker and bulkier than standard webbing, it's good for use as bag handles, hiking straps or any where you want more strength.

Figure 1



A sewn Wichard webbing loop. Note the cross pattern of stitches rather than the traditional boxed "X" stitch.

Figure 2

A #4 spur grommet securing a loop in 2" (50mm) webbing.

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TABLE 1 WEBBING FIBER COMPARISONS

	Nylon	Poly-Pro	Spectra	Polyester
Cost	Average	Low	High	Average
Strength	Excellent	Very Good	Excellent	Good
Abrasion Resistance	Very Good	Good	Excellent	Excellent
UV Resistance	Very Good	Good	Excellent	Excellent
Mildew Resistance	Excellent	Excellent	Excellent	Fair
Acid Resistance	Poor	Excellent	Good	Good
Alklis Resistance	Good	Excellent	Excellent	Good
Oil & Gas Resistance	Good	Excellent	Excellent	Good
Melting Point	480F/249C	330F/165C	260F/127C	500F/260C

It's important to note that the initial strength of a length of webbing will not be even close to that of the same piece one year later. Exposure to sunlight easily halves the strength of webbing each year it's in use. Thus webbing with a 5,000lb (2,268kg) breaking strength may well have only 2,500lb (1,134kg) after a year and perhaps only 1,250lb (567kg) after the second year. Most webbing manufacturers refuse to even rate the strength of their products for this reason. Even when strength is given, assume a very much reduced working load depending upon the extent to which there will be UV exposure and, when strength is not indicated, err on the side of a much heftier webbing than would seem necessary.

Sewing Tips

When lengths of webbing are secured, either to themselves or to attachment hardware, some sewing is usually required. Use the largest thread possible for your machine (usually a V-92 or a V-138) or use a six to eight ply waxed twine for hand sewing. Use a straight stitch or a small zigzag of moderate length (1/8" or 3mm long). The reason for all this is that webbing joints, whether end-to-end or looped, can easily be exposed to peel stress where just a few stitches must bear the separating force. So it's a good idea to maximize the thread in any given local. Wichard tethers, for example, are locked to hardware at either end of the webbing, with loops closed by closely spaced back and forth rows of narrow zigzag stitches, 5 or so to the inch (25mm). Wichard calls this a "bar tack" stitch (**Figure 1**). The traditional boxed "X" stitch that was so common in military gear through WWII is really not so appropriate for modern synthetic webbing, which has more strength and a harder surface that doesn't cushion the thread by allowing it to sink into the weave.

Loops of webbing can also be closed and lengths of webbing attached to each other by installing spur grommets to lock them in place (**Figure 2**). Even quite thin webbing has enough bulk to make such installations quite secure. So long as the grommet covers roughly one-half of the width of the webbing it gives strength similar to a proper sewing job. Such a grommet provides a secondary means by which webbing straps are secured.

Buckle sliders provide a reasonably (but not absolutely) secure way to attach webbing lengths. Be sure to match the buckle and webbing properly. If the webbing is too thin, slippage occurs. If it's too thick, the buckle is difficult to tighten properly. As a rule of thumb, the rectangular gap in the slider should be the same width as the webbing and just over twice as wide as the webbing is thick. The old double ring closure common on military belts is not very dependable with synthetic webbing because it's so hard and slippery.

Applications

So, how do we employ all this in the construction of boating gear? Jacklines are usually made of nylon with sewn loops for hardware (often carabiners or stainless-steel rings) at each end. Here strength with a minimum size (to reduce deck clutter) is the primary concern. Stretch is undesirable in jacklines and only nylon can provide the strength required by the latest Offshore Racing Council (ORC) rules; namely, 4,500lb (2,041kg) in 1" (25mm) wide webbing. The strongest polyester webbing readily available is automobile seat belt webbing, 2" (50mm) wide with a breaking strength of just 3,800lb (1,725kg). Nylon is the obvious choice even though it stretches about 10" (254mm) per 30' (9m) of length at maximum tension. The ORC rule does approve uncoated stainless steel wire of similar strength as an alternative but that is not desirable underfoot on deck.

Tethers need not meet the same strength standards. Indeed, the ORC rules do not set any standard at all except to require that a colored flag be embedded in the stitching to indicate an overload. The European Norm (EN1095) specifies that tethers not fail a drop test of 6.5' (2m) with a 220lb (100kg) load. The tubular construction enables the insertion of shock cord that reduces the tether length to roughly half its maximum length when not under tension. The colored flag need be nothing more than a 2' (50mm) or so doubling of the webbing over a tab of colored fabric, sewn in place with thread (**Figure 3**) that will break away at anywhere from 500lb to 2,000lb (226kg to 907kg) of loading.

Figure 3

Inserting a flag to show overload.

About the author: Jim Grant is the founder of Sailrite (sailrite.com), a supplier of specialty marine fabrics, hardware and tools, sewing kits and sewing machines. All materials mentioned in this article are available from Sailrite.

Keeping a Ship's Logbook

Creating an official record of your boat's voyages is prudent piloting and provides useful data for future trips, systems maintenance and evidence in legal actions, if needed.

Story and photos by Sheryl Shard

A collection of some of the many ship's logbooks we've kept over the years for our Classic 37 sailboat, "Two-Step." Ship's logbooks can be kept in any format from commercially published ones (yellow book shown on the left) that was given to us as a gift when we first launched the boat in 1988, to our homemade hardback accounting journals, which we set up ourselves.

The start of a new boating season is filled with many rituals, from anti-fouling, to polishing the stainless, to countless trips down the dock loading on supplies. One of the more pleasant seasonal rituals my husband, Paul, and I have celebrated for the last 18 years aboard our Classic 37 sailboat, "Two-Step," is setting up a new ship's logbook. This always involves going over the logbooks kept over previous years, reliving adventures of past voyages as we pour over records of the speeds we achieved under sail, weather conditions we endured, navigational challenges we overcame and the magical landfalls we've made in over 50 countries around the world. The exercise reminds us of lessons learned and, at the same time, raises our excitement for voyages about to begin.

A ship's deck log is a daily record kept on each watch, noting occurrences of importance relating to the navigation, operation and safety of the ship and its crew. It's not compulsory to keep a log of any kind on a recreational boat but it is an invaluable tool that we would never do without, despite all the high-tech navigational equipment now installed on our boat. Equipment does fail and the minimal, hourly written record we keep of our position, course, boat speed, wind direction and wind speed provides us with enough reasonable information to reach our destination by dead reckoning, if necessary.

In cases where there is an accident involving your boat, the logbook may be the only available evidence for your defence and, if set up properly, is considered a legal document upon which a legal decision could be based.

Officially, logbook entries are written legibly in a black ballpoint pen or typewritten. No erasures are allowed. If you make a mistake, you draw a line through the original entry so that it remains legible, insert the correct entry, and then place your initials in the left margin. Date each entry and number every page, which is then signed by the captain. At the end of each watch, the crewmember in charge updates the logbook and notes who was "on duty" and then signs the log entry. Even if you do not go to this extent, any form of documentation is helpful as a reference in the event of an emergency or in legal proceedings and shows that you attempt to run your boat in a safe and seaworthy manner.

When we first launched our boat in 1988, we received several beautifully bound ship's logbooks as gifts. They came in a variety of sizes and were all formatted in different ways, some with labelled columns relating only to navigational information, such as wind direction and speed, true and magnetic course, deviation and boat speed, while others had blank columns to fill in headings of our choice. Some had additional sections to record maintenance routines and repairs, radio exchanges or weather observations. Some were leather bound for use down below only. Others had waterproof covers so we could keep them handy on deck in all conditions. During our initial travels, we worked our way through them adapting ideas and eventually evolving our own format.

You do not need a professionally printed logbook. Instead, use a standard notebook, adding your own columns or loose pieces of paper stapled together or a three-ringed binder or a computerized spreadsheet or document. Select whatever works for you and fits your style of boating so long as the end result is a tangible document containing useful information for your boat's safe operation.

Paul and I are marine journalists and filmmakers so we keep a lot of records, which we use for reference in the work we do documenting our voyages as well as for navigation and safety. Early in our cruising life, we kept several different log-

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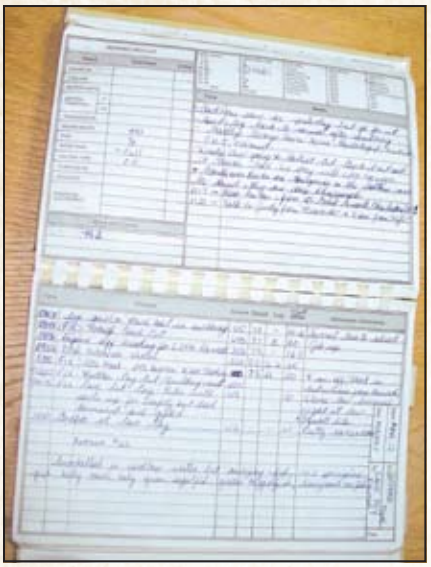
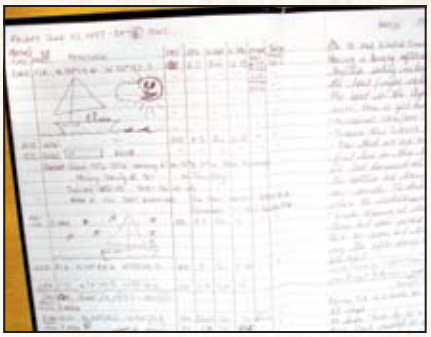
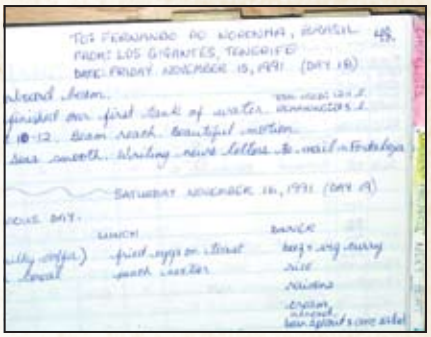


A page showing the set-up of the commercially published logbook we used initially.



A sample of our custom logbook recording day five and six of a 14-day passage to the Azores made in 1997, our third transatlantic passage in "Two-Step." By then our logbooks had become a mix of ship's data and personal journal with our personal feelings and impressions recorded through the cartoons we both like to draw. At that time GPS was new and way out of our budget so we relied on SatNav, which only gave fixes when the satellites passed over, so we were not recording hourly fixes on that passage like we do now. We used a sextant as back-up.



Page showing Day 18 of our passage to Brazil from the Canary Islands. Food notes are one of the many things I record in the logbook, especially on long passages for future reference planning provisions. In this logbook we made a tabbed section at the back of the book for special notes on things, such as ideas for the next boat.

Cartoons from our logbook on the last day of our 14-day passage from Fernando de Norohna in Brazil to Grenada in the Caribbean showing a change in feeling. We had spent 45 days at sea within the two months preceeding our arrival in Grenada and were ready to be ashore for awhile.

books; the ship's deck logbook, a maintenance logbook; radio logbook; journal of our travel experiences; a scrap book; guest book and financial accounts book. However, all these things are so related that, over the years, our ship's logbook has become our one main record book, incorporating all the facts, figures and fond memories of our voyages.

We use a hardcover, lined accounts' journal, available in most stationery or business supply stores. We dedicate the left page strictly to navigational information and we use the facing page on the right for related notes, observations, personal comments, scrapbook material such as postcards of the ports we've just visited, lists of expenses such as the cost of the marina where we currently are, phone numbers and locations of chandleries or repair services we've discovered and any other information that may be useful to ourselves or others for planning future visits. This keeps everything in one place and quick reference is easy. We generally keep a single logbook for a season of voyaging and label it by year and the major cruising destination we've traveled to since that is how we tend to remember things, e.g. "2001 Adriatic Sea: Italy & Croatia."

At the beginning of each book, we leave a few blank pages so we can create a summary log of the season that includes the itinerary of the entire season's voyage, distances between all major ports, total distance travelled over the season and reference to any major repairs.

Before every day sail, we start a fresh page and place the date and "intended" destination at the top of the left-hand page. On the right-hand side of the page we write down the day's weather forecast, the distance to our intended destination, our estimated time of arrival (ETA), the start mileage on our distance log, the engine hour meter reading, the level of fuel in the fuel tank and the level in our water tanks, as well as which of the four water tanks we are currently using (as a safety check). If we're doing a passage of several days, we'll update this information daily. On the left-facing page, we draw columns for time, procedure (departure/arrival, sail change, course change, radio contact, etc.), position, course, bearing, boat speed, wind speed, wind direction, sails (which ones being used, e.g. main, 1 reef and jib) tack, other (e.g. tide times). We begin with the time of our departure and, throughout the voyage, we make notes whenever we pass significant landmarks, make a change to our course, speed or sails. We also do our best to record our position, boat speed and course every hour in case the GPS chartplotter goes down and, on a long passage of several days, to do this at least once at the end of every watch.

Some sailors chose to record their ship's log information on computer, like Ellen MacArthur on her around the world voyage, which she then uploads to her website to share with the rest of us. We prefer the hand-written version since it doesn't drain the battery, is easily accessible and portable, and we don't have to worry about our logbook sliding off the table or suffering splashes or coffee spills from time to time, which just adds to our memories of the voyage.

However you chose to do it, keeping notes for a ship's log is good seamanship and may help to save the day in a challenging navigational situation.

About the author: Paul and Sheryl Shard are hosts of the Distant Shores sailing TV and DVD series (distantshores.ca), which airs in the USA on WealthTV and in Canada on Canadian Learning Television.

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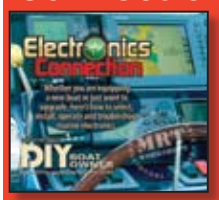

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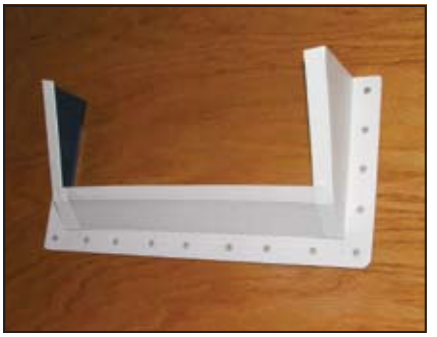
By David and Zora Aiken

Jan Mundy

Herreshoff port on Cherubini 44.



Make a pattern, using artist's mat board or a comparable weight, smooth cardboard.

The screen fits within the port's frame, held in place against the interior surface of the cabin by wooden wedges.

David and Zora Aiken

To close the port, the Lexan panel replaces the screen, held in place against the interior surface of the cabin by the wooden wedges.

Who hasn't grumbled about opening ports that don't close tightly enough to prevent a maddening drip or the mystery leak that appears hours after the rain? Having seen an "old and different" kind of port on some traditional boats, we decided to try what appeared to be a simple, splendid idea.

With these ports (variously credited to Cherubini, Herreshoff and Ralph Wiley), the closing mechanism is not a finger-breaking handle, the sealing mechanism not a cushioned gasket. Instead, two wooden wedges hold either a screen or a Lexan panel tightly against the port's framework. The frame can hold the screen alone, the Lexan alone, or both. In the case of both, a space remains open between the two, bringing air into the boat even when it's raining. Any rain that hits the port runs down the Lexan to the bottom of the frame, which is slanted to send the water out on deck.

Photographs that accompany this written description should help clarify the words that don't satisfy the mind's eye in picturing this design. The frame of each port starts with an elongated U-shape that has a bottom and two sides and fits flush to the interior surface of the cabin. Attached to that flush portion are side pieces that extend into the boat's interior (on each side, the long side of an inverted triangular piece connects to the frame). The bottom extension is attached on an angle to provide a path for water runoff. These frame extensions each have a 3/8" (9mm) lip forming an inside edge. When the Lexan port is in the open position, it rests in this lip, slanted down and outward. If the screen is also in place, it stands upright against the interior cabin side.

Construction Details

If you're replacing an existing port, remove it and measure the cutout. Establish the size of the new port and cut the hole. With maximum dimensions of 11" by 6" (279mm by 15mm), these ports are not suited for use as wheelhouse windows.

Next, seal the cut edge. On a wooden cabin side, saturate the exposed end grain at the opening with unthickened epoxy resin and cover the edge with fiberglass cloth and more epoxy. If the cabin side is a fiberglass sandwich construction, fill any voids and fiberglass the edge. Boats with fiberglass cabin liners need similar preparation for a solid, waterproof edge.

To make a pattern, start with the frame that fits flush against the interior cabin side. The inner edge of the frame should be about 1/2" (12mm) wider than the cutout on each side. This allows space to brace the wooden wedges. Add 3/4" to 1" (19mm to 25mm) for the outer edge of the frame. Though the top remains open, the sides must extend above the cutout, so overall height is about 1" (25mm) taller than the actual cutout. Add the inverted triangular side extensions, the slanted bottom extension and the 3/8" (9mm) lip to all three.

When in position, the slanted bottom of the frame should align evenly with the bottom edge of the cutout; it could be placed slightly higher but never lower, because that would allow water to sit between the frame and the cabin side's cut edge. Check the pattern in position, with wedges in place.

Take the pattern to an aluminum welder for assembly. You may choose to do the finish grinding/sanding on the frames and drill the holes for screws. Have the frames powder-coated (check Yellow Pages for shops that do this) or paint them using good epoxy paint or a spray paint for metal with the appropriate primer. As an alternate idea, the "real" ports of this type are made of wood. Attach the frames to the cabin interior using adhesive sealant (e.g. 3M 4200) and stainless-steel screws.

Cut a Lexan or Plexiglas panel to fit. The width is the size of the cutout, plus a 1/2" (12mm) on each side. The height should be about 1" (25mm) taller than the opening, to prevent any wind-blown rain from reaching the interior.

Make screens for each port, same size and shape as the Lexan. Use kits or

components from a hardware or home warehouse store (corner pieces, side frames, screening, and spline). Cut wood for the wedges using a hard wood, about 1/2" (12mm) thick.

On a wooden cabin side, a wooden exterior frame gives the ports a more finished look. On a fiberglass boat, such a frame could be painted, or an outside frame might be designed to connect directly to the inner frame.

If the boat is headed offshore, take along outer port covers (heavyweight Lexan or plywood) and a way to secure them in storm conditions.

— David and Zora Aiken have been liveaboards for more than 20 years and are authors of numerous boating and camping books.

Buyer Alert: Manifolds, Risers and Elbows

What your mechanic may not know and some points on changing them is sure to save you money in costly engine repairs.

By Michael Myers

8

(left) A filed riser surface. (right) Various screwdrivers used to separate the elbow from the exhaust hose, the file used to flatten the machined surfaces and Aero Kroil penetrating oil.

My previous boat was powered by older, twin 5.7L (350 cu.in.) engines. I replaced one engine but the other engine seemed fine. I had owned the boat about 8 or 9 years and decided to replace all the Barr-style manifolds and risers.

Soon after replacing them, I found water in a cylinder. I presumed that the problem must be the head gasket, since the risers and manifolds were new. I disassembled the engine and then decided to replace it with a new long block. In shopping for an engine, I mentioned to one vendor that I had recently replaced the manifolds and risers and therefore, knew they weren't the cause of the water problem. What he told me next was shocking and proved true. "If the manufacturers of manifolds and risers machined their mating surfaces true, I would never sell an engine. Check them with a file laid across the surfaces and you'll find your problem," he advised. He also recommended a special gasket sealer.

So, in addition to swapping out the long block, I removed and disassembled the manifolds and risers on the other engine. He was right. A file laid across the surfaces revealed that the riser on the problem engine, on the problem side, wasn't true, it had a bow in it. Careful filing removed the high ends and flattened the surface. All was waterproof thereafter and I sold the boat a few years later.

Repeat Affair

Six years ago I bought my current boat, a 1974 38' (11.5m) Egg Harbor with twin 454 Crusaders. I had no idea how old the exhaust system was but it looked good and was freshwater cooled. Recent weeping at the gasket areas, some steam coming from the exhausts, and temperatures that were beginning to approach 180F (82C), convinced me to go ahead and replace the risers and elbows but not the manifolds since they were freshwater cooled and, I presumed, in good condition. I ordered the Osco parts: four risers, four elbows, some gaskets and some stainless-steel block-off plates (these block the mixing of raw and fresh water between the manifold and riser). The new parts were purchased from E-Basic Power (ebasicpower.com). Its catalog (which they send with any order) has valuable information about which gaskets to use where and Osco's site had similar specific information about installation (oscomotors.com/catalog/catalog20.asp). The parts cost US$750.

Osco instructions said to remove the primer paint from the machined mating surfaces of the risers (two surfaces each) and elbows (one machined surface each). As I did this, I checked them for flatness. Of the eight cast iron pieces, with a total of 12-machined surfaces, half the surfaces needed some work. They were bowed with the center section being shallower than the outer edges and all threaded holes had protrusions around them that came up into the machined surface. I spent a couple of hours cleaning off the primer, checking and flattening the machined surfaces and then taping those surfaces and painting the pieces.

To Gasket or Not

Osco recommends no gasket sealer be used. (I can't recall the Barr literature saying anything about sealer at all.) I would use a sealer anyway, the special gasket sealer recommend to me by the same guy who told me about the machined-surface problem; namely, Quicksilver Perfect Seal Sealing Compound, part number 92342271. I had a can that I purchased at a Mercury engine repair shop years ago. The label says it never hardens and that must be true as, with a little stirring, mine was like new. It's not cheap. A new pint cost about US$20.

The first thing to do was to drain the manifolds of coolant. Even though I wasn't replacing the manifolds, I would have to break their seal to the riser. I disconnected the raw-water cooling hose from the risers of the two engines and collected about 5 gallons (19L) in a bucket.

Elbow Disconnect

The next step and the hard part, was getting the old elbows off; more spe-

cifically, getting the exhaust hose off the elbow.

In my case, the hose connects to the elbow whereas, in some other applications, the hose connects to the riser. You must break the rubber exhaust hose loose from the elbow before you disconnect the elbow from the riser. Otherwise, it's too difficult to hold the elbow or riser, if that's where the hose connects, while trying to loosen the hose.

To loosen the hose, take a long, small tip, small diameter screwdriver and drive it between the metal and hose, being careful to always keep the tip against the metal so as not to dig into the hose. Once I had driven the screwdriver everywhere I could, I sprayed some Aero Kroil penetrating oil between the screwdriver and metal, putting a long straw on the nozzle and inserting it alongside the inserted screwdriver. Then, I inserted a somewhat larger screwdriver and gently pried the hose upwards away from the metal. Finally, I used a chain wrench, which I put on the hose just past the inserted elbow, to gently twist the hose, until I was sure it had broken loose from the elbow. Now, I could unbolt the elbow and easily slip it off the rubber hose.

Riser Removal

Next, the riser had to come off the manifold. In my case, removing the riser from the manifold was difficult because the prior installer had put 3M 5200 adhesive sealant around the studs, washers and nuts. The rubbery caulk would ball up around the studs while I was trying to get the riser off.

I used an Exacto knife and carefully cut the sealant from around each stud, before trying to remove the riser, which made disassembly easier. Nevertheless, I had to do some prying. This is dangerous because, in my case, I was not replacing the manifolds and prying against them to remove the riser could damage the manifold's sealing (machined) surface. Luck played a part because there was a stainless-steel block-off plate installed between the riser and manifold on my application. I was careful to keep that plate on the manifold side to protect the manifold as I tried to pry the riser off with two screwdrivers at first, followed later with a large cresant wrench and some hammering with a large rubber mallet.

I duly noted that the person who installed the parts I was removing had used a very hard, blue, rubbery gasket sealer. It took 30 minutes to scrape the old gasket off the first manifold. The remaining ones were not scraped off. They were sound and clean and I reused them.

I also wondered why the prior installer had used an adhesive sealant on the washers and nuts. The Osco parts list informed me that they sold sealing washers and recommended they be changed with each removal. Close inspection of the riser revealed that the studs that held it on passed right through the cooling passages and, therefore, the washers and nuts would probably, if not sealed, leak. I didn't order the sealing washers. Rather, I cleaned the ones I had and spread Perma-Tex non-hardening gasket sealer around the studs and underneath the washers during installation.

Reassembly

I spread lithium grease on the elbow, where it connects to the exhaust hose, before installing the hose. Torque was listed at 25 foot-pounds for the risers and elbows and 35 foot-pounds for the manifolds (which I checked and set while I was replacing the other parts).

Keeping track of how much coolant came out of the manifolds was important. When the new parts were all installed, I suspected that there might be air pockets that would prevent me from putting the same amount of coolant in as had come out. My suspicions proved right. So, I ran each engine, with the heat exchanger cap off and with coolant in hand and, as the engine heated up and the coolant level dropped, I was ready to top off the coolant. I used a 50/50 mix of coolant and water. The temp on both engines is now 160F (71C).

Viewpoint

The point of the story really boils down to this: Most people probably believe, as I did, that spending US$500 to US$1,000 on some cast iron parts entitles you to take them out of the box and install them. It isn't so. Remove any paint or primer from the machined surfaces, check them for true flatness and paint them before you install them. I wonder how many boat mechanics similarly check or prepare these parts? Finally, over the years, at least two other boats in my small marina have had their risers and manifolds replaced and subsequently had head gasket failures.

About the author: Michael Myers is a construction consultant who boats on Lake Pontchartrain and Gulf of Mexico. The building of a fiberglass swim platform for his 1970 31' (9.4m) Chris-Craft was documented in DIY 2000-#4 issue. For the last six years he has been fiddling with the second "Wendy Lynn," a 1974 38' (11.5m) Egg Harbor.

Reading Volts Digitally

The typical analog gauge found on older boats gives a ballpark battery charge reading that, for this boat owner, was not accurate enough for his power hungry electrical system.

By Graham Collins

A lot of the boats favored by the DIY crowd have analog DC voltmeters. The reason is simple: Analog was the only option but an analog gauge is no longer the best choice for several reasons.

With today's sophisticated electrical systems, it's just not accurate enough. You can't reliably tell the difference between 12.4 volts and 12.6 volts and this represents a big difference in the battery charge. An analog gauge also draws a fair bit of power just monitoring the voltage level and you cannot easily read it at night unless it's backlit.

The author's original analog gauge. Would that be 12.8 or 13 volts?

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DIY BILL OF MATERIALS

The Datel subminiature panel meter is available online at newark.com in the U.S. and e-sonic.ca in Canada. Replacing an analog gauge takes about one hour.

Datel MDS-20PC-0-DCM-C.....$58.00
Panel mount bezel DMS-BZL3.....$4.70
Shipping $7.00

New digital meter installed. The photo of the analog gauge was taken just before installing the new meter so both meters read the same actual voltage. Certainly, it's easier to know the true voltage with the digital one.

For these reasons, the upgrade to a digital voltmeter is a good investment. Installation is well within the reach of a DIY boater, as well. I chose a Datel subminiature panel meter. It's a 1.33" by .83" (33mm by 21mm) rectangular shape and measures voltage to two decimal places (e.g., 12.58 volts). It is a two-wire meter, which means that it's powered by the same voltage that it is measuring. (A powered meter requires it's own separate battery supply and is more complicated to install and maintain.) Power draw is about 8mA. The meter has red LED digits, approximately .38" (9mm) high. I also purchased the optional bezel, which gives it a more finished look. The bezel holds the meter in place and mounts by four hidden screws. Though it's not a recognized brand in the marine market, the meter is epoxy encapsulated so it should be reliable in the marine environment.

Step one was to construct a mounting plate, as the existing opening was bigger than the new meter. I had a piece of thin teak lying around but almost any thin material would work. Carefully mark and cut out the hole for the meter and then drill the holes for mounting the plate in the boat, as well as the holes to hold the bezel to the mounting plate.

Next, remove the old meter and install the new meter. In the case of my installation, the terminal connectors attaching wires to the old meter were okay to reuse on the new meter so installation was simple. I have three wires attached to the negative side, which I do not like, but we'll fix that another day.

— Graham Collins sails and messes about with "Tardis," an Aloha 8.2 sloop, on the waters around Halifax, Nova Scotia, with wife, Jill, and son, Sam. He is an engineer on weekdays.

Encounters of the Foul Kind

The sewage odor emitting from the cabin didn't stop this couple from purchasing their "dream" boat but it did prompt a quick redo of the waste plumbing system.

By Dave and Barb Heilman

7

One of the initial impressions we had when we entered the cabin of the 38' (11.5m) Easterly we were considering purchasing on one hot August day was that it was, literally, full of sewage. Solid and liquid holding tank waste had accumulated in the small cubby in the head where the tank was placed. By the odor, it was obvious there was a serious problem with the plumbing.

One of the previous owners had replaced the original 22-gallon (83L) holding tank with a 6-gallon (22.7L) tank, likely in an effort to comply with the letter of the law, albeit the arrangement was not in the spirit of it. On closer examination, we found that the overflow cap had ruptured and the tank was leaking around the intake hose from the toilet causing a cesspool of waste about 6" (152mm) deep below the shelf holding the tank. Yuk! In spite of this and other problems with "Jurate," we still decided to purchase her.

Finished location of the new 28-gallon (106L) waste holding tank.

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DIY BILL OF MATERIALS

28 gallon (106L) Todd heavy-duty holding tank with tank fittings)	$220
15' of 1-1/2" (38mm) marine grade sanitation hose	$51
7' of 1" (25mm) Marine grade venting hose	$21
Hose clamps, 2x4s, 1x2, paint, screws, straps	$25
Total	**$317**

Overboard discharge thru-hull is capped off, as discharge is not an option when cruising in freshwater.

Locker dividers were installed to make the lockers more functional and add strength to this area of the hull and settee. Holes were then drilled for hoses and cables.

Our choice of location for the new tank was dependant on size, proximity to the head, access to plumbing, ability to secure the tank, access ports to check on it, balance of the boat with a full tank and, most important, ease and security of fit.

The aft port settee met all of these requirements. As our use is primarily on weekends for two people, a 20-gallon (75L) tank would allow us pump out only once a weekend based on a generous estimate of use per person of 2 gallons (7.5L) per day with flushing water and still have a reserve capacity for occasional guests.

Measurements for the tank to fit a location on a boat are the obvious length, height and depth of the tank. Other considerations are leveling materials used to stabilize the tank, the curvature of the hull and the access port on the tank top.

To stabilize the tank, we used 2x4s laid side by side the long way, placed on the sub floor of the settee. This gave us the basic area for measuring the space for the new tank. West Marine has a variety of polyethylene sewage tanks. We settled on a Todd heavy-duty, 28-gallon (106L) tank, which, according to our measurements, would fit perfectly.

Dry fit of the tank confirmed the fit, with a 1x2 strip along the backside of the tank and curvature of the hull. All 2x4s and the 1x2 were cut to length to be hidden below and behind the tank. Stainless-steel wood screws secured the mounting platform of 2x4s to the settee sub floor and the 1x2 along the hull curvature was secured to the hull with 3M 5200. All were then painted with oil-based epoxy paint. Two 1" (25mm) nylon straps were added and secured under hardwood strips on all four sides of the tank. The tank is

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Chafe protection, namely Gorilla Tape, is installed around sanitation hoses where they pass through the locker divider.

Hose connections are double clamped. Note proper orientation of clamp screws.

also held in place by being a perfect fit under the settee framework. If your tank is not as snug a fit as this one, you can adjust the size of the mounting boards around the tank to adjust the fit to your boat.

Locker dividers were installed to make the lockers more usable and add strength to this area of the hull and settees. These dividers also add support for the plumbing and electrical wires running through the settees, so these are not in the way of storage. Certainly, installing a holding tank does not require these dividers but it may be a project for your future consideration.

Whenever you acquire a good old boat, careful examination of the plumbing is a must to keep seawater out of the boat and keep the boat afloat. One of the first things we did with "Jurante" was to remove all the thru-hull fittings and valves and check them for corrosion, function, serviced as necessary and then rebed and reinstalled.

Remember the cubbyhole behind the head where the entire overflow was going because of the too small holding tank? After cleaning out the cubby, replacing the shelf and repainting it, it makes perfect access for the head plumbing and for storage of cleaning and holding tank treatment solutions.

— Dave and Barb Heilman have lived near Manitowoc, Wisconsin, their entire lives. They enjoy rescuing and restoring old boats almost as much as sailing on Lake Michigan.

From Gas to Diesel: A Lesson in Repowering

Needing a replacement engine for his '70s vintage sailboat, this owner found one engine supplier who was very willing to work with do-it-yourselfers.

By Dan Martin

9

"Orion," our 1977 Islander 36 had the original Atomic 4 gasoline engine when we purchased the boat as a project and for a place for my son to live while attending college.

The engine was a total loss. It had been deprived of maintenance for many years, water had intruded into the cylinders and the engine surfaces were heavily rusted. I searched online and found many Atomic 4 aftermarket rebuild and parts suppliers. After arriving at repair and/or replacement costs of about US$4,500 to US$5,500 at the time, I decided to abandon the Atomic 4 and instead looked at diesel options. A diesel would increase the value and marketability of the boat when that time came.

I met a lot of resistance when I called the local engine suppliers. I wanted to do the job myself and the locals had little to no interest in helping a DIYer. Many seemed reluctant to give me pricing, information or references. This was another incidence of the Twilight Zone, something I've encountered many times in the boating industry. Simply put, I can't find anybody to do the job or willing to help me do it.

I happened upon an ad in DIY magazine for Beta Marine (877/227-2473; betamarinenc.com) and its direct replacement Atomic 4. I called and spoke with Stanley Feigenbaum who was by far the most informative and helpful person I have had the pleasure of dealing with. He supplied me with literature, references and a right-on-the-money dollar figure on what this project would cost. He also gave me step-by-step instructions on what to expect. This was particularly helpful as we were replacing the engine with the boat in the water.

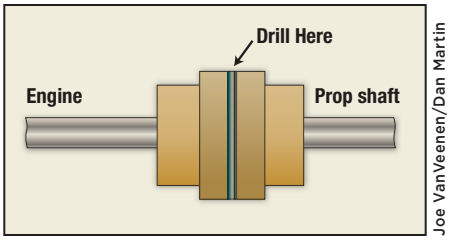
Engine and Tank Switchover

We stripped anything that would come off the Atomic 4 to reduce the weight and then drained all fluids and unbolted the engine mounts. We rigged a metal bar across the companionway hatch and used a small, 1/2-ton chain hoist to lift the engine out through the opening.

Unfortunately, the 30-year-old shaft coupling did not break free. I drilled multiple holes where the two flanges met and then used a chisel and hammer to break it loose. Once the coupling was free, we lifted out the engine. At this point, we disconnected the chain hoist and attached a large metal bar across the top of the engine using a large ratchet strap to secure the bar. We then carried the old engine, estimated at 300lb (136kg) stripped, down the pier to a cart and rolled it to the car. This beast was donated to the local high school auto shop and I received a tax deduction certificate. (The shop teacher told me that the school was always looking for old engines to tear apart.)

With the engine removed we cleaned the engine compartment of all the old grease and oil stains. Electrical wiring was removed and discarded, as was the old exhaust system, which was not adequate for the diesel.

The aluminum fuel tank was now accessible and we removed it and the drained the gasoline, which was mainly varnish by this time, and disposed of it at a reclamation service. We cleaned the tank and removed and cleaned the pick-up tube and then installed a fuel return line fitting as well as a shut-off valve on the top of the tube. Once the tank was dry



Joe VanVeenen/Dan Martin

Drilling multiple holes (visible in the top photo) freed the corroded shaft coupling from the engine.

(top) Original 30-year-old Atomic 4 was inoperable. (middle) Removing the old engine with a chain hoist suspended from a metal bar across the main hatch. (bottom) A mess of wiring and hoses and years of dirt.

inside, we reinstalled it and routed all new fill, vent, return and supply lines using U.S. Coast Guard Type A-1 or A-2 hose. Replacing the deck fill with one that read "Diesel" completed the tank installation. [Ed: Handling a gasoline fuel tank, filled or empty, is extremely hazardous. Even an empty tank emits volatile vapors. Make sure all this work is done in a well-ventilated area and that no spark producing devices are used in the work you do. The same goes for other nearby appliances or tools. Also, after 30 years in service, this tank is at the end of its useful life. The cost of a new tank is small relative to having to go back and replace the old one in a few years.]

Shaft Challenges

Our next problem was removing the old flange from the prop shaft. The bolts were frozen in the flange and, being so close to the packing gland, I did not try heating them. Instead, I took a sawzall and cut the flange at the keyway. This allowed me to cut all the way through the fitting without cutting the shaft. After tying the shaft so it didn't slide out the stern tube, I notched the opposite side and, using a chisel to spread the flange apart, I was able to remove the fitting without hurting the shaft.

Installing the new coupling to the shaft was next. It's important that the shaft isn't pulled up tight against the cutlass bearing or shaft strut. I had a diver check this and had to readjust the coupling. He also told me to drill into the shaft where the coupling set screws meet the shaft, using a smaller drill bit to avoid damaging the threads. The coupling set screws need to bite into the shaft so that the coupling does not move or allow the shaft to come out, especially in reverse.

DIY BILL OF MATERIALS

Prices in U.S. dollars as of November 2005. Price of engine was discounted 10% (boat show rate) and shipping was free.

Beta Marine BD1005, 28 hp with PRM 80 2:1 transmission and shaft coupling	$7,516
"B" control panel upgrade	$192
High-rise exhaust elbow	$245
2" (50mm) exhaust and muffler; Racor fuel filter and water separator model #500FGSS-2	$1,591
Anti-siphon loop	$100
Miscellaneous hose for exhaust, water, fuel	$400
Teleflex marine engine control (purchased on the Internet)	$200
Miscellaneous wire	$75
Blue Seas battery switch	$60
Groco SA water strainer rebuild kit	$25
Miscellaneous wood and screws	$75
Crane rental to lift new engine	$150
Total:	$10,629

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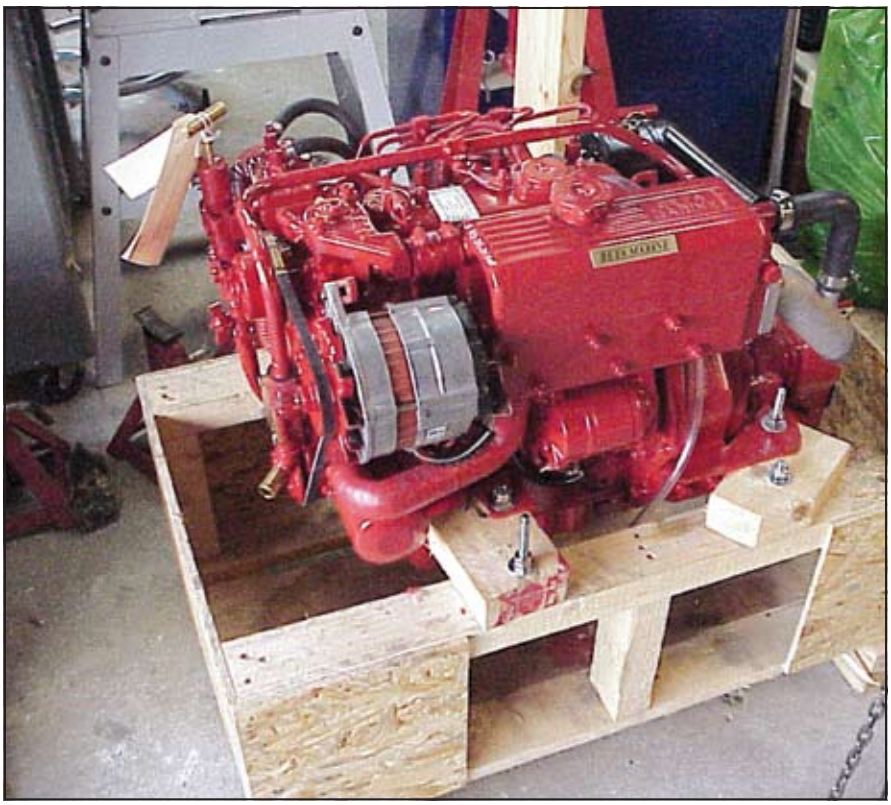

New Beta Marine BD1005 28-hp diesel awaits installation.

Cleaned fuel tank gets a return fuel connection and shut-off valve.

Engine Positioning

The next step was to fit the new engine. The boat was towed to a yard nearby and we paid to have the new engine lifted into the hatchway with a crane. We then used the same bar and chain hoist to suspend the new engine in the hatchway. Prior to this point, we had repaired all mounting holes in the engine bed. So, starting with a clean engine bed and compartment, we proceeded.

At this point, we had to remanufacture the motor mounts. The factory supplied basic mounts but, unfortunately, it can't

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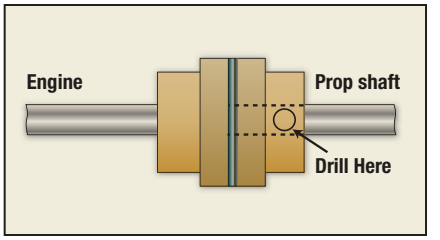
anticipate all engine bed arrangements. We took the existing mounts and, after about four different configurations and trips to our favorite metal fabricator's shop, we came up with a working set. This was probably the most time consuming part of this installation but getting this right is crucial. We set the mounts at a predetermined height and began the fiddling to align the engine.

The instructions that came with the coupling explained the tolerance required between the engine and shaft coupling. Believe me, it's very tight. We followed the instructions supplied with the coupling to the letter. Also, as the prop shaft slides back and forth, we made sure that it was in the proper position when aligning the engine.

Using feeler gauges, the coupling clearance was set according to the instructions, adjusting the motor mounts as needed to achieve it. Once we had the proper clearances, we then marked the mount footings. Sliding the engine aside, we drilled holes for the motor mounts and then repositioned the engine. I used the old bolts as examples and bought new stainless-steel bolts for mounting. With the mounts secure, we rechecked the clearances and completed the coupling installation.

Coupling clearance is critical to ensuring the correct engine alignment. Shown is a R & D Marine flexible shaft coupling supplied with the engine.

With the engine secured, we proceeded to hook up all connections. First, we ran a new 3/4" (19mm) raw-water pick-up hose from the seacock to the old (cleaned) Groco strainer. We then connected the exhaust system and, at this point, determined that the riser on the manifold needed raising. Stanley exchanged the riser at a minimal cost and there have been no problems with it. Stanley also had us install an anti-siphon loop in the exhaust hose behind the manifold to



Drill slightly through set screw hole into shaft to allow set screw to bite into the shaft.

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(Top) Chain hoist takes the engine weight until completing engine alignment. (bottom) Adjustable, customized mounts simplify engine alignment.

New engine control panel has tachometer with hour meter, key start, push button stop, warning lights and audible alarm for low oil pressure, high temperature and alternator not charging, and optional temperature gauge.

keep the engine from siphoning water back into itself. We followed the directions supplied with the new exhaust for routing the hose and double-clamped all hose connections.

Next, we installed the Racor filter, a top load filter recommended by Stanley as the cartridges are cheaper than canisters but, more important, the filter can be removed from the

Job completed. Note the top-load fuel filter and water strainer.

top without a mess or losing prime. A shut-off valve installed in front of the filter gave ease of access.

Rigging

Beta engines come prewired. The weathertight plug on the control panel harness connects into the engine wiring harness. The control panel itself was mounted in a new housing then installed in a cutout in the cockpit.

The next item was to hook up the throttle. We purchased a Teleflex single lever throttle and cables of the proper length from West Marine. The control was mounted in the cockpit and the directions were very precise and easy to follow. The engine controls are plug and play. The only difficult part was making the new housing.

The old battery cables (they were in excellent condition) were routed to a master disconnect switch and then to the start battery. The three-way switch allows for the charging of the house batteries off the alternator or, in an emergency, allows the use of the house batteries for starting.

With everything connected, we filled the transmission and engine with the proper oils. The engine has a priming lever and filling the filters with fuel before proceeding saves a lot of time. The instructions said to pump until the lever action gets hard, which may take 10 to 15 minutes. After opening the seacock, we cracked the throttle and started the engine, checking for water flow through the strainer and exhaust and watching for any leaks.

The diver returned to pull the propeller to check the pitch, size and rotation. We contacted Stanley and he gave us the thumbs up on our prop so it was reinstalled. Our boat was finally able to leave the dock under its own power after nearly 10 years of sitting motionless.

— Dan Martin is an avid fisherman who has owned 20 boats, with "Orion" being his most ambitious project. His article on replacing a worn headliner with maintenance-free materials purchased from Home Depot appears in DIY 2007-#3 issue.

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View from the Stern

The Naked Truth

If you cannot be heard you might not be seen either and this poses a critical concern for your safety when underway.

By Roger Marshall

I was sailing when the fog rolled in. We could see the fog bank coming and took GPS readings and bearings on the land to make sure we knew where we were. It then occurred to me that a sailboat is the ultimate stealth vehicle. They are small and continually moving so they merge nicely with the background clutter. Made of fiberglass and wood, even with an aluminum mast, the boat is a poor reflective target and underway the mast is heeled so any radar signals bounce upwards. Put a carbon fiber mast on your boat and the chances are you'll be totally invisible to radar. In fact, the most reflective part of a yacht is the keel and that's underwater.

So why is the U.S. spending millions of dollars on stealth ships, such as the FSF Sea Fighter catamaran ship, which came into Newport, Rhode Island this fall? Why doesn't it enlist the aid of yacht designers who have been designing stealth vessels (unintentionally) since time began? Why does the Navy need a specially designed 262' (80m) ship when it can send the marines ashore in a fleet of virtually invisible sailboats? Of course, the marines would require shallow draft catamarans rather than the FSF's 11' (3.3m) draft and they might be a little slower than the FSF with its four water jets driven by both diesel and turbine engines. The point is that a fleet of Hobie 14s sailing up to the beach would totally confound an enemy.

Better yet, why doesn't the yachting industry offer to design stealth ships for the U.S. Navy? It obviously needs help. After all, it's still building ships out of highly reflective steel and aluminum and painting them with radar-absorbing paint. If a sailboat designer designed a stealth ship, its crew could sail in the lap of luxurious yacht comforts and be totally hidden to any enemy.

WHEN THE FOG ROLLED IN.

Let me return to my original premise. Be sure you can be seen on the water. In fog, rain, hail and even snow. I know that not many of us sail in snow but, if you're from the north, stranger things have happened. Various studies done both in the U.K. and U.S., show radar images that the average sailboat is visible only on every third sweep of the radar antenna or between 20% and 30% of the time. If you consider that many large ships have a single watch keeper on deck when at sea and that it takes three hits of the radar beam to set off an alarm, that doesn't bode well for sailors.

If you sail in fog-laden waters, at night or shorthanded, install a radar reflector. Have a friend on a boat with radar test it to ensure you are seen when your boat is underway and know that you are safe, rather than assuming you are safe. Having the reflector is one thing and installing a radar responder that responds to being hit with a radar beam is a better thing. Better to wake up the watchman than be run over by a supertanker.

There are a lot of radar reflectors on the market and to quote DIY columnist John Payne from his article titled, "In the Zone" in DIY 2005-#3 issue, some "…are about as effective as a gaggle of geese." Refer to this article before purchasing a reflector. Look for one that works at all angles of heel and lets an oncoming boat know that you are there and then add suspenders to your safety belt by installing a radar responder. Your life may depend on it.

About the author: Roger Marshall is a boat designer and author of 12 books on sailing and yacht design.