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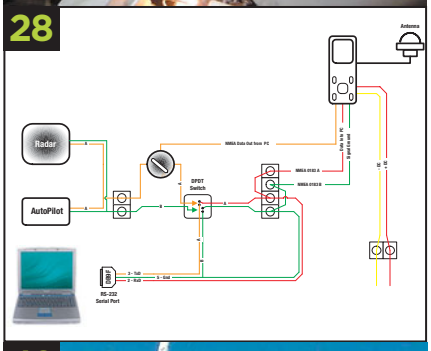
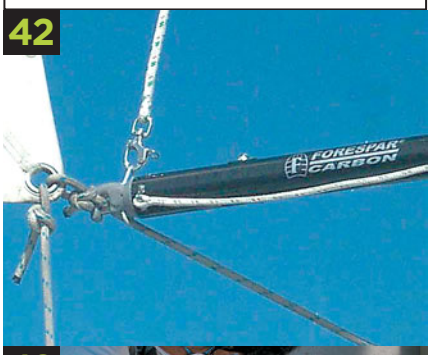




Currents

Edited by Jan Mundy

DIY Delivers

Customer service is often talked about but you deliver the goods. I sailed on merchant ships as an engineer and owned a marina in the Florida Keys, so I'm looking forward to a long relationship with your excellent publication.
Reagan Tucker, San Antonio, Texas

Congratulations on a great magazine. I can't understand why a subscription to your magazine isn't mandatory before owning a boat!
Marc Faubert, "Serrano II," Gatineau, Quebec

I have been a DIY subscriber for one year. The articles are extremely well written and helpful in maintaining my Maxum 2800SCR. The excellent color photographs and the specificity of correcting a problem, install an accessory or select an antifouling paint are all a tremendous benefit to boat owners. You and your staff are to be complimented on a job well done.
Alan W. Gorenstein, Vienna, Virginia

Thank you for your prompt attention to my phone call and subscription renewal. I'm delighted to be a subscriber and a beneficiary of the knowledge and wisdom found in the pages of DIY magazine and in the responses from your technical staff when a message requesting help is submitted to the Technical Helpline.
Paul D. Bohac, Panama City, Florida

I am very impressed with the rapid response by DIY. It confirms that customer service still exists in good companies.
Jack Bokkers, "Andrew James," Oshawa, Ontario

"Life may not be the party we hoped for but while we are here we might as well go boating!"

CD Lost in Action

I previously purchased your 1995-2001 Hands-On Boater CD-ROM and have found it to be the most comprehensive source of information available to the new (or old) boat owner as myself. Unfortunately, it was lost or destroyed in a recent move. Can you replace this valuable reference tool for me.
Todd C. Bradley, Ypsilanti, Michigan

DIY replies: *Purchase of a Hands-On Boater CD-ROM includes an upgrade for just US$20/CDN$25 plus shipping. We gladly send Todd the current version, 1995-2003.*

Anti-Siphon for Gen-Set

The exhaust systems article in DYI 2004-#1 has me questioning the installation of my Onan generator. It mounts completely below the waterline, including riser and water pump and recently raw water appeared in the cylinder and oil. There was no antifreeze in the oil so this is not a head gasket issue. Your article mentions that a siphon break would help. If I install a siphon break, does it go between the strainer and water pump or between the pump and riser? The Vetus ad in this issue features a siphon break with an overflow port. This complicates the installation with another thru-hull. I'm also concerned that the little two-cylinder Kabota 6.5kW genset water pump will not pump water through an additional 10' (3m) or so of hose with a siphon break.

Will Heyer of Vetus replies: *"If a generator or any engine is near or below the waterline a siphon break is necessary to prevent raw water from siphoning into the exhaust system and into a cylinder. Vetus makes two types. Air Vent V has a one-way valve that allows air in when the engine is shutdown thus breaking the water column and preventing raw water from siphoning into the exhaust. This doesn't require an overboard vent. Vetus Air Vent V has a small hose fitting 3/16" (5mm) ID that is routed overboard. This allows the operator to visually see that the raw water is pumping. The open hose allows air to break the siphon when the engine is shut off. A siphon break should be mounted well above the waterline, 15-1/2" (40cm) minimum, after the heat exchanger and before the exhaust riser. It cannot be used before the raw water pump (suction side), as it will draw air in. A typical installation is shown in DIY 2004-#1 issue or can be seen on the Vetus web site (www.vetus.com) under "Exhaust Systems."*

Desulphating Batteries

Do you have an opinion on a 12-volt electronic device known as a Battery DeSulphator?
Bill Smith, Prince Rupert, British Columbia

John Payne replies: *There are other similar devices on the market. Such devices work by generating and directing a pulse of the required resonant frequency (3.26 megahertz pulse) onto the battery to break down the lead sulfate crystals. The risk is that this higher voltage and current spike can affect the electronics. There's plenty of anecdotal information on these devices but no proven tests and trials to validate their effectiveness. There are a few types of devices like these and they seem to be getting cheaper. As for risks, they can damage electronics' power supplies or other electrical equipment. Battery chargers use equalization to achieve the same results. I guess battery desulfators do work to a degree but smart chargers with equalization are doing the same thing.*

Technical Help:
Trailer Brake Bleed Valves

I have a tandem axle Load Rite boat trailer (26T8000TG2) with 12" (30.4cm) surge brakes. Could you tell me what size brake bleed valve I need? I damaged one trying to loosen it to bleed the brakes. The auto parts store has several types available (I didn't remove one from the boat). Any ideas? I called Load Rite and they don't sell any parts over the counter and would not give me any part numbers or size information. They would only sell me an entire wheel brake set-up.
Jerry Uber, "At Ease," Aberdeen Proving Ground, Maryland

Jerry sent his question to our Technical Helpline and as he is a subscriber, he qualifies for free technical help. DIY contacted Load Rite on Jerry's behalf and though it was a struggle getting the information from the company, we eventually received this response: "The valve isn't available by itself, you need a complete assembly that holds the bleeder valve. If it's the right side valve the Load Rite part is 6015.11, left side is 6015.12. Expect to pay about $100 for the assembly." When you're in need of technical assistance with your boat or looking to source replacement parts, DIY can help. To subscribe, call 1-888-658-BOAT or log onto www.diy-boat.com. If you are a current subscriber send questions to info@diy-boat.com.

USCG Shift to LED

According to an article published in Boating Industry International magazine, a U.S. Coast Guard regulation has taken effect officially endorsing the use of LED (light emitting diode) lighting technology for private aids to navigation. The new regulation means that, for the first time, individuals, corporations and all levels of government will be allowed to use approved LED based marine lighting for their marine navigational aids. In the U.S., these aids account for more than half of all aids to navigation registered, according to a spokesperson for Carmanah Technologies Inc., a Canadian LED manufacturer that supplies the Coast Guard. Compared to tungsten incandescent bulbs, LEDs burn 20 times longer and use up to 90% less electricity, Carmanah said. Previous regulations specified the use of tungsten incandescent bulbs.

LED inserts from OGM (www.orca-green.com) replace bulbs for Aqua Signal 25 series and some Perko housings. The firm also offers waterproof anchor and navigation lights as shown above.

CURRENTS

Aluminum and Chlorine Don't Mix?

Treating water with chlorine is good practice in areas where the water may be suspect but, if used in combination with normal tap water that has concentrations of chlorine, it's an invitation to disaster for those with aluminum potable water tanks. This is contrary to your mention in DIY 2003-#3 issue regarding ABYC standards for treating potable water. Chlorine is highly corrosive to aluminum and will not only blacken the metal (one indication of damage) but also cause pitting corrosion and can eventually weaken the tank to the point that it will leak or structurally fail. When treated correctly aluminum tanks should last for many years. The one shown in the photo below did not and it was because it was unnecessarily zapped with chlorine. For boat owners who have aluminum potable water tanks who experience a moldy and/or sweet taste, especially after a long period of non use, run a chlorine or vinegar solution through just the water hoses and let it sit for a couple of hours, then fully flush the system. Clear plastic water hoses facilitate mold growth because they admit light. Better quality hose has an inner core that blocks light.

-- Butler Smythe, "Caerulean," Annapolis, Maryland

A chlorine damaged aluminum potable water tank on a boat that always filled up with treated "city" water yet routinely added extra chlorine. Removal of tanks is not always easy as shown in this photo.

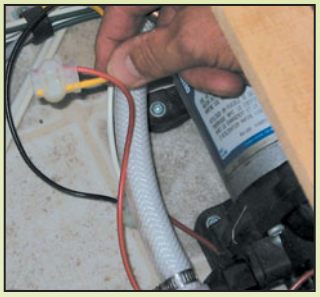
DIY replies: *The process of sanitizing a water system is one provided by the U.S. Food and Drug Administration. The standard also makes clear what tank materials are accepted for use as potable water tanks in boats. Aluminum is not one of them. The standard requires that "Materials in contact with potable water shall be non-toxic and corrosion resistant. Acceptable materials include: copper alloys (including bronze or brass); AISI Type 300 series, stainless steel; nickel-copper alloy; glass-lined metal and plastic and rubber materials that comply with applicable National Sanitation Foundation Standards and/or requirements of the Food & Drug Administration for potable water." The chlorination process is for sanitizing a system, not for stored water. The system (including tanks) should be thoroughly flushed using the following method and in the order given:*

1. *Flush entire system thoroughly by allowing potable water to flow through it.*
2. *Drain system completely.*
3. *Fill entire system with a chlorine solution having a strength of at least 100 parts per million, and allow to stand for one hour. Shorter periods require greater concentrations of chlorine solution.*
4. *Drain chlorine solution from entire system.*
5. *Flush entire system thoroughly with potable water.*
6. *Fill system with potable water.*

This process deals only with chlorinated water used to sanitize a system, not that which is stored and used as potable water. Short periods of chlorine exposures will not corrode a tank if the tank is flushed thoroughly after the sanitizing process.

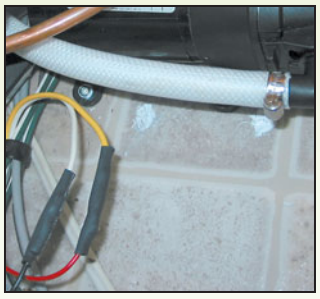
REPLACING A WATER PUMP

Annoying, irritating and loud best described this boat's factory equipped 12-volt pressure water pump, which serves our potable water needs and our freshwater flush head.



Step 1
Remove the old pump. Note the original off spec wiring connector.

Step 2
New pump installed and hoses attached.



Step 3
Wires connected with marine grade butt connectors then covered with heat shrink tubing. Mounting holes for old water pump filled with 3M 4200 sealant. It's not pretty, but surely watertight.

The pump whined like a freight train or so it seemed and the pump's running for a nighttime head flush would wake the sleeping. Even though the pump was buried deep in a locker, our dock neighbors would ask what was making such a racket onboard. Finally, we replaced it with a Flojet Sensor VSD, a variable speed, demand pump. (Refer to DIY 2001-#4 issue for additional product and installation details.)

It's a quiet pump, much like a four-stroke outboard compared to a thundering two-stroke. Now flushing the head is louder than the pump. As a bonus, this pump ramps up to meet the water demand so we can now shower and do dishes concurrently. (The original pump would roar for up to five minutes to refill the hot water tank.) Installation took about one hour, once we assembled all materials and tools.

Force 10 Burner Shortage

Force 10 plans to discontinue its 10004 heater by the end of this year. The manufacturer in Portugal that makes the d/k burners has ceased business. Stock of 94405 and 94305 burners are also permanently out of stock, though parts such as spindles, prickers etc. are still available. Next year, the company will integrate the SIG Marine diesel stoves and heaters into the Force 10 line.

CURRENTS

MORGAN OWNERS WANTED

DIY reader Art Surowiec has some concerns about the centerboard on his Morgan 30 and would like to correspond with other Morgan 30 owners. Send emails to maryandart@earthlink.net.

Offshore Tune-up

Peter Pisciotta, a professional captain, DIY contributor and founder of SeaSkills Personal School of Seamanship, now offers SeaSkills Offshore Classroom, a unique five-day training that includes 200 offshore miles along the rugged and scenic Pacific Coast for up to six participants. "Crew" receive in-depth training in weather forecasting, yacht systems, diesel maintenance and navigation from a team of three experts. The class is rigorous but comfortable: the 61' (18.5m) luxury trawler yacht has three guest staterooms, provisions are top quality, and there is plenty of personal time to explore stops in Monterey, Santa Cruz and Half Moon Bay. It's a great way for couples and individuals to hone their cruising skills or decide if cruising is right for them. For additional information, log onto www.seaskills.com/OffshoreClassroom.html or phone Peter at 415/402-0473.

Anti-Skid Deck Products

In DIY 2002-#4 issue, the article titled "Getting A Good Grip," by Nick Bailey, shows a photo on page 16 of a stipple type, random non-skid finish. I would like to know the manufacturer so I can purchase some.
Martin Robinson, "San Martin," Southampton, New York

Nick Bailey replies: *This photo shows a 1987 C&C 37C cabin trunk. It's a gelcoat antiskid so strictly speaking you can't buy it. It's created from scratch if you plan to work in gelcoat as a medium. It's a close-up photo but, to get an idea of the scale, note the screw head in the dodger fitting (top left-hand corner), which is about 0.25" across and it's in the background. In other words, the antiskid is finer than it looks. This pattern was originally created on the male tooling for the deck plug by applying paint mixed with an aggregate non-skid additive. This style is quite difficult to replicate in gelcoat outside of the mold. However, it is not too difficult to reproduce a similar style if applying a painted antiskid. All the major paint manufacturers sell special non-skid additives designed to be mixed with or applied to polyurethane paint, e.g., Interlux 2398 or US Paints Awlgrip Griptex.*

Refer to the article titled "Non-Skid Deck Coverings," in DIY 2000-#4 issue (also on the MRT "Marine Painting & Refinishing" CD-ROM) for completed details on refinishing a fiberglass deck with polyurethane paint, which includes applying an aggregate type non-skid additive.

"It's in the details."

Installing heads on #2 engine — she did all the torque work while I read the book! *Mike Wolfe,"River Queen," Stockton, California*

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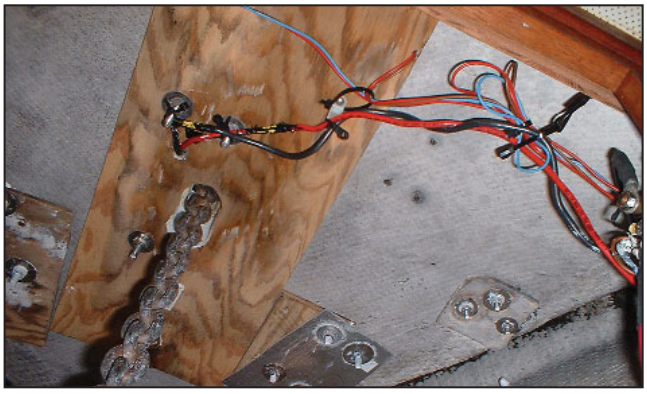
What Electrolysis Is, Is Not

Debunking the myth that corrosion to underwater metals is caused by electrolysis.

Story and photos by Pat Kearns



"Lectrolisis!" Few words spoken or written about boat condition generate more misunderstanding, myth and mystery, and sometimes, fear than electrolysis as it relates to the observations of corrosion on a boat.

One of the most stunning moments in my educational experiences as a marine surveyor was when I heard a corrosion expert of no dispute, Ed McClave, tell the class that electrolysis is not something that happens to boats. What! The class was incredulous and many of its participants piped up with vigorous objections to the statement. It had been pronounced that metals don't decay from electrolysis. The process of electrolysis is something that happens to and in water (or other aqueous fluids).

Nowadays, from my own experience in the yard as a marine surveyor, I'm only mildly amused at the "expert" who appears at the haulout area when one of my customer's boats is lifted out for a bottom inspection. This "expert" observes that the zinc anodes are wasted and that, perhaps, a propeller is looking a bit ragged around the edges. Shortly follows the foreboding pronouncement, of course, in plain hearing distance of all the nervous parties to the event (boat owner, broker, buyer), "That boat's got 'lectrolysis."

Several kinds of corrosion affect boats. We have crevice, stray current, galvanic, poultice, biological and exfoliation to name just a few. What's missing? Electrolysis. There is no such thing as electrolysis corrosion. Search the Internet using the google.com search engine and you'll come up with no less than 15,000 references to marine corrosion and electrolysis. Some of what you read will amaze and entertain you. Don't believe everything you read.

Everett Collier, in his book, "The Boatowner's Guide To Corrosion," defines electrolysis as follows. "The process that takes place in a conducting solution when an electric current is passed through it…these changes in the conductive solution — the electrolyte — constitute the process of electrolysis. Note that this process is something that happens to the electrolyte. The term is improperly used as a synonym for corrosion."

What you see is corrosion or some form of it when you are dealing with a shaft that has sheared from crevice corrosion; a prop that has been eaten away by galvanic activity; a wood thru-hull fitting backing block that has become "hairy" as its fibers separate from stray current corrosion or an engine seawater pump that looks like it's covered with fuzzy white or gray "snow." None of it is electrolysis. All of it is corrosion. Much of it happens because the parts affected are touched by an electrolyte, in this case water that is undergoing the process of electrolysis. That chewed up zinc? Thank heaven for it. It's doing its job, dying to protect other more valuable metals on your boat.

Don't worry about "electrolysis." Worry about corrosion and what causes it.

About the author: Besides being DIY's proof editor and a regular contributor, Patricia Kearns formerly was assistant technical director of ABYC. She is a NAMS certified marine surveyor and operates Recreational Marine Experts Group, a marine surveying and consulting firm based in Naples, Florida.

Talkback Q&A

Helpline info@diy-boat.com

Outboard Duty Cycles

Q: I understand that outboard motors have a life expectancy of about 1,000 hours of operation and the manufacturers typically count 100 to 150 hours of use per year as normal. How many hours of continuous non-stop use would be detrimental for outboards?
Dave Underwood, Fort Erie, Ontario

A: The amount of time an engine can be run continuously is called "duty cycle." Although outboard motors are designed for pleasure craft use, there are extreme demands connected with the load carried and power required and, therefore, these engines have a much shorter duty cycle than an automobile engine. Most marine engine manufacturers recommend a duty cycle of 75% throttle (or 3/4 of the maximum rpm) for a maximum of three hours. Under no circumstances is the engine designed to run at wide open throttle for longer than a minute or two or you can expect engine damage to occur. After a run of three hours (or more), it would be advisable to allow the engine to idle for a few minutes before shutdown to allow the different alloy temperatures to stabilize. This is a must with turbocharged engines.
— *Steve Auger*

What Won't Catch Bass

Q: We are new to sailing. When we put our 30' (9.1m) O'Day away last fall, we unintentionally pulled the outhaul line into the Isomat boom. What is the easiest way to retrieve the line?
Lynn Graves via email

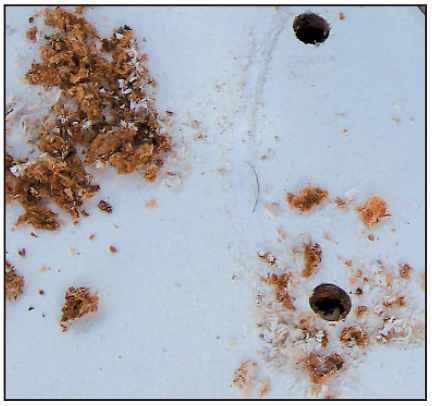
A: The most common method for "fishing" the outhaul through the boom is to first remove the outhaul line completely if it's not already out. Buy, rent or borrow an electrician's "fish." This tool consists of a stiff wire wound onto a closed plastic reel. You can get one at most well-equipped hardware stores or improvise one from wire that is flexible enough to bend around fittings but stiff enough to push without piling up inside the boom. Tie a light line around the end

of the fish wire and push the wire carrying the spare line (messenger) into the boom through either the outhaul entry or exit fitting. Push the messenger all the way to the other end of the boom with the fish. Make a hooked tool from a piece of wire (coat hanger works) and use this to reach through the outhaul fitting, snagging the messenger and pulling a loop of it out through the outhaul fitting. Make sure the line is slack at the free end. This may take some fiddling. Cut the loop to free the messenger from the fish tool and securely tie the line to anything on the boom. Now extract the wire fish. Securely tie (and tape for good measure) one end of the messenger to the outhaul line, making sure you've got the outhaul headed in the right direction, and then gently pull the outhaul line through the boom. Don't haul too hard or the messenger may pull off and you'll have to start over. If it hangs up partway through, roll or shake the boom to free it. When you get to the end fitting, use the hooked tool to help finagle the outhaul line back through the fitting. When the outhaul line is successfully fished back through, remove the string and make sure you tie a knot in the free end of the outhaul.
— *Nick Bailey*

Sound Fix for a Wet Transom

Q: My 1990 Cadorette 210 was sandblasted last fall and now (6 months later), the majority of the hull is dry. The only exception is the area surrounding where the trim tabs were mounted and which I removed before sandblasting. This area is still wet. While hand drying the area using a hair dryer, I noticed some water dripping out of the portside mounting holes. What would be the best course of action to get this area dry quickly?
Scott Hartill, "Misty's Lair," Keswick, Ontario

A: Water dripping out of the transom at the fastener holes is coming from the plywood core of the transom, not the outer skin. Water has seeped into the core, which is probably 1-1/2" (38mm) thick, at a poorly sealed fastener. Because the transom is completely encapsulated with fiberglass, it's difficult to dry out. To speed up the drying process the only method is to expose the plywood core to the air. This means peeling back the glass skin (the inside skin is easiest) and exposing the damp plywood. After the core has dried, the glass skin is relaminated.



Another less invasive but slower technique is to aerate the core by drilling many holes into the damp area of the transom core with a .125" bit. This is done from the inside. Space the holes 1" or 2" (25mm or 50mm) apart and drill as deeply as possible into the core without penetrating the outer glass skin. While drying, keep the boat in a warm dry indoor location. Once dry, seal the perforations on the inside skin with thickened epoxy or polyester resin or lay over glass cloth. What will happen if you ignore the damp spot on the transom? Nothing much for quite a long time. Damp plywood will eventually rot, weakening the transom structure.
— *Nick Bailey*

Wiring Battery Direct

Q: We purchased a 36' (10.9m) 1978 Niagara Nautilus pilothouse sailboat. A refrigeration system with a compressor was wired directly to the house battery with no breaker. Shouldn't this circuit be run through the boat's electrical distribution panel?
Allen Rice, "Hot Fudge," Muskegon, Michigan

A: Absolutely. In general, any equipment should connect to the main elec-

trical panel and be provided with its own dedicated circuit breaker. An exception to this rule would be a bilge pump but, wired direct to a battery, the circuit still must have overcurrent protection (fuse or breaker) to protect the wire.
— John Payne

Barrier Lore

Q: Though my 1979 Trojan F-30 shows no evidence of blistering at this time, when is a barrier coat needed and how long will it last?
John Weathers, "Voyager,"
Stafford, Virginia

A: There is no absolute answer to your question. Barrier coatings are designed to prevent blisters but the occurrence of blistering is unpredictable and subject to many variables. Chances are that, if your boat has been in the same geographic area with the same haulout schedule for many years and has suffered no blistering, it is not likely to anytime soon. Take the boat to a fresh water lake in Georgia and leave it in the water for 20 months straight and it might suddenly develop a blister problem. Some of the variables that affect a particular boat's proclivity for blistering include the quality controls on construction and materials at the time the boat was built, such as the length of time the boat has continuously been in the water and water temperature and salinity content. The next time you haul out have a surveyor inspect the hull bottom and check the moisture levels with a moisture meter after the boat has been out of the water for awhile. High relative (relative to the normally dry hull topsides) readings may give early warning of a potential for hydrolysis of the resin and the resulting blisters. In that case, you can dry the boat out and apply a barrier coating before the blisters have a chance to start. A barrier coat applied to a dry hull helps prevent blisters by preventing water migration into the laminate. Like an insurance policy, it's never a bad idea but you might not ever actually need it.
— Nick Bailey

Fuel/Air Diesel Diagnostics

Q: I have a 42' (12.8m) 1989 Jersey sportfisherman with twin Caterpillar 3208TA, 375 hp diesels. For the past three years, there's been a problem with air getting into the fuel system intermittently on one motor. The engine runs fine at spring start and for about a month and then air gets into the system during an overnight or even after a one-hour shutdown. The motor starts with a second person turning the key while I pump the Cat pump on the engine mounted secondary fuel filter. Once the motor starts, it runs fine and at the specified 2,800 rpm. The primary Racor fuel filter has been checked out for leaks and the motor and all fuel lines show no signs of diesel fuel leaking. Where can the air be coming from on this beast?
Doug Moore, "Retriever,"
Solomons Island, Maryland

A: As the fuel moves from the tanks to the engine, air is being drawn (sucked) in. This is the primary fuel system because it's under a vacuum. Usually, leaks in the primary sector of the fuel delivery system don't show the typical indications, such as fuel dripping or spotting. As the vacuum increases, so does the chance of having an air leak. In the spring, you are likely operating with full

Talkback Q&A

Helpline info@diy-boat.com

fuel tanks and clean Racor fuel/water separator filters. It requires less suction to draw fuel with no filter restriction and the added hydrostatic push of the full fuel weight. As fuel burns off, the vacuum goes up. If the fuel is dirty, solid particles become lodged in the filter element and more suction draws in more air. It's important to study the amount of air trapped in the Racor when this occurs. If the filter has no air, we can conclude that the problem is not on the tank to the filter inlet side of the system and concentrate on the filter and beyond towards the engine. Troubleshooting is made easier with a crossover line between the two engines and filters that allows you to shut off the filter supplying the problem engine and run both engines on the other filter. Also, study the condition and tightness of the flexible fuel supply line running to the engine. This is a very common area for an air leak to occur. Cat engines return high volumes of fuel back to the tank. When the engine starts, following a problem, there is plenty of fuel being delivered to allow the air being sucked in for return to the tank. This allows the engine to operate without shutting down but usually causes hunting (fluctuating rpms) when you slow down, or even a knocking sound. To isolate this problem, single out as much of the system as possible, eliminating bad fittings or connections that admit air.
— Bob Smith

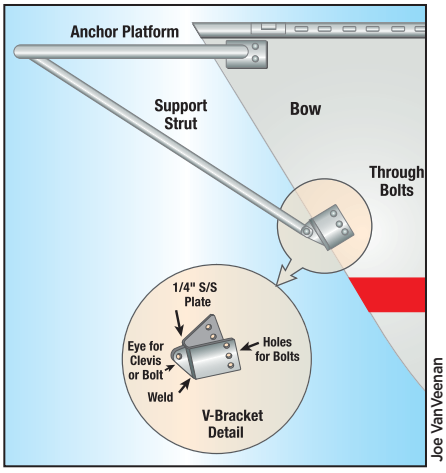
Grounding Outdrives

Q: I have an old OMC sterndrive with a rubber transom boot sealed to the hull with an aluminum ring. I have stainless steel screws through the aluminum into the hull that are causing the aluminum to corrode. Would using another type of screw stop the corrosion?
Bill Gallant, Ipswich, Massachusetts

A: The reason your aluminum ring is corroding is because your sacrificial anodes are not doing the job of protecting the aluminum components of your drive boot. Replace one of the stainless screws with a small stainless-steel bolt and attach a ground wire to the bolt on the inside of the transom with a stainless nut. Attach the other end of this wire to battery ground. Your aluminum ring will now be protected by the sacrificial anodes. A hull potential test will confirm this diagnosis and the repair. (Refer to DIY 2003-#2 issue for how to test your boat's grounding system.)
— Steve Auger

Bow Refit for C&C 35

Q: I want to install a U-bolt to the stem of my C&C 35 Mk I above the waterline that will connect a support for the anchor platform/roller (side load on bolts) and also become an anchoring point for the anchor rode (loaded straight out) to reduce the amount of anchor line required. I need advice on the reasonableness of doing this; size and type of U-bolt; installation process, given the need for keeping it waterproof, not weakening the stem and ensuring the U-bolt won't pull out or distort the holes when under load, perhaps using stainless-steel sleeves?
Don Siddall, "Blue Blazer," Toronto, Ontario



Joe VanVeenan

A: The stem of a C&C 35 is strong enough for the addition of a U-bolt, either 5/16" or 3/8" (8mm or 9mm) for use as an anchor rode attachment provided a decent sized backing plate is used on the inside. A large single eyebolt would even do the trick. However, when it comes to carrying the vertical loads of an anchor platform bashing through waves while carrying 30lb to 70lb (13.6kg to 31.7kg) of anchors, the U-bolt might prove to be a bit skimpy. I would suggest a custom fabricated stainless steel V-shaped bracket that wraps around the stem and fastens with several bolts into the hull on both sides just aft of the stem. This bracket would have a heavy eye welded onto the front to accept the fork and clevis pin (3/8" or 1/2"/9mm or 12mm) at the bottom end of the platform support bar or tube. The real stress factor that comes into play here is not the dead weight of the loaded platform but the constantly changing dynamic loads as the whole mass pulls multiple G's leaping through a steep chop. A single U-bolt or heavy eyebolt might work loose and is likely to eventually elongate the bolt hole in the stem causing leaks or worse. A proper

WHAT'S HUNTING?

According to Bob Smith, DIY's diesel engine advisor, hunting is a term used to describe the action of the injection pump governor when it cannot find a firm idle speed. You could probably better envision it as a rolling variance of speed. It is even sometimes called a gallop (like a horse).

anchor platform support is similar to a bobstay under the bowsprit of a cutter rig and can also provide the necessary vertical support for a very useful addition to the standing rigging: a second (outer) forestay, assuming the anchor platform itself is strong enough to carry the side loads. This is the perfect place for a lightweight reaching sail (maybe with a Code Zero style furler). Above the waterline on the C&C 35 Mk I, the installation is through solid glass so no stainless sleeves are needed. Caulk all the thru bolts thoroughly with 3M 5200, use a large backing plate with Nylock nuts and there should be no problems.
— Nick Bailey

Painting a Metal Bracket

Q: I have a truss style outboard bracket (galvanized steel I think) on my 1981 Campion Alert. What is the best Interlux solution (or other) for repainting this bracket? I run and moor my boat in saltwater year-round.
Jerry Perry, Ahousaht, British Columbia

A: DIY contacted Interlux on Jerry's behalf and received this prompt response from Jim Seidel. "Use a magnet to test the surface: galvanized metal attracts the magnet and aluminum won't. The coating system would be similar for galvanized or aluminum. Galvanized has kind of an oily feel to it so the best suggestion is to thoroughly clean the surface first with Interlux Fiberglass Solvent Wash 202. Sand with coarse emery cloth and then wipe off the sanding residue. Alternatively, have it sandblasted. This works well for prep but requires coating within a couple of hours of blasting to prevent flash rusting, if it's galvanized, or oxidation building up on the aluminum. Immediately apply one thin coat of Viny-Lux Primewash 353/355 thinned 30% with 355 thinner. Wait about an hour and apply 4 to 5 coats of Interprotect 2000E. If it's galvanized, use the same antifouling paint you are using for the bottom. If it's aluminum use Trilux 33 (U.S. only) or Tri-Lux II (available in Canada)."

Removing Bonded Thru-hulls

Q: A recent survey suggested that I replace two thru-hull fittings because they are "badly pitted." They are also firmly attached to the boat. I have tried the Don Casey method of using a bolt through the fitting to a block on the outside, putting on the nut and pulling the fitting out. I tightened the bolt as tight as I dared. No luck. Is there a Plan B? It's on a 1975 fiberglass boat, which is solid glass, not cored.
Mark Carlson, "Goda Tider," Ashland, Wisconsin

A: This is a routine problem. A well-bedded thru-hull will always put up stiff resistance to removal. There are a few different ways to remove a solidly adhered thru-hull. If it's a mushroom style thru-hull (with an external flange), use a grinder with a very coarse disc to carefully buzz away the outer flange. Try not to abrade the hull too much while doing this and wear eye protection. Next, go inside the boat and knock the remaining stub loose with sideways blows from a heavy mallet or dead blow hammer. Another technique used, with or without the removal of the outer flange, is to cut through the wall of the thru-hull from outside the boat using a saber saw (fast) or hacksaw (slow) and then knocking the two pieces loose individually. Cutting or grinding may not be required. Sometimes all that's required to break the sealant grip is a series of heavy blows (using a heavy mallet or dead blow hammer) delivered on the top of the thru-hull from inside the boat. There are various combinations of cutting and smacking and I wouldn't worry too much about hurting the solid glass layup of the hull at the thru-hull. Solid glass is tough and resilient. When it comes to thru-hull removal (especially if the old thru-hull is to be discarded), brute force is usually called for. You should also expect to replace any old backing blocks as well. These will usually need to be ground or chiseled away from the hull.
— Nick Bailey

Running Racing Fuel

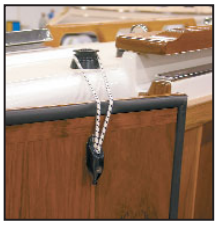
Q: I have two 700 cc, two-stroke Polaris Waverunners. Can I run them with racing fuel (110-plus Octane)? Also, is there any fuel system cleaner that I can run through the system like STP gas treatment? The engines are oil injected, no pre mixing.
Mark Cavanaugh, Eastlake, Ohio

A: You can run racing fuel in two-stroke engines that are designed for that type of fuel. Your PWCs are designed to run on automotive grade fuel. There will not be any advantage in using racing fuel in these stock engines and may even cause major engine damage as the ignition timing and fuel metering are not correct for race fuel. Any name brand fuel system cleaner will work on these engines; however, if you add fuel stabilizer each time you fuel the boat and during storage, a fuel system cleaner should not be required.
— Steve Auger

Tech TIP

WHAT'S THAT METAL
To determine if a tank is made of aluminum or stainless steel, scrape the surface with a nail. If it scratches easily, it's aluminum.

LEAD ACID SPLASH SAFETY
When working with lead acid batteries keep a spray bottle of strong baking soda solution near the batteries to neutralize the acid if a splash should occur on skin, clothing or any nearby equipment.
Alan Porter, "Te Tiaroa," Victoria, British Columbia

SIMPLE RESTRAINT

Install shock cord hangers to securely hold hatch tops or locker and companionway doors in the open position.

PAINT AROUND CORNERS
Trying to reach those far away corners and impossible angles while painting the engine compartment in a small boat is easy if you use long handled barbecue basting brushes, which have a 45° angle on the brush end. You can find these brushes at popular hardware stores.

Bert Small, "Sea Eagle," Salt Spring Island, British Columbia

MANUALS FOR OLDIES
Owner, parts and technical manuals for early BMW, Chris-Craft, Crusader, Cummins, Elco, Faryman, Gray Marine, Hino, Lathrop, Palmer, PCM, Universal and dozens of other gasoline and diesel inboard engines can be purchased at marineengine.com. Prices range from US$18 to US$300.

STUFFING BOX BANDAGE
You can temporarily stem the flow of a severe shaft stuffing box leak by going overboard while the boat is on the hook or grounded at low tide. Take an elastic tension bandage and wind it around and around the shaft and stern tube (presuming that it sticks out a little) to stanch the incoming flow while making repairs.
Hal Roth, "Whisper," St. Michaels, Maryland, republished from the book, "How To Sail Around the World."

REFLECTIVE IDEA
Strips of self-adhesive 3M Scotchlite Reflective Material SOLAS Grade 3150A taped to spinnaker pole ends, deck hardware, the dinghy and especially safety gear provides high nighttime visibility for easy locating.

BECAUSE HEAT RISES
The most efficient passive ventilation system in a boat's cabin is to mount two vents: the intake vent as low as possible, the exhaust vent high on the cabintop.

RECYCLED ROPE TIES
Before tossing out worn out braided line, remove the inner core, cut it into lengths as needed and seal the ends, then use as sail ties, etc.

NOT JUST FOR COWS
Normally used to treat cows udders, Bag Balm, available at farm supply stores, makes a good grease to lubricate turnbuckle screws.

ANODE DO TOUCH
A sacrificial anode may look okay but when touched, it turns to powder. Do touch when checking anode condition.


HANDS FREE OIL CHANGING
Changing oil on my boat's twin OMC 5L engines involved unscrewing the filter cartridge with one hand and with the same hand holding a plastic bag to collect the oil spill, usually unsuccessfully. I purchased an OMC remote mounting kit, mounted the filters upside down on the transom and connected the supplied hoses to the engines. To change oil, I now drill holes in the top (which really is the bottom) of each filter using a cordless drill and the oil drains into the engine sumps, which is easily pumped out into containers and given to the marina for disposal.
Dennis Williamson, Kingston, Ontario

ROLL-UPS

When storing biminis, cockpit enclosures, convertible tops and curtains with plastic windows, lay a towel or sheet between the layers and only roll. Never fold plastic windows.

FRESHEST AID
When you leave the boat, even for a few days, pump a white vinegar and water solution through the potable water and waste holding systems. Be sure to flush the former with freshwater upon your return to remove any vinegar residue.

PIPE CALIPER
When you need to know the diameter of a shaft, pulpit tubing or any other round metal and you don't have calibers, lay a pipe wrench over the tube until it just touches, then measure between the jaws and you have the diameter.

TECH TIPS WANTED
Do you have a boat-tested tip or technique? Send us a photo (if available) and a description, your name, boat name and homeport and mail to:

DIY TECH TIPS
P.O. Box 22473
Alexandria, VA 22304

Or Email to info@diy-boat.com

Reader tips are not tested by DIY, but we won't publish anything we feel might harm you or your boat.

PRO SERIES

KEEPING The Lid On

The hull-to-deck joint fastens the deck the hull. Unfortunately, not all joints are engineered for enduring watertightness. Stress cracks along the joint and interior leaks are the first signs of a problem. Here is a review of the most common hull-to-deck joint configurations and how a professional shop performs repairs and rectifies leaks.

By Nick Bailey

In the beginning and for a long time thereafter boats were just open hulls made from pieces of trees and maybe animal hides or large plant fibers. Later decks were invented because even Vikings get tired of being wet and cold. The hull-to-deck joint has been important ever since.

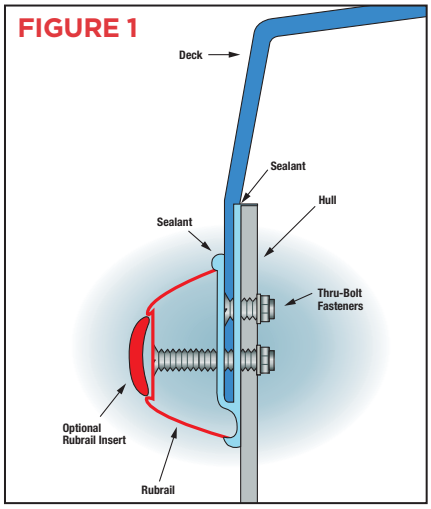
On a wooden boat, the hull-to-deck joint or sheer clamp is just one of the many places where individual parts are carefully fitted and fastened together. These days, however, most of our boats are built of glass fiber and resin, that revolutionary "frozen snot" that the famous designer Francis Herreshoff found so utterly unappealing. Compared to wood construction, molded plastic boats have only a few large parts that need to be bolted, screwed or riveted together. This trend towards minimal mechanical assembly and automation in the boat building process means that soon your favorite boat builder will be popping out one-piece hull-to-deck units out of a high tech mold like many plastic bathtub toys. Some smaller high-volume boats are already built this way. In the meantime, attaching the hull to the deck remains the last bastion of mechanical assembly when creating a boat's outer shell.

A good hull-to-deck joint should be strong, waterproof and from the boat builder's point of view, efficient to assemble. They are not always designed to be taken apart again. Unfortunately, this can complicate collision repair work and make rectifying leaks more difficult. The good news is some of the most difficult joint styles to service are also the least likely to leak and vice versa.

Joint Style: Shoebox

If you own a small to medium size powerboat the "shoebox" joint is the most likely method used to join the hull and deck. The inside diameter of the deck's vertical perimeter flange is slightly larger than the outside diameter of the top of the hull. During assembly the deck is slipped over top of the hull so the deck flange overlaps, much like the lid of a shoebox (**Figure 1**). This joint style is usually close to deck level on a small boat or part way down the hull on a larger boat where what may appear to be the upper part of the hull side is actually part of the deck molding. The two halves are often secured temporarily with pop rivets and then thru-bolted or screwed together. This style of hull-to-deck joint often provides a base for installing a rubrail. The fasteners that secure the hull and deck together may also serve to fasten the rubrail.

FIGURE 1

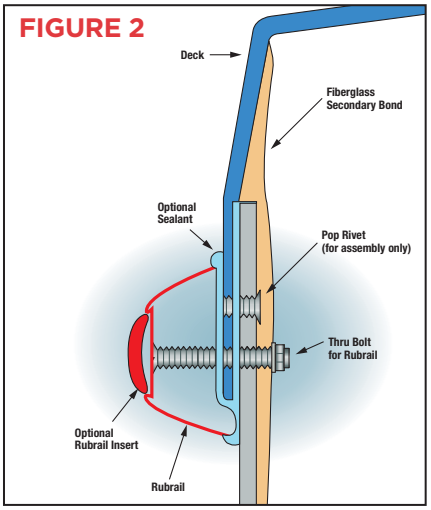


Details of the shoebox joint including fasteners and rubrail style vary according to boat size, manufacturer, boat model, etc.

Shoebox style hull-to-deck joint on a Searay 480. Solid PVC rubrail overlaps joint.

Poorly fitted shoebox style joint at bow on cuddy cruiser is only visible from underneath the PVC rubrail. Filling the 1/2"- (12mm-) wide gap with 3M 5200 sealant will prevent water leaking into interior when bow is buried in rough seas.

The shoebox joint naturally resists rainwater leaks but needs to be sealed against plunging into waves or, if used on a sailboat, against immersion when the boat is heeled. Builders seal the joint in different ways. Sometimes, the only seal is an external bead of silicone along the edges of the rubrail. Other builders apply bedding compound to the overlapping area of the joint. Depending on the adhesive strength of the sealant, this method helps bond the hull and deck together. Some boat builders now use high-strength methacrylate adhesive to bond the joint. The inside of the joint is overlapped with a fiberglass secondary bond (**Figure 2**) on better-built boats (read more expensive). A completely bonded



Melissa Patane

Similar to the joint shown in Figure 1, this shoebox joint is secured and reinforced by fiberglass secondary bond on the inside. In this case, the pop rivets are meant to locate and temporarily hold the joint during assembly and contribute little to the ultimate strength of the joint.

joint is usually immune to leaks from above or below and the bond can be strong enough to make mechanical fasteners redundant

Shoebox Failure Modes and Repairs

On a mechanically fastened hull-to-deck joint, the forces a boat hull is subjected to can loosen the fasteners and enlarge the fastener holes and in some cases create gaps between the hull and deck where the original fit wasn't the best. Leaks are the usual result but, in rare cases where a boat has taken a pounding, the deck can pop loose from the hull. More common is damage resulting from collisions with docks, pilings and other boats. The first victim of a collision is the rubrail and if the impact is severe enough, broken fiberglass at the joint can be expected.

Most hull-to-deck joint damage is due to storms or collisions.

The damaged portion of the rubrail is removed before inspection or repair of the joint. Most aluminum or plastic rubrails consist of a rigid extruded aluminum or semi-rigid vinyl rail with a flexible vinyl insert. The one-piece insert runs from a transom corner forward around the bow and aft to the opposite transom corner. The rail itself is usually discontinuous and comes in 12' (3.6m) sections. If the damage is localized, only one rail section may require replacing. Damage to the insert, however, requires replacing the entire one-piece length.

The insert is held in place by an inner lip that slips into a recess in the rubrail and is usually easily removed by unfastening the retainer clip at the transom

Look for the hull-to-deck joint under the rubrail. Here black vinyl rubrail insert is peeled back to expose the rubrail fasteners (pop rivets).

end and then peeling the insert out of the rail. The damaged rubrail section itself is now unfastened for access to the hull-to-deck joint. This may involve drilling out pop rivets and/or unfastening bolts. If the rubrail and hull-to-deck joint are thru-bolted, you will need access to the nuts on the inside of the boat. Boat builders like to hide unsightly fasteners behind interior fittings like lockers and/or fiberglass liner moldings or soft hull and deck liner materials like carpet, "bunny fur" or vinyl. Lockers can be removed or access holes cut; glued hull liners are peeled back and then reinstalled or patched and plugged as neatly as possible when the job is finished.

Once the rubrail is off the joint, it's closely inspected for damage. A cracked or broken joint is prepped for glass repairs by first separating the deck and hull with wedges. Grinding and laminate renewal are then carried out sep-

(top) The glass repair on this runabout is complete and the hull-to-deck joint is ready for bedding and fastening. Wedges separate the hull and deck to allow glass repairs to the hull and deck portions individually. (bottom) Hull-to-deck joint is sealed with lots of 3M 5200 and fastened this time with thru-bolts instead of pop rivets.

arately on the deck and hull portions, followed by gelcoat repairs. The joint is then clamped back together with lots of polyurethane sealant (3M 5200 or an equivalent) and refastened along with a new rubrail piece if required.

Most bonded hull-to-deck joints, whether glued or glassed, should be immune from leaks unless the joint has been damaged. However, any rubrail fasteners that penetrate the joint might leak. In this case, the rubrail insert is peeled back and the suspect fastener caulked with polyurethane sealant. It usually takes a good whack to disturb this style of joint.

TIP *Buyer Beware the Band-Aid Repair*

A common quick fix for a leaking hull-to-deck joint is to run a thin bead of sealant along either side of the rubrail or toerail where they meet the hull and deck. It's a temporary fix and a good telltale of a leaking joint.

TIP *Joint Maintenance*

This photo shows a shoebox type hull-to-deck joint on a new 22' (6.7m) cuddy cabin cruiser. Note the lack of sealant covering the joint and fasteners, which could lead to water leaks, as well as multiple drilled holes for self-tapping screws. When purchasing a new or used boat, or if your existing boat is more than 10 years old, remove an arm's length of rail section and inspect the joint. If recaulking is needed, use wedges to hold the rail off the hull/deck joint, remove any residual sealant and apply a generous amount of 3M 5200 or 3M 4200 (or equivalent) to clean, dry surfaces.

Some bonded hull-to-deck joints might have a few layers of glass fiber overlapping the joint on the inside as a secondary bond. It may not be possible or desirable to separate the hull and deck for individual glass repair. The joint is treated as a single skin laminate repair and reglassed from inside and outside. The exposed outside part of the repair requires the usual sanding, filling, fairing and high-quality gelcoat refinishing whereas the new work inside may be hidden after reinstalling the liner. Nonetheless, care must taken to make sure the inside repair is not conspicuously lumpy.

Special repair problems arise when a methacrylate joint has debonded but the hull and deck remain intact. Old Laser sailing dinghies are famous for this. Short of removing the deck and starting over, the best repair procedure is to rout out the old adhesive with a rotary tool using a fine bit or manually sanding inside the gap with coarse grit paper. Methacrylate adhesive is then injected into the gap and clamping pressure immediately applied in the repair area. Methacrylate cures very quickly so a large repair area may require a team effort. If rebonding with adhesive is not practical, one option is to prep grind the joint area on the inside of the hull and apply a new fiberglass secondary bond to overlap the joint. This converts the joint from glued to glassed, presuming enough of the damaged area is accessible inside.

Joint Style: Flange

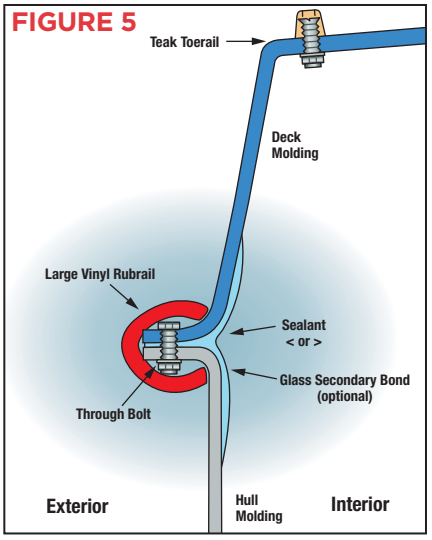
The second type, the flanged hull-to-deck joint, is most often used on sailboats. The two most common types are the inside flange (**Figure 3**) and outside flange (**Figure 4**). Either style works well with an aluminum or wood (usually teak) toerail. These hull-to-deck joints are usually mechanically fastened with thru-bolts that, in most cases, also pass through the toerail. A variation of the outside flange is used when the designer decides to have the hull-to-deck joint partway up the hull side instead of at the sheer line. In this case, the joint is often hidden by a large rubrail (**Figure 5**). Various sealants, from polyurethane to gray butyl tape, are used between the hull and deck at the flange overlap as well as at the thru-bolts. Sealant is also applied under the toerail. As with the shoebox joint, high-end boats often have a fiberglass secondary bond on the inside of the joint.

Flange Failure Mods

The inside flange style is more aesthetically attractive than the outside flange but fasteners terminate inside the boat. This means any leaks at the fasteners and water ends up inside. The outside flange has its fasteners outside the boat, which allows easier access and it may reduce leaks. Regardless, in the event of sealant problems, either joint style can leak into the boat if immersed during the dynamics of rail down, upwind sailing. As with the shoebox joint, a fiberglass secondary bond capping the joint on the inside not only reinforces the joint but also greatly reduces the likelihood of leaks into the cabin.

If hit hard enough both flanged types can be damaged but the outside flange style is also vulnerable to getting hung up on docks and pilings on a falling tide or during storms or when wakes from passing boats "rock the boat." It's not uncommon to see an outside flange suffer from minor stress cracking along the deck edge due to normal flexing particularly if there is any loaded sailing hardware mounted outboard on the flange. This includes slotted toerails carrying the genoa sheet blocks or even stanchions mounted on the toerail.

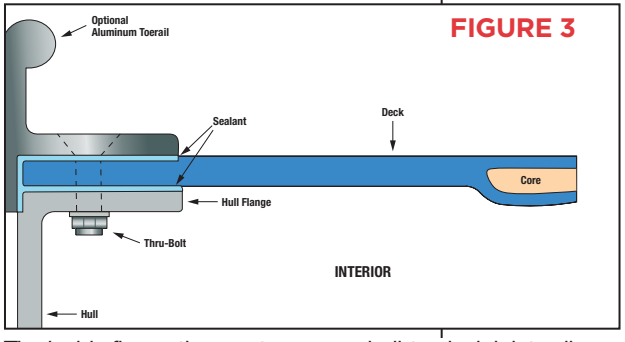
FIGURE 5



Melissa Patane

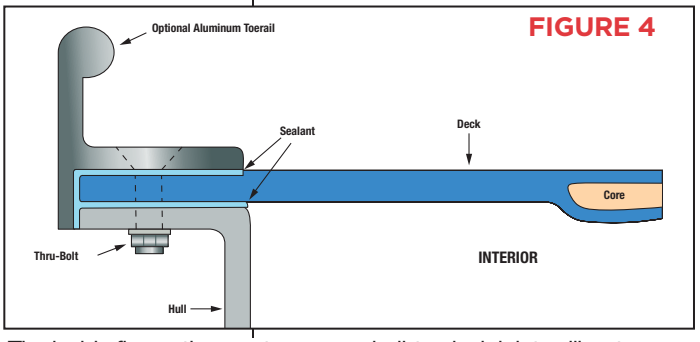
A variant of the outside flange with the joint well below the sheer. Note how the rubrail hides the joint.

FIGURE 3



The inside flange the most common hull-to-deck joint sailboat style.

FIGURE 4



The inside flange the most common hull-to-deck joint sailboat style.

Hairline stress cracks do become an issue when they enlarge and weaken the laminate.

Glass joint repairs follow the general principles outlined above but are complicated by the presence of toerails or rubrails as well as the usual problems of access to the fasteners in the case of the inside flange. [Ed: Refer to articles in DIY 2003-#2 and 2003-#3 issues for more detailed information on collision and toerail repair.]

Butyl Joint Maintenance

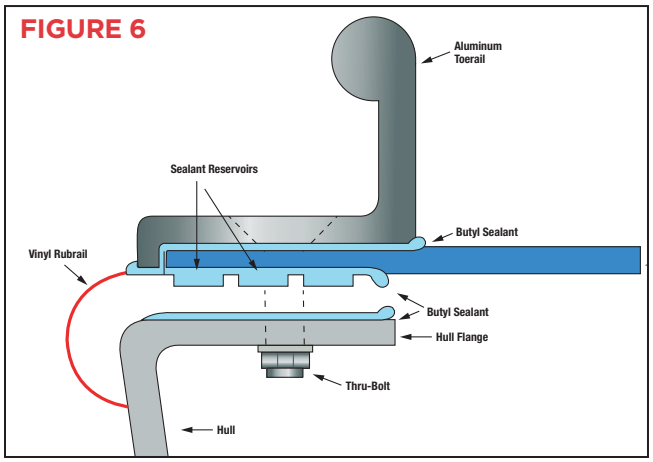
Most hull-to-deck joints never need maintenance, just repairs after leaks are detected or the joint is damaged . Older C&C sailboats and other makes that used rubbery gray butyl tape as a hull-to-deck sealant (**Figure 6**) will require occasional attention. This type of sealant has the consistency of chewing gum and remains pliable and sticky indefinitely. It has a habit of slowly squeezing out or creeping under load. To avoid a hull-to-deck joint that leaks like a sieve, the fasteners need tightening occasionally. This is not a difficult job provided the fasteners are accessible and, on boats of this type, they usually are. Two people are required to do the job. One must be on deck with a screwdriver to hold the bolt and prevent it from turning. The other person is below with a 7/16" socket that fits the UNC 1/4 / 20 bolts typically used in hull-to-deck joints plus a short drive extension. The nut is the only thing tightened. If the bolt is allowed to turn, it can break the seal at the threads and begin leaking. While tightening, one eye is kept on the edge of the butyl protruding from the underside of the hull-to-deck joint. Starting at one end and working towards the other, each nut is tightened until the hull and deck begin to clamp together and the butyl begins to squeeze out of the joint. At this point, tightening stops and the team moves to the next fastener. Don't tighten beyond what is required to reclamp the butyl otherwise it's possible to squeeze too much sealant out of the joint and increase the likelihood of leaks. If a leak does occur at a specific fastener, it's removed, caulked thoroughly with a polyurethane sealant and then reinstalled and tightened as outlined above.

Hull and deck are undergoing reconstruction in close proximity to the deck flange on a Dufour 38.

Hull flange reconstruction on a J-35. The deck flange in this case is relatively undamaged and requires little in way of repairs.

In some cases, the butyl sealant may already be squeezed out from the joint. If leaks are persistent, the hull-to-deck joint must be unfastened, wedged apart and fresh butyl tape applied to the hull flange above and below the vinyl rubrail that is usually fitted between the hull and deck. The fasteners are then tightened again until the butyl begins to squeeze out.

FIGURE 6



The classic C&C Yachts version of the inside flange hull-to-deck joint. This one needs occasional maintenance to avoid leaks.

About the author: Nick Bailey is DIY Magazine's repair specialist who has spent 26 years in the boat repair business and is service manager of Bristol Marine in Mississauga, Ontario.

DIESEL

DIESEL FAQ

Bob Smith, DIY's diesel advisor, owner of American Diesel Corporation and formerly with Lehman Power Corp., provides solutions to a questions submitted to DIY's Technical Helpline.

Edited by Jan Mundy

Perkins Parts Wanted

Q: I just bought a used sailboat with a Perkins Prima M50. I'm having trouble finding a parts dealer here in the North East (New York).
Jim Westpfahl, Lindenhurst, New York

A: Perkins has an extensive list of dealers throughout the world. Unfortunately, not all of the dealers stock parts for all engines marinized by the company over the years. The master dealer for Perkins in the northeast is: W.A. Kraft, 199 Wildwood Avenue, Woburn, MA 01888-2024, Tel: 888/925-7238.

Steaming Bukh

Q: My boat's Bukh DV20 continually emits steam through its exhaust. I have replaced the thermostat and cleaned out almost everything in the cooling system that is accessible and yet it still steams. There is no evidence of water in the engine oil, the engine temperature is normal and the exhaust water approximates the suggested amount according to Bukh specifications. What's next?
Ian Dwight Phillips, "Spectre," NSW, Australia

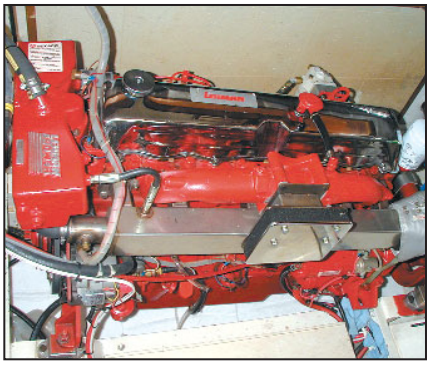
A: I know it's difficult to believe that things are normal whilst a cloud of steam follows your boat. If the gauges confirm all to be normal and the engine exhaust emitted out the thru-hull is cool to the touch, this should put your mind at ease. So, what creates this cloud of steam? If your engine has a cast metal exhaust elbow or riser, it might have corroded from the inside, creating a restriction to the water normally blended into the exhaust at the elbow's end. As the rust worsens, the elbow develops a crack, thus allowing a fine, high-pressure injection of cooling water into the hot gases. This water curtain effect produces steam, or as most victims call it "white smoke." If the piping is fabricated, not cast, the point of injection should be examined for size and condition. Remove the exhaust hose at the point of exit from the engine and check for rust or a restricted elbow. By the way, if it's a cast iron riser check it soon. If it lets go, water will flood the cylinders.

Larry Blais

Cutaway of an exhaust elbow. In saltwater, cast iron elbows can rust through the inner wall.

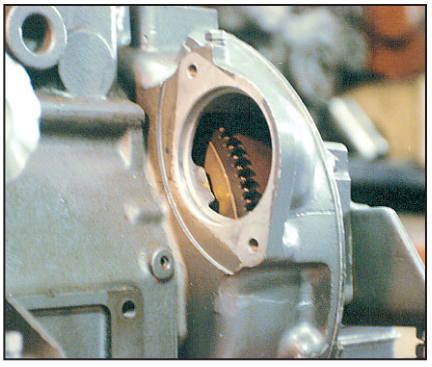
Hard Starting Ford Lehman

Q: We have a problem starting our Ford Lehman when the engine is cold or has been idle for more than 24 hours. Compression is at 390 on all cylinders. The starter was overhauled. We installed a new mechanical lift pump, have a Racor fuel/water separating filter as the primary filter and Algae-X. Timing and valves are as per specs and there are no fuel leaks. Batteries are new and we inspected,



cleaned and tightened all cables and terminals. If the engine has not been started for a week or more and I plug in the block heater for 80 minutes, the engine starts immediately without the use of the cold start button and with a minimal amount of blue smoke. Also, the engine starts immediately when using the cold start, no matter how long it has been since the last start, one day or one week, no matter. I'm reluctant to use the cold start, especially during the summer in a crowded anchorage, due to the huge cloud of smoke created by the use of the cold start button. My mechanic and I tried all the suggestions as per the Ford Lehman manual, including: installing an electric fuel pump on a trial basis to see if this would solve the problem; checking the cable stop lever system and advancing the timing to 23 btdc but there's no change in the hard starting. Is this an inherent problem with these engines?
Joe Larche, "Chez Nous," Campbell River, British Columbia

A: Having built and supplied over 20,000 Ford Lehmans, I can assure you that hard start after a few days of idle time is not a common problem. There is something wrong when this situation persists. Reset the timing to 20° before you do anything else. Now, I know this might sound stupid, but I



want you to remove the remote stop cable and then put the lever all the way aft to the full run position. Now, try to start the engine. When the engine has been sitting and would likely be hard to start, check the secondary fuel filter bleed screws for air. If none found, check the injection pump bleed screws for air. If none found, disconnect whatever is connected to the stop lever on the injection pump. This might be a rod from the electric stop solenoid or a remote cable attachment. With the stop lever free from its external control, slide the lever all the way aft (towards the flywheel). With the stop arm all the way aft, open the throttle wide (all the way forward). Now, push in the little rubber booted button in the center of the stop lever until it clicks. Reduce the throttle to normal start position and start the engine.

HOW DID IT WORK?

Joe replies: We did as you suggested but the engine cranked repeatedly, same as before, before starting. One thing is different. Now, we now have a large fuel oil slick as well as a large cloud of blue smoke when it finally does fire up. Why, if I plug in the block heater for 80 minutes or so, does the engine fire up at once?

Bob replies: From everything you're telling me, the effects are those of low compression. Fuel is being injected but will not fire, resulting in blue smoke and fuel on the water. Running the block heater enlarges the aluminum pistons, raising the compression so it starts. Is the cranking speed too low? This can cause the same low compression. Unfortunately, none of the Ford manuals show what cranking speed to expect. The compression standard called for is 360 lb at 215 rpm. Glazed cylinder walls may also be the cause. Many Lehman owners overfilled the crankcases by filling to the mark on the dipstick instead of filling to 12 quarts (11L) with a filter and remarking the stick. The most common Lehman engines to experience this glaze were the 1968 to 1971 2704E models, 363 cubic-inch displacement with dry liners. The liners are hard and the rings don't seat. If the cold compression is great, there is just an outside chance that someone has messed with the fuel calibration of the injection pump. I saw this only once in 40 years. They broke the seal on the pump (just forward of the slotted oil fill plug) and then turned the screw. This calibration is meant to be done only on a machine, not in the field. If you know that this has been done, let me know.

Cleaner Running

Q: I am running a 1979 Perkins 6/354 diesel that leaves a slight smog behind the vessel when running at cruise. I have been told that, if I run the engine on stove or furnace oil, this smog will disappear due to a hotter burn from higher octane. My inquiries of many local sources yielded answers in the range of confirmation to total disaster. Can I get you folks to weigh in on the subject?
Ron MacLeod via email

A: Putting my experience hat in the ring compels me to say that what you were told is wrong. Normally, the No. 2 motor fuel your Perkins diesel engine likes is cracked more finely than No. 2 heating oil would be. Knowing your fuel supplier and what he offers is very important. Amoco supplies the cleanest running fuel you can buy in the U.S. Cetane not octane is the measure of fuel heat. Sulfur content of the fuel is a very important factor. If you have clean, fresh fuel and add Marvel Mystery Oil at a rate of 1 quart per 100 gallons (946ml per 378L) of fuel, your chances of a smooth and clean running engine are good. There is a time when injectors and injection pumps will need service. Also, a propeller that is too large for the power of the engine will cause smoking. This is identified when the engine will not reach the 2,700-rpm rated at wide-open throttle underway. High engine hours and infrequent cleaning of the injectors are other considerations.

Why Low Engine Revs

Q: We are looking at a 1989 35ft Chien Hwa trawler with a single Perkins 135 (4,160 hours). The motor will not rev above 1,200 rpm. We are being told it's a fuel problem. Change the filters; polish the fuel and all will be well. What else could also cause a low revving condition?
Bill Restivo, Kinmount, Ontario

A: You need to conduct a series of checks to diagnose the problem. Is the 1,200 rpm underway running with wide-open throttle? Is shifter in neutral? If not, have you tried disconnecting the throttle cable from the injection pump lever and then operating it by hand? With the throttle full open, will the engine turn about 2,900 rpm? Does the engine start and run well? Does it blow black smoke after you get to 1,200 rpm and throttle is traveled further forward? When were the propeller and bottom last cleaned? Could bottom fouling be holding down the engine? What did the engine turn previously and has the boat speed changed dramatically? Is it possible that the propeller has been damaged? Has the alternator been changed recently without recalibrating the tachometer? Has the engine ever stopped running? You will note that I have not gone to the obvious conclusion of dirty fuel filters. This is because I assume that a restriction of fuel flow, which will starve the engine of fuel needed to make horsepower, would have been the first thing you checked and that your normal maintenance routine would have dictated doing so. The primary and secondary filters should have been changed first thing.

Check primary and secondary fuel filters first when engine is fuel starved.

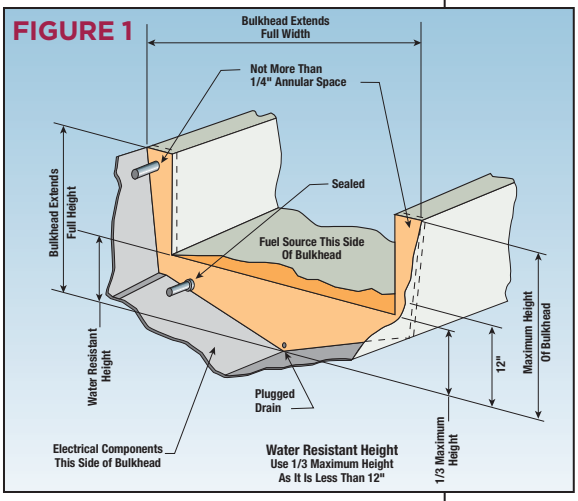
ELECTRICAL

Is Your Boat Ignition Protected?

All electrical components exposed to a potentially explosive environment must be ignition protected. At risk of an explosion and/or fire are older boats with electrical devices added by previous owners and newer boats with replacement and add-on parts. Here's how to explosion-proof your boat and minimize that risk.

By Susan Canfield

Anytime you have gasoline onboard a boat, there's an inherent risk of explosion and/or flash fire occurring if gasoline vapors are present and there is a source of ignition such as a spark.



ABYC Electrical Compliance Guideline

Isolation bulkheads must be water resistant (and vapor tight) for at least one-third of their height, or 12" (30cm), whichever is less. Openings above the water-resistant height of an isolation bulkhead must not have more than a 1/4" (6mm) wide space around whatever passes through the bulkhead, e.g., wiring, piping, etc.

That's why U.S. federal law requires builders of gasoline-powered boats to install ignition protected electrical components in these potentially explosive environments.

Ignition protected components are designed and constructed so they won't ignite a flammable hydrocarbon mixture — gasoline, propane (LPG) or CNG and oxygen — under normal operating conditions. Ignition protection of electrical components is achieved using seals, flame arrestors and/or potting (encapsulation) to prevent sparks from escaping when the equipment is operating. To be able to label their electrical products as "ignition protected," manufacturers must obtain independent third-party certification in accordance with specified Society of Automotive Engineers (SAE J1171), Underwriters Laboratories (UL 1500) or United States Coast Guard (USCG) test procedures.

While it's generally safe to presume that a new boat from a reputable builder has been constructed in compliance with federal law and that installed electrical components exposed to a potentially explosive environment are ignition protected as required, that status can easily be compromised by aftermarket modifications to the boat's structure or equipment. Your awareness of the risk of explosion and/or fire and the knowledge of the what's required to minimize that risk are essential to the continued safe operation of your boat.

Onboard Inspection

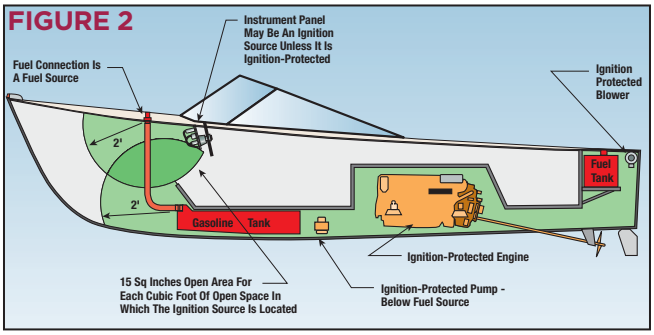
If your boat has a gasoline fueled inboard engine (propulsion or generator) or a permanently installed fuel tank, include ignition protection on your annual fuel system checklist. While the federal law is intended to apply solely to boat builders (new boats), compliance has been a key factor in preventing explosions and fires triggered by the deadly combination of explosive vapors and an ignition source. Even though the law does not apply to the individual boat owner, you would be, quite literally, playing with fire to compromise the built in safety features by cheaping out with non-complying equipment when carrying out routine maintenance procedures and doing your own repairs. ABYC standards, which equal and/or exceed the federal requirement but are not enforceable as law, do not make this distinction and are intended to apply to builders, repairers and boaters servicing or maintaining a boat. (Boats with diesel engines are not exempt if an ignition source, LPG for example, is located in the engine compartment.) Start by identifying the potential sources of a gasoline fuel leak. These include piping connections at fuel fill fittings, tanks, tank vent fittings and engines, as well as any other connections that may be found in between.

Next, evaluate the degree to which electrical components are isolated from the potential sources of a fuel leak you have identified. Fuel vapors are heavier than air and will tend to settle in low areas. If not isolated from potential fuel sources by bulkheads, decks or special enclosures, electrical components must be ignition protected. The only permitted exception to this requirement is for components installed at least 2' (61cm) away from a gasoline fuel source in compartments that are open to the atmosphere. A compartment is considered "open to the atmosphere" if it has an unobstructed opening of at least 15 sq. in. (97 sq. cm), to the environment outside the boat, for every square foot (square .09m) of compartment volume.

Isolating Fuel Sources

Isolation bulkheads must effectively close off one space from another. They must be closely fitted to the top, sides and bottom of the space being closed off. By law, isolation bulkheads must be water resistant (and vapor tight) for at least one-third of their height, or 12" (30cm), whichever is less. For example, if the total height of a bulkhead is 30" (76cm), then its water-resistant height must be at least 10" (25cm). If a bulkhead is 60" (1.5m) high, its water-resistant height must be at least 12" (30cm).

Any openings below the water-resistant height of an isolation bulkhead for



The switches in the dashboard are within 2' (61cm) of both the fuel fill fitting in the foredeck and fuel hose connection at the fuel tank. Since both of these connections are potential sources of a fuel leak, all dashboard switches must be ignition protected.

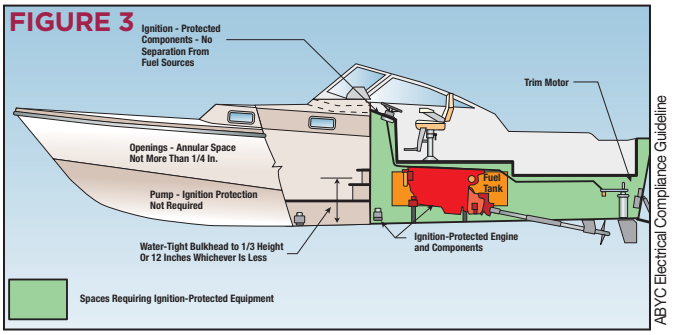
wiring, piping, controls, doors, hatches, access panels, or drains, must be sealed or have a fitting to minimize seepage. There should be no limber holes. By law, the maximum seepage permitted for all bulkhead openings and edges may not exceed 1/4 ounce or about 2 tsp (7ml) of water per hour.

Per USCG policy, "Any hole installed for drainage in an isolation bulkhead must be fitted with a plug or sealing device that is intended to be in place when the boat is being used. The plug or sealing device must be attached to the drain fitting or bulkhead near the drain hole so that it will not be lost. It must be understood that when this drain hole is open, the isolation integrity of the bulkhead has been breached causing a potentially hazardous condition. It is the responsibility of the boat manufacturer to make this intent known to the consumer via means such as labeling, information in a boat owner's manual, etc."

Openings above the water-resistant height of an isolation bulkhead should not have more than a 1/4" (6mm) wide space around whatever passes through the bulkhead, e.g., wiring, piping, etc. Openings in bulkheads around engines and their exhaust systems require special attention since they must also be sealed to prevent the passage of carbon monoxide gas. Figure 1 depicts many of the attributes of an isolation bulkhead.

An electrical component can also be isolated from a potential gasoline fuel source by a deck located between the two, or by means of an enclosure. If the electrical component is installed below the fuel source, the isolation deck or enclosure must be water (and vapor) tight. If the component is located above the fuel source, then there must be a deck or enclosure to provide isolation, but it need not be water or vapor tight.

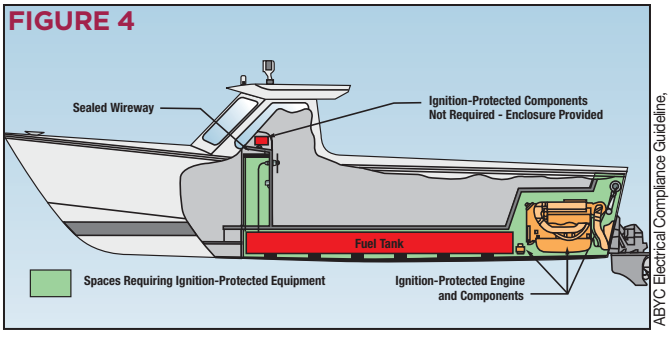
As you evaluate your boat's isolation bulkheads, floors and enclosures, pay particular attention to any aftermarket modifications to these structures that may have compromised their ability to isolate electrical components from potential fuel sources. **Figures 2, 3 and 4** illustrate the use of isolation bulkheads, decks and enclosures.



An enclosure is provided to isolate electrical components at the helm; they need not be ignition protected. However, the bilge pump, blower and engine electrical components must be ignition protected.

Checks and Tests

Once you have determined which electrical components on your boat are not isolated from potential fuel sources, verify that those components are ignition protected. Photos on the opposite page show typical "ignition protected" labeling of electrical components. If you can't find a similar label on an electrical component, or verify its ignition protected status by reading the owners manual or by calling the manufacturer, the only safe assumption is that it is not. To minimize



Electrical components in the engine compartment require ignition protection, however, given the isolation bulkhead forward of the engine, the bilge pump need not be.

COST FACTORS

An automotive alternator, distributor or starter sells for half the price or less of an equivalent marine ignition-protected unit. The cost of a rebuilt starter that is ignition protected but not certified to that protection can shave $100 off the bill. You'll save a bundle purchasing a household air conditioner versus a marine one. Valid considerations for sure but what could happen if that non-ignition-protected starter attached to a gasoline engine should spark? Or a non-ignition-protected air conditioner was placed with the lead-acid (hydrogen gas) battery that powers the bow thruster or windlass in the same locker? How about the budget RV water heater to replace the rusted one in your gasoline engine space? Don't be tempted to take the risk. The extra cost of the protection provided by certified marine ignition-protected equipment is a best buy in boating. There are many reasons for the higher price of marine ignition-protected electrical components. Production runs are small compared to automotive. Manufacturers must shell out additional fees for extensive UL and SAE testing and certification. Additionally, ignition-protected units are periodically pulled off production lines and tested to insure they meet standards.

— Jan Mundy

(left) This high amperage circuit breaker is ignition protected as it conforms to SAE J117. (right) This water pump's label states that it complies with USCG and International Standards Organization (ISO) regulations for marine ignition protection. (bottom) The manufacturer's label says this marine water heater is ignition protected. Information on the specific testing criteria met will likely be found in the accompanying owner's manual.

the risk of explosion, any component not in compliance with the law should be replaced. Electrical components produced for the automotive and recreational vehicle (RV) markets are typically not ignition protected, e.g., starters, alternators, fuel pumps, distributors, water pumps and water heaters, to name a few. Since many of these products are also marketed to boaters, it's truly a case of buyer beware.

Gas Hazards

When combined with oxygen, both propane and CNG can also explode if ignited. Boats with LPG or CNG piping connections belowdecks (other than at an appliance located in an accommodation space) are very likely operating at increased risk. Should vapor leak from one of these connections, a non-ignition protected electrical component or internal combustion engine located in the same compartment could potentially trigger an explosion. Boat owners should refer to the appropriate ABYC standard for further guidance in correcting such a situation. Gasoline containers and reserve LPG or CNG cylinders also pose a significant hazard belowdecks if not stowed in an appropriately vented enclosure or locker that meets or exceeds ABYC standards.

About the author: Susan Canfield is a marine surveyor in Annapolis, Maryland. A frequent DIY contributor, she also teaches "Surveying Fiberglass Boats" at WoodenBoat School in Brooklin, Maine.

WATERMARKS

Finding and Keeping the Water Out

Water, when trapped, becomes a foul enemy in boats. It eventually breaks down fiberglass laminates, rots or delaminates wood, eats away at critical metal fittings — all circumstances that can lead to failures that break both the boat and the bank. Learn how water gets in, the damage it causes and what you can do to prevent it.

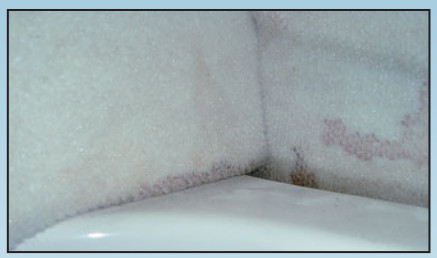
Story and photos by Pat Kearns

"Keep the boat off the rocks. Keep the water out of the boat. Everything else can be fixed." I don't know the source of this quoted intelligence but can attribute it to a very wise and realistic creator. Keeping water out of the boat is a more complicated process than most boaters anticipate. Unlike bilgewater, which is easy to remove with pumps when it does get in, water that migrates into other areas of a boat's structure is not as simple a matter. Let's explore some of the most common problems that involve water that gets in and doesn't go out, a.k.a. "moisture intrusion." Nice, seemingly innocuous words for a nasty and potentially expensive problem that's better prevented.

"It's an all fiberglass boat." That's a famous assumption that can really bite you in the wallet. Relatively few boats are all fiberglass. Most boats comprise other materials such as plywood, balsa core and wood in some form wrapped in fiberglass. These materials add strength and stiffness and reinforce the fiberglass panels. This construction is known as fiberglass reinforced plastic (FRP), a layered structure with laminations of multiple materials and/or the inclusion of a core sandwiched between two layers (skins) of fiberglass. What you see is fiberglass or gelcoat, the pigmented resin outer skin. What you have is a composite component of the deck, hull, rudder (in sailboats), stringers, transom and engine bearers.

Boat builders wrap wood in fiberglass to achieve a desired or necessary thickness for strength and/or compression resistance. In a powerboat transom, for instance, where a stern drive or outboard motor is installed, a fiberglass lay-up alone would have to be so thick that weight and cost would be prohibitive. So, builders use other materials to reinforce the panel; typically, by laminating a core of plywood to stiffen the panel without adding the undesirable weight. It's a good manufacturing compromise, provided the wood remains totally sealed inside the fiberglass. Therein lies the rub. When (and it will happen) the inevitable wear caused by vibration and movement from normal operating dynamics results in the composite laminate working, water will seek its opportunity to invade the structure. The dynamic of normal boating activity stresses the part, which, over time, begins to separate and that separation, at any point, provides tiny, sometimes microscopic paths for water to get into the structure. That's where "moisture intrusion" comes on scene. On new boats, there is a much more conscientious effort on the part of the best boat builders to seal every possible pathway where moisture can enter a composite structure but the normal oscillation dynamic that every boat undergoes eventually works to separate and unseal a FRP laminate sandwich with wood as the filling. Metals that travel though a wet laminate can also be affected by insidious, trapped moisture. A classic example of this is on a sailboat where stainless-steel chainplates pass through a cored deck. That flat stainless bar can look like Swiss cheese where crevice corrosion has eaten the metal away. More masts have toppled because of this kind of corrosion than have been lost to the forces of nature.

The real trick for the boat owner is to be aware of the potential for moisture intrusion, be vigilant in the quest for symptoms of a problem and diligent in doing the necessary preventive maintenance to limit the potential for damage. Make sure that the water that comes around goes away "like water off a duck's back" with little or no chance of seeping and creeping into the tiny cracks and crevices around a stern drive's transom assembly, a cleat or a hatch on deck, a chainplate's (sailboat) passage through the deck, at the hawse hole for the anchor rode, the windlass installation, into a fiberglass rudder molding via the rudder post, to cite just a few of the places water can migrate where it's not wanted. How does the water get in? It all starts with a hole. Holes intentionally made for fittings and equipment are the primary potential sources of water



Water leaks at portlights have traveled to wet the headliner as seen by the unattractive staining.

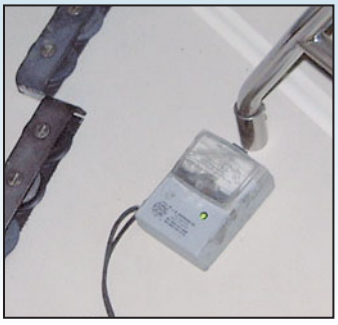
The air-conditioner compressor condensate collection pan didn't drain properly and trapped water overflowed and soaked the carpet (under the fire extinguisher). Boat owner was unable to determine the source of the water.

Condensate drain for this refrigerator was plugged and water had been leaking onto to plywood cabin sole beneath carpet. Flooring and plywood subfloor have both delaminated.

ingress, especially if the boat builder was not obsessive about taking those extra steps to seal the openings to prevent water from migrating into the core. [Ed: DIY recommends the recaulking of all deck and hull hardware minimum every 10 years and to sample fittings on just purchased new and used boats to check sealant condition.]

Hull Survey

Cored hulls are vulnerable to damage from moisture intrusion at any point where the hull has been penetrated. Thru-hull fittings, bolts for a strut, swim platform mountings, stern drive, trim tabs, senders and transducers, any hardware that results in an opening, all influence the watertight integrity of the hull. Before you buy any boat with a cored hull, find out how the builder deals with the hull penetrations. If it's a used boat, your surveyor should know its vulnerabilities and take a close look at the areas around hull penetrations for evidence of delamination. A moisture meter comes in handy here. [Ed: For complete details on how to repair delaminated cored hulls, refer to DIY 2000-#3 issue.]



This US$300 Overseas GRP 33 diagnostic tool is a boat owner's best friend. Use it to check the condition of your FRP deck and hull a few times a year.

Transom Flaws

Plywood remains the reinforcement material of choice for composite transoms on stern drive and outboard-powered boats. Plywood encapsulated in a FRP sandwich gives the boat builder the thickness, stiffness and compressive strength needed to withstand the load demand from the engines. Boat owners must be aware that such loads create constant stress on the structure. Stress develops pathways for moisture to work its way around and behind machinery and hardware mountings and into the core. The problem is easy to identify and the fix is pretty straightforward, albeit expensive. [Ed: Step-by-step details on transom core replacement appear in DIY 1998-#4 issue.]

Swim ladder mounting on FRP platform on a four-year-old boat. View is of underside at ladder mounting bolts. Water has worked its way into the cored area of the platform molding. Trapped water has corroded all of the ladder mounting hardware.

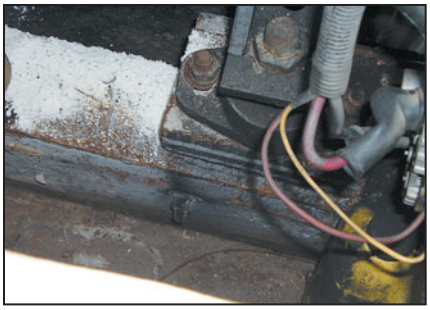
Prevention is the key to avoiding core damage. As with any hardware that penetrates an opening in the hull, these instal-

Core is soaked and the swelling and working of the structure under the outboard motor load has caused the structure to separate as seen by the crack along the top of the transom cutout. This transom needs a complete rebuild.

lations must be periodically removed, rebed and reset in place to assure watertight integrity. Even the smallest of cracks around a stern drive's transom assembly can be a riverbed for water migration. The potential for damage to a transom is not limited to boats with outboards and stern drives. Bolts used to mount swim platforms, ladders, trim tabs, etc. are also points of entry for water. Not all water that makes its way into a transom comes from seawater, either. Bilgewater can migrate into the transom structure where the ends of longitudinal stringers butt to the inside of the transom. That water often makes its way through poorly sealed limber holes in the stringers. It migrates aft through stringers and makes tracks through the inner FRP skin of the transom and into the core.

Stringers and Mounts

Encapsulated wood inside FRP stringers and engine bearers is another area that requires regular monitoring to ensure that



Torquing engine mount bracket bolts at the bearers resulted in compressing the bearers as well as the need for continual engine realignment. The more the bearers were compressed, the more water that intruded. Encapsulated wood was completely rotted.

Aft portion of FRP keel is a hollow cavity filled with foam but not sealed at the top inside the hull. Over the years, bilgewater saturated the foam, which triggered delamination of the laminate. It was only noticed when water trickled out after dinging the keel at the lowest spot.

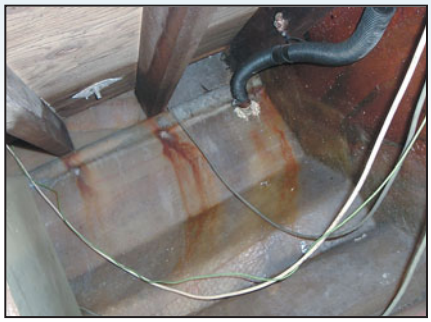
the hull's skeleton remains strong and that the engine(s) are properly supported. Water generally enters this structure through unsealed limber holes. These holes are intended to drain bilgewater accumulations to the main bilge for pick-up and discharge by the bilge pump(s). The problem comes when bilgewater levels are consistently high, keeping water in the holes instead of passing through them. Those limber holes should be sealed but often the wood inside the FRP lapping to the hull is exposed. Another place of water intrusion is the engine mounts themselves and/or the bracket mountings to which the mounts are fastened and which are subsequently fastened to the bearers. Corroded engine mount bolts (where the bolts pass through the bearers) are a good indication that water has invaded the bearer. In this case, the bolts should be removed and inspected immediately. Rotted stringers are usually a huge surprise to a boater who thinks he owns a healthy fiberglass boat.

Rudder (in sailboats) Blowout

The sailboat rudder molding sustains constant stress under the high loading of steering the boat. Its support usually passes through and/or into the molding at the top, sometimes with support at the bottom of the rudder blade as well as with long keeled designs. In any case, the seal at the top penetration of the rudderpost is at risk for water intrusion. The problem does not rest with the water going in if it goes out but rather with water that

Anchor rode leading to rope locker in forepeak. Opening is not sealed and wood core is wet. It's not too late for this situation to be addressed proactively.

Bolt penetrating deck has created a path for water. Rust staining tells the tale.



Rust is weeping from the fasteners that attach the rubrail on the outside of this hull. Rail has started to rot, plywood deck at shear is also wet, and backing plate and bolt are corroding.

Leaky chainplate (water staining visible at base of chainplate gusset) allowed water to pool and migrate to locker joinery, which is now ruined.

becomes trapped within the molding where it can attack the molding, separating the laminate and corrode the metal structural braces, including the rudderstock. In cold climates, water-soaked rudders swell as the water freezes and expands, forcing the laminate apart, a condition that is visually evidenced by

Plywood core can be seen at the hawsehole opening under the windlass gypsy. Plywood is not sealed and will eventually be subjected to water intrusion and, ultimately, rot. Highly loaded windlass mounting surface will likely suffer as well.

cracks and/or large bulges in the outer skin and water leaking at the base of the molding where cracks have opened under pressure. When that water appears black or brown, you also face the likelihood of corrosion of the internal metal support and/or rudderstock. The fix? Rebuild or replace the molding. Just as important is to make sure the rudderstock, often stainless steel, is intact. Stainless steel suffers crevice corrosion when deprived of oxygen and water in a rudder molding is the ideal environment for this type of corrosion to thrive. [Ed: Three issues of DIY contain information on rudder repair: 2000-#3, 2001-#3, 2002-#3.]

Deck

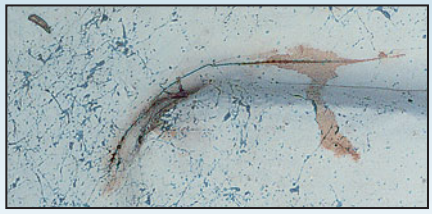
Boat builders carefully mold a deck to be watertight and then, in the process of fitting out the boat, put zillions of holes in it to install cleats, windlasses, sailboat standing and running rigging hardware, rail and lifeline stanchions, deck fittings for tanks and a whole boatload of other accessories necessary to fit the boat for duty. Conscientious builders take special precautions to seal the areas where they install deck fittings, particularly those that can expect high loading. In these areas, the wood core, usually plywood or balsa, is removed and the laminate reinforced with solid resin, fiberglass or other form of a seal so that no core is exposed. If that is not done, then every penetration is a potential point of water intrusion.

Monitoring the situation is relatively easy with a moisture meter. Routine metering can be an excellent investment in preserving the structural integrity of a composite FRP deck molding. [Ed: On older boats without the core properly sealed at deck hardware or when adding new fittings, always prep the deck by removing the core underlying the fitting and filling with solid epoxy resin. This is known as "potting" and is outlined in DIY 2000-#3 issue.]

Once you hear that telltale dull thud heard under the face of a hammer used in percussion sounding or, worse yet, you see water squishing out from under a deck fitting or a nasty brown goo oozing from a sailboat chainplate bolt, it's too late for prevention. Watch for the formation of tiny, hairline cracks at the bases of deck fittings and hatches. These cracks are screaming to you that the deck is flexing beneath them and that you must take action now. If the fittings are moving and the moving is causing the cracks, then water is finding its way into the FRP substrate.

Most boaters worry a great deal about keeping big water out of the boat, the kind of water that leads to sinking, the wave that overtakes them in rough seas, hurricane driven rains and other dramatic events. Truth be told, on a day-to-day basis, there is more to worry about, in terms of damage to the boat and its value, from the water that gets into those tiny, almost invisible cracks and crevices that develop as a boat ages. Sooner or later, extensive water damage occurs unless you are fastidious about the proactive maintenance that can deter or defer the unrelenting quest of water to find a path into a fiberglass laminate. Fortunately, most damage can be prevented and, if it hasn't been, "everything can be fixed."

Bolts penetrating foredeck at the windlass installation have been leaking, resulting in wet core and corroded bolts.



Brown ooze seeping out of the laminate indicates advanced stages of delamination.

About the author: Patricia Kearns formerly was assistant technical director of ABYC. She is a NAMS certified marine surveyor and operates Recreational Marine Experts Group, a marine surveying and consulting firm based in Naples, Florida. She also is DIY's copy and technical editor.

ELECTRONICS

MAKING THE GPS CONNECTION

The first step in operating charting software is to ensure the "talker" speaks the same language as the "listener." Here's a look at the common mistakes in connecting a GPS to a computer and some troubleshooting tips.

By David Anderson

Wouldn't it be great if you simply connected the blue and green wires from your GPS to the blue and green wires in the serial interface cable and then you turned on the computer to see your boat's course plotted on the correct computer chart? In most cases, getting a GPS to "talk" to a computer is fairly simple. Problems arise because of the way GPS manufacturers interpret the voluntary NMEA 0183 standards or because of the myriad types of computers and the way their serial (Com) ports are configured.

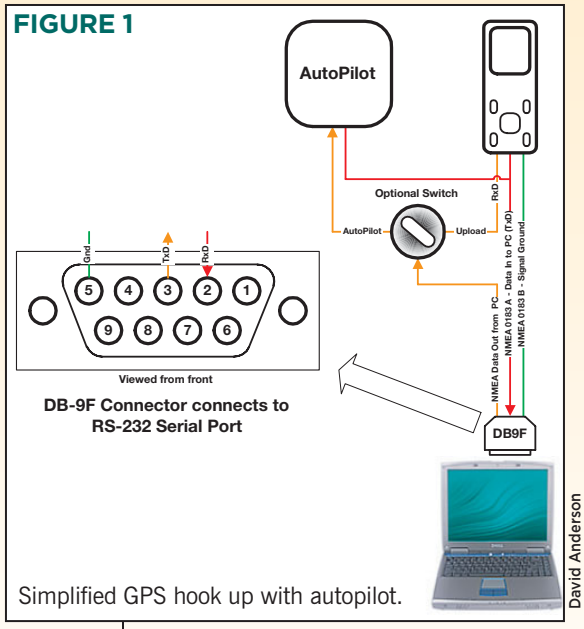
The first step is to set up the GPS correctly and then establish which wires are used to transmit data. Next, determine which wires in the serial interface cable are used to receive data. The GPS manual and the instructions for the navigation software cable interfacing will guide you. If you need more help, a phone call or visit to the manufacturer's web site will usually clarify things. **Figure 1** illustrates a simplified GPS hookup with an optional switch for sending information to an autopilot.

Most GPS units have I/O terminals and a cable for connecting to other devices. To transmit information from the GPS to the computer, connect the GPS signal ground wire (SG) to the serial port ground wire (NMEA B line). Next connect the GPS transmit data (TXD) to the serial port receive wire (NMEA A line). If you intend to upload data, such as waypoints and routes, from the navigation software to the GPS, you will need to connect the GPS receive data (RXD) wire to the serial transmit wire. Not all navigation programs or GPS units allow data uploading. These wires are identified by color code in the user's guide.

THE SERIAL INTERFACE

To connect a GPS Receiver to a PC, the internal transistor transistor togic (TTL) signal levels of the receiver for which the standard levels are 0 volts (space) and 5 volts (mark), must be converted to the RS-232 signal levels used by the serial interface. The standard voltage levels for data signals are +5 to + 25 volts (space) and -5 to -25 volts (mark).

FIGURE 1



Simplified GPS hook up with autopilot.

David Anderson

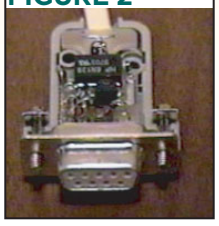
Opto Isolation

Navigation and electronic charting programs have a serial interface cable. Most manufacturers include the cable with the software, though some charge extra for it. Software companies also offer (for an additional charge) an optional opto-isolated cable, which I highly recommend.

An opto-isolated NMEA cable provides a communications link that has no electrical connections between the GPS and the communications port. Isolation is an important consideration in systems using different power sources, systems with noisy signals or systems that operate at different ground potentials. In a data logging or acquisition system, an opto-isolated NMEA cable protects against ground loops between the system controller and monitoring devices. Ground loops create offset voltages that result in reducing the system's noise immunity. A non-isolated path allows RF noise and voltage spikes to appear on the controller's data lines. When this happens the likelihood of data errors and system faults increases. An opto-isolated cable insures against these problems while providing optically isolated signal paths for data (**Figure 2**).

An opto-isolated NMEA cable provides optimum performance and protection for your computer workstation. The cable also ensures the proper performance of your autopilot or other NMEA 0183 instruments that receive data from your computer. Many opto-isolated cables do not include a plug to fit your GPS unit, since the GPS manufacturer usually supplies this plug.

FIGURE 2



Opto-isolated NMEA GPS cable.

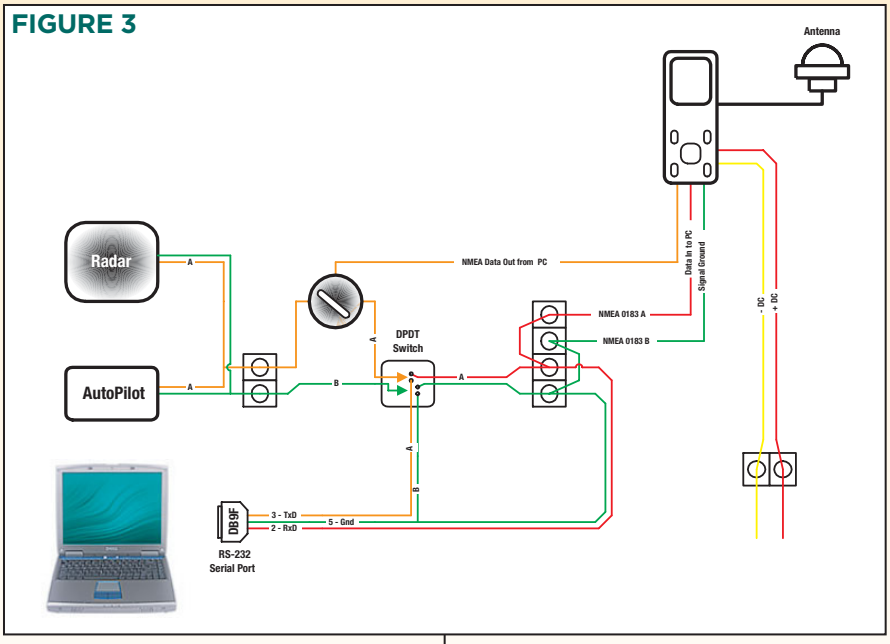
Check to ensure that your GPS unit is set up to transmit the NMEA 0183 standard sentence of RMC or GLL, VTG and DTG. Your GPS operating manual provides instructions on how to do this. The navigation software program looks for the correct NMEA sentences on a Com port.

PC Issues

If you are using one of the serial ports for a mouse and the other for a modem or, if your notebook has only one serial port and it's already being used, then you have another problem but one that's easily solved. A serial port PC card can add an extra port and an A-B switch will allow you to use a serial port for the GPS or modem.

Most Windows-compatible computers have at least one connector for receiving and sending information in a serial mode (one character after another) to external devices, such as a modem or a GPS. The connector is usually called Com 1 (short for communications port No. 1). If your

FIGURE 3



computer has only USAB ports, you will have to obtain a USB to serial port connector.

Before you can use GPS data in your navigation and charting program, the cable from the GPS must be plugged into an unused serial port. If you only have one Com port on your laptop and if you're using it for an external mouse connection, then you will need to either forego use of the external mouse or install a Com port PC card to obtain a Com port for the GPS connection.

Internal fax modem cards can also interfere with the Com 1 connector. The fax modem may have been set up to use Com 1. Your choices are to set it up for Com 2 or reconfigure your computer so that the serial connector on the back is Com 2. The manual should explain how to do this. In some cases, you can solve the problem by removing the PC card modem from your computer when you want to receive GPS data.

Figure 3 illustrates a system block diagram that allows for NMEA information to be sent to both a radar and an autopilot.

Using a Multiplexer

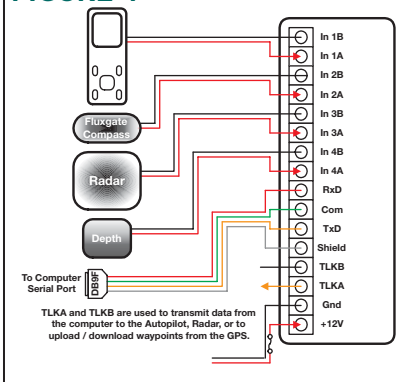
If you want to import additional data into your computer, such as wind data and depth readings, you'll need either additional Com ports on your computer or, more realistically, a multiplexer.

A NMEA 0183 serial multiplexer can combine up to four NMEA-0183 listener channels into a single RS-232C output for connection to a computer's Com port. This will have complete Opto-isolation (in accordance with NMEA requirements).

Installation and wiring a multiplexer is quite simple (refer to **Figure 4**). Simply connect the multiplexer output terminal to your Com port and connect all the inputs to the multiplexer's terminal strip. The module can be mounted to any convenient surface with all connections made via a terminal strip. The unit is fully automatic once power is applied. If more than four inputs are required, then additional multiplexers can be ganged together.

The multiplexer reads and stores the incoming data from each instrument without user interaction. Whenever a complete message is received, the multiplexer automatically dumps it to the RS 232C output even while it's still reading the inputs. Therefore, complete messages are dumped as soon as they are received without any loss of input data. A NMEA 0183 "talker" port is also included to allow the computer to request specific messages from instruments with multiple message types such as GPS receivers. Multiplexers come with complete connecting instructions and can be purchased from the company that provides the charting software.

FIGURE 4



David Anderson

Multiplexer GPS hook-up.

Troubleshooting: *When your Setup Doesn't Work*

If you think your navigation program is set up correctly to receive and display GPS data, but still don't see a boat icon on your screen you can test the Com port to find out if GPS data is being received by your computer. Do this by using Hyper Terminal in Windows 9x.

1. **From the Start button menu, select Programs, then Accessories.**
2. **Double click on the Hyper Terminal.**
3. **Enter a name, such as GPS Test.**
4. **When the phone-number window opens, select Direct to Com 1 in the "Connect Using" box and click on OK. If you are using a different Com port, select Direct to Com (port number you are using, i.e., 2, 3 or 4.).**
5. **In the Port Settings window, select 4800 bits per second and click on OK. The majority of GPS units use 4800 but there are some newer GPS units that can also use 9600. Check your GPS manual to be sure. The other default settings are correct and there is no need to change them.**
6. **If everything is set correctly, the GPS is locked on and the selected Com port is okay, you will see GPS data being displayed in the HyperTerminal window. This means the problem lies in the Electronic Charting software settings. If you can't fix the problem, a call to the company's tech support should get you on track.**
7. **If no data is displayed, check to ensure that the GPS is working and set up to transmit the NMEA data. Recheck all the wire connections. Each GPS manufacturer uses different color wires for sending out and receiving data. Check your GPS manual to ensure that you are connecting the correct color wires to the corresponding wires on the cable that came with your navigation program. If everything is set up and wired correctly, your Com port may be out or disabled.**

About the author: A professional engineer with an extensive knowledge of boat systems, David Anderson has more than 40 years of sailing experience. He operates Stand Sure Marine (www.standsuremarine.com) offering specialty sailboat hardware and designs and installs electrical systems, electronic navigation and communications.

POWER BOAT RIGGING

Steering Refit

Replacing worn-out mechanical steering with a new hydraulic system is well within the scope of the experienced DIYer but it does require a combination of diligence and a willingness to endure some snakelike physical maneuvers in the small, dark places in your boat.

By Peter Caplan

A boat's steering system winds up in the out-of-sight-out-of-mind category when it comes to maintenance until responding to stiffness and play in the system, the symptoms of wear, forces an inspection of the installation. A dual steering station set-up aggravates the situation, as the wheel in use must not only turn the rudders, it must also turn the wheel at the other steering position via another cable, compounding the stiffening effect. This was the case with UK boat owner Alan Hanson's 30-plus year old 42' (12.8m) Sealion. Steering was a matter of first overcoming 50° or so of free-play in the wheel before the wheel would turn the rudders and the wheel at the other station. Although the system still did the job, steering the boat on long passages was a tiring exercise. Eventually, with a system replacement imminent, the obvious choice of new equipment was a hydraulic system. The light action and reliability of modern hydraulic steering systems make them the norm on nearly all larger power yachts. [Ed: If you are sticking with a mechanical steering system, refer to DIY 2004-#1 issue for step-by-step details on installing a new mechanical (cable) steering system.]

There are several manufacturers of reliable marine steering systems and the boat owner settled on Teleflex SeaStar, a system that's installed as original equipment on many production boats, such as Boston Whaler, Carver, Cruisers, Grady White, Hatteras, SeaRay and Viking. No matter which system you select, the installation of hydraulic steering is pretty well identical whatever the make.

Preplanning

During extreme system demands in rough seas, rudders generate high forces that feed back through the system to the rudder actuator, in this case, the steering cylinder or ram. This is why it's vital that all the system components be bolted to a support structure that is strong enough to take the strain. On many boats, the original mount will be adequate but, if additional sections are needed to support the new system, these must be equally as strong as the original structure.

On the Sealion, there is a substantial aluminum mounting frame extending across the lazarette. It needed only a couple of solid aluminum spacers fitted to bring the new hydraulic cylinder up to the same height as the old mechanical steering connections.

The installation of the hydraulic steering is very simple but the routing of the cables throughout the boat complicates it. This is a simple process when a boat is being built and the equipment can be fitted before the deck is set down onto the hull.

For a retrofit, the cables have to be passed through, around and behind all the furnishings and fittings. Tying messenger lines to the old steering cables before they are withdrawn can help draw the new cables back through the boat to the various connection points.

Piping Choices

Hydraulic steering suppliers offer a choice of materials for the piping (hydraulic lines), which includes plastic, copper or made-up hydraulic piping (hose). The Teleflex SeaStar system specifies either 3/8" (9mm) copper, which can be purchased in rolls from natural gas suppliers, or hydraulic piping with swaged end fittings for quick assembly. They don't recommend plastic piping for this system, as the burst limit for plastic is not sufficiently above the maximum pressure relief valve settings on the helm pumps.

The choice of whether to use copper or hydraulic piping is then a matter of either cost or convenience. Copper piping is a fraction of the price of swaged hydraulic hoses but is more difficult to route through the boat as every curve and bend must be formed as it passes through. It's possible and, with care, offers a significant cost saving. The flexibility of 3/8" (9mm) copper makes is relatively easy to install. It's essential that copper be securely supported throughout through the boat to prevent vibration, which causes work hardening and fractures. This need for support can sometimes cause problems where access to various compartments is severely restricted.

On a boat with unrestricted access, properly installed and adequately supported copper piping that is not subject to corrosion from saltwater exposure lasts just as long as hose.

For this installation, hydraulic hose was chosen for ease of installation and a long life with no worries of the effects of vibration on the piping. Many hydraulic steering system suppliers can supply hydraulic piping but a look in the local Yellow Pages will produce a list of hydraulic equipment specialists who can make up the necessary lines. Prices vary between suppliers so it's a good idea to shop for the best price.

When using copper tubing, you can buy coils of sufficient length to complete the job. When using hydraulic hose, each hose must be ordered to the correct length so that the end fittings can be swaged on. This is the only critical part of the installation but is easy to achieve by running

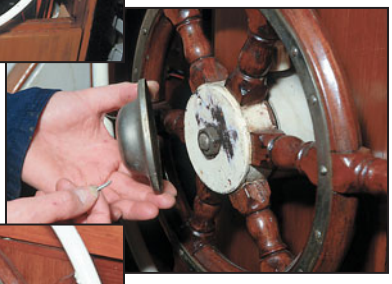
DIY BILL

All the parts necessary to install a dual station hydraulic steering system can be purchased for less than US$1,400. Completing the job took two days of actual work but was spread over several weekends, which included planning and allowed time for ordering and receiving the piping. While no two boats are the same, the work involved and the problems encountered are typical of most boats as well as different makes of hydraulic steering systems. While hydraulic piping makes the routing job very much simpler, using copper tube reduces the overall cost.

stiff cable through the boat to each connection position and then carefully measuring each length. It was at this stage that we ran our messenger strings to allow easy threading of the new piping through the boat as each length of measuring cable was withdrawn. The big advantage of hydraulic hose is the ease of connection once everything is fitted and the piping is run. Hydraulic fittings, unlike compression joints, use a cone and seat connection that only needs connecting and tightening to make a perfect joint. It's virtually impossible to overtighten or spoil a hydraulic connection, whereas compression joints are all too easily over tightened and damaged by inexperienced installers.

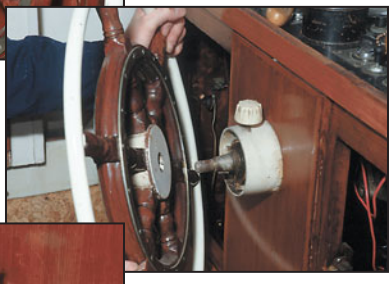
Removing The Old Steering

The lower helm position, with fascia panels removed, reveals both ends of the original steering rack.



Remove the wheel hub cover by undoing the securing screws.

This exposes the wheel securing nut, which is undone with a large wrench.



Remove the wheel by gently rocking it back and forth to free it from the taper on the shaft.

The steering shaft is held in place by a wire circlip. Pry this off using the tip of a screwdriver blade (or split ring pliers).

The nylon bearing block is now free to pull out, leaving the steering assembly loose behind the fascia panel.

The steering mounting assembly is held on with four nuts and studs behind the fascia. Once these are removed, the whole assembly slides out. This leaves the steering rack loose on the end of the cable inside the fascia panel where it remains until disconnecting the other end of the cable from the rudder arm. Follow the same procedure at the upper steering position before proceeding to disconnect from the rudders.

The original steering system still in place in the lazarette shows the size of the push-pull cables and the sturdy alloy mounting frame that connects both rudder tubes and provides a solid mount for the cable ends.

The first step of the dismantling process at the rudders is to disconnect the ends of the cables from the fork connection on one of the rudder arms. These are clamped into position with a nut and bolt through a slot in the side of the cable end fitting. Once the nut is undone and the bolt removed the cable end slides out of the fitting. Note the heavy-duty construction of all fittings in this system, one reason it lasted so long.

Next, dismantle the mounting bracket holding the outer cable. This consists of a double cup arrangement that allows the outer cable to pivot slightly as the rudders are turned. A spring keeps the whole assembly under tension to prevent vibration. Undoing the four machine screws and lifting off the top section accomplish removal.

Once the uppermost cable has been removed, the lower cable is dealt with in the same manner.

The original push-pull mechanical steering used on this boat is probably common to boats of this era and quality.

Remove and discard the mounting bracket that held the outer cables along with the cable end fittings attached to the rudder arm. The eye to which the fittings are attached is left in place, as it may be suitable for the later attachment of the new hydraulic steering cylinder.

This provided the length required for the balance piping between the two pumps. The same procedure was followed from the helm pumps to tee connectors where the two systems meet. More electrical cable was drawn from the tee connectors to the lazarette. Each of these cables was formed into sweeping radiused bends to emulate the run of the piping and then marked with masking tape and cut, leaving extra length to allow for error; slightly longer piping can be hidden out of sight; piping that is too short is absolutely useless.

With all cable ends disconnected the old cables are withdrawn from the boat. At this step, tie drawstrings (messenger lines) to the ends of the old cables to assist with threading the new piping. As we were installing hydraulic hose, rather than copper tubing, it's now necessary to determine pipe lengths. Using the messenger lines, we pulled spare electrical cable through the boat between the upper and lower helm pumps.

As each length of cable is withdrawn with another messenger line attached, its length is carefully measured and recorded for later ordering of the made up piping.

Installing the Hydraulic Steering

Calculate the position for the cylinder by measuring the total length of movement of the shaft within the ram and then moving it to its mid point and measuring from the eye on the end of the shaft to the center of the mounting base on the cylinder.

The installation begins with marking the hole for the lower helm pump in the front fascia panel and then carefully cutting it out with a jigsaw.

Use the template supplied with the kit to mark the holes for the helm pump mounting studs.

Carefully drill the holes, taking care to keep the drill square as the bit passes through the fascia. This was critical due to the close proximity of the original mounting holes.

Apply a coat of varnish to seal the cut edge to prevent moisture intrusion that can rot the wood. Allow to dry prior to fitting the pump.

Follow the same procedure at the upper command bridge steering position where the helm mounts on a fiberglass panel.

Before mounting the helm pumps, install the necessary fittings after first removing the protective plugs.

Apply liquid thread sealant to both lock and seal the threads. Don't use tape as stray ends can get into the system and block the valves.

There are two main connections, port and starboard, and one balance pipe fitting in each helm. The upper helm pump (left) has the balance fitting in the bottom and the lower pump (right) in the upper fitting. Note also the different oil filler caps. The upper helm pump has a vented knurled cap for easy removal for system top up. The lower helm has a semi-permanent cap that needs a screwdriver to open. Once the system is filled, this cap should not be opened otherwise oil pours out.

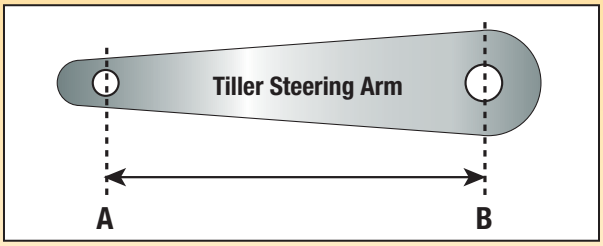
When all fittings are installed, the pumps are ready for mounting and securing with nuts and studs behind the fascias.

Moving back into the lazarette, mark the position for mounting the steering cylinder onto the original frame.

Transfer this figure to the mounting frame in the lazarette and measure from the rudder pivot point along the mounting frame to give the position for mounting the cylinder.

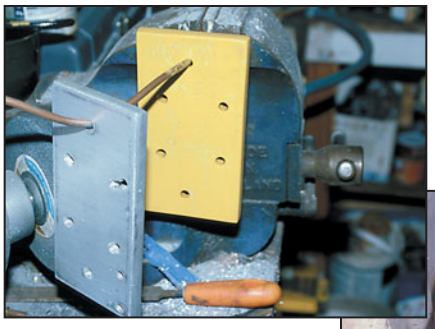
Calculate the position for the cylinder by measuring the total length of movement of the shaft within the ram and then moving it to its mid point

The only modification required to the mounting frame was to fabricate two 1/2"- (12mm-) thick aluminum spacers to raise the cylinder up by 1" (25mm) and back far enough to align it with the eye on the rudder arm. A piece of alloy from a local scrap yard was used.



Once the athwartship position of the cylinder had been finalized, the next point to check is the distance (shown as A-B in the illustration above) from the rudder pivot point along the rudder arm for attachment of the cylinder shaft end. This is important as it decides the number of turns on the wheel and the correct loading on the cylinder. If the turning radius is too small, there will be fewer turns on the wheel but the amount of force required to turn the rudders may exceed the designed limits. If it's too large, the rudders may not turn to the required 35° in each direction. In this case, the heavy-duty eye on the rudder arm was within 1/4" (6mm) of the required position, which was considered close enough. The kit comes with detailed instructions and clear diagrams to assist with correct installation and, in this case, most of the measurements were so close to those of the original steering that little modification was necessary.

and measuring from the eye on the end of the shaft to the center of the mounting base on the cylinder. Transfer this figure to the mounting frame in the lazarette and measure



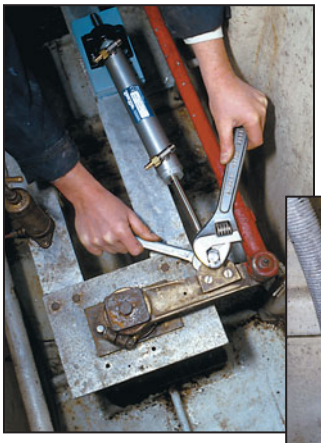
After cutting the plates to size, they were drilled, etch primed and epoxy coated to protect from corrosion.

The spacing plates and cylinder are placed in position and the fastening holes in the mounting frame are marked.

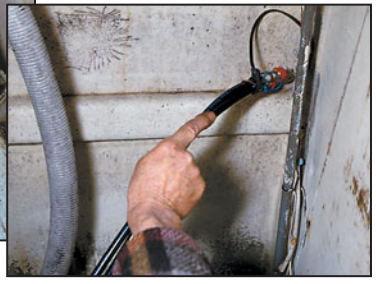
The fastening holes are then drilled into the mounting frame. Only two of the cylinder bolts pass right through the mounting frame. The other two pass through the spacers that overhang the mounting frame.

Once all holes are drilled, the cylinder is bolted firmly into position. We used Allen Head machine screws because they were onboard.

For additional security, holes are drilled and bolts attached to either end of the spacers.



Finally, the eye connection between the rudder arm and cylinder rod is firmly tightened. A Nyloc locking nut prevents loosening under vibration.



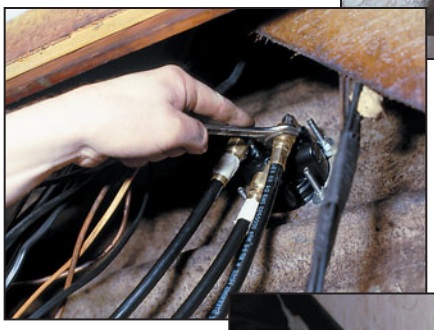
Now route the piping using the messenger lines that were prepared earlier and make this a very quick and simple operation. The two pipes from the cylinder in the lazarette are the first to be run.

Piping was originally routed across the transom but, for safety, we reversed the bleed valves on top of the cylinder so that the piping would clear the steering cross bar and avoid the possibility of chafe.

Piping soon appears through the access hatch in the head cabinet, ready for connecting to the tees.

Fit and tighten the tee connectors behind the head cabinet.

Once connected the piping is routed across the lazarette forward bulkhead and held temporarily with plastic cable clips.



Connect the piping to the upper helm pump from inside the wheelhouse. The lower pump connects in the same way.

Once the equipment and piping installation is complete, replace all plastic cable clips with proper stainless steel P-clips fitted with anti-chafe grommets.

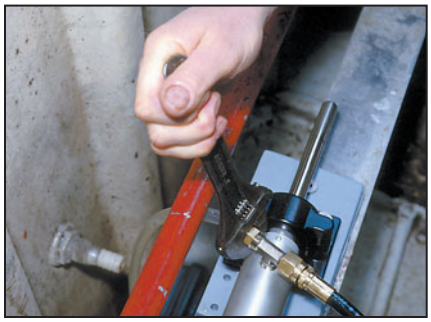
from the rudder pivot point along the mounting frame to give the position for mounting the cylinder.

Filling And Bleeding The System

Bleeding a dual station system is accomplished in two phases, beginning at the lower helm position. It's most important to ensure that the section of the system to be bled is completely filled with oil before starting the bleeding process. The system comes complete with a tube and fitting those

Reinstall steering wheels before beginning the bleeding process. Once air bubbles have stopped coming out of the helm pump (this may take some time), turn the wheel clockwise until the steering rod on the cylinder is fully extended one way.

Connect the bleed tube (supplied) onto the bleed valve at the end where the rod is extended and the bleed valve opened. Turn the wheel in the opposite direction to force air out of the system. It's vital to keep the helm pump constantly topped up with oil from the container throughout the process to prevent air entering the helm.



Once the oil is free of air bubbles, close the bleed valve and tighten. Bleed the other side of the system in the same way.

screws into the filler hole. The tube is connected to the oil container so that oil can run into system while air vents up the tube and into the container.

Fit and tighten the filler cap on the lower helm pump and follow exactly the same process with the upper helm. It was found, in practice, that small amounts of air remained trapped within the system after the bleeding was complete but when left for a couple of days the air found its way into the helm pumps. To purge the lower pump, slacken the filler cap and allow the air to escape under pressure from the oil in the upper helm. Simply topping up the system purged the upper helm.

Performance Comparison

It was interesting to note the difference in steering power between the hydraulic system and the old manual steering. While testing the system with the wheel hard over, we managed to bend the rudder stops that, for 30 years, had been more than adequate for use with the manual system. This meant beefing up the stops with additional angle sections.

The difference in steering performance is marked. There is now no play at all in the steering compared with 50° of free play on the old system. More noticeably, the steering is no longer a muscle straining exercise. In fact, the action is so light now that it's easy to steer with one finger. The owner's only comment on the subject was “wish I'd done it years ago!”

About the author: Peter Caplen is a mechanical engineer and British technical writer with nearly 30 years experience in building, maintaining and renovating mainly powerboats.

Boat Licensing, Registration & Titling Made Simple – the DIY way

Can you document, register, register and title or license your boat yourself? What follows is the short course in "how to" from a professional registration and documentation agent.

Story and photos by Janet Ross

Documentation, registration, titling, licensing — all terms related to the methods available to you when you own a boat (in the U.S. or Canada) and you want to (must) assure all the gods of boat ownership that the boat is, indeed, yours, albeit often with an ownership interest shared by a bank. These terms also provide the bases for law enforcement officer's identification of recreational boats. You can document, register, register and title or license your boat yourself, it's only a matter of how much time you want to spend with forms and protocols. (Boats that are registered or documented in a foreign country are beyond the scope of this article.)

You bought it. You own it. Now, prove it. Navigating the required course for registration or documentation can be complex and time consuming but you can do it yourself. In both the U.S. and Canada, you must register or document your recreational boat, either federally or in a local jurisdiction. One or the other is mandated for all recreational boats navigating U.S. or Canadian waters.

Making Your Boat Legally Yours

The United States Code Of Federal Regulations (CFR) prescribes requirements for "numbering" boats (and for reporting accidents). The law applies to any and every boat equipped with propulsion machinery of any type used on waters subject to U.S. jurisdiction. There is a lot more in the reading of the law but, in the interest of keeping things brief, we are going to deal only with the immediately relevant basics. The law does have some exceptions that are clearly identified within the language of the law. Exempted from the law are powered tenders (less than 10hp) of properly numbered boats (mother ships). These tenders must display the "mother" boat's number followed by the suffix "I." Boats used exclusively for racing are also exempted.

"If you are taking your trawler, cruiser or sailboat to Bermuda or offshore to foreign waters like the Bahamas or Mexico, documentation is your best bet..."

Boat owners in the U.S. can get numbers for their boats from the state of their principal use (state registration and/or titling) or from the U.S. federal government (documentation). Each state agrees to honor the numbering system of other states so, when a boat from one state is in temporary use in another, the states recognize those numbers and/or certificates issued by the U.S. government (USCG Official Number). That's a relief. Register your boat in your home state and it's legal in all states (at least, temporarily). There are important limits to "temporary" and you should review the laws of the relevant states whose waters you use. Your registration (numbering) certificate or document must be onboard for surrender at any time to any law enforcement officer for inspection on request. A state registered boat bears state numbering in alpha and numeric characters, usually showing the state abbreviation as the first two characters in the series. These numbers are displayed on both sides of the boat's bow. A boat that is registered with the federal government is said to be "documented." Such a boat is listed with the National Vessel

Examples of illegal identification numbers: (top) Numbers should be on the boat structure; (second from top) Okay for a registered (state) boat only as missing the hailing port; (second from bottom) Lacks a hailing port required for a USCG documented boat; (bottom) Haven't a clue as neither state nor documented be.

Examples of proper identification: (top) Name and hailing port that comply with USCG documentation marking requirements; (middle) Properly displayed number for a state registered boat; (bottom) Registration numbers on flybridge meets requirement that state numbers be on the forward half of the boat.

Documentation Center (NVDC) of the U.S. Coast Guard (USCG), a registration agency of the federal government, instead of a state agency. Many states have established provisions for titling a boat along with registration but both title and non-title states require registration. USCG documentation may be an acceptable form of registration in some states. Always check your state's position before you presume anything.

There is a hitch among all these knots: a documented boat is not exempt from applicable state registration laws. Even if your boat is federally documented, the state of "principal use" may also have a claim to recording your boat ownership. Some states require a form of registration (but not titling) for documented boats. You have to check with your state boating authority to find out what's required.

In Canada, the requirements are similar, but the nomenclature is different and all forms of registration or licensing are national (not provincial). The Canada Shipping Act effective February 2000, is law in transition but is the current status quo. In Canada, unless a boat is already registered in a foreign country, you must register any pleasure boat over 15 gross tons and, in most cases, registration is a privilege accorded only to Canadian citizens. Registration provides legal title and allows for a boat name and official number. It also provides for using the boat as security for a marine mortgage. Once all requirements are met, a Canadian registered boat receives a Certificate Of Registry, which must be carried onboard at all times. If your boat is less than 15 gross tons, you can register it but it's not mandatory. You have the option of licensing the boat. If you do register, you may not later license the boat.

For those boats less than 15 gross tons (13,607kg), whose owners chose not to register under the Canada Shipping Act, there is a Small Vessel License required for any small boat with a motor greater than 9.9hp, including personal watercraft. You don't have to be a Canadian citizen or even live in Canada to get your boat licensed but the boat must be principally used in Canadian waters.

Title and Register or Document?

Documentation in the U.S. is patterned after the British (and Canadian) system of registering yachts, with the primary purpose of establishing an internationally recognized maritime title and registry for the boat. If you have a 23' (7m) sailboat with an outboard engine or you tow water skiers behind your runabout and you use your boat on a lake in Georgia, documentation is probably not for you. Registering the boat with the state of Georgia will probably be quite sufficient. If you are taking your trawler, cruiser or sailboat to Bermuda or offshore to foreign waters like the Bahamas or Mexico, documentation is your best bet for lots of reasons, not the least of which is that your boat becomes a vessel of the U.S. (or Canada) and the document becomes the boat's equivalent of a passport. That status does carry with it one caveat. In times of war, your boat could be pressed into U.S. military service as some were during World War II to patrol the U.S. coast keeping watch for German submarines. There are still living boat owners who are enormously

	U.S. State Registration	U.S.C.G. Documentation	Canadian Registration	Canadian Licensing
DIY?	Yes	Yes	Yes	Yes
Looking for help?	Follow state guidelines often found on state government web sites or call your state boating authority.	Go to www.uscg.mil/hq/g-m/vdoc/nvdc.htm .	Go to www.tc.gc.ca/marinesafety. Follow the links. Ship registration hotline: 1-877-242-8770.	Go to www.tc.gc.ca/marinesafety . Follow the links.
Process	One stop; usually same day results. Much like registering a car.	Many forms; time consuming; lots of steps and hoops.	Many forms; time consuming; lots of steps and hoops.	Simpler than ship registration.
Cost	State registration and/or title fees plus taxes, if applicable.	As little as $92 (DIY); other fees apply for mortgages and complicated transfers, abstracts, etc.	Government established fees.	Government established fees.
Marking	Numbers on the bow.	No exterior numbering.	No exterior numbering.	Numbers on the bow.
Hailing Port	Not required.	Required to be marked on the stern.	Required to be marked on the stern.	Not required.
Name	Not required.	Required to marked on the stern.	Required to be marked on the stern.	Not required.
Liens	Can be recorded in states with titling provisions.	First Preferred Ship's Mortgage	Allows the boat to be secured by a mortgage.	No provision for securing a mortgage.
Pros	Simple; cheap; usually can be completed in one day.	Perfect chain of ownership; preferred mortgage recording; international recognition.	Reserves a name; provides title; enables a marine mortgage to be secured.	Simple process.
Cons	Sometimes lacks provision for recording liens; not internationally recognized; requires display of numbers.	A lengthy, complex process; no local assistance; relatively costly.	Mandatory for boats over 15 tons.	Mandatory for boats 15 tons or less.
Ownership	May require multiple state searches to locate prior owners.	Absolute.	Absolute.	May require multiple provincial searches to locate prior owners.
Taxes	Pay them.	Pay them.	VAT	VAT

Hmm, I'd like to see a ruling on this for a documented "mother" boat and tender.

proud of their boat's participation in the defense of U.S. shores in the 1940s.

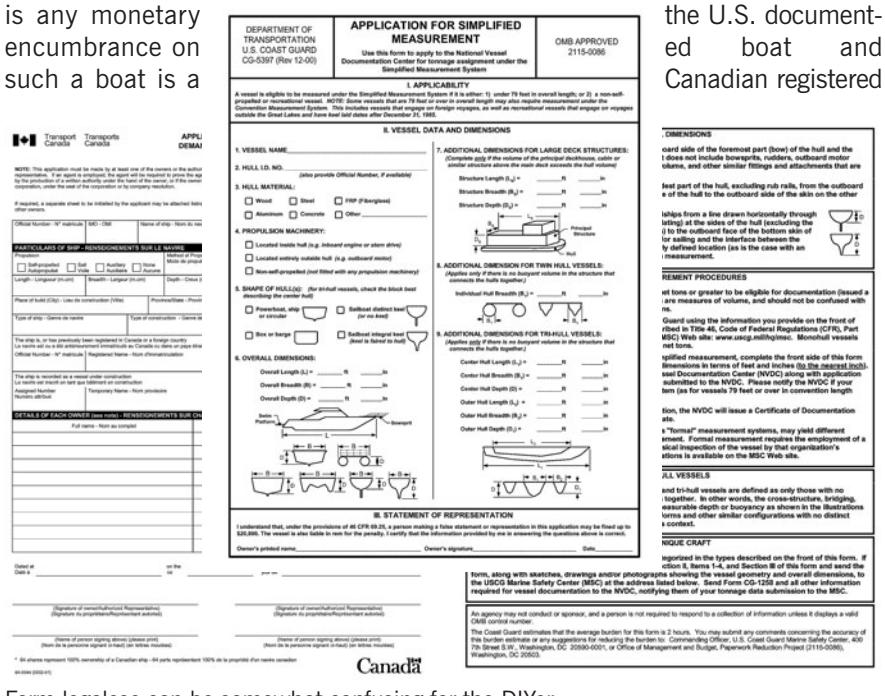
Aside from the remote possibility of being impressed into the U.S. Navy, being a documented boat carries with it only benefits and prestige. Many banks and marine lenders require that a boat on which they lend purchase money be documented in order that the funding underwriter can rest assured that its interest is recorded as "preferred mortgage." A boat that has been continuously documented since new, regardless of the number of owners, carries with it a perfect chain of ownership in its Abstract of Title. States can also record liens on a boat's title but non-title states have no instrument for providing this safeguard and a single boat may have been titled/registered in many states by multiple owners. Finding out whether there is any monetary encumbrance on such a boat is a daunting task.

When purchasing a boat that will have a mortgage you may find that depending on the size of the boat and/or the loan, the U.S. lender wants a First Preferred Ship's Mortgage placed against the boat to secure its loan. When purchasing a documented boat, the first thing you should do is request an Abstract of Title from the Coast Guard. In addition to showing the chain of ownership, it shows any liens that have been placed on the boat and if and when they were satisfied. The USCG doesn't allow transfer of ownership without satisfaction of any outstanding liens or statement from the leinholder that transfer of ownership is allowed.

Records of Choice

Documentation in the U.S. and registration in Canada both carry the benefit of being the records of choice for maritime lenders to secure their financial interests in a pleasure boat and both countries provide for recording these loans on the document or certificate of registry.

There is also the vanity benefit of not having to display numbers on the boat hull. Boats in national registries are easier to trace when stolen. When voyaging to faraway places, the U.S. documented boat and Canadian registered boat are received as vessels of their respective homelands, a not so small matter of prestige and security in international waters.



Form legalese can be somewhat confusing for the DIYer.

Now that's a stern!

Due Process

Whether a boat is documented or state registered, the forms and protocols for creating or transferring ownership can be complicated and intimidating. It's definitely a test of tolerance for the bureaucratic process. The USCG has a website for the NVDC that explains the forms, the cost and instructions for completing the paperwork. To do-it-yourself USCG documentation, go to www.uscg.mil/hq/g-m/vdoc/nvdc.htm. Individual states have boating authorities that handle such matters. All the forms necessary for the Canadian equivalent are available at www.tc.gc.ca/marinesafety. Just follow the links. Both U.S. and Canadian processes require certain boat measurements. While they appear to be related to the weight or displacement of the boat, they are not. These special measurements, in both countries, relate to the volume in either gross or net tonnage, a calculation only obtainable by an approved tonnage measurer unless the simplified self-measurement method is used, which is approved in both countries. These measurement requirements are very often misunderstood but they are very important in qualifying a boat for U.S. documentation or Canadian registration. Both countries require periodic renewals of their respective documents or certificates and each notifies the holder of the paperwork of expiration dates and renewal requirements.

Much too pretty for numbers this one's a USCG documented yacht.

Ownership Issues

Only U.S. citizens or a U.S. corporation with no alien directors can own a documented boat. Anyone who can demonstrate a state's ownership prerequisites can register and title a boat. In Canada, you must be a "qualified person," e.g. a Canadian citizen or corporation to register a boat with the registry.

Naming the Boat

Name your boat anything you want but, before you christen that new boat, think about how the name is going to sound on the VHF radio when you identify yourself for all to hear. Many an eavesdropper on the radio has been royally entertained by marine telephone operators' translation of what they heard as a boat name. Canadian boat owners must reserve a name for their boat. No two registered boats can bear the same name. One way to skirt this issue is to add a Roman numeral after the name to create a name different from the one already reserved. Canada has some strict guidelines on reserving names and will not allow a name that is likely to offend the public or one that is likely to hurt Canada's reputation. Pretty subjective but something to consider.

Questionable whether the lettering for the name meets the legibility requirements for USCG documented boat.

A Numbers Game

The USCG official number stays with the boat forever. If a boat is deleted from documentation and then later is redocumented, it retains the original number. The official number assigned to documented boats, preceded with the abbreviation "NO" must be marked in block-type Arabic numerals at least 3" (7.6cm) on some clearly visible interior structural part of the hull. The number must be permanently affixed so that alteration, removal or replacement would be obvious and cause noticeable scarring or damage to the surrounding area.

The name and hailing port of a recreational boat must be also be marked. These two identifiers must appear together on some clearly visible exterior part of the hull. On recreational boats, this means the stern. All markings must be clearly legible letters of the Latin alphabet or Arabic or Roman numerals, at least 4" (10cm) high and made by means and materials that result in durable markings. The hailing port must include both a place and state abbreviation, territory or possession of the U.S. Boat owners often are confused by the terms "hailing port" and "home port." For example: the USCG documentation

Canvas stern extension is presumably designed to deter waterfowl from nesting on swim platform but Inspector Clouseau might think it was concealing a boat's registered name.

office headquarters is located in Falling Waters, WV. Falling Waters, WV, is the "home port" designation and it doesn't go on the stern of the boat. It's the "home" of USCG documentation services. "Hailing port" is the place name where the boat owner lives and, if the boat lives there, too, fine. That's the "port" marked on the boat's stern.

A state registration number stays with the boat as long as it stays in the same state. When ownership changes between parties from the same state, only the name on the registration (and title, if applicable) changes. If a boat is moved to another state and registered in that state, the new numbers reflect that the requirements of the new state registration are met.

The corresponding numbering practices in Canada parallel U.S. practices. A boat operating under a Small Vessel License must be marked with the letter-number combination on the bow. A registered boat bears its name and port of registry on the stern.

Who's in Charge

Boat owners can DIY or hire experienced agents to process the paperwork for U.S. documentation. Agents at the NVDC will

Lien Search

Want to do your own lien search on a used boat? MarineLiens.com offers a central posting and searching facility in eight languages. You can search a boat by hull number, state or country registration number, or name and hailing port and country of registry. If the boat is found in the database, there is a fee of US$20 to view its lien status. If searching results in no matches, then the boat in question has no presently registered liens at marineliens.com.

Not compliant with USCG requirements for documented boats and numbers can be easily removed without leaving a trace. Better to etch numbers into an interior structure.

help the taxpaying consumer process documentation but their time is limited and, with a huge backlog of applications, these civil servants are constantly asked to do more with less. Throughout the country, professional documentation agents work at documenting boats for boat owners or boat brokers/dealers. Some lenders have preferred agents that they use. The American Vessel Documentation Association (AVDA) was formed in 1995 and is a professional organization that certifies its members to their expertise in handling boat documentation and interacting with the USCG at the NVDC.

Fees for professional documentation services are reasonable and include all the form filings. If you value your time, you'll want to consider having a professional handle this process. At the very least, discuss the options with a professional documentation agent. It costs nothing to ask questions so that you can make an informed decision about who will handle the registration and/or documentation of your boat. Bear in mind that most lenders of boat purchase money require that an independent documentation agent handle documentation and the first preferred ship's mortgage. (This is the same protective stance the home mortgage lenders take as well as the lenders who make automobile financing possible.) It's simply a matter of the lender's comfort in assuring that its interest is promptly and properly secured. It's a cost of doing business.

Where Has My Delaware Gone?

Before you rush to register or document your boat in the no-sales-tax states of Alaska, Delaware, Nebraska, New Hampshire or Oregon, know this. A documented boat is not exempt from applicable state and/or federal taxes. States that have sales and/or use taxes have become very savvy about collecting taxes due on boats using their waters. If your boat is used primarily in a state that has sales and/or use tax, pay the tax promptly. Seemingly, clever evasion tactics will only delay the inevitable and the fines and interest for failure to pay will make the pain of compliance even more agonizing. A boat in Maryland with a Nebraska hailing port or registration number, berthed in a year around slip or on a mooring, will attract the attention of motivated tax collectors. In times passed, Delaware hailing port markings for boats owned by closely held Delaware corporations, residing in post office boxes established solely for creating a residency, were a fact of the boating life. Things are changing as the tax revenue base has become so valued by the individual states that having a no-tax state hailing port is only a short lived degree of separation from the tax collector.

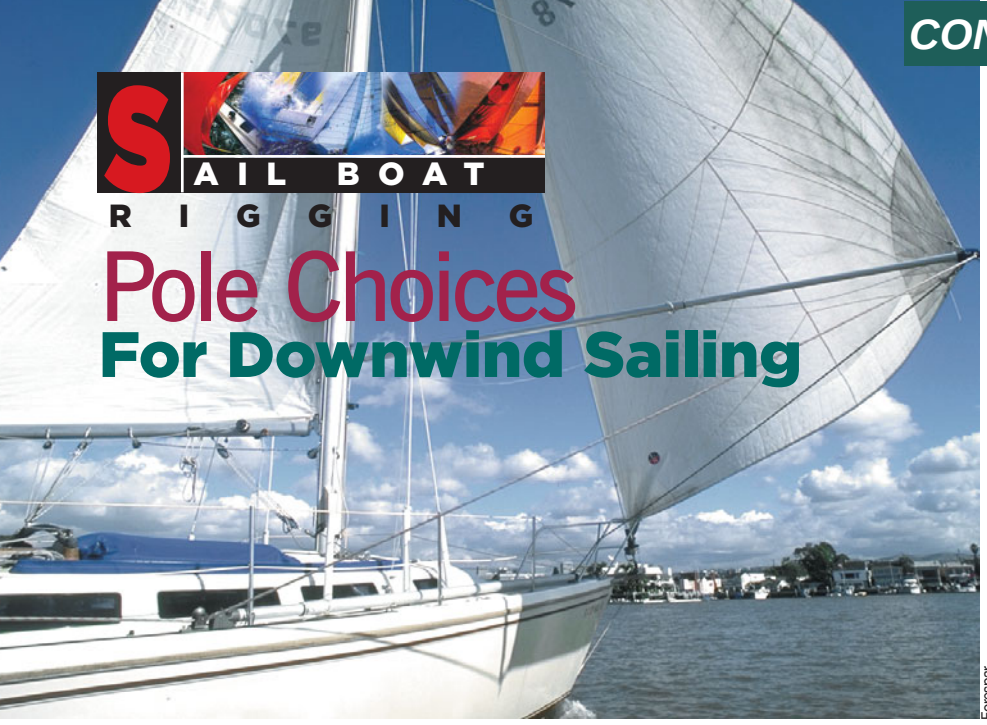
Wise Words

Whether you DIY it or not, don't wait until the last minute to set your course on U.S. documentation or Canadian registration. These processes take time and diligent effort to complete successfully.

Author: Janet Ross heads up the yacht documentation division of a marine service company in Naples, Florida. DIY readers can pick her brain at vesseldoc@comcast.net.

SAIL BOAT RIGGING

Pole Choices
For Downwind Sailing


Forespar

Catalina 30 sailing wing-on-wing with telescoping whisker pole.

With the proper equipment combinations, flying a headsail attached to a whisker pole makes for fast, fun, downwind sailing. Here's how to select, install and set the pole.

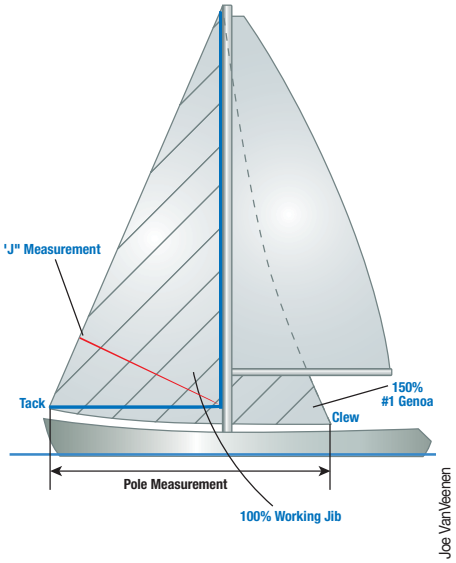
By Jan Mundy

When sailing downwind, your headsail choices are a spinnaker, asymmetrical "cruising" spinnaker or genoa or jib. Many sailors shun spinnakers, as they require additional hardware and lines and a skilled crew. In this instance, your options are a cruising spinnaker or headsail and, with either sail, using a whisker pole to extend the clew outboard to windward will capture more air, increase boat speed and maximize downwind performance. In sloppy seas, light winds or sailing dead downwind, a headsail or cruising spinnaker tends to yaw and spill air when set without a whisker pole. Attach a whisker pole and you gain control of the clew so, with adjustments in trim, you keep the sail filled with air. If you like to sail dead downwind, wing-on-wing, with the mainsail and genoa on opposite sides, adding a whisker pole acts like a boom to control the foot and shape of the genoa.

Whisker poles are made of aluminum and/or carbon fiber and come as either fixed tubes or with two or three telescoping sections. As pole length is based on the foot length of the sail, a telescoping pole is the best choice if you want to set various sizes of furling or hanked headsails. When flying a cruising spinnaker, may be better to use a fixed rather than a telescoping whisker pole, as the latter may not be able to withstand the extra loading if the length required is egual or close to the fully extended pole. (Note: A spinnaker pole is too short to double as a whisker pole as it's made to the "J" measurement (forestay to mast). Therefore, a "J" length pole will only work with non-overlapping headsails.)

Pole Sizing

Pole length and diameter is relative to boat length, headsail size (100% jib, 130% genoa, etc.) and type of sailing planned (coastal versus offshore). Forespar (www.forespar.com), the world's largest manufacturer of whisker and spinnaker poles, publishes pole size selection charts based on over 40 years of experience equipping boats with whisker poles. Before selecting a pole, you'll need to first determine the length of the largest sail, measured across the foot from tack to clew. This equates to the overall pole length needed for that sail. Telescoping poles require little extra length added for tube overlap. Running a genoa in medium to heavy air with the pole fully extended is good cause for breakage. Boats with a bowsprit require a pole one size larger for strength and the added length. Ditto if you plan to sail offshore.



Joe VanVeenen

Measure the headsail from tack to clew to obtain pole length.

System Components

Once you have determined the correct size pole, you'll need to select the component hardware to complete the installation. If your mast, at the forward centerline is equipped with a T-track, either


Telescoping pole with piston ends and external triggers.


Heavy-duty telescoping whisker pole for a larger boat has jaw outboard end and socket inboard end. This pole features Forespar's patented Line Control. Simply uncleat the external line to adjust pole length.

Forespar

Combination pole with inner tube made of lightweight carbon and an aluminum outer tube is noticeably lighter in weight than an all aluminum pole when compared to an all carbon pole. Note where the topping lift attaches to the outboard end of the pole and pole end clips over genoa sheet so it slides freely and with the jaw facing down.

All carbon pole is 50% lighter than aluminum one.

1-1/4" or 1-1/2" (31mm or 38mm) wide, you're all set. If not, consider adding a track. A track with a sliding car allows adjustment of the inboard height of the pole to suit different wind conditions, especially on boats larger than 25' (7.6m). This system may require a pole lift and downhaul blocks to control the mast car movement and position on the mast track. If this system doesn't fit your budget, plan on purchasing a fixed padeye, preferably two, for mounting on the mast centerline. Additional padeyes facilitate setting headsails with different clew heights, mounted at the proper mast height as needed (see below). Always mount the pad eyes on the forward centerline of the mast so the pole can be set port or starboard on the same mast eye.

Will the pole be stored on deck or on the mast? There are chocks sold for deck mounting of fixed length and telescoping poles and storage cars (upper end) and chocks (lower end) for vertical mast mounting and storage. This last option requires purchasing deck chocks as well for safety. Underway in severe weather, the pole adds weight and windage aloft and vibrates. Another choice is to mount the pole on V-shaped brackets on stanchions. This option is fine on calm waters, light wind conditions and up to 3-1/2"- (9cm-) diameter poles. Any boat going offshore, or using larger poles should have deck chocks securely mounted on deck to stow the pole in adverse conditions. Always stow twist-lock telescoping poles in a cockpit locker or in the cabin away from saltwater.

Sample mast attachments: (top) Non-adjustable padeye for small day cruisers; (middle) Sliding ring car allows easy vertical adjustment but no mast storage for the pole; (bottom) Toggle car accommodates a socket pole end and provides unfettered vertical and horizontal movement as well as secure storage on the mast.

Pole storage options: (left) Deck chocks for storing fixed or telescoping length poles; (bottom left) Fittings for vertical mast storage include mast car,storage car, track, pole lift and downhaul line controls and chock. (bottom right) Stanchion chocks mount to lifelines for storage of poles up to 3-1/2" (9cm) diameter in calm conditions.

End fittings are sold with poles. Forespar ends are constructed of fiberglass nylon filled (same as Marelon plumbing fittings) and come in two styles: jaw (a.k.a. piston or latch) with external trip lines or internal trigger, and socket. Obviously, a fixed eye or sliding ring car on the mast takes a jaw end; a sliding toggle mast car couples to a socket. Outboard ends are always jaw fittings as they hook over jib sheets.

(top) Jaw or piston or latch end. (bottom) Socket end slips into sliding toggle mast car.

Set Up

Install the mast attachment hardware. A fixed padeye mounts on the mast at a height that allows the pole to be set level with the headsail's clew. (Refer to DIY 1998-#1 issue for details on installing hardware on aluminum masts.) Install one pad eye at the proper height for each headsail size and clew height set. Here is the distinct advantage of using a sliding car on a track. Once installed, a track/car combo is quickly adjusted to set level with any headsail.

Whisker poles sold for boats 22' (6.7m) and larger require a topping lift. This line attaches to the outboard end of the pole and helps keep it level and supported when hoisted. Use a spare jib or staysail halyard for the topping lift. Spinnaker halyards can be used but only for short periods. As this halyard usually exits above the headstay, it chafes severely when used extensively. It's best to rig a dedicated topping lift if you plan to do a lot of downwind sailing. A downhaul line is rarely needed and moving sheet leads as far forward as possible usually solves upward lifting of the pole. You may also require longer jib sheets, snap shackles, cam cleats, additional control lines, fasteners and additional jib sheet leads, all of which can greatly increase the refit costs.

How to Fly

To rig a whisker pole, attach the pole to the mast with the jaws always facing down. Unfurl or hoist the sail, clip the other pole end over the sheet at the clew so it slides freely. Never attach the pole end to the clew of the sail or a knotted line. Follow these steps in reverse for takedown. Never attempt to extend or retract a telescoping whisker pole under load. Always furl or depower the headsail before hoisting or taking down a whisker pole.

TIP: *No Forestay Rest*

Don't let a whisker pole rest against the forestay or shrouds. Aluminum poles may dent or bend and carbon fiber poles will break from side loading if laid against a stay.

TIP: *Clean Soak*

Never oil or spray lubricant on an aluminum twist-lock telescoping pole or end fittings. This voids the three-year warranty if it's a Forespar pole. If a pole becomes difficult to open, usually from oxidation or salt build-up, soak the pole in a tube (a rain gutter works) filled with white vinegar for a few days. This dissolves the salt without harming any internal components. If a pole end becomes stiff to operate, immerse it in a bucket of white vinegar. Then rinse with freshwater. All end fittings are shipped dry (no lubricants) and should never be oiled or lubricated with anything. Keep them clean and they will function as designed for years.

Keep the pole horizontal by adjusting the topping lift. Should the pole want to "sky," (be lifted up by the sail in a puff) move genoa leads farther forward, which changes the sheet angle to the pole and eliminates the need for a downhaul line. A notched toerail makes this simple. Boats without this setup may need to extend the genoa track further forward. Another option is to attach a jib sheet lead block to a removable deck padeye. If it's necessary to rig a temporary downhaul, use the lazy sheet and run to a cam or jam cleat. Don't cleat it off, just use the cleat to turn the sheet aft (like a turning block) and pull it in. This pulls the pole down as well as helping to keep it forward. In strong or gusty winds, using a downhaul improperly can break a pole. As wind conditions change, adjust the topping lift, sheet lead, and downhaul, if used, to reposition the pole. Always keep the pole off the forestay and shrouds; crank in the sheet to pull back the pole but not so far back as to pull it against a forward lower or cap shroud.

To tack downwind you need to jibe (or gybe). There are two ways to do this: the dip-pole jibe or simply furl the sail and take down the pole. Then reset on the opposite side and unfurl the sail. This is the safest way to jibe a whisker pole as, unlike a spinnaker, both the sail and pole are trying to move through the fore-triangle at the same time. This makes for some pretty tricky sail and pole handling and requires good practice. The former demands that you have a mast track and car. Suppose you are sailing with the wind blowing from the starboard side and want to do a dip pole jibe. The

helmsperson heads the boat dead downwind then steers just slightly by the lee, while the boom is pulled to center and then handed across to the starboard side and trimmed. When the skipper gives the jibe command, unhook the pole's outboard end and raise the inboard end of the pole so the outboard end clears the forestay, pulpit and lifelines and is free of the sail. Release the sheet and furl or tack the sail, swing the pole under the forestay (be carefull not to tangle the sheet around the pole), hook the pole over the windward sheet then trim the sheet and adjust the topping lift. Who handles what tasks depends on the number of crew onboard. Jibing a pole takes planning and practice to perfect and is best rehearsed in light winds. Again, the best and safest method is to drop or furl the sail and reset.

SAMPLE POLE PACKAGES

Estimated prices listed are in U.S. funds and may vary with suppliers.

Up to 22' (6.7m) with Genoa	
1 6'-12' (1.8m-3.6m) whisker pole	$332
1 mast pad eye	$30
2 stanchion mount chocks	$70
Up to 28' 8.5m) with Working Headsail (100% jib)	
1 8'-14' (2.4m-4.8m) whisker pole	$705
1 car for vertical storage on mast	$285
1 vertical pole storage car	$106
1 6' (1.8m) T-track with end stops	$115
2 deck chocks (price varies with pole ends)	$100
Options: 2 stanchion mount chocks	$70
1 mast ring car (no vertical storage)	$83
Up to 35' (10.6m) with Genoa	
1 13'-24' (4m-7.3m) 50/50 combo whisker pole	$1,620
1 car	$285
1 12' (3.6m) T-track with end stops	$210
2 deck chocks (price varies with pole ends)	$100
1 vertical pole storage car	$114
Options: 2 stanchion mount chocks	$80
1 carbon fiber whisker pole	$1,915

Note: Forespar recommends fixed length poles for heavy offshore use (long distance cruising) or on boats 50' (15m) and longer.

A STRONG CASE For Treated Sewage

Did you know that it's legal to discharge treated waste in many coastal waters? If a head refit is in your future, there are some alternatives to a waste holding tank.

By Peggie "Headmistress" Hall

Most boat owners know that it's illegal to flush a toilet directly overboard in all U.S. waters and that it's been the law of the land for 25 years, since the effective date of the Federal Water Pollution Act (Clean Water Act) of 1977. The sewage holding tank, the simplest MSD (marine sanitation device) is not the only option for compliance with the law against dumping sewage into the water, even though that's how most boats are equipped from the factory. Illegal to flush the toilet directly overboard doesn't mean the same thing as "no discharge." There are many waters in which boaters can legally discharge properly treated waste from a U.S. Coast Guard (USCG) certified Type I MSD, which is legal on boats up to 65' (20m) or Type II MSD on larger boats.

So much misinformation and outright mumbo-jumbo about Type I MSDs is being circulated by environmental extremists and the politicians who pander to them that, even boaters who are aware that these MSDs exist, they are unwilling to install them, afraid that, after making the investment in equipment and installation for these currently legal devices, they will be banned. Manufacturer's of Type I MSDs have struggled to counteract the tall tales that the Type I treatment system is harmful to the environment, costs too much, takes up too much space, is complicated to operate and maintain or consumes too much power. Boat owners have been led to believe that holding tanks are the only affordable, practical and environmentally responsible way to manage onboard waste.

In fact, just the opposite is true. A sewage holding tank is complicated and, all too often, an ineffective way to manage onboard sewage. Holding tanks are the only option for boats on waters that have been declared "no discharge." "No discharge" waters encompass 90% are inland waters including all of the Great Lakes, all non-navigable inland lakes and municipal reservoir impoundments on navigable rivers. The relatively few "no-discharge" zones in coastal waters include a few harbors between Rhode Island and the Florida Keys on the East Coast and Destin Harbor in the Gulf of Mexico. While most of the waters of Southern California are "no discharge" north of Santa Barbara, only a small harbor off San Francisco Bay and one marina in the Seattle area are "no discharge" zones along the rest of the entire west coast. In all other coastal waters, and most navigable inland waters, the discharge of treated waste from a Type I or II MSD is legal.

Holding Tank Alternatives

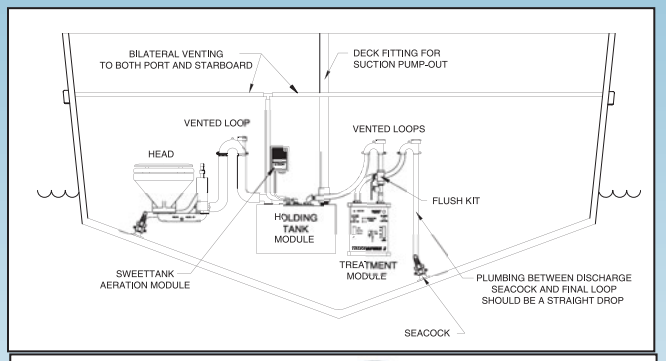
A treatment device is not a toilet and adding a treatment system does not require replacing a toilet. Type I and II MSDs are separate devices where waste from the toilet flushes to be treated and discharged overboard (or into a tank for pump out later if you are boating in a "no discharge" zone). Type 1 systems include: Raritan Lectra/San, which doesn't require the use of any toxic chemicals and Groco ThermoPure, which uses heat to kill 100% of the bacteria. It requires 120-volt AC power and treats waste that's batch fed from a holding tank. It can be an excellent solution for large yachts already equipped with large holding tanks. Galley Maid and Microphor also make both Type I and Type II MSDs. Other options are composting heads from AirHead, SunMar and others.

The list price of these units may shock you, but only until you compare prices from the discount retailers to the cost of installing and maintaining a holding tank. The average cost, presuming that you will install it yourself, for the materials to install a quality holding tank is US$400 to US$600. [Ed: refer to DIY 1997-#2 issue or the MRT "Plumbing 101" CD-ROM for installation instructions.] To that must be added the ongoing cost of odor control products, pumpouts and periodic replacement of sewage hoses, bringing the actual cost of installing and using a Lectra/San [Ed: refer to DIY 2002-#1 issue for a sample installation], purchased at discount price, to just about breakeven with that of a holding tank in only a couple of years. While federal law requires that Type I MSDs reduce bacteria count to less than 1,000 per milliliter (ml), the bacteria count in the discharge from a Lectra/San is less than 10 per 100 ml, making it one of the world's most environmentally friendly sewage treatment devices.

Grounds for Treatment

Now that you know that there are alternatives to holding tanks, let's debunk the arguments against them in favor of "no discharge." The following is from a press release issued by New York state dated October 2003 announcing that a 135-mile (217km) section of the Hudson River had been declared "no discharge" and is typical of "no discharge" propa-

Lectra-San creates its own form of chlorine (hypochlorous acid) by charging the ions in saltwater with electrical current. Its power consumption of 1.7 amp hours per flush appears a bit extreme at first until you take into account that the average adult uses the toilet only five or six times a day. Presuming that, the average daily power consumption for two adults averages 17 to 20 amp hours per day, it's well within the capability of most house battery banks.



ThermoPure uses AC power from a boat's generator or shore-power to supply heat to eliminate bacteria, rather than chemicals or additives, or water. After the warm-up period, the system runs on DC power. Peak load treatment capacity with 65F (18C) flush water is 46 gallons (174L) per eight-hour day. During this time, the maximum AC power consumed is 12kWh, 14.7 amp hours on the DC side.

ganda. "Treated wastes often contain microorganisms, nutrients and/or chemical additives such as chlorine, formaldehyde or phenyls, that can degrade water quality in areas of the river where they are discharged. Among the potential effects from these waste discharges is nutrient loading, which can deplete oxygen levels in the water (hxpoxia) and significantly damage fish and other aquatic life. In addition, the release of toxic materials and pathogens also can harm marine and estuarine life and potentially spread diseases such as hepatitis to humans who come in contact with contaminated waters."

Let's challenge this argument one point at time. We've already established that there are several devices that treat boater generated sewage, some of which do not contain or require the use of any chemical additives. As for nutrient loading and potential damage to fish and other aquatic life, the following study illustrates what biological oxygen demand (B.O.D.) represents in the context of the marine environment: B.O.D. 5 results from a boat's holding tank contents is approximately 4,000 to 5,000 milligram per liter (mg/L). B.O.D. 5 results from untreated waste is approximately 1,000 to 4000 mg/L. B.O.D. 5 results from 12 oak leaves per 250 ml of water is 2,241 mg/L. B.O.D. 5 results from Lectra/San treated waste is approximately 300 to 1,200 mg/L. B.O.D. 5 results from municipal treatment is approximately (no national standards) 50 to 700 mg/L. These figures indicate that the discharge from a Lectra/San has a B.O.D. impact of no more than four oak leaves landing in the water. It has never been established that treated particulate from boats has ever caused oxygen depletion. An independent study done by the University of Sydney, Australia, to determine the effectiveness of the Lectra/San's ability to destroy the hep-

atitis A virus (HAV), concludes, “This system is effective and will remove 78% to 98% of viruses from fecal material. As HAV is one of the most difficult viruses to destroy by chemical sterilization, a higher rate of removal for other enteric viruses can be expected when using this device. The system will provide an effective viral barrier protecting any direct users of recreational water as well as shellfish farmers and shellfish consumers.”

Treatment Disparity

Now you know that Type I and II MSDs can reduce bacteria levels to less than 10 fecal coliform per 100 milliliters of water. What you may not know is that this is 20 times better than the standard for municipal treatment plants, which is where the contents from most marine pumpout facilities ends up. More concerning is that, even where there are pumpout facilities, a number of studies have shown that some boat owners either choose to, or are forced to, due to limitations of accessibility to and operating hours of pumpout facilities, dump their tanks illegally. Furthermore, the active ingredients in many holding tank products are the very chemicals the “no discharge” advocates want to keep out of the water; namely, formaldehyde, gluteraldehyde and quaternary ammonium compounds. The raw sewage and chemical holding tank products in just one illegally dumped holding tank has more negative impact on the environment than a 1,000 boats discharging treated waste from a Type I or II MSD in the same area.

The bottom line: if you have a choice, you can choose treatment.

About the author: Peggie Hall is an independent consultant and boating industry expert in marine sanitation and is often referred to as the "Headmistress.” Her book “Get Rid of Boat Odors! – A Guide to Marine Sanitation Systems and Other Sources of Aggravation and Odor,” (Seaworthy Publications, http://www.seaworthy.com/html/get_rid_of_ boat_odors.html) is the first book ever written devoted entirely to that subject.

AirHead from EOS Design separates the liquid from the solids without using electricity. A 12-volt DC fan operates continuous in the vent line and consumes about 50mA. Peat moss is added to the lower tank to decompose the solid waste. DIY reader Bob Hays installed an AirHead onboard "Manx," a 35' (10.6m) catamaran and had this to say about the product: "There is virtually no head odor and power consumption is easily handled by our solar panels. You must dump the liquid daily or have it plumbed into a holding tank or order another liquid holding tank. We feel the entire process is much simpler than dealing with holding tanks and pump-outs."

Fresh Look

A complete cockpit redesign and some repairs convert an aging cuddy equipped for Great Lakes fishing to a comfortable and stylish, compact "camper" cruiser.

Story and photos by Jan Mundy

Chipped gelcoat, cracked fiberglass, weathered teak, broken plastic fittings, deck leaks and corroded hardware, all combined to create the classic effect of wear and tear on Freeport, our 1990 22' (6.7m) trailerable cuddy cabin boat. Equipped with two livewells, one large fish box, rod holders and downriggers, this boat is rigged for fishing on the Great Lakes. Since our interest had shifted to camping afloat, this fishboat sorely lacked the amenities needed to satisfy our new priorities. Storage for camping gear, more comfortable helm seating, extra seats for guests, a canvas enclosure, docking lights, etc. were on the list. While the boat was laid up for repairs, it made good sense to tackle the refit at the same time.

Optimism is a necessary quality when tackling a boat refit, as what began as a month-long project, evolved into a two-year undertaking. Simple repairs grew into major reconstruction, nuisance items needing repair had been overlooked in the planning and mismatched replacement parts required reworking installations, plus my work as editor of *DIY* and family commitments, all contributed to postponing launch day. Taking measurements, drafting a new cockpit layout and producing cardboard mock-ups consumed the first few weeks. Next was to compile a two-page list of materials, replacement parts and new gear to order and jobs to do. Then came the budget. Comparable boats on various used boat websites were selling for US$13,500 to US$16,000. Knowing that whatever we added to the boat would return to us tenfold in cruising enjoyment and certainly double its resale value, the budget was capped at US$5,000.

From the Keel Up

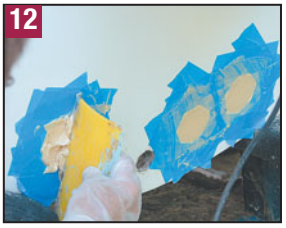
Initial inspection of the hull revealed a few areas of spider cracking below the waterline just aft of the bow on both sides, likely the result of hull panel flexing when bouncing off waves. There were also stress cracks emanating from cleats, rod holders and fasteners. Replacing the original bimini with a T-top a few years ago, which now was being traded in for a custom-made camper top with standing headroom, left plenty of drilled holes to fill in the cabin sides. Now was a good time to probe a suspicious pinhole crack and spongy laminate the size of a quarter on the helm bulkhead, an area that I had been purposely ignoring for too many years. All but one of the drains leading out the transom from the livewells and fishbox were removed and then the fiberglass laminate was patched from both the inside and outside. These drains were installed below the waterline and, having no seacocks, were always a concern.

After completing the filling, fairing and two gelcoat applications, the hull was compounded to remove oxidation buildup, then glazed with 3M Finesse-it II and waxed. The final result was a satisfying mirror shine. (Follow the steps for gelcoat restoration in DIY 2002-#1 issue to obtain a similar finish.) This job was completed during the first year (the eternal optimist) and a year later, before the launch, the hull, which had retained its awesome gloss, only required a wash and wax. Replacing outdated vinyl graphics with contemporary styled graphics, as documented in *DIY* 2003-#4 issue, completed the hull mods.

Removing 3' (91cm) of vinyl rubrail exposed a bare, sealant-less joint. Since the rail's rope insert was badly frayed (a cosmetic condition), this was the time to remove it and that allowed access to fasteners holding the rubrail to the hull-deck joint. Working in arm's length sections, the rail was unscrewed, held off the hull with wood wedges while the mating surfaces were wiped clean with solvent and 3M

(1,2,3,4) Teak trim in cockpit of 1990's walkaround cuddy cruiser adds character but demands frequent maintenance. Note polyethylene lids over floor-mounted livewell. Bracket for removable table is shown on the right in photo 2. (5a) Huge, ungasketed fish box in stern and one of two (5b) floor-mounted livewells would always fill with seawater when backing up. (6) Helm console shows defunct key ignition on the left and rotomolded bucket seat.

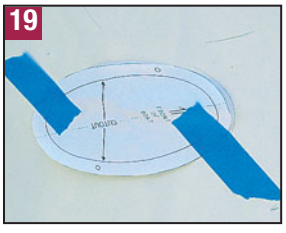
PROJECT BOAT



(7,8) Repairing dings, fractures and cracks on the hull and deck and filling drilled holes from previously installed equipment and then applying two coats of color-matched gelcoat (9,10,11), took a month of weekends to complete. (12) Livewell drains at the stern were plugged then filled. Complete details of this repair appear in DIY 2003-#4 issue. (13) Bimini top hardware (this boat's second top) was mounted on cabin sides. Fastener holes, visible just below the windshield by the companionway, are from the adjustable track from original convertible top. All hardware was removed and holes were filled and finished with color-matched gelcoat.

(14) A small pinprick at the bottom of the helm console revealed delaminated fiberglass, resulting in a huge hole to fill.

(15) No sealant was applied by the manufacturer under this rubrail.(16) Rubrail was pulled down, mating surfaces solvent cleaned, caulked and refastened (17). On a summer day, you must work quickly when using the 3M Fast Cure version to prevent the sealant from setting up before completing the job. (18) Spilled sealant is easily removed with BoatLife Release adhesive and sealant remover.



(19) Supplied template helps to properly position docking lights just back from the bow so they point straight ahead with the centerline of the light housing parallel to the water. (20) A 1/32" (.7mm) pilot hole is drilled to be sure there is adequate clearance inside the hull for the light housing. (21) To cut, drill a 3/8" (9mm) hole within the drawn line, insert the jigsaw blade and cut. (22) Heat shrink over crimped terminals provides a waterproof connection. (23) Mounting the docking light. (24) The compact, Paneltronics waterproof circuit panel for docking lights, washdown and one spare is now located where the keyed ignition had previously been.

4200 applied liberally. While doing this, a huge gap was discovered in the deck-to-hull joint at the bow. Here the deck overlapped the hull by about 1" (25mm). Filling with 3M 5200 would make it watertight. Finally, we resealed the rubrail and installed a more durable vinyl insert.

Light the Way

Trailering a boat means that you're likely to find yourself idling up to a launch ramp at any time of night. Most ramps are poorly lit as are some approach channels. Many upscale boats come with docking lights, which seems to be a worthy safety feature and a great convenience. Could they be installed in our boat? Docking lights mount flush with the hull so they require sufficient space between the hull and liner for the light housing and access to route the wires. Aqua Signal's 85101 fit the bill, needing just 3-1/2" (9cm) clearance behind the light. Installation was easy. Finding the correct placement on the hull was more difficult and the instructions weren't clear on the procedure.

Dismantling the interior panels allowed easy access to wires for routing back to the Paneltronics waterproof panel mounted at the helm. The total run was 12' (3.6m), so allowing for a voltage drop of 3% (I consider docking lights "critical" equipment), ABYC recommendations required 14 AWG.

A Teak Alternative

Teak trim surrounded Freeport's cockpit interior in a style typical of older boats. Sideboards, aft locker doors, rod supports and the companionway were all teak. It's a very functional wood that rarely rots and is pleasing to the eye when maintained on a frequent basis. Sporadic applications of teak coatings over the years, which peeled and gradually turned the wood black or gray, were followed by attempts to rescue the coating and an even worse looking finish resulted. Either I scraped, sanded, and pledged to maintain the teak or I replaced it all with King StarBoard, which is the more expensive option, but well worth it in my opinion. Besides, I've built many items of StarBoard and felt confident this was an easy task.

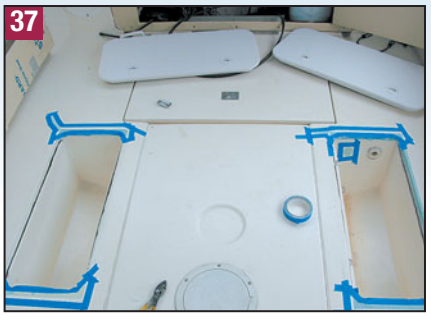
StarBoard cuts, routers and drills just like wood, using common woodworking tools. Small pieces are cut on a bandsaw or with a jigsaw with a 10 teeth per inch (TPI) blade. To cut large pieces, I use a circular saw with a sharp panel blade, and 80 TPI. Using the proper saw blade produces a clean edge that's ready for shaping. This is done on a router with a carbide, double-fluked bit with a bearing. Drill fastener holes, install and the job's finished. No maintenance, no wear. Sideboards were made of StarBoard AS, the same product as the original except the surface has a skid-resistant, textured pattern. Mounting a toe kick along the

(25) Teak trim removed from stern locker reveals poor fitting to the adjacent bulkhead; the entire filler piece was replaced with StarBoard. (26) Original trim served as patterns for new pieces. Here fastener holes are transferred from sideboard pieces onto 1/2" (12mm) StarBoard AS. (27) Rod holder dimensions are transferred onto 3/4" (19mm) StarBoard. Offsets from stern locker (28) are marked onto 1/2" (12mm) StarBoard. (29) Cutting StarBoard with circular saw fitted with panel blade. (30) All edges are routered to remove the cut sharp edge; note bearing (31) on router bit. Holes for fasteners (32) are predrilled into rod holders to exactly match original piece. In the background is cleat stock made of StarBoard epoxy glued after flame treating to reinforce the 1/2" (12mm) thick anti-skid StarBoard sideboard (should have used 3/4" (19mm).

side compartments neatly bridges the gap and provides a place to stow fenders, paddles, kneeboard, etc. Small teak doors covering the aft locker restricted access to the oil tank, battery and engine filter. Additionally, trim pieces on locker sides hid large gaps between the locker front filler piece and the stern bulkhead. The solution was to replace the entire filler piece with a new one constructed of StarBoard, made to fit tight against the bulkhead and with larger doors.

Livewell Begets Storage

Two floor livewells had "floating" polyethylene lids. Both tanks drained out the transom through flush-mounted thru-hulls. Without a waterproof gasket, the livewells filled with water when it rained and, with the increased listing angle due to the volume of water, they didn't always drain. When backing up, the livewells would always fill with water, sometimes very nasty water when in a dirty harbor. Converting these to waterproof lockers gave us an additional 10 cu. ft. (92 cu. cm) of dry storage. Key here was to find a prefabricated lid that closely fit the dimensions of the existing compartments without vast modifications to the cockpit floor. Measuring 10" x 30" (25cm x 76cm), the Bomar 81030 was close in width but a few inches too short. Locker ends were filled in with 3M Premium filler and finished with color-matched gelcoat. Locker sides where cut with a circular saw, the blade being the exact width of the new hatch rims.



(33) Dry-fitting Bomar access hatch over molded fiberglass livewell tank. (34, 35) Cutting locker sides with circular saw allowed hatch to seat neatly flush with the floor. (36) Drilled holes connect to form corners in ends. (37) Applications of 3M Premium Filler fill in the locker ends and hole from livewell nozzle.

Seating's Optional

A discussion on seating (or berths) always leads to the comfort factor. This boat's tough rotomolded bucket seats, though completely maintenance free and weather resistant, had become much too hard for our aging bodies. More cushioning was desired to support our anatomy. Besides, one of the seat couplings had cracked so one replacement seat was already on the list. We considered the state-of-comfort seat pedestals with built-in suspension but at about US$700 each, they were too rich for our budget. Our

research led us to decide on two Garelick contoured captain's chairs mounted with Garelick's seat suspension unit and slide system. Fortunately, the new pedestals had the same mounting footprint as the old and using toggle bolt anchors facilitated mounting without removing a floor section.

If we wanted to have guests onboard, we needed additional seating. I designed a stern seat that fastens to the transom locker bulkhead using pull-apart hinges. This allows the seat to fold down or completely detach for unfettered access to the aft locker for battery and engine service and to the storage locker.

Cockpit Trim

We had a portable 12-volt powered washdown pump, the kind with a pickup tube that hangs over the side and a wiring harness with alligator clips that connects to the battery. It lasted three years before it expired. A washdown pump is one of those nice to have luxuries and the Flojet Quad II fit nicely in the aft port locker. One livewell thru-hull was reserved for the washdown intake. This required removing the plastic thru-hull and replacing it with a bronze thru-hull and ball valve. Reinforced hose was routed down to the new thru-hull and to the fixed washdown panel to which we would attach a hose when needed. Wires passed underneath the cockpit to the new panel at the helm and a negative bus bar. This task was simplified by using the messenger line we had installed years ago. I used 14 AWG to comply with ABYC guidelines for voltage drop and wire length from the pump to the panel.

The wide, flat stern deck provided a stable platform when using the stern ladder or performing visual checks on the outboard but its glossy and slippery, waxed finish was a safety hazard for our dogs and us. For a better grip, a piece of synthetic non-skid, leftover from another project boat, was epoxy glued to the deck.

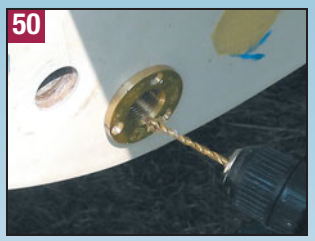
Now was a good time to replace all the nuisance items that either never worked or had broken soon after installing. Included on my list was the outboard bracket that required

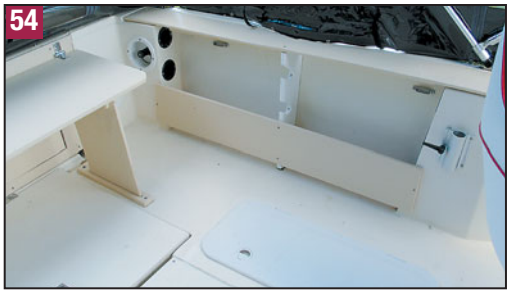
(continues on page 56)

(38) Flojet Quad 11 washdown pump kit (model 4325-143L) includes a pressure nozzle, inline strainer and various hose ports. (39) Pump outlet hose connects directly to an outlet. To use, screw on a garden hose and wash away the dirt. (40) Water supply for washdown pump comes from an existing thru-hull fitting upgraded with a bronze thru-hull and ball valve. Note: Visible on both sides are laminates of 6 oz. fiberglass cloth and epoxy resin laid down to reinforce original livewell drain holes on inside of stern.

(41) New seat base fits the original hole pattern and installs easily with toggle bolt anchors. (42) Garelick seat suspension unit fastens to the seat base then to the slide. (43) Seat suspension is adjustable from soft to firm by pulling the quick release pin and moving the rubber shock . (44) Sewing stern cushion seat and seat back, and bow seat using my Sailrite LSZ-1 sewing machine. This tough and durable machine sews as well as any industrial machine.

(45,46) Epoxy resin, thickened to a mayonnaise consistency, is spread over one-half of the stern deck using a notched trowel and then the synthetic non-skid is laid over and rolled out to remove air bubbles. (47,48) Procedure is repeated for the second half. Working in smaller sections allows plenty of time to work the surface and clean up any (49) excess before the epoxy kicks off.

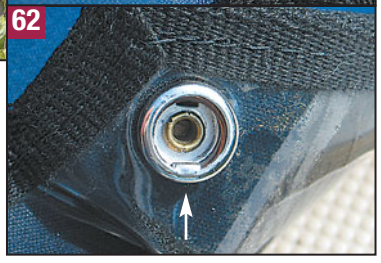




(50) No more rubber drain plugs with this permanent bronze plug. (51) A lift-and-hold assistant for the heavy hatch over the fish box, now dry storage locker. (52) StarBoard companionway doors and hatch trim replace teak. (53) Rebuilt stern features removable custom stern seat made of 3/4" (19mm) StarBoard, two larger access ports with the washdown housed behind the port one, watertight floor lockers, and maximum width aft locker doors for easy reach to batteries and oil tank. StarBoard skid-resistant sideboards on port (54) and starboard (55) provide an excellent gripping surface for your feet. Note toe kick in photos.

(continued from page 53)

a line to hold the spring lever in the up position; the all-round white light that blinded us at the helm at night; a corroded 12-volt plug; a cheap plastic holder for the fire extinguisher; a horn that never sounded called for an all-stainless one; broken plastic drink holders; cracked in-line fuse holder for VHF radio; corroded cam lock on the companionway hatch lid; and finding a better solution to the rubber drain plug. Unable to locate a bronze plug with a threaded insert, I modified a B4 Play plug given to me as a sample many years ago. This bronze drain plug (see photo on page 55) has a sensor that detects water and sounds a horn if one should forget to screw in the insert (near sinkings occur often due to forgotten drain plugs). I liked the plug design but didn't want the electrical component so I cut the wires to the sensor and installed the plug with 3M 4200. A gas hatch lift was installed to support the heavy fish box lid and a gasket sealed for dry storage. Both much too small and difficult to unscrew ports that provided access to small stern compartments were replaced with larger, better sealed and easier to remove locking deckplates (refer to *DIY* 2003-#2 issue for installation details). Dams made of StarBoard were mounted vertically with 3M 4200 to prevent water from the self-draining cockpit from entering the battery and oil tank compartments. This completed the cockpit renovations.



(56,57,58,59) It's the finishing details that make a quality top: Screened aft curtains with double pull zippers so you can open up as needed or completely remove and roll up; zippers that all start at the same place; "beartails" (60) to cover up the "ratholes" where zippers collide and secured with a dome. (61, 62) Pull the Dot dome fasteners were strategically placed at high stress points along the perimeter where the cover fastens to the deck. These domes hold so securely they are actually difficult to unfasten. The canvas maker tapped each Pull the Dot with a dot on the outside (61) to mark the lifting point, which is directly across from the flat spot on the dome as shown in photo 62. Just pull up at the dot to detach; push down at the back and roll to fasten.

Under the Big Top

Accommodations were slight on our compact cuddy and the best way to extend living quarters was to enclose the cockpit. We presented the task of building our new canvas to Barry Parker of Custom Covers (Tel: 705/887-3557). Our criteria required that the cockpit be completely enclosed yet the enclosure had to provide access to stern cleats, swim platform and engine and a walkthrough to the bow; that the enclosure provide a minimum 6' (1.8m) of headroom throughout the full length of the cockpit with sufficient height at the helm so the driver could stand up and drive. Finally, the front panel must open and be screened. This top became Barry's worst nightmare but his finished product is stunning and without compromise. It's different, it serves the purpose and it's exactly what we wanted. Made of Marilux, a coated acrylic from Germany, it's completely waterproof yet breathes, preventing the build-up of mold and mildew. Easily removed by one person, the entire cover falls back and leans against the self-supporting main frame to stow in a boot.

To some boaters, these amenities might appear to be the barest of comforts but having running water, comfortable seating, docking lights, a dry cockpit and room for friends (and dogs) makes a huge difference to this compact cruiser. All added for a fraction of the price of a new boat.

DIY BILL

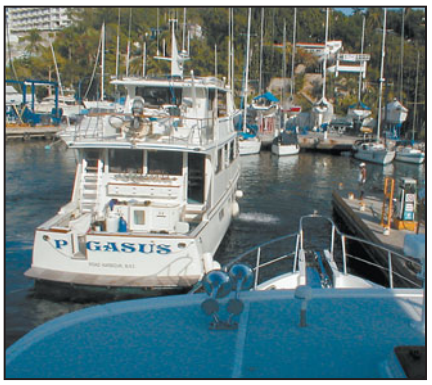
The following summarizes the cost of converting our 22' (6.7m) walkaround fishing boat to a cruising "camper." There are still some items to complete and they are included below along with estimates. My original budget was exceeded largely due to cost of the seating upgrade. Prices are in U.S. dollars.

Aqua Signal docking lights, pair	$180
Custom canvas camper top	$3200
Fabric and cushion for stern and bow seats	$60
Ongaro 10036 Horn	$29
2 tubes 3M 4200	$22
1 tube 3M 5200	$11
2 Garelick Captain's Chairs	$460
2 Garelick seat suspension units	$199
2 Garelick Millenium 2000 seat slide system	$180
2 Garelick pedestal bases, 14" high	$110
Garelick stainless steel outboard motor bracket	$160
2 Bomar access hatches, 10" x 30"	$188
1 Bomar 8" deckplate	$34
1 Armstrong 8" compression deck plate	$30
1/2 sheet, 1/4" StarBoard in Sanshade	$45
1-1/2 sheets, 1/2" Starboard in Sanshade	$378
1/2" sheet StarBoard non-skid in Sanshade	$150
1 3/4" Bronze thru-hull	$14
13/4" Bronze ball valve	$22
Perko navigation light	$22
SSI fire extinguisher holder	$10
Flojet Quad II washdown pump	$188
Taco flexible vinyl rubrail insert V12-0003 70'	$64
Paneltronics 9960011 Waterproof panel	$100
Fiberglass supplies: 1 can each color-matched brushable and sprayable gelcoat, MEKP Polyester hardener, Duratec Clear Hi-Gloss	$70
Miscellaneous Sandpaper, solvent, fasteners, masking tape, hinges, 14' gasket, 1 roll 3M VHB, wire-reinforced hose, gas hatch lift, 12 toggle bolt anchors, TBS nonskid	$150
Total	$6076

Remaining Jobs to Complete:

- Install replacement outboard bracket. Existing bracket was installed with everlasting 3M 5200. (I'll document its removal in an upcoming issue.)
- Rebed stanchion bases
- Sew stern seat cushion and bow cushion
- Install Perko 1637 reduced glare bow light
- Sew canvas storage bags and install in interior
- Upgrade interior lighting
- Make a StarBoard boarding ladder
- Sandblast and paint trailer (estimate US$500), replace bunk carpet, add skid-resistant step pads.
- Epoxy glue nonskid on the foredeck

PAINLESS DOCKING



Mastering close quarters maneuvering of a twin-engine boat requires an understanding of the shopping cart effect and prop walk and the proper use of rudder, throttle and gears. Follow these tips from a pro to hone your docking skills.

Story and Illustrations by Peter P. Pisciotta

I recently watched an older couple approach a side tie at a yacht club floating guest dock. They were aboard a 45' (13.7m) twin-screw trawler yacht with 15 knots of wind setting them off the dock. In the clubhouse, overlooking the guest dock, several barstools turned to see how this vessel would negotiate the locally known adverse conditions. To compound matters, there was only about 55' (16.7m) between two previously docked boats.

The landing was uneventful. The visiting yacht tucked her bow near the forward vessel and rotated her stern toward the dock, coming to a halt just as the fenders touched the dock. Around the bar, a few compliments were muttered about the maneuverability of twin screws. The fact of the matter is it looked easy because the helmsperson knew what tools were available and used them well.

There are only three directional controls on any boat: rudders, gearshifts and throttles. Okay, some boats have thrusters, but maneuvering with these was covered in DIY 2003-#4 issue. Twin screw boats, while more maneuverable, are inherently more complicated than single engine boats because there are more controls: the single engine has but three possible gear settings (forward, neutral, reverse) whereas a twin has nine. Add throttles and helm and the permutations are endless. It's little wonder conventional wisdom teaches leaving the rudder centered and not touching it at all (more on this later).

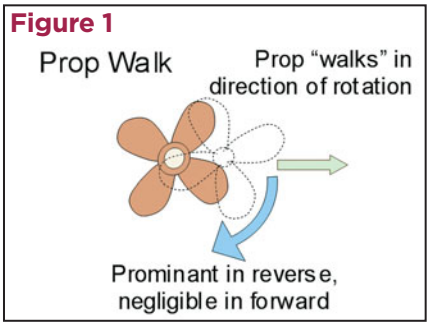
Three Turning Tools for Twins

The rudder is the one the operator knows best because it's the only tool with no other purpose but turning. Because most docking can be accomplished without rudder action and the rudder can add a confusing dynamic, many people chose to center the rudders and leave them alone but there are times when rudder action is needed in close quarters.

Twin engines are offset from center. If you put the right engine in forward, the bow will veer to the left. This is known as the shopping cart effect. Push on the right side and the front of the cart will veer to the left, pull on the right and the cart veers to the right. "Pull" on the right gearshift lever (put it in reverse) and the bow veers to the right (actually, as we'll see soon, the stern actually veers to the left). Putting one shift lever in forward and the other in reverse ("splitting the gears") makes the boat spin.

Exercise: Stand at the helm and imagine a shopping cart. Physically rotate your shoulders to decide which gear to place in forward or reverse.

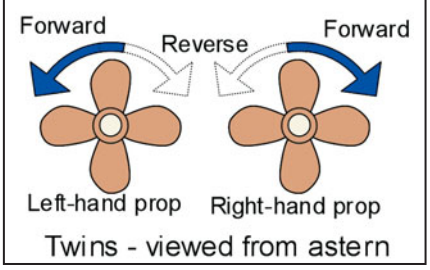
Figure 1



Prop walk is virtually unknown to most twin-screw operators and is the most difficult to master. When a propeller spins in water, it has a tendency to creep sideways in the direction it's spinning. If it's spinning toward the right (clockwise), it will "walk" toward the right (**Figure 1**). Most modern twin-screw installations have counter-rotating propellers, with the right engine turning right and the left engine turning left (**Figure 2**). Prop walk is most noticeable when in reverse. If the left engine is in reverse, the propeller is turning to the right (clockwise) and it will "walk" to the right carrying the stern with it toward starboard (**Figure 3**).

Exercise: In an open area on a calm day, steer your boat in a straight line toward a good reference point (perpendicular to a long pier works well). When

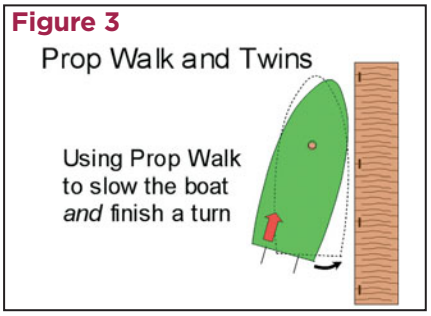
Figure 2



you are within a couple boat lengths of the target, put one engine in reverse, the other in neutral. As the boat slows you will see it turn, mostly from the "shopping cart" effect, but as it comes to a complete stop you will notice a considerable increase in rotation. This is due to prop walk.

That's your entire toolbox. There are no other tools, except spring lines or dragging an anchor like the big ships occasionally do but that is an article for another time and not very useful in the middle of a fairway.

Figure 3



Physics of Boat Handling

There are two basic principles governing how a boat moves in close quarters: pivot point and wind lock.

A boat rotates around a point roughly one-third length aft of the bow. This is known as the pivot point. When the boat is turning, as it would be when approaching a slip, aligning the bow results in a missed landing (**Figure 4**). Left adrift, a boat will lie almost perpendicular to the wind, not bow-to. If there is wind forward of the beam, the bow will increasingly struggle as you turn into it, a condition known as wind lock. Wind also affects the stern if you turn the other direction. Turning the bow into the wind is usually easier. This is important not only in docking but also in making an emergency U-turn in a narrow fairway (**Figure 5**). While there are more effects, knowing these two principles will help you make more successful maneuvers, especially in unfamiliar situations.

Figure 4

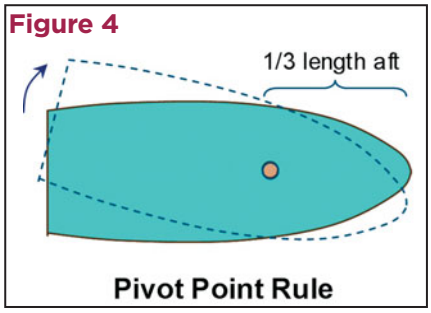
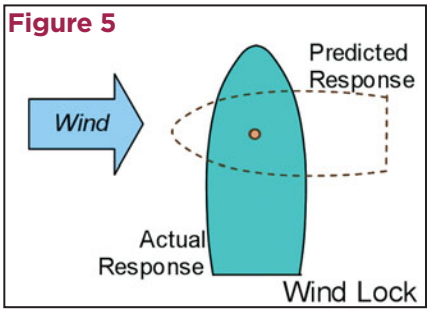


Figure 5



Task Tools

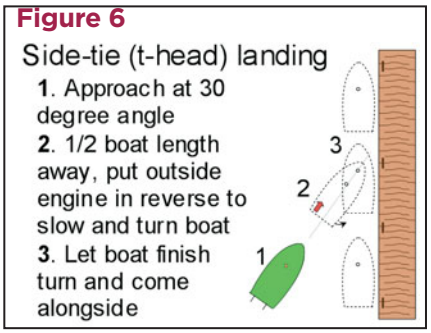
Rather than try to describe and resolve all the infinitely possible scenarios, I teach what the military calls "situational awareness." You decide what you need the boat to do (slow down, speed up, rotate the stern in, creep sideways, etc.) and then you use the appropriate tool to accomplish that task.

Close quarters scenario #1 is to approach a side-tie between two other boats. The goal is to "slide" the boat into the side-tie. By approaching at an angle, you'll be able to land between two boats (**Figure 6**). Here's how.

Step 1 The approach. Approach at slow (idle) speed at a 30° to 40° angle. Decide where you want the bow to ultimately end up and aim directly for this point (a common mistake is aiming too far aft). Keep pace slow by alternating one engine then the other in gear instead of both.

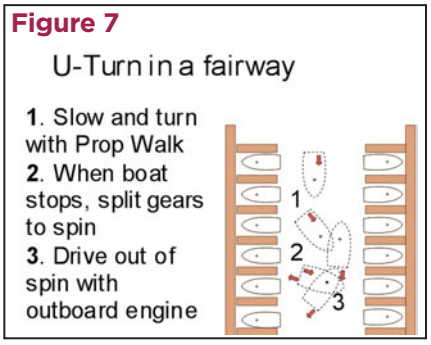
Step 2 Begin the turn at about one-half boat length away from the dock. Putting the outboard engine (the one furthest from the dock) in reverse will simultaneously slow the boat and start swinging the stern toward the dock due to prop walk and shopping cart effect.

Figure 6



Step 3 Stop the boat and finish turn. As soon as forward progress halts, put the engine in neutral. If everything has gone well, the boat will still be rotating and will finish the turn. If it's rotating too fast, put the inboard engine in reverse momentarily to induce opposite prop walk and slow rotation.

Figure 7



Close quarters scenario #2 is a U-turn in a narrow fairway. The dockmaster has assigned you a guest slip but, as you head down a narrow fairway, you find the slip is occupied. You must turnaround and exit (**Figure 7**).

Step 1 Decide the direction of your turn. Usually, this decision is based on where the wind is coming from. Always work into the wind whenever possible.

Step 2 Slow the boat and start the

TIP: *Stern Action*

All close quarters handling tools (rudders, props) are located at the stern of the boat so you have more control over the stern than the bow. If you watch skilled operators carefully, they get their bow placed somewhere then rotate the stern as needed.

turn. Rather than put both engines in reverse to stop the boat then start the turn, why not accomplish both tasks simultaneously? Accomplish this by placing just one engine in reverse. Prop walk and shopping cart effect start the turn while slowing the boat. A port-turn is initiated by placing the port engine in reverse. Adjust rpm if necessary to control pace.

Step 3 As soon as your boat stops, split the gears to induce maximum turning momentum. As the turn is almost complete, start driving out of the turn by putting the reverse gear in neutral.

Close quarters scenario #3 is coming into a slip. Key to managing adverse wind or current is to keep the boat moving forward throughout the maneuver. Many operators try to make a 90° turn in front of their slip and head straight into their berth. This can be challenging because the timing must be precise and the boat's momentum is lost during the turn and this is when wind can take over. This approach needs a long, carved turn into the slip, with the helmsperson making small adjustments throughout (**Figure 8**).

Step 1 is to plan the approach. Start a wide radius turn early enough so that you end up about 10' (3m) in front of the slip. Use the two engines independently: the outboard engine in forward increases turn and speed; the inboard engine in reverse slows the boat and increases turn etc.

Step 2 Align the boat's pivot point with the centerline of the slip. As you near the slip, increase rotation and slow the boat but try to keep it moving forward if possible. It may be necessary to split the gears to increase rotation.

Step 3 Drive the boat into the slip. Rather than putting both gears in forward, use the two gears independently to adjust alignment.

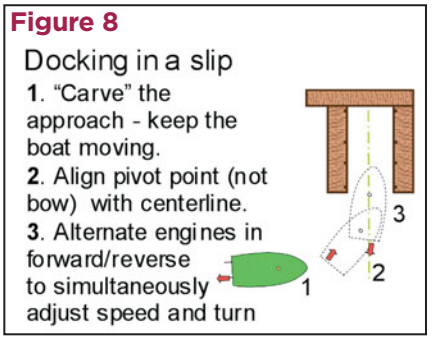
Gaining More Control

Sometimes wind or current overwhelm boats in close quarters. There are two options for counteracting the wind's influence on control. First, you can move on, looking for a side tie, anchor out or try the next marina. It's your responsibility to dock safely. If you are not confident you can execute a painless landing, come up with a Plan B. Your other option is to magnify the effect of your maneuvering tools by using (adding) helm (rudder) or increasing throttle (speed). Increasing rpm has pronounced effects on prop walk. If the helm is hard over, adding rpm greatly increases turning momentum. Maximum turn is induced when the gears are split with the helm hard over and rpm is increased. Be careful. It's easy to get confused! Use this tool very carefully. Many novices forget to recenter the helm so, when the gear is put in forward, an undesired turn is induced.

To offset the effects of wind and/or current, you do not need to go faster but you do need to keep the boat moving. You need to practice building and managing momentum, including the turning momentum that forces your boat to slide into a berth while offsetting adverse wind. Adding rudder and/or increasing rpm both work well but require a cautious hand that comes with practice.

Effects are magnified by increasing rpm and/or turning the rudder(s). Practice when conditions are light so you can feel effects and then slowly find increasingly complex situations where you can test your skills without an audience. By viewing this as your entire toolbox, you will become more comfortable approaching challenging situations.

Figure 8



About the author: Peter P. Pisciotta, founder of The Trawler Institute, is a USCG 100-ton licensed vessel operator and the owner of SeaSkills Personal School of Seamanship (www.SeaSkills.com), which offers yacht delivery endorsed by Nordhavn, West Marine and Willard Marine, new boatowner training, boat handling and boat docking instruction and spouse/crew instruction.

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FILLING A GREASE GUN

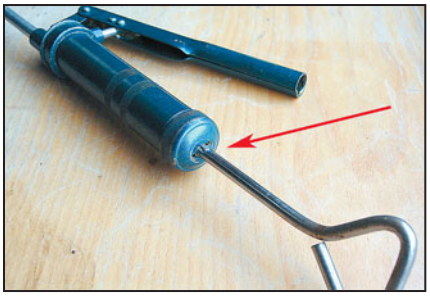
What is a simple task can be a total mess for the uninitiated.

Story and Photos by Peter Caplan

A small grease gun can be an ideal addition to the boat toolbox. Inside the gun, the grease is pressurized by a strong spring inside the pump body. Pumping the operating handle allows grease into the nozzle and further pressurizes it to overcome the resistance of the tiny valve inside the grease nipple.

The seemingly simple job of filling a grease gun or remote stern gland greaser causes incredible difficulties for many boat owners. When performed correctly it's clean and uncomplicated but it's easy to get into a terrible mess trying to stuff handfuls of grease into the end of the gun and then packing it to remove the trapped air. Here is an easier way.

To fill the gun, the plunger is first pulled out to the locked position. The locking method varies among makes of grease guns so check how it's done before starting.



Small grease guns like this are often locked open by pulling the plunger fully out and turning it 90°.

With the plunger locked the nozzle end can now be unscrewed. The plunger is then slowly released and any grease with-

in the body pushed out. This can be put back into the tin of grease to use again.

Small tins of grease have a flat disc inside with a hole in the center. This is provided to ease gun filling.

The end of the grease gun body with the nozzle end removed is placed onto the disc and pushed down while at the same time pulling up on the pressurizing plunger of the gun. The combined effort of pressing the gun down and lifting the pressurizing plunger up forms a partial vacuum and forces grease into the gun's body with little or no trapped air ensuring the body is almost totally filled with grease.

With the gun full of grease and the pressurizing lever fully out it's again locked into the open position. Screw the nozzle back on and then release the pressurizing lever.

If there is air in the nipple, open it now to free trapped air. If there is no air to bleed, pump the handle a few times to start the grease flow and the gun is ready for use.

Fill remote stern greasers by removing the top cap and unscrewing the body from the base. (OK, I admit this is the grease gun body but the principle's identical!)

Simply push the body down on the disc in the tin until it's totally filled with grease. When full, the body is refitted to the base, the pressurizing screw in the top cap is unscrewed and the cap refitted ready for use. In either case, there is little wasted grease and very little mess. Famous last words!

MISSION POSSIBLE:
Help for Mildewed Cushions

Sooner or later, this happens to all cruisers. We leave a port or hatch open in the rain or a big wave dunks us. Our cushions get soaked. Not the cockpit cushions, which can take abuse, but interior cushions. If ignored, they soon mildew and add to those odors that cause the mate to threaten mutiny.

I learned the hard way. It was a hot, windless summer day onboard *Raven* and all the ports and hatches were open when we were hit by the mountainous wake of a large cabin cruiser. Our bow scooped up water that cascaded into the vee-berth like Niagara Falls, soaking the interior cushions. After yelling the appropriate admonition at the stern of the perpetrator, we hauled out the cushions to air dry on deck. By the end of the day they seemed to have dried, at least the fabric was dry. So, we stowed them back in the vee-berth. In a few weeks we noticed that our boat a particularly foul odor emanating from the vee-berth, rather than the head, which is the usual situation. It had been long enough since our dunking that we didn't immediately connect the dots. We knew something was terribly wrong after an attempt to sleep on the cushions. Investigation revealed that the inner foam was still damp and badly mildewed.

Pat Kearns

I'm frugal (the mate calls me cheap). I could not bring myself to toss the cushions and buy new ones. I took the cushions home and removed the foam from the fabric covers. These were shipped to the dry cleaners and came back clean and odorless. The foam was a different story. I mixed up a solution of laundry detergent with a small amount of bleach, set the foam out in the back yard and soaked it with the cleaning solution. Like a wine maker stomping grapes, I proceeded to march around the top of each cushion to make sure lots of the good stuff got inside and it did. In fact, the second hardest part of the project was getting the cleaning solution out of the foam. I rinsed and marched and rinsed and marched. The neighbors, who are not nautical, thought I had gone off the deep end. Only another frugal sailor could understand why I would go to such lengths to save a few cushions. It took all afternoon before the water coming out of the foam was finally clear but it was worth it. The foam sparkled and even smelled nice. The next day was hot with no rain, a perfect day for drying our newly cleaned foam. Then I encountered the hardest problem. The foam would not dry. We were blessed with hot rainless days but a week in the sun still did not dry the innermost foam. Clearly, this was not going to work.

An answer came from an unexpected corner of our back yard. The top of our central air conditioner compressor produces a lot of hot air. I suspended one of the foam mattresses about 4" (10cm) over the compressor on a metal grate (part of a collapsible dog kennel) so that the hot air would blow the foam dry. Since the foam was open cell, I hoped that the hot air would permeate the foam and dry it. It did. It took a full day but it worked. Putting the foam back into the fabric covers was not as difficult as I thought it would be. The open cell foam compressed easily and with a bit of effort I was able to work it all back in again. To keep the cushions smelling sweet, I placed a fabric softener sheet between the foam and fabric.

Our foam cushions gave us good service for the next two years. Then, while pondering my to-do list, I remembered the fabric softener sheets I had placed in the cushions. It was time to replace them. As I thought about it though, I realized there was probably a better way to go: closed-cell foam.

Most interior cushions on boats are made with open-cell foam because it's inexpensive, easy to work with and arguably offers the best in comfort. Closed-cell foam is considerably more expensive, especially in large sheets, and is stiffer and harder to work with. Advantages of closed-cell foam are that it doesn't absorb water so the inside cannot mildew and it floats. I figured if I was unlucky enough to hit something big, closed-cell foam would be a useful item to temporarily plug a breach in the hull and, if the boat did sink and the life raft malfunctioned, I could float to safety on the foam.

"Fuzzy math," exclaimed the mate, but she was secretly considering the prospect of a new interior design with new cushions and gave the project a green light.

I found the foam available in large sheets (mattress size) and several thicknesses, up to 3" (7.6cm), from Defender Industries (www.defender.com). It was expensive, so, over the next year, whenever we had a little extra money, we replaced the open-cell foam with closed-cell foam. I used the old foam as a pattern. Closed cell foam is hard to cut but a sharp bread knife will do it. [Ed: This is a great job for an electric carving knife.] It's also hard to work into the fabric covers and, in some cases, the foam had to be inserted in pieces rather than one large sheet [Ed: Wrap foam in lightweight plastic and it slides easily into the fabric.] Also putting small pieces of open-cell foam in corners helps to soften them. I have heard that because closed-cell foam is stiffer than open-cell foam, one can get by with thinner cushions but I kept the thickness the same to use the old covers (much to the dismay of the mate) and to insure that they fit the spaces properly. Now, all of the foam on the boat is closed cell. I find I sleep much better on the closed-cell foam because it's firmer and supports my back better. [Ed: Test the foam before buying as some will find this foam too firm. One way to get the best of both worlds is to use the egg crate type foam mattress toppers found in bedding stores to supplement the thinner closed-cell foam. Cut them to fit.]

Just a few days ago I saw my friend and his wife sitting on a neighboring boat, looking forlorn and obviously not speaking. Although we hadn't had much rain that summer, the hatch had been left open on the one night that it did rain. "It was only open a little," explained my friend, holding up a thumb and forefinger to indicate about 3" (7.6cm) but the cushions in the main saloon were soaked. "Even had puddles on them," lamented my friend's wife. They asked if I had any advice. I think I told them more than they wanted to know.

— Charles F. Bahn, "Raven", Bethesda, Maryland

STERN FLAGPOLE HOLDER

A standard wall flagpole holder, available at hardware stores, makes a practical flagpole fastener for your boat. I used a wooden drapery rod for the staff, sized at the bottom to fit the holder and bought a finial at a lumberyard to finish the top. Both received multiple coats of marine varnish. The setscrew holds the pole securely in place; add two stainless-steel screw eyes for the flag.

— Bert Small, "Sea Eagle," Salt Spring Island, British Columbia

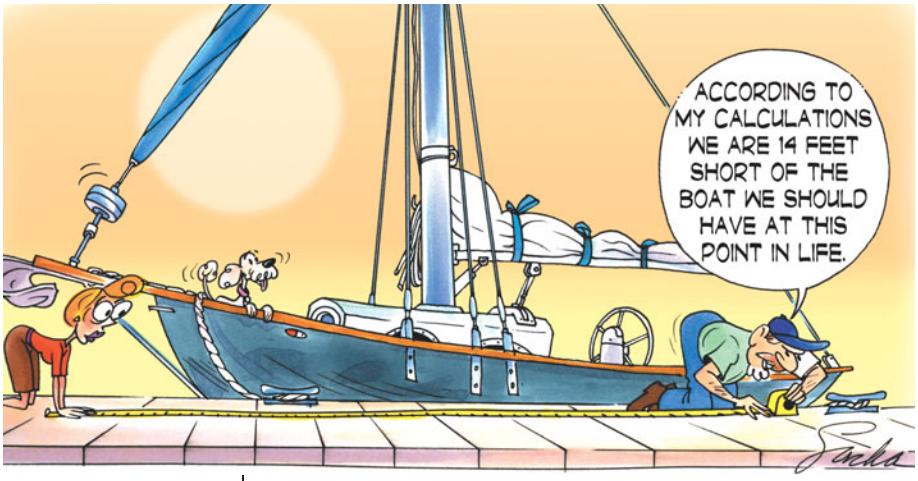
View from the Stern

Is Bigger Better?

It's popular belief that trading up is a good thing. Before you do, here are a few variables to consider.

By Roger Marshall

There is a school of sailing that suggests that you should not go to sea in a boat with less than 1' (30cm) of waterline for every year of your age. That means that as you get older, you should get a larger boat. As I age with grace, I heartily subscribe to this school of thought, although I am breaking that rule to sail on a 56-footer (17-meter) for the Bermuda Race this year. This is because the owner has also offered to take my eldest son on his first offshore race. In my opinion, a boat is not worth sailing unless it's large enough to hold at least one bottle of rum, several bottles of tonic, a few limes and a couple of large glasses. If you own on a boat that gets saltwater into your drink, definitely find a larger boat.



Having said that, I have to admit that there is a lot to be said for smaller boats in certain situations. If you want to explore some of shallow coves and inlets of Chesapeake Bay, Florida Keys or San Francisco Bay, a bigger boat can inhibit your exploration of the best kept secrets of these waters. Bigger generally means a deeper keel, more beam and a longer boat with more sail area. In this case, a smaller boat enables you to go to more interesting places and have fun on the water. That's what it's all about. If you are having fun on the water, enjoy whatever boat you are aboard. Worrying about the mortgage payments on a larger boat will detract from your enjoyment of being afloat.

On the plus side, larger boats have it better in every area except cost. They handle rough weather better, have a longer range, better creature comforts and can offer a more hedonistic sailing experience. However, you can figure that for every foot (30cm) of length, the bills go up exponentially!

As an example of larger being better when sailing long distances, I remember an experience I had on a transatlantic race. We were 11 days into the trip from New York to Falmouth, England, and were about a 1,000 nautical miles from land on a 100' (30.4m) sloop in 30 to 35 knots of wind when we overtook a First 33 that had left Bermuda 10 days before. We carried a full mainsail and a headsail with just two rolls on the headstay. Our boat speed was around 12 to 14 knots. The smaller boat was under a working jib with two reefs in the main and pounding along, throwing spray everywhere. They expected to make Falmouth in another 10 to 15 days, while we arrived just six days later. Just after we arrived a big storm hit and I wondered how the two men on that First 33 had fared. In this case, bigger was unquestionably better.

How should you decide what is best for you? Take a look at the type of sailing that you do now. Do you putter in and out of coves and harbors or do you spend time crossing expanses of an ocean? Do you sail for an afternoon and go ashore for the night? Do you sleep aboard with your family? Do you race regularly?

Sailing overnight requires that a boat have, at least, enough bunks for the crew, unless you're sailing solo. It also requires that the boat have a head and somewhere to wash the dishes, unless you are a diehard supporter of the local Pizza Hut. At a minimum, a boat that has these amenities is usually 22' to 24' (6.7m to 7.3m) in overall length, be it power or sail. However, there is no way that I would sail a 22-footer across an ocean, although more intrepid sailors than I have done it.

If you sail with your family, you will probably find that your boat size increases at approximately the same rate as your family increases. One child usually results in a 3' (91cm) larger boat, two children begets a 4' to 6' (1.2m to 1.82m) increase in boat size and so on. When your kids grow up and get families of their own, boat size shrinks accordingly. I know of a retired couple who've adopted the Florida lifestyle and now own a 20' fishing boat to take the grandchildren fishing. They owned a 50' (15m) before the kids left home.

So is bigger better? Only you can decide. But take my word for this. The average boat owner considers a boat of around 40' (12m) as large as he or she wants to own unless they plan on living aboard or crossing oceans. After that, boat size shrinks until, as I said before, you are back to a runabout and teaching your grandchildren how to bait a hook.

About the author: Roger Marshall is a boat designer and author of 12 books on sailing and yacht design. He has a boat design company in Rhode Island and is the vice-president of Boating Writers International.

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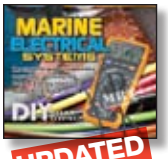

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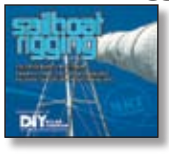

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