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WIN 3M 4000UV ADHESIVE SEALANT

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Currents

Edited by Jan Mundy

Diesel Flows Short

We inadvertently dropped the last line of the Diesel Engine column in DIY 2004-#3 issue, page 25. It should read: … change the oil and filter at least once a year.

Search for Gaskets

I own a 24-year-old Gulf 32 and was naturally very interested in your article on Leak Proofing Cabin Windows in DIY 2004-#1 issue. I first noticed all rubber frames on a LM27, which started me searching to see if they were still available. I finally found some one-piece and two-piece, self-sealing extruded channels listed in the Spaenaur catalog (www.spaenaur.com). They are on pages K3 and K4. While not pretty, these seem to be the perfect solution to the different coefficient of expansion of fiberglass and window material. Is there a reason that they are not more common? The two-piece one seems particularly suitable.

Alan Kirk, Saltspring Island, British Columbia

Nick Bailey replies:

The main problem with this window gasket style is exactly what you noted. They are not pretty and are difficult to integrate with an inner liner. They are also not completely immune to leaks and will sometimes need some assistance from silicone between the gasket and the cabin trunk, as well as between the gasket and the lens. These window gaskets are most popular on commercial workboats and smaller sailboats where there is no interior liner on the inside of the cabin trunk. They are also used on RVs and in other transportation related applications. If you don't mind the appearance, this style of gasket may be a good option.

Mislabeled Algae

Further to a DIY newsletter that discussed using additives to prevent the growth of "algae" in fuel tanks, we received this comment from Mike McLennan, Calgary, Alberta: "Algae do not grow in fuel tanks for they are plants that are photosynthetic, i.e. they need light to grow." Of course, Mike is absolutely correct but to clarify we asked the experts at Algae-X (www.algae-x.net) for an explanation and received this response from Bill O'Connell: The term "algae" is a misnomer. It is commonly used to describe the sludge that clogs filters and makes up the bulk (95%) of tank sediments. The sediments are actually fuel components that tend to form clusters (agglomerations) or repolymerize and separate from the fuel itself when they become too large or dense. The term "algae" originates from the use of biocides that has become common among diesel fuel users in hope of preventing the sediments but, since biocides only control the population of bacteria and other microorganisms, this is not a means of preventing the sedimentation process. There are other types of microbes that can cause foul odors, mostly anaerobic bacteria and, on rare occasions, fungi, molds or yeast. We adopted the algae term for our product line simply because most diesel users think of the problems related to fuel filters, smoking engines and tank sediments as an "algae" problem, thus "Algae-X" or no more algae problems." To sign up for DIY's biweekly newsletter of tips, tricks and projects, log onto www.diy-boat.com.

RFI Feedback

I have a few comments regarding John Payne's article on radio frequency interference (RFI) in DIY 2004-#1 issue. It's difficult to cover RFI introduction and troubleshooting in three pages, particularly the section that suggests that the plug wires and spark plugs be checked for RFI shielding. Perhaps John intended to call it RFI suppression, meaning that the first areas to check when ignition noise is a problem, is to ensure that resistor-type plugs are installed and resistor/inductive ignition cables are installed and in good condition. RFI shielding of plug wires and spark plugs is perhaps a last ditch resort and certainly isn't a common solution. The way it is written might make some readers with this problem think that they should have a shielded ignition system in place as a matter of design. This could put them on the wrong track to dealing with the problem. Also, the top illustration in the sidebar titled "Proper Grounding" on page 42, clearly identifies a CPU or processor inside a shielded enclosure showing a single point ground. In this situation, the ground is not necessary for the enclosure to be a good RF shield. It can be an effective shield without any ground connection; however, other factors may dictate that the enclosure be grounded, such as safety and lightning side flashes to mention two. The middle drawing clearly relates to shield grounding at one end as stated in the text but the statement, "Never ground at both ends," may have some people cutting the braid on coaxial cables. With balanced systems, grounding at one end is often best; however, even then there are situations where grounding at both ends may result in less RF noise. The bottom drawing with the twisted pairs actually reduces the magnetic field and not the electric fields as stated; the shielding

As Good As It Gets!

We feel safer living aboard, being able to consult DIY.
Robert Foose, "Anabas," Manhasset Bay, New York

I recently purchased my first and not the last copy of DIY and I must tell you that your magazine has hit the mark! A publication for those of us that either would like to do it ourselves or have to do it ourselves!
Dave Green via email

Love DIY I just wished it was published more often. It's become my favorite reading for boating info. Keep up the good work.
David L. Roberts, Malvern, Pennsylvania

I've been a subscriber and hold every issue of DIY since your inception. Great magazine and the best on this subject that there is.
Charles Monroe, "Ebb Tide," Solomons, Maryland

I make DIY required reading by all employees at Ontario Boat and Engine Works. There has not been an issue yet that someone hasn't learned something from reading DIY. Your articles are super and technical information is top notch. This publication should be an industry standard for all in the boating business. I don't think there is a finer boating publication anywhere in North America.
Peter Godwin, Ontario Boat & Engine Works, Orangeville, Ontario

Thanks for the recommendation of Ultimate Sole Finish (www.ultimatesole.com). It's great. I used it to finish the new teak and holly sole I laid in my 1979 Carver 26' (7.9m) fly bridge sedan. I recommend it to everyone.
Frank Roberts, Calabasas, California

in the middle sketch reduces the electric fields.
Kevin Dean, Surrey, British Columbia

John Payne replies: *You are correct in saying that it's difficult to cover RFI introduction and troubleshooting in three pages. Your comments regarding shielding can be summed up with one qualifying sentence: If you have acquired a used boat and this type of problem occurs, then you should look at this as a possibility. I have seen frequent cases where backyard repairers didn't use the correct replacement parts, which causes this problem. I must disagree with your statement, as I have found this to be a relatively common problem and prefer to direct people to the common causes first. Suppression is entirely different from shielding and we erred towards an expression that everyone can identify. In regard to the illustrations, you are theoretically correct that the CPU would work without being grounded but it's common and standard practice to do so to maintain the same potential and is more effective, which moves this discussion into Faraday Cages and electromagnetic shielding solutions, which would take another page to explain. The reason that grounding is carried is based on the principle of equipotential bonding. As for the possibility of "cutting braid on coaxial cables," the subject of aerial coaxial cables is an entirely different one and certainly I have never seen anyone do this as an RFI reduction exercise. With balanced systems, grounding at one end is often best; however, even then there are situations where grounding at both ends may result in less RF noise. It's an industry standard practice to ground one end to minimize loop effects. I'm currently commissioning manager on the world's largest floating oilrig (BP Thunderhorse) with a computer management system having some 20,000 inputs and outputs and this is the principle used without exception. It's not possible to advise readers in which cases they should do so, so I have erred to what I do in the commercial electrical world of one end only and, so far, I have never seen a system improve by doing both ends.*

What's "Lugging"

On page 23 in DIY 2004-#3 issue, Larry Blais states "Running in gear at the dock will lug the engine...." What on earth does he mean? I have looked up "lug" in English and American dictionaries and none of the definitions have any relevance to diesel engines. I could also find no reference to the expression in a book on diesel engines. What language is he speaking?
Alan Porter, "Te Tiaroa," Victoria, British Columbia

HI Alan, it's a common term used when describing engine performance and is defined at www.dictionary.com as:

1. *To drag or haul (an object) laboriously.*
2. *To pull or drag with short jerks or as if under a heavy burden.*
3. *To cause (an engine, for example) to run poorly or hesitate because of strain.*

If you drive too slowly in third gear, you'll lug the engine or the motor might lug on acceleration.

Sacha

CURRENTS

Adding Shorepower

We are planning to add shorepower to our Hampton. We are weekend cruisers and would like some convenience items as well as a battery charging system. Have you written an article on adding shorepower to a boat that is not currently equipped for this?
Ed Andrews, Sparta, New Jersey

DIY's MRT **AC Electrical Systems** *CD-ROM (US$19.95/ CDN$24.95) details everything needed to install shorepower, including: AC wiring tips, troubleshooting AC systems, gensets, high-output alternators, inverters, controlling galvanic corrosion and more.*

Yet More Erroneous Bacteria Conversions

I have read the correction in DIY 2004-#3 issue by Pete Dubler pertaining to the 2004-#2 article, "A Strong Case for Treated Sewage." He correctly states that the number of bacteria according to federal regulations should be expressed as 1,000 per 100ml. You mentioned that the discharge from a Lectra/San is less than 10 per 100ml. He erroneously states that "...the two numbers are equivalent since 1,000 per ml is equal to 10 per 100ml." These two numbers

DIY WINNERS

Winner's of DIY's Product Information Card Giveaway from DIY 2004-#2 issue who received a cartridge of 3M Marine 4000UV adhesive sealant, are: Susan Bussinger, Daytona Beach, Florida; John MacDonald, Delta, British Columbia; and Rod Sumner, Niagara Falls, Ontario. When you need information from marine manufacturers, log onto DIY ONLINE at www.diy-boat.com and click on "Information On Marine Products." This automatically enters you into this issue's draw of three 3M Marine 4000UV Adhesive Sealant.

are not equivalent. If the number is expressed according to the federal regulation it would be as stated correctly in the Code of Federal Regulations (C.F.R.) as 1,000 per 100ml, which is not the same as 10 per 100ml. Furthermore, convert 1,000 per ml to the corresponding number expressed as the number of bacteria per 100 ml and the number would be 100,000 per 100ml, well above the federal standard. Again these numbers are not equivalent. His statement implies that the Lectra/San system produces a discharge that is very much higher than the bacterial counts established by the federal government. This is truly not the case since the Lectra/San produces a discharge of 10 per 100ml which is 990 per 100ml below the federal standard and well within acceptable levels. This information is derived from the USCG and EPA, which share the responsibility for the marine environment; namely, USCG 33 C.F.R. 15 (1998) and EPA 40 C.F.R. 140 (1998) for a Type 1 marine sanitation device. Furthermore, I have been a scientist for approximately 25 years and have experience with bacterial growth studies.

John Koch, Euclid, Ohio

Color me red with embarrassment.

There is perhaps nothing so embarrassing in print as an incorrect correction. How surprised I was to open DIY 2004-#3 and see my name staring back at me under the title "Correction." As I read the correction, I immediately noticed how totally incorrect part of my correction was.

Selling Privately

Before you can finalize a boat sale, you'll need to write up a sales contract. But where do you find one?

Pat Kearns responds: *This was a classic question when I was a yacht broker (before my life as a surveyor, et al). The same question is asked of those who want to sell or buy a house without the aid of a realtor. When the time comes, they don't want to mess up by not having the "real thing," a tight contract with all the provisions necessary to protect the interests of each party to the transaction. I've told many such inquirers that knowing the ins and outs of purchase or sale contracts was my profession. They would chuckle, saying that they didn't want to pay a commission and I would then tell them that, if that's the case, they need a lawyer to stay out of trouble with the contract.*

One solution for the amateur in these matters is to go to an office supply store and purchase a standard agreement form. Risky business but cheap if going on the cheap is the goal. [Ed: Cheap is often expensive!] Neither yacht brokers nor realtors will part with their product, especially if it's the standard for a regional Board of Realtors or Yacht Brokers Association form. It's a long and expensive evolution to arrive at a state of contractual expertise such as now exists in both areas.

A lone ranger in matters of buying or selling boats could go online to see what's out there for an example of a contract. Almost any contract for the transfer of personal property will do for a boat (not so for real estate, the conveyance of which is governed by state law). It's the contingencies that are the sticking points. If you don't know what should be there for contingencies (buyers' and sellers'), then you can get the shaft, pun intended. If it's a boat of small monetary consideration, then the contingencies are not unlike those involved when buying a used car. You want to test drive it, get your mechanic to look at it and maybe even finance it and you want to make sure there are no title problems. The other option is a handshake and you take your chances. No easy answers here. Some expert advice is needed, whether that is a yacht broker or an attorney and even with the best of contracts, sorting out the contingencies and their satisfaction can be daunting.

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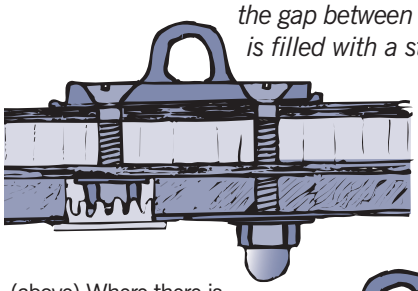
MEMBER ABYC Setting Standards for Safer Boating

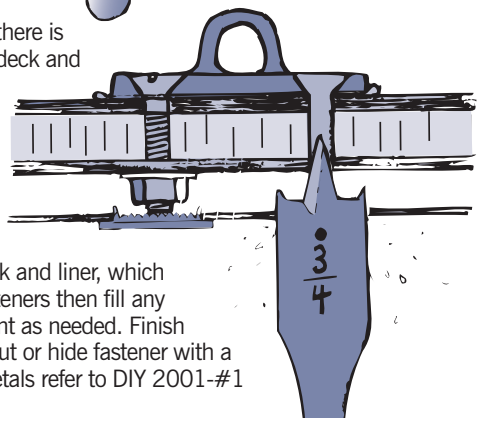
While the two ratios stated are not equivalent (not even close), the key message, which is correct, is that 1,000 per ml should be 1,000 per 100 ml (as written in the correction). For additional reading refer to page 3 of USCG circular regarding MSD Effluent Standards at www.uscg.mil/ hq/g-m/nvic /9_82/n9-82.htm.
Pete Dubler, "Regina Oceani," Fort Collins, Colorado

Hardware Installation

"Simplicity" is a 1970 Ericson 32-II with liner and I wish to install deck hardware to rig the halyards and reef lines aft. The problem lies in that doing so requires bolting to the deck in the annular space between the liner and the deck. I understand from an article in DIY that this issue has been addressed in a past issue. I want to have the cabin work look as professional as possible.
Michael Flynn, "Simplicity," Alameda, California

Instructions for installing deck hardware on a boat with a cabin headliner appear in DIY 2001-#1 issue. Briefly, there are basically two different approaches to securely thru-bolt hardware in the liner. Which one you choose will depend on the configuration of the liner, bonding putty and deck and your own aesthetic preferences. You can cut holes in the liner to access the underside of the deck and then hide the fasteners and holes under a cover plate or cap. Another approach is to ensure the gap between the liner and the deck is filled with a structural material that prevents crushing the liner as the fasteners are tightened. This latter method leaves the fasteners exposed.





(above) Where there is a gap between deck and headliner cut an oversize hole and cover with a liner cap. (right) If there is no gap, drill through the deck and liner, which exposes the fasteners then fill any gaps with sealant as needed. Finish with an acorn nut or hide fastener with a liner cap. For detals refer to DIY 2001-#1 issue.

Fiberglass Repairs Prevail

"What maintenance-related topics are you most interested in learning about?" was the question asked on DIY ONLINE last month. Of the 10 choices listed and with respondents allowed to select one only, "fiberglass repairs" rated the top pick with 25% and "engine troubleshooting/repair" followed a close second with 22%. "Electrical and wiring" was chosen by 12% and "cabin upgrades" and "electronics installations" 9%. Wood repairs received 8.4% of the vote. "Equipment installations" and "sails/rigging" both garnered 5%, closely followed by "plumbing upgrades" with 4% and in last place with .6% was safety gear. To enter DIY's current poll log onto www.diy-boat.com.

CURRENTS

Boom Padding Wanted

Can you please refer me to companies making a boom covering that pads against accidental boom related head injuries.

Bruce Heubach, "Ninfa," San Francisco Bay, California

You've got us beat on this one. We've not heard of a product known as boom padding.

Mercathode Does Exist

At IBEX, a boat builders' trade show held in Miami every October, a manufacturer of galvanic isolators informed me that the Mercury Mercathode was discontinued two years ago. Being skeptical and aware that some salespersons will say most anything to get publicity, I contacted DIY's engine tech Steve Auger at Mercury Marine for clarification. My hunch was correct. Mercathode is alive and available to consumers. Standard on Bravo models, optional on Alpha, MIE and ski tow models, Mercathode is a 12-volt accessory that acts as an electronic sacrificial anode to prevent galvanic corrosion due to the use of dissimilar metals that share a common ground and are submerged in water (the electrolyte). Galvanic corrosion is caused by a noble metal (a stainless-steel propeller and shaft) and an anodic metal (an aluminum sterndrive unit) that share a common ground and are submerged. Electrons flow from the anodic metal to the noble metal and, as the electrons leave the anodic metal, the anodic metal is consumed. Mercury sacrificial anodes are made of an alloy that is more anodic than the aluminum XK360 alloy used in the drive unit. This moves the corrosion process to the most anodic metal (the sacrificial anode or Mercathode, if equipped) and protects the sterndrive unit from damaging corrosion.

— Jan Mundy

DIY EDITORIAL INDEX

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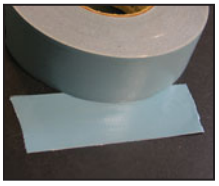
NEAT BOATING STUFF

A selection of some new and some very cool boating gear.

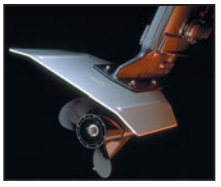
By Jan Mundy



Poor man's solder, more commonly referred to as duct (not duck) tape, has few uses on a boat's exterior where it's quickly dissolved by UV exposure, leaving a glooey adhesive to remove. For those who can't do without, 3M Marine offers Performance Plus Duct Tape 8979. Its UV and water-resistant properties mean that it bonds to surfaces without deterioration for up to one year, even after exposure to extreme weather. For up to six months, this duct tape apparently removes cleanly from most opaque surfaces, eliminating the hassle of removing sticky residue.

If you have a 1997 or earlier, carbureted Mercruiser sterndrive or inboard engine that doesn't like to start, particularly in cold weather, consider retrofitting with Mercruiser's turn-key starting (TKS) system. TKS uses a redesigned carburetor with an automatic fuel-enrichment system, instead of a traditional choke, to produce instant starts at the turn of a key in the same way as an EFI engine. You don't have to pump the throttle prior to a cold start up anymore. TKS retrofit kits have been available for the Mercury Sport Jet engine for a few years. Look for two-barrel Mercarb models in spring 2005.

New Found Metals (www.newfoundmetals.com) portlight window screens will keep bugs outside where they belong. Tight fitting screens snap in and out from the inside without the use of tools, allowing easy access to windows for cleaning. The stainless steel mesh with an EPDM gasket (the same material used on auto windshields) seals firmly against the port's main frame and spigot. Screens fit all New Found Metals stainless and Trimatrix opening ports.



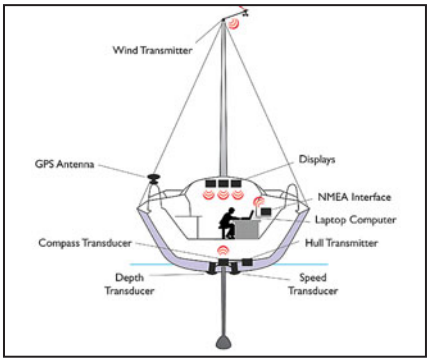
Hydrofoils aren't new. Mounted on an outdrive's anti-cavitation plate, a hydrofoil provides lift to improve hole shot, get a boat on plane faster, reduce cavitation and porpoising. Whale Tail XL ($49.95) from Davis Instruments (www.davisnet.com) is the latest generation of hydrofoils. Its unique hydrodynamic design transforms prop wash into usable energy. Ideal for bow-light boats, ski boats and any runabout sluggish to plane, it stabilizes a boat, lowers the bow for better visibility, provides a flatter wake for skiers and is claimed to increase top-end speed and boost fuel economy. Made of anodized aluminum, it can be used in fresh or saltwater.

Bilge counters are useful tools that let you know how often float switches activate the bilge pumps. The count can clue you to an appreciable increase in pump activity, which means a leak, either rainwater or seawater. The ePanel (US$79 plastic model, US$99.13 aluminum one) from Water Witch (www.waterwitch-inc.com) provides complete diagnostics of a boat's bilge pump systems. It displays the pump count total since last reset and the total counts from the past 24 hours, seven and 14 day periods. It updates and recalculates all totals every 24 hours and there's also a power failure alert.

If you have an inboard gasoline or diesel engine, there's no excuse not to install a Sea-Fire Fire Foe (www.sea-fire.com) onboard. This affordable automatic fire suppression system mounts in an engine compartment to become your first line of defense against engine space fires. Should the compartment temperature reach 175F (79.4C), the self-contained and self-activating cylinder ruptures and sprays non-toxic Envirogel, smothering the fire and preventing re-ignition. An optional pressure switch can be wired into the ignition to shut down the engine upon activation. A non-toxic Halon alternative, Envirogel causes no harm to

you, the environment or a naturally aspirated diesel engine. Five models protect engine compartments from 15 ft. cu. (.42m cu.) to 130 ft. cu. (3.68m cu.) Prices range from US$99 to US$249. Fire Foe won the Innovation Award for Mechanical Systems at the International Boatbuilders' Exhibition and Conference (IBEX).

A new series of solar-powered instruments from Tack Tick (www.tacktick.com) promises to revolutionize the marine electronics world. Using high speed radio com-



munication protocol, Micronet instruments operate on a wireless transmission at a power consumption level that runs on solar power. There are no cables to route up masts, through overheads or cockpits. Better yet, the electronics consume no onboard power supplies. Solar cells deliver up to 300 hours of use without sunlight before needing recharging. Units mount anywhere on the boat, even under a dodger as they don't need direct sunlight and will recharge from ambient light. Displays are multifunctional, meaning you can have boat speed, depth, windspeed, compass heading, etc., all in one unit. Installation is quick and easy: install the transmitter (masthead, hull, etc.) up to 150' (46m) away from the display and mount the display bracket. Remove the display for safe storage when it's not in use. A NMEA 0183 interface allows connection to a GPS. This system won the Innovation Award in the OEM Electronics category at IBEX.

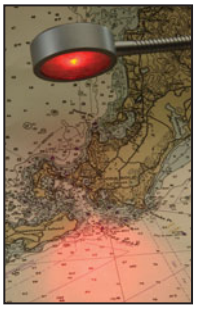
Westerbeke's (www.westerbeke.com) new Safe-CO generators are electronically fuel injected (EFI), gasoline fueled gen-sets that reduce life-threatening carbon monoxide

(CO) emissions by an astonishing 99% plus, compared to conventional carbureted generators. Gen-sets combine EFI, catalytic technology and an ECU processor to produce CO as low as 1 part per million (ppm), which is well below the danger level, depending on engine load and ambient temperature. Ten models, from 2.7kW to 22.5kW, sell for a 20% premium but that shouldn't deter anyone in the market for a generator from considering the incalculable value of the safety aspects. A CO monitor inside your boat is still required. Safe-CO was the Innovation Award recipient of the Electrical Systems category at this year's IBEX.

System 3 (www.systemthree.com) has taken the science out of mixing epoxy resin and packaged a product specific resin system that I've dubbed "Epoxy for Dummies." These epoxy resins are premixed for laminating, bonding, filling or fairing to eliminate messing around with fillers and compounds. Mix A and B at a 2:1 ratio and you have a fairing compound, for example, without the addition of cabosil, colloidal silica, microballons, wood flour, etc. Resins are packed under vacuum to reduce air bubbles when mixed, curing agents are not moisture sensitive and they are blush-free, requiring no prep between coatings.

There's now a bottom paint alternative for owners of runabouts, cabin and cuddy cruisers, daysailors, trailer sailors and rack

stored boats. Interlux's new VC ECO is designed for boaters who don't want to apply antifouling paint or haven't had much luck with bottom waxes yet need an easy-to-clean surface. It's a hard, super-slick translucent coating containing Teflon that lasts longer than wax. VC ECO requires minimal prep before application and dries very quickly. Clean your boat bottom, apply two coats of VC ECO and launch the boat on the same day. VC ECO's biocide-free technology won't cause corrosion, which makes it an obvious choice for application over underwater metal parts. That's the good news. The bad news? It's available in Canada only (CDN$30 per 710ml can).



You're dashing (carefully) through the cabin at night and are groping with cold fingers to find the switch to light your way. If there was a TouchLED F-4 light onboard, just one touch of the lens would produce light. This new series of 12-volt, LED task lights from Imtra (www.imtra.com) combines 15 white LEDs with one red LED placed in the center. This red LED controls the on/off switch, switches the mode between white and red LEDS, deactivates the automatic red night-light mode, if desired, and remains in standby mode to provide just enough glow to locate the touch spot. Available in three sizes, 6", 12" and 20" (available soon) (15cm, 30.4cm and 51cm) and five finishes. Prices start at US$199.

Gemlock, a collapsible frame hinge and strut, makes so much sense for biminis, convertible tops, awnings and most canvas supported by a frame hanging over the flying bridge, cockpit or deck. Developed by Gemini Marine Canvas of Rockland, Maine (www.geminicanvas.com), Gemlock collapses frames easily. Simply slide the locking sleeve and pop the hinge to fold the frame. There's nothing to adjust and no fasteners to install. Available in plastic or stainless steel versions for 7/8" (22mm) and 1" (25mm) tubing, a retrofit starts at US$250.

Nuts About Shaft Nuts

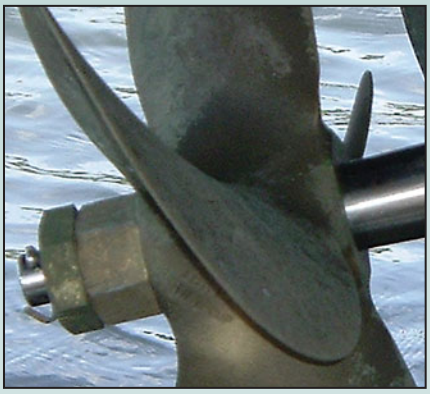
The proper order of two propeller shaft nuts is highly controversial among surveyors, boat builders, boat mechanics and boat owners. There are proponents of threading the half height nut on first, followed by the full height nut torqued down to the thin nut and there are proponents of the reverse sequence. Which one is right?

By Pat Kearns

Which nut is which? Which nut goes on first? These questions have been a topic of debate among experts and amateurs who are installing shaft nuts. There are often two nuts to thread onto the end of a propeller shaft. Although both nuts are the same diameter, there is a "big" or full height nut and a "small" or half height nut as measured on the depth of the nut. Here's the debate.

The big nut goes on first. No, it's the small nut that goes on first. Why? Usually, the answer is that, "I've always done it that way" and usually that rationale is based on threading the nuts back onto a shaft so that they are positioned as they were originally found. Do you put the big nut on first and tighten it and then thread the small one down onto the big one to "lock" it, preventing the big nut from backing off? Or thread the little nut on first and then torque the big one down on it? Of course, some shaft nuts don't get doubled. They are locked from backing off by a cotter pin inserted into the end of the shaft taper. Sometimes, even with two nuts, there is a cotter pin in the shaft end. Even I can be confused by a passionate discussion about shaft nut position. This argument can really drive you nuts.

First, let's define the nuts. According to Society Of Automotive Engineers (SAE) 1755, Marine Propeller Shaft Ends And Hubs, the "jam" nut is the thin or half-height nut; the "plain" nut is the thick or full height one. So, which goes on first and why? Go into any boatyard and you'll see the variations on the big nut-little nut theme and every rationale, including the old standby, "I've always done it that way," is cited for the why of which nut is where. Is there an absolute answer to this silly dilemma? First of all, it's not really a big deal. Few props back off when secured



According to ABYC, SAE and naval architect Dave Geer, this propeller nut installation is WRONG.

with double nuts, no matter which nut bears against the hub. [Ed: Squeeze some 3M 5200 on the threads and the nuts will never come off.] However, if doing it right matters to you, here is the proper way to orient the prop nuts.

The comfort of knowing that your propellers are secure on their shafts, when installed according to the recommended practice, comes from making sure the nut placement sequence is correct. Logic and common sense would seem to be the key to that knowledge but the little nut or big nut first arguments each have their own staunch defenders who can be quite convincing about the "logic" they use to support their stance. Ask a hundred "experts" and you'll get authoritative guidance that encompasses both nut arrangements. The reigning guidance on the issue appears in an SAE standard that has been incorporated by reference in the ABYC standard P-6, Propeller Shafting Systems, Appendix 1, Materials, Size And Installation Of Propeller Shafting Systems. Few boaters would think that SAE has anything to do with boats but SAE has, for a very long time, been an important player in standards for "vehicles" that are not on wheels and it has its own set of marine standards,

The correct theory: the half-height nut goes next to the propeller and, when torqued, it bends and is followed with the full-height nut that, when torqued, straightens the thinner nut creating a locking nut.

most particularly applicable to a boat's machinery and control systems. If your prop installation uses a double nut and key system, it goes like this.

While it would appear that the full-height nut is the strength of the assembly, it actually plays two roles. One is its normal threaded position on the shaft, acting just like any other nut threaded on to a bolt. The other job is to jam the half-height nut, which goes directly up against the hub. Logical? According to the nut guru, Dave Gerr, "The half-height nut should always go against the load." This is because when the full height nut is torqued down aft of the half-height nut, it compresses and deforms the half height nut (the nut closest to the prop hub) a tiny bit and rotates it a fraction of a turn. That effectively unloads the thread of the half-height nut and engages the threads of the full-height nut and, with that, the full-height (bigger) nut takes the load. Got it? The logic is there but it's a bit dim in what appears to be an obvious reverse of the nut order. In any case, the big nut takes the load, no matter where it's installed in the order of nuts. And remember to insert the cotter pin!

About the author: Besides being DIY's proof editor, 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

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Leaky Hydraulic Steering

Q: I have a 1986 Bertram 35 with what appears to be the original hydraulic steering. At the fluid reservoir, there is a pressure gauge, which normally reads about 30 psi. On a recent trip, the gauge read zero and, of course, I had no steering. I pumped air to get back to 30 psi and the steering returned. Since then, the pressure has slowly decreased and now is at zero again. What causes such a leak and where and/or what do I check?
Bill Barker, "Fisherman's Luck," Annapolis, Maryland

A: It sounds like you have a Teleflex Hynautic hydraulic steering system. The tire-style air valve (a.k.a. Schrader valve) on the reservoir, where the hand operated air pump is connected, has probably developed a slow leak. After it's pumped up and pressurized, try dabbing a sponge soaked with soapy water onto the valve and around the top of the pressure reservoir to see if any bubbles are produced by air leaking out. If the leak is anywhere else in the system other than the top of the reservoir, you'll notice leaking hydraulic fluid. I'm not sure if a standard automotive tire Schrader valve can be used as a replacement. Check with your local Teleflex dealer for parts and service.
— *Nick Bailey*

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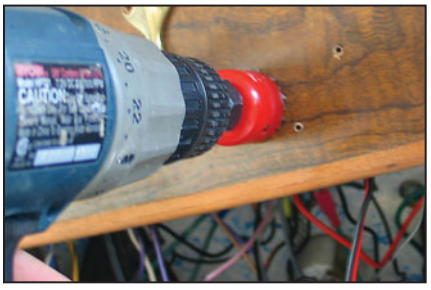
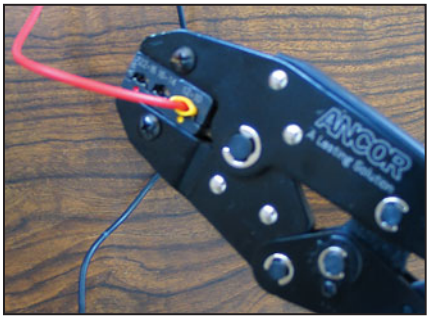
Wiring a 12-Volt Receptacle

Q: I want to install a DC battery adapter for a 500,000-candlepower spotlight. I would like advice on wire gauge as well as circuit breaker amperage or should I run directly to the battery with the appropriately sized in-line fuse? The distance could be approximately 8' (2.4m) one way or 25' (7.6m) one way depending on where I install it.
Mark Hoesman, "Maldemer," Cheboygan, Michigan

A: I'm presuming you're discussing a 12-volt receptacle, known as a cigarette plug before smoking became unpopular. The circuit breaker or fuse amperage depends on the number of amps the spotlight draws. For example, a Guest 300,000 spotlight draws 12.8 amps so it would need a 15-amp circuit breaker or fuse. There should be a panel on the light that states the amperage. The positive wire could run to a distribution panel or directly to the house battery, the negative to a negative bus bar or to ground. Wiring directly to the battery requires an inline fuse and remember that ABYC standards permit only four connections directly to a battery. This fuse must be placed within 72" (182cm) of the battery. The longer the run, the larger the wire size. As I consider a spotlight to be a critical item, we'll refer to ABYC's 3% voltage drop tables, as opposed to a 10% voltage drop for non-critical items. A wire that is 15' (4.5m) in total length (power source to spotlight to and back to negative ground), conducting 15 amps, requires a 10 AWG wire. A 50' (15m) long wire (25'/7.6m each way) requires a 6 AWG. Heat increases the wire size requirement so, should the wire pass through an engine room, I would go up one wire size or 8 AWG and 4 AWG.
— *Jan Mundy*





To install a 12-volt receptable cut a 1" (25mm) hole, wire the positive line to a power source, the negative to a negative bus bar and install the switch.

Bonding Radio Strap

Q: I want to bond 3" (7.6cm) copper strapping to counterpoise my Ham radio system to my sailboat's inside hull. I was going to use Dap contact cement but directions say not to use on copper. I want to use contact cement so that I get instant bonding with the hull. Any suggestions?
Jim Tyner, "Ahoy," Titusville, Florida

A: Because the copper strapping bends and twists it's difficult to get a contact adhesive to work. Also, where the strap lies the surface is normally dirty and difficult to clean which can affect the bond with a contact adhesive. Ocean Marine Outfitters (www.oceanmarine.on.ca), who specializes in equipping blue water boats, uses 3M 5200 sealant to bond this strap. It's messy so use the fast cure version.
— *Jan Mundy*

Good for Truck Beds

Q: I want to eventually repaint or refinish the upper deck on my boat. The fiberglass has some cracks and the gelcoat has worn thin in spots. I am wondering what product I should use. Have you ever heard of a product called Speedliner? A number of people on the Trawler List have spoken highly about it.
Al Miller, Palm Coast, Florida

Talkback Q&A

A: Normally sold as a spray-on truck bed liner, there's the possibility that an application of this product works for non-skid areas to replace carpet or refurbish non-skid decks. According to a representative of the U.S. distributor Bearcat Industries (Tel: 800/821-8820, web: www.speedliner.com), the recommended thickness is 90mls and coverage is 15 sq. ft per gallon (1.39 sq. m per 3.78L) to obtain the 90mls thickness. It's sold direct from Bearcat Industries in case (4 gallon) quantities for US$38.95 per gallon and that includes the color pigment as selected from 17 standard colors. It's polyurethane with a UV-resistant chemical so it won't chalk but it will lose its shine in two to three years, at which time you would need to refurbish with the company's Topcoat #6. The application requires that you first degrease the surface to remove all contaminants and any wax residue, sand with 80-grit paper, clean with MEK, apply 450 Primer, which promotes adhesion and then apply Speedliner. You'll get a better finish when applied with the recommended hopper gun (an acoustic drywall gun) but it can be brush or roller applied. Rhino is another comparable non-skid bed liner that's just recently been introduced for marine use.
— Jan Mundy

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Recalibrating Oil Capacity

Q: I read with great interest your comments about how much oil to put in a Ford Lehman engine. You stated that a measured amount of oil be used and the dipstick recalibrated. My boat is equipped with twin diesel Ford Lehman, SP-185 model, and serial numbers 5839010 and 5838030. I'm currently using Shell Rotella 20W20. Both engines have a pretty healthy appetite for this oil. I'm filling to the mark on the supplied dipstick. Any comments?
Arthur Hamlyn, "Taian Princess," St. John's, Newfoundland

A: Your 4C91 Lehman owner's manual and parts book published the incorrect oil capacities. The correct oil amount for your Ford 2728T engine is 21 quarts (19.9L), including the filter. The 23.5 quarts (22L) mentioned in the manual is too much oil. I recommend the use of Shell Rotella T, 30W in cooler climates and 40W in tropical climates. The dipstick oil fill mark was calculated for a level engine installation, which is not usually the case in a marine installation. Installing the engine in the boat at a nominal angle causes the oil to run aft in the pan and away from the dipstick. As a result, filling to the stick mark results in overfilling the engine. Too much oil causes oil leaks, higher than normal crankcase pressure and glazing of cylinder walls. Drain all oil from the pan using the drain plug at rear of pan, usually supplied with a pump on the SP series. With all oil drained and a new filter, put in the 21 quarts (19.9L). Run the engine, shut it off and allow the oil to drain into the pan as you would normally do for each pre-run check. The oil level on the stick will be the correct full level in the future. Remark the stick or better yet reduce the length of the dipstick tube to compensate for the low reading. With the tube shortened, you'll be right on the correct mark.
— Bob Smith

Hull Crazing, One Side Only

A: Our 1974 Yorktown 34' (10.3m) fiberglass sloop has a really nice painted dark blue hull but crazing, small spider web-like cracks, are appearing in the paint on the port side of the hull. There is absolutely no crazing on the starboard side. The boat is in a slip pointed due north with the port side of the craft always facing west. Since November 2003, the boat has not moved because I've pulled the engine and I'm rebuilding the cockpit and making other major modifications. What do you think is the cause and what might be the remedy? I hate to see it worsen if there is something I can do about it.
Peter Favre, "Soaring Eagle," Morro Bay, California

A: It's likely not a surface contamination problem, as this typically shows up shortly after application or even during paint application. For an explanation, DIY contacted Interlux and received this reply from technical director Jack Hickey: "I am presuming the starboard side of this hull, which faces the east, must be in the shadows of the dock, whereas the port side is open to UV attack. Star or spider cracking is not unusual for aged enamels but usually takes many years to develop. If this hull was painted in recent years (less than five) the film thick-

ness may be too low. Conversely, if the paint is quite old this may be normal since dark colors have the greatest UV absorption (surface heat). The only way to fix such problems is to completely sand the area to remove the crazing/cracking, prime with Primekote and topcoat with Brightside." [Ed: A sample area affected by crazing should be sanded to make sure that this is, in fact, a coating problem and not something that is going on in the hull laminate itself.]
— Jan Mundy

Gluing Mahogany Veneer

Q: I would appreciate any advice on gluing mahogany veneer to the transom of a fiberglass boat.
James Waites, Huntsville, Alabama

A: I would glue the veneer on with epoxy resin. To do this, first degrease the transom with Interlux Fiberglass Solvent Wash 202 or other solvent cleaner to remove wax and other contaminants and then sand with 80 grit to abrade the surface and give it some tooth to which the epoxy will adhere. Apply one coat of unthickened epoxy resin to the wrong side of the veneer panel and let cure. This seals the wood so the glue doesn't soak in. Wash the transom molding surface to remove any amine blush and sand with 120 grit. Mix up a batch of epoxy thickened to a mayonnaise consistency. Tape the edges to facilitate clean up of the squeezed out epoxy. Coat both the transom and veneer with epoxy then connect the mating surfaces. Use a paint (or rubber) roller and roll out to the edges, applying light pressure to remove air bubbles and excess glue. You'll need to devise a method to hold the veneer tight against the transom using staples, tape, battens, braces, etc. When the bond has cured, seal the veneer with three coats of clear epoxy then varnish or paint.
— Jan Mundy

Apply one coat of unthickened epoxy resin to matting surfaces and let cure to seal the wood before gluing.

When gluing together flat panels use a roller and apply light pressure to remove air bubbles and excess glue. Note taped edge to facilitate cleanup.

Talkback Q&A

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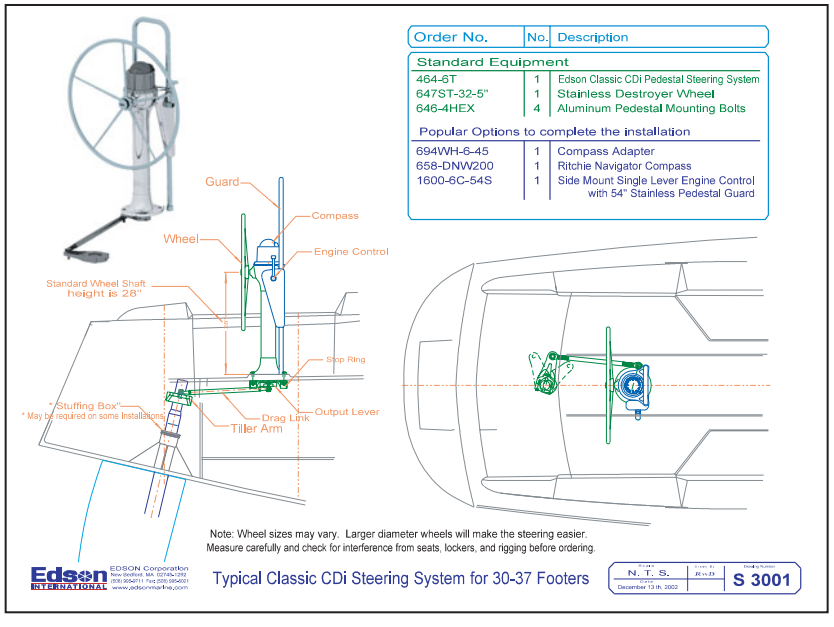
Pedestal Strip Down

Q: My 1981 Islander Freeport 36 has a broken shift linkage, which is actually sheared in the threaded section at the shift lever. My problem is that I can't get the Edson pedestal apart to get to the bracket/clamp holding the end of the shift and throttle Morse cables. There are four long screws (about 4"/10cm) attaching the collar that holds the shift and throttle levers to the main pedestal post. I've gotten two out but the other two are really stubborn. I'm afraid I've pretty much destroyed the slot in the screw heads. Do you have any suggestions for getting these screws out? They are essentially freestanding except for the bottom 1/2" (12mm) that is screwed into the pedestal. Also, the bracket holding the cables is midway down the inside of pedestal and seems to be attached with one screw that is accessible from outside the pedestal. I can't tell if the clamp is two pieces, which will separate when I release the screw (and fall into the pedestal) or a one-piece unit that remains attached to the cables and comes out when I pull them up.
David Crisp, "Avanti," Half Moon Bay, California

A: According to Fred Johnson of Edson, you likely have a 300 series pedestal. Over time the 7x19 wire, which is part of the steering system, eventually saws through the Teflon lining of the conduit and inhibits the steering system from moving, especially where the wire turns corners. Based on your boat's vintage, you're looking at replacing the chain-to-wire system, conduit system and conduit end fittings. Depending on what else may be wrong, replacement parts could cost $500. Before proceeding, request a free data spec sheet from Edson customer service at 508/995-9711, which provides a complete schematic of your pedestal. The four stainless-steel bolts at the top of the pedestal fasten the compass to the aluminum pedestal. Being dissimilar metals, these seize without frequent service. To remove, cut off the bolt heads with a rotary (Dremel) tool or use a large Phillips screwdriver held in Vise-Grips and torque the bolts until each sheers off just below the heads. Now lift off the engine control and compass and then apply lubricating oil to the bolts and spin them out. When reinstalling new bolts, coat with Never Seize, lanolin, Lubriplate or Tel-Gel to isolate from the aluminum. Fred recommends purchasing bolts from Edson as they have a mil-spec coating to prevent galling.
— Jan Mundy



Sample data spec sheet available from Edson.

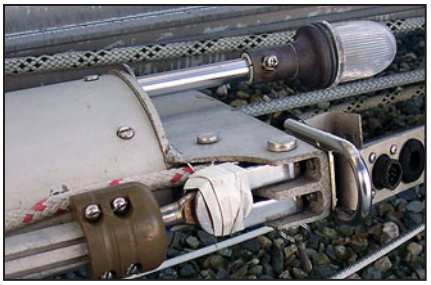
What's in the T-Stats?

Q: My boat's engines are 1985 Chrysler 360s that were freshwater cooled until about five years ago, when the previous owner had them rebuilt and converted to raw-water cooling. The boat is run in freshwater and, on rare occasions, in mildly brackish water. The temperature stats are 140F (60C), which makes the engines run around 145F to 150F (63C to 65.5C) on a regular basis. I suspect the engines would run more efficiently at 180F (82C). As I don't boat in saltwater, which attacks cast iron blocks more aggressively at higher temperatures, and rarely go into brackish water, why not go with 180F (82C) T-stats?
Jeff Perry, New Tripoli, Pennsylvania

A: Not a good idea and here's why. Modern inboard engines use 160F (71C) thermostats. This is because the pressure in marine engines with raw-water cooling systems varies from 0.5 psi at idle to 18 psi at wide-open throttle. Water boils at 215F (101.6C) degrees at 0.5 psi. This means with 180F (82C) stats water in the block, returning to idle after a hard run could raise the temperature to 240F (115.5C) at 0.5 psi, at which point the water boils in the block and turns to steam. Steam produces an airlock and then an overheat condition, likely cracking the cylinder heads. With a 140F (60C) stat, the temperature after a hard run is about 200F (93C) at 0.5 psi, which is below the boiling point and there's no overheating. On a closed-cooled system, the pressure remains at 15 psi constant and you could increase the temperature to 180F (82C). If this were a good idea, every marine engine company would be doing it as it would increase fuel economy.
— Steve Auger

Rigging a Spare Halyard

Q: On my 29.9 Bristol sloop with Harken roller furling, I want to add an additional external halyard on the forward part of my masthead (see setup in photo below). If the new halyard is used for a free flown, light air drifter, tacked at the deck and head only, where should the halyard be mounted? Should it be above the existing furler on the masthead or



Masthead of reader's 29.9 Bristol sloop.

below it on the forward face of the mast? If above the furler, I assume the drifter would tack forward of the furling drum. We are cruisers and want to set this up for easy handling in light-air sailing.

Dick Dowd, "Sands of Time," Dennis, Massachusetts

A: You need to rig the external halyard for any off wind sail forward of the furled genoa. This allows you to easily tack the sail outside of the furling gear. If it's rigged inside the genoa, tacking becomes a chore. On your masthead rig, you would need to use a spare sheave or add a tang. The tack of the drifter attaches to the forestay padeye. On a masthead rig, it may be necessary to install the mast tang off to one side of the mast and stow the halyard at the mast base to prevent halyard wrap when furling the genoa. This set-up is also ideal for rigging an asymmetrical (poleless) spinnaker. The masthead tang in your photo looks to be very close to the furler, say 6" (15cm) or so. The concern here is halyard wrap. When not in use, you'll need to ensure the new halyard is wire tight so it doesn't wrap around the forestay when furling.

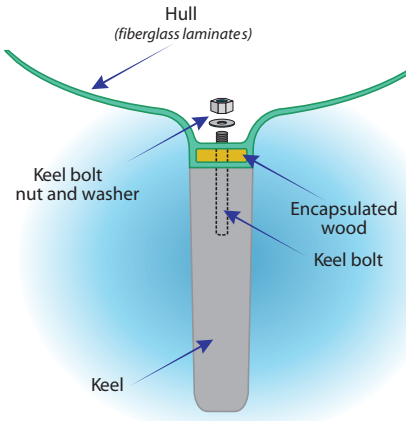
— Jan Mundy

Oozing Keel Bolts

Q: Upon hauling my 1983 Catalina fin keel sailboat, I noticed a black substance oozing out from under two of the keel bolts. I think Catalina used a plywood piece in the keel stub to attach the keel. Could this be deteriorating and the source of the black ooze? If yes, is the keel liable to detach at some inopportune time? Any thoughts on how to correct this?

Ed Hottenstein, "Edelweiss," Rockland, Maine

A: Your Catalina has a piece of wood incorporated into the keel stub as a core material. Seeing the dreaded black ooze is a sure sign that water has gotten into the wood core and this is now on its way to becoming compost. This is a well-known problem with certain Catalina models and a serious issue. If the wood becomes punky, the inner skin of the keel stub will compress at the keel bolts, making the keel behave like the bolts are loose. In other words, the keel will be poorly supported and become wobbly. This promotes leaks and fatigue at the keel bolts. The cor-



Schematic of keel construction on 1983 Catalina.

Talkback Q&A

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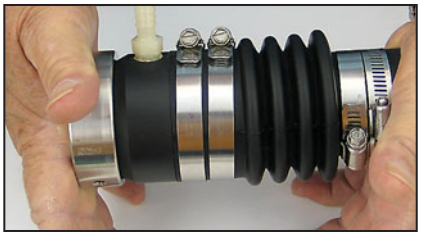
rect fix requires hauling and cradling the boat with good keel support, removing the keel bolt nuts and washers, cutting open the inner glass skin of the keel stub and digging out all the wet and rotten wood core (on the Catalina 30 this wood core is about 1"/25cm thick), which is replaced with new high-density wood (or better, solid glass). Next, relaminate the upper skin and refasten the keel. If the keel bolts have been leaking, this is a good time to drop and rebed the keel. Finish by reinstalling the nuts and washers and torquing them to spec. This is a repair job best done by professionals (unless you are good with structural fiberglass work).
— Nick Bailey

Black Mist on Shaft Seal

Q: My Downeaster 36' (11m) has a 350-hp Yanmar and a high-speed PSS Shaft Seal (serial 02-134-314). There are 230 operating hours on the engine and seal and I notice that, at top shaft rpm (1,800), there is a black mist emitted that disappears when cruising at 1,300 rpm. This is the first high rpm engine the boat manufacturer has installed so, there is no track record of experience with this application. Please advise if this indicates an early failure.
Henri Degioanni "DDIV," Montreal, Quebec



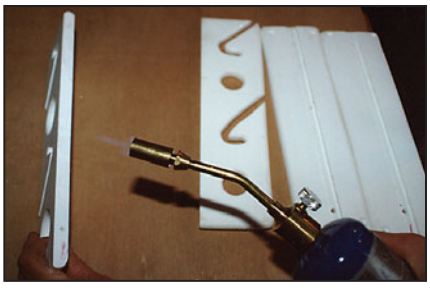
Compress the bellows together to set the tension.

A: I presume the black mist is emitting from the shaft seal. This condition normally occurs initially and then, with use, disappears. As it's persisting, the seal might be set incorrectly or the tension on the bellows is incorrect. First, recompress the bellows. Do this by squeezing the bellows together to compress. If this doesn't resolve the problem, take some 600-grit wet/dry sandpaper, fold it in half, compress the bellows enough to open the gap between the stainless steel and nitrile seals and then slide the sandpaper between the mating surfaces. Don't remove the setscrews. This is messy as water now leaks into the bilge. Run the sandpaper around the seals about 10 times to remove any unevenness. If you didn't receive the owner's manual for the seal, ask the installer for it. [Ed: For complete details on servicing and troubleshooting PSS shaft seals turn to page 23.]
— Jan Mundy

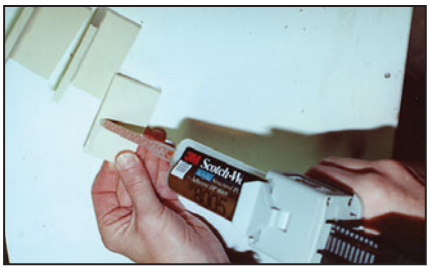
Ways to Bond StarBoard

Q: My boat's deck hatches are flush mounted and the hatch coaming and gutter are made of StarBoard and mechanically fastened with screws to the fiberglass balsa-cored deck. I need information on gluing StarBoard to the underside of the fiberglass deck as the screws are pulling out. I understand that there is a procedure and adhesive that can be used for this application.
John Garback, "It's About Time," Barnegat, New Jersey

A: The trouble with inserting fasteners into cored fiberglass is that, with the different flex characteristics of the laminates, the deck flexes, the fasteners work loose and water migrates into the core. Fasteners should always be installed using the potting technique. Potting involves drilling an oversize hole, using a nail (or similar tool) bent at 90° to dig out the core around the hole, plugging the hole from the bottom and then filling it with epoxy



Always flame treat StarBoard before gluing.



Use a two-part glue, such as 3M DP8005, to bond StarBoard.

resin. Once cured, you would then drill the correct sized hole for the fasteners. This solves your loose fastener problem. When mounting Starboard, some professional builders bed screws in 3M Marine 5200 polyurethane adhesive sealant but its ability to adhere to StarBoard is uncertain, though it does stick to fiberglass and StarBoard doesn't absorb water. Solvent wipe the fiberglass to remove all contaminants before applying the sealant. I've found that epoxy resin successfully bonds flame-treated StarBoard provided it's used for components that don't flex. Proper surface preparation is critical. Lightly sand StarBoard bonding surfaces with 120-grit paper, clean with solvent (acetone, Toluene or alcohol and then flame-treat with a propane torch. Practice this technique on some scrap before treating your finished piece. Working in a well-ventilated area, hold the torch so the flame is approximately 1" to 2" (2.5cm to 5cm) away and the blue (oxidizing) portion of the flame is on the StarBoard bonding surface. Pass the flame over the surface at a rate of 12" (30cm) per three seconds. Don't scorch the surface. There should be no visible difference in the appearance of the treated surface. Ideally, flame treating should be performed within four hours of bonding. Bonding StarBoard to fiberglass requires a solvent wipe, then a light sanding with 120-grit paper and then an acetone, Toluene or alcohol) wipe. To glue, apply epoxy resin thickened to a peanut butter consistency and then clamp in place until cured. Don't over tighten the clamping or you'll squeeze all the glue out of the seam. Ideally, you want an approximately 1/16" (1.5mm) bond line. Should this joint flex under weight, it will come apart unless mechanically fastened. Alternatively, you can purchase StarBond or 3M DP8005, two glues specially formulated to bond StarBoard. They are two-part glue that come in cartridges that fit in a custom gun. Expensive and not readily available, most users go the 3M 5200 or epoxy resin route.
— Jan Mundy

Cause of Engine Backfire

Q: My 1989 5.0L Mercruiser with Alpha One drive is backfiring. I have replaced the fuel filter/water separator and cleared the fuel line of possible water. It idles smoothly in and out of water. I read "Exhaust Fixes" in DIY 2004-#1 issue and do not feel it's an issue. Would a bad riser or exhaust elbow cause intermittent backfiring?
Tom Dolbec, "Goin' Coastal," Portsmouth, New Hampshire

A: Backfiring is caused by three situations: a air-fuel ratio that is too lean (below 14.7:1) that's caused by a carburetor or fuel pressure problem; incorrect spark timing caused by a cracked distributor cap, leaking high-tension leads, failed ignition module or a bad tachometer; or an engine mechanical problem, such as burnt valve, blown head gasket, failed timing chain or leaking exhaust system. Install a vacuum gauge in one of the intake manifold runners and run the engine at 1,000 rpm. The needle on the vacuum gauge should be steady. If not the engine has a mechanical problem. Refer to Mercury's vacuum gauge guide to determine the source of the unsteady vacuum. [Ed: To request a PDF copy of this guide, email the editor at tech@diy-boat.com.]
— Steve Auger

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Edited by Jan Mundy

Runaway Condition?

A naturally aspirated diesel engine can "run away" at speed. To shut down the engine, most skippers would stuff a towel or other material into the air intake to block airflow and starve the engine of combustion air. Sputter, sputter, gag! Those rags can be sucked into the engine, creating an expensive problem. Keep a CO_2 fire extinguisher handy to a naturally aspirated diesel engine and should you need to block the air intake in case of a runaway condition, just discharge the extinguisher into the air intake — no oxygen and the engine stops. Be careful when using as CO_2 can cause frostbite on exposed skin and can asphyxiate if inhalated.

Bob Smith, American Diesel

Crack Sealer

To seal small hairline cracks in fiberglass, gelcoat, wood, deck fittings, windows, portlights, etc., put a small drop of Capt. Tolley's Creeping Crack Cure on the crack. The capillary action of this thin, water-based sealant travels into the crack and covers it with a clear, flexible seal.

Rust Arrestor

When you need to extract a screw or bolt that has rusted in place and don't have any penetrating oil on hand, treat the head of the fastener with a few drops of a cola drink or hydrogen peroxide, allow a few moments for it to penetrate and then try turning the fastener again.

Liquid Sealer

The liquid solution sold for sealing frayed rope ends (e.g. Liquid Electrical Tape) works great for sealing carpet or canvas edges or for coating electrical wire ends to retard corrosion.

Plug Hanger

It's easy (and potentially disastrous) to forget to reinstall a powerboat's drain plug, especially after long-term storage. To prevent this from happening when storing your boat, our local marina recommends putting the plug in a clear plastic bag and tying it to the steering wheel (also makes it easy to find).

Doug McKenzie, Toronto, Ontario

Good Enough For Nylons

If your screens have small holes in them, you can keep the bugs at bay by dabbing on a few drops of clear nail polish on the screen to keep it from ripping further.

Layering Latex

When working with fiberglass and resin, put on two to three pairs of cheap, disposable latex gloves (US$8 for a box of 100) and, when the first pair gets too sticky or full of fiberglass strands (especially when working with mat), peel them off and you've got clean gloves ready to go.

Sandra Turney, last seen cruising the Caribbean

Sealant Caps

To cap open caulking cartridges and tubes so the contents don't harden before using, slip some rubber finger "condoms" over the nozzle to create an airtight seal. Available at Lee Valley (Nozzle Caps, part number 25k80.80; tel: 800/267-8767, www.leevalley.com), a pack of 20 costs US$4. Beats nails or Marrette plugs.

Transducer Ticking Test

To determine if a malfunctioning transducer is causing problems with a depthsounder, turn on the unit, put your ear beside the transducer inside the boat and if you hear a loud, constant ticking sound, chances are it's working.

Stick-On Optics

If you wear corrective lenses and like to dive but cannot see details underwater, a quick and economical solution to adding magnification in a dive mask is DiveOptx (www.optx2020.com). It consists of two, 1.6" (4cm) diameter lenses (US$35) that bond with water, yet are removable and reusable.

Ties That Bind

An improvement on plastic cable ties, Velcro self-gripping straps are easily removed for repositioning or reused for securely wrapping electrical wires and cables, lines, hose — there are a thousand uses on a boat! We bought a pack of 50, 8" (20cm) ties at Home Depot for $4.

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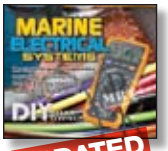

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Saving The Grid

Stringers are the backbone of a fiberglass hull. Construction methods sometimes make these crucial structural components susceptible to delamination and rot. Follow these steps to repair your boat's stringers.

Story and Photos by Nick Bailey

Example of the structural grid system below the cabin floor of a 33' (10m) sailboat. Note the two parallel stringers running fore-and-aft adjoining the athwartship ribs. (Refer to photos of damage and repair throughout this article.)

The hull of any powerboat that is fast enough to plane takes a tremendous beating during its normal operating cycles. Each time it strikes a wave two things happen. First, the wave yields to the force of the impact imparted by the V-shaped hull and water is thrown to each side. Second, in keeping with Newton's Law about every action having an equal and opposite reaction, the forward part of the hull accelerates (sometimes violently) upwards. Further aft, the inertia of the rest of the hull resists being accelerated vertically and as a result each wave impact tries to bend the hull. This fore-aft bending moment is a big factor that can cause interior furniture to break loose; stress cracks to develop and premature hull delamination to occur when the sides of the hull pant in and out each time the boat goes over a wave. To resist the potential effects of this pounding action as well as other bending forces such as those imparted by the thrust of the engines, most fiberglass powerboats are built with longitudinal stiffeners known as stringers (**Figure 1**).

Sailboats also have longitudinal stiffness concerns due to the high loads imparted by the standing rigging. One important element that separates a sailboat with good upwind performance from its slower brethren is the hull's ability to resist the bending forces of a tight backstay and forestay. A good fore-aft stringer system helps prevent a sailboat hull from looking like a banana.

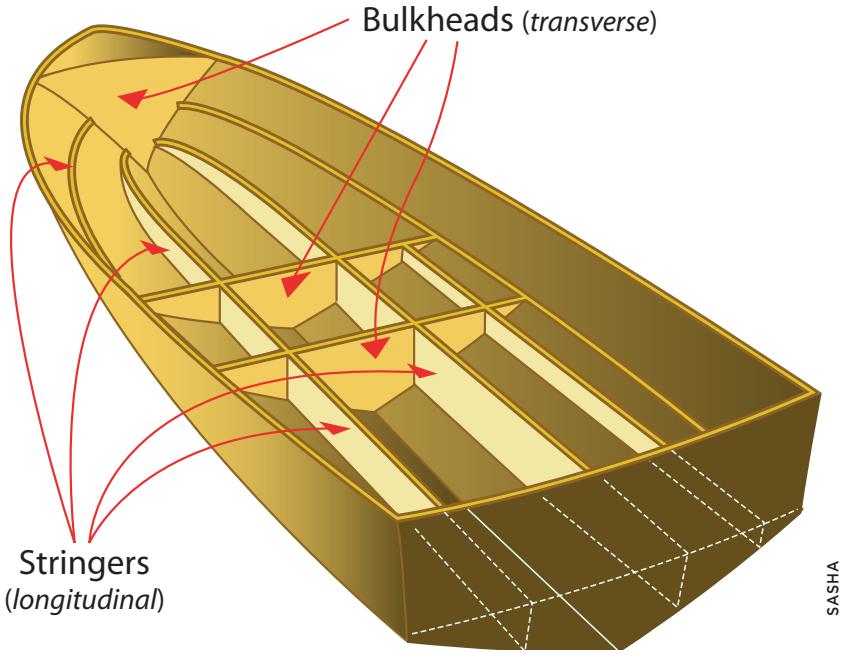
Stringer Design

Depending on the design of the boat, the stringers may be individual reinforcing beams running fore and aft or they may also be linked to athwartship ribs to form a grid structure that stiffens the whole bottom of the boat (see **Figure 1**). On a smaller outboard powered runabout, the majority of this structure lives unseen (and usually neglected) under the cockpit floor. All of an outboard motor's thrust is applied to the transom, so it's normal for stringers to run all the way aft and attach to the transom. Boats with stern drives typically see a much heavier type of stringer aft because it also serves as a motor mount. Since most stern drives (other than antique OMC "stringer drives") also apply the driving force to the transom, their engine bearing stringers also go all the way aft and connect with the transom. On larger boats with inboard engines, the stringers not only carry the weight of the engine but also transfer all the propulsion thrust to the hull. In this case, the engine stringers are usually massive.

Stringers in a smaller boat may be just lengths of 3/4" (19mm) plywood placed on end and tabbed to the hull with half-height fiberglass secondary bonds. Unfortun-ately, this style of exposed wood stringer is particularly vulnerable to rot. Completely encapsulating the wood in fiberglass, which also extends out onto the hull to provide a stronger secondary bond, is an improvement in the goal to keep the wood dry.

Depending on the thickness of the

Figure 1



Longitudinal stiffener beams or stringers come in many sizes and often tie into athwartship bulkheads or ribs to create a structural grid system that stiffens the entire hull.

(top) The left hand stringer here was overloaded by a grounding incident and has broken just forward of the mast step (the mast step has been removed). (bottom) Closeup of cracked rib and stringer joint.

glass overlay, the fiberglass box formed by encapsulating a piece of wood can be much stronger than the wood piece alone, so much so that, on many newer boats, the builder dispenses with the wood core completely and uses stringers that are hollow or foam-filled fiberglass boxes bonded to the hull.

Stringer Problems

There are three things that go wrong with stringers: rot, cracks and delamination.

For obvious reasons, it's always the biodegradable wood parts of a fiberglass boat that seem to cause the most grief. In the case of the exposed wood stringer, it's not a matter of if, but when rot will attack, although pressure treated wood will survive longer. In the case of encapsulated wood, water can enter at cracks or at fastener holes, particularly at the motor mount lag bolts. The wood rots away on the inside of the stringer and, unless the fiberglass outer shell is particularly heavy, the stringer loses its stiffness and strength, which leads to cracks and delamination. Other bad things can happen when motor mount lag bolts no longer have a firm grip. A poorly fastened motor is a remarkable sight as it rears and bucks like a rodeo bronco. Unfortunately, that doesn't even begin to compare with the mayhem resulting from a motor attempting (and sometimes achieving) a 360° snap roll in the engine compartment.

Sometimes a weakened or overloaded stringer cracks and breaks. This is not uncommon in the bow where the force of wave pounding is greatest but it can also result from hitting a bad pothole while towing the boat on a trailer or even improper blocking when storing. A punky wood core often contributes to this type of failure.

It's quite common to see the fiberglass secondary bond attaching the stringer to the hull pop loose. The same causes listed above can contribute to this type of failure but sometimes the bond adhesion was poor

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from the day of original installation. This is the dreaded “never bond." Look for a telltale shiny surface at the failed bond line.

Surveying the Damage

First, you must determine the extent of the damage on either side of the fracture. Presuming the stringer has a wood core, check it with a moisture meter and mark the wet section for removal. If it's uncertain whether or not the stringer is cored or hollow, use a holesaw to remove a “coupon” of the stringer’s glass skin and reveal the core. If the stringer is hollow or filled with foam limit the repair to the damaged area plus 12" (30.5cm) or so on either side. If the stringer contains degraded wood, a proper repair requires complete removal and replacement of the degraded section of the stringer.

Wet foam can also be a problem but at least it's not biodegradable. Complete removal is ideal but not mandatory. Dig out any wet foam in the way of new fiberglass work and replace with fresh two-component expandable polyurethane foam. The new foam is then carved and sanded to the correct shape before applying new glass.

Make Ready

To prep for grinding fiberglass, you'll need to protect the interior of the boat against fiberglass dust (a truly vile and irritating contaminant.) Tape curtains of polyethylene sheeting in place, using removable masking tape to seal off the work area inside the boat. Set up a ducted fan for ventilation and dust extraction in an overhead hatch and use a vacuum cleaner to collect as much dust as possible. For personal protection against dust, our technicians don a hooded Tyvek suit and use tape to seal the cuffs as well as seamlessly connect the suit to heavy cotton work gloves. A full face respirator and hearing protection round out the safety package.

The dark area is where wet floatation foam has contributed to rotting the aft stringers under the cockpit floor of a 24" (7.3m) sterndrive-powered cruiser. The wet foam and rotted plywood stringer both require replacement. (See photo of repair under “Glass Lay-up.”)

Grinding and Cutting

Using a grinder fitted with a 24- or 36-grit disc, remove the secondary bond tabbing that attaches the bad portion of the stringer to the hull. Take care not to grind too deeply into the hull laminates. Once the tabbing has been ground away, cut the bad section of the stringer from the sound portion with a jigsaw or apply the grinder disc on edge as a cutting tool, making a cut at approximately a 45° scarf angle (**Figure 2**).

It should now be possible to knock the punky stringer loose with a mallet; however, some installations may need removal with a hammer and chisel. Clean the inside surface of the hull where the bad section was removed

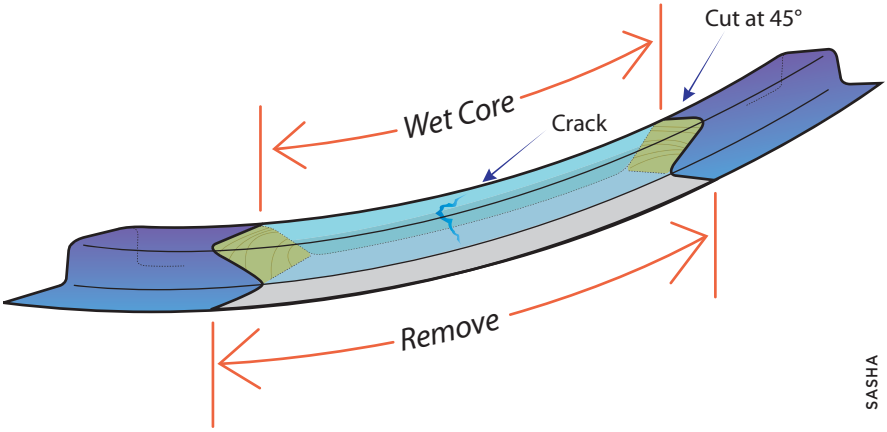


Figure 2
To prepare for making a strong, crack-resistant join, cut out the wet portion of a damaged wood core stringer at a 45° scarf angle.

Dry fitting a new wood stringer core on the sailboat stringer shown on page 19.

and level to prepare it for the new wood piece. This usually entails lightly buzzing it with a grinder. Grinding is also required on a few inches (cm) of the old stringer adjacent to the cut off point to taper and prep it for the new glass overlay.

Replacing the Core

To replace the old wood core, shape a new piece of dry wood (pine, spruce, cheap mahogany) and dry fit it to the gap in the stringer. If the new piece needs to be bent slightly to conform to the hull curvature, it may be practical to brace it into position with lumber jammed between the overhead or the underside of a nearby bunk or settee. This sort of ad hoc bracing also does a good job of clamping the new piece in place during the bonding step.

Now, remove dust from all prepped surfaces and wipe clean with acetone. One method is to bond the wood piece in place with putty. The alternative method is to use a resin rich layer of glass mat underneath the wood, using the bonding putty for filleting and gap filling only.

A typical batch of bonding putty is prepared by mixing catalyzed resin (polyester or epoxy) with colloidal silica (and possibly some chopped glass fiber) until a mayonnaise consistency is achieved. Apply the putty (or resin rich mat) approximately 0.125" to 0.25" (3mm to 6mm) thick onto the recess for the new stringer core with a trowel or putty knife. Immediately place the wood piece on top of the bonding material then weigh down or jam in place with lumber braces. Now apply the leftover bonding as a fillet along the edges of the wood where it meets the hull. A tongue depressor stick works well for this job and allows a nice neat radius to be created (**Figure 4**). The fillet serves two purposes. It

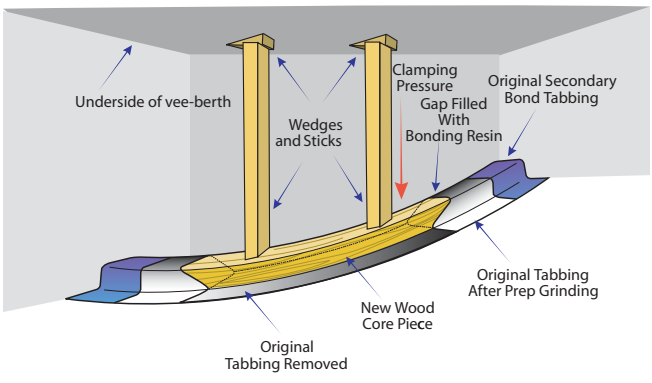


Figure 3
One method to clamp the new wood core in place for bonding is to use pieces of wood as bracing between the new stringer and any solid overhead surface.

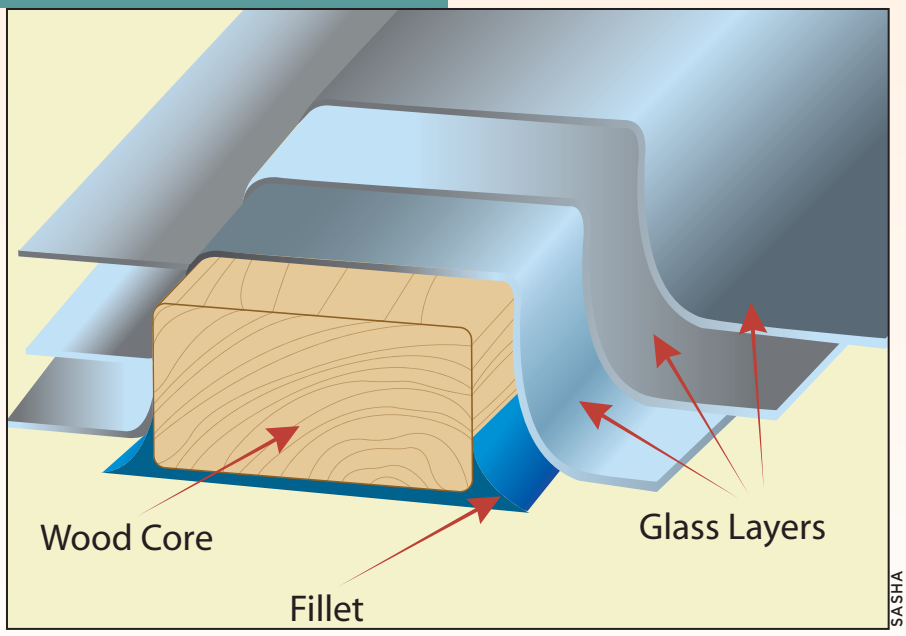


Figure 4
Location of the fillet and overlapping layout of typical encapsulating glass secondary bonds.

maximizes the contact surface of the bonding putty and prevents a hard 90° corner that is difficult to properly laminate with fiberglass. Any gaps at the joint between the old and new wood are also filled. [Ed: For additional details on filleting refer to page 48 in this issue.]

After the bonding putty has cured (next day), knock out the braces. Use a dual action (DA), random orbit sander with a 40-grit disc to smooth out any rough areas in the bonding putty. Clean up the dust again and wipe the repair surface with acetone.

Location of the fillet and overlapping layout of typical encapsulating glass secondary bonds.

Glass Lay-up

Now, cut the fiberglass cloth to encapsulate and reinforce the stringer and then dry fit it. On small boats, it's common practice to use only one or two layers of 1.5 oz. glass mat. Larger boats need more depending on the thickness of the original secondary bond lay-up. Size the glass pieces to completely cover the stringer and overlap out onto the hull at least the same distance as the original layup. To maintain longitudinal strength, the new glass must also overlap onto the original stringer at both ends of the repair. Each glass layer should be a little larger than the previous so that the last one overlaps and "caps" all the previous layers (see **Figure 4**).

Prepare a resin batch. If polyester, use unwaxed resin, except for the last layer of glass or gelcoat, which should contain Air-Dry wax (or Duratec) to promote a tack-free cure. Apply the catalyzed resin to the repair surface using a disposable brush. Drape the first piece of glass cloth (pre-wetted, if possible) carefully into place on the stringer. If needed, pour on additional resin and distribute with a 3" (7.6cm) roller until the new glass is fully wet. Roll or squeeze out any excess resin and eliminate bubbles with a serrated metal bubble buster roller. Allow this first layer to just begin to harden and then follow immediately with the next layer (if required) and a new batch of resin.

Freshly painted new stringer under sailboat mast step.

Finishing

The next day use your DA sander with an 80-grit disc to sand off the rough spots and clean up. If needed, paint the repair to match the hull interior. If the repair resin was polyester use an air-dry gelcoat. If using epoxy, an epoxy primer or paint is appropriate (you cannot apply gelcoat over epoxy) but only after scrubbing off any amine blush (a byproduct of curing).

Repair Variations

Repairing a broken hollow glass stringer or a delaminated wood core stringer (provided it's dry) is simpler than the steps outlined above. Simply grind away any delaminated glass secondary bond tabbing and replace. A cracked or broken stringer can usually be put back into service with a substantial glass patch. Engine bearing stringers require similar techniques but are complicated by the necessity of removing and reinstalling the engine(s).

Sub-floor stringers and grids in runabouts are also repaired using the techniques outlined above plus removing and replacing the floor.

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

ENGINE TROUBLE SHOOTING

Maintaining and Troubleshooting PSS Shaft Seals

A dripless shaft seal eliminates the maintenance and wet bilge that comes with a conventional stuffing box. Though relatively trouble free, problems do arise. Here a professional offers the ins and outs of the PSS Shaft Seal, one of the more popular units.

By Jan Mundy

The PSS Shaft Seal is a mechanical face seal, which creates a watertight seal by the contact of a rotating surface (rotor) against a stationary surface (carbon flange). A rubber bellows attaches this flange to the boat's shaft log. The stainless-steel rotor connects to the propeller shaft and is positioned during installation to compress the bellows. This compression applies the pressure necessary for the two faces to remain in contact during operation.

When installed correctly, a PSS shaft seal is, for the most part, maintenance and trouble free. This presupposes that no petroleum products were used during assembly, the exact number of setscrews fastens the rotor, you have properly tensioned the bellows and, on a sailboat, the hose barb (on new models only) connects to a vent hose to burp the bellows after launching and, on a powerboat, the hose feeds cooling water into the seal. The hitch is that boats are more diverse than cars and each one has a distinctive set up.

J.C. Milton of Spurs (www.spurs.com) based in Ft. Lauderdale, Florida, has for many years been instructing commercial and recreational boaters in the technicalities of engine components. A former commercial diver, licensed operator who has skippered private yachts on most of North America's waterways, aircraft aficionado and jack-of-all-trades with an "isn't much I can't do and haven't done" attitude, J.C. agreed to share his professional experiences on troubleshooting and maintaining the PSS dripless shaft seal.

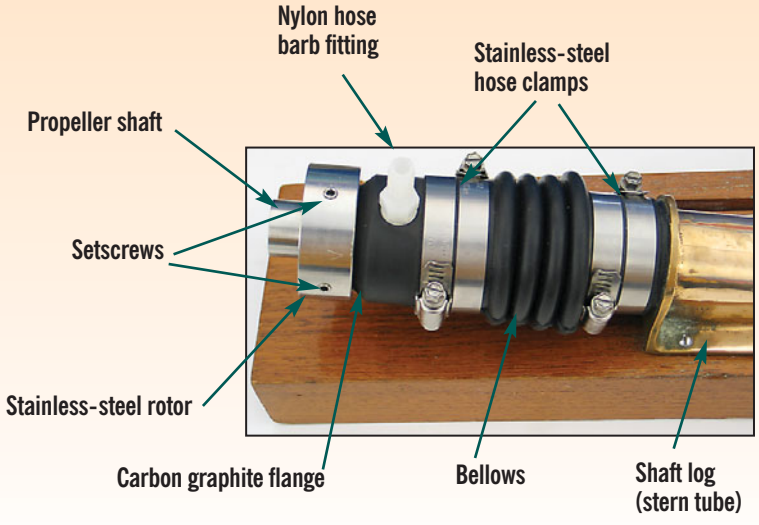
Problem: The boat is docked, the engine isn't running and you check the engine compartment to find that there's water dripping from the seal.

Solution: There are several places a seal can leak. Make sure the hose clamps securing the seal to the shaft log are tight. Foreign material even as fine as a one grain of sand, between the rotor and carbon graphite flange, results in seepage. To clean the faces of these surfaces without disassembly, force them apart by compressing the bellows, run a clean cloth around the unit once between the mating surfaces and then pull out the cloth so the seals reconnect. Incoming water flushes the debris and the leak should stop. Do this quickly to limit the quantity of water gushing out the seal and into the bilge.

Problem: After cleaning the mating surfaces water continues to drip from the seal.

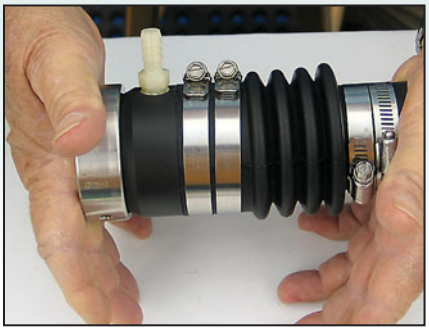
Solution: Improper tension on the bellows also causes the seal to leak. Compression guidelines provided in the owner's manual may differ with each individual installation. Clamping the bellows to a smooth, shaft log with no lip for the back of the bellows to butt up against, for example, may push the bellows, when compressed, over the log and thus reduce bellows pressure. Excess vibration, in some instances, causes the rotor to slide up the shaft and take pressure off the bellows. If you suspect vibration, remove the top two rotor setscrews and then slowly back out the two bottom setscrews until the bellows relaxes. Note that there are 4 setscrews in 2 holes. Now, recompress the bellows to the distance recommended in the installation manual and then reset the rotor. If leaking persists, reface the rotor and carbon flange using 600-grit wet or dry sandpaper (see

ID PARTS



method in next Solution below). Check that the hose barb (if equipped) is not broken and that the hose clamp is secure. Tip: A shaft zinc installed just ahead of the rotor will give peace of mind to vibration problems.

Problem: At high rpm, a fine black mist emits from the shaft seal.
Solution: A black mist occurring after the break-in period (one hour) could mean incorrect bellows tension. Recompress the bellows by squeezing it together to the chart recommendations in the installation manual. If black mist continues coming from the seals there might be some foreign material on mating surfaces. To clean the seals, take 600-grit wet/dry sandpaper, folded in half, and compress the bellows to open the gap between the rotor and carbon flange. Slide the sandpaper between the two surfaces and run the sandpaper around the mating surfaces about 10 times. Alternatively, wait until your next haulout and, once on land, loosen the rotor and slide it up after thoroughly cleaning the shaft. Use a whitening style toothpaste, which contains baking soda, to clean the rotor face and carbon flange. Apply the toothpaste to the rotor then clean by lapping it over the carbon flange and turning to "grind" both surfaces. Wipe both faces with acetone and a clean rag. Polishing both to a mirror finish should stop the leak.

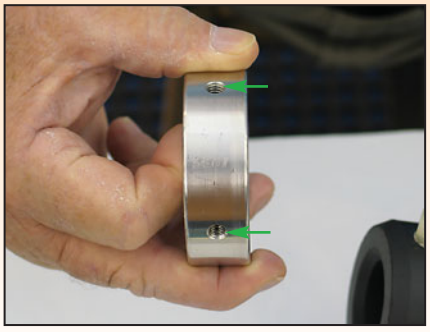


Problem: When running the engine, water sprays from the seal.
Solution: A drop of oil on the seal faces can result in the seal spraying water. As the rotor rubs against the flange it creates a chatter and water mist. To repair, sand with 600-grit wet/dry sandpaper as detailed above, scouring the mating surfaces about 10 times. Keep the seal as free of oil and grease as possible.

Problem: White deposits have built up along the edge of the rotor and carbon flange.
Solution: This is normal for boats run in saltwater. As the shaft spins, the salt crystals dry on the top edge of the rotor and carbon. Salt doesn't harm the seal. Just wipe off the residue with a damp cloth.

Problem: The engine is running and suddenly there's a high-pitched squeal coming from the seal.
Solution: Shutdown the engine immediately. Such sounds result from insufficient cooling water on a powerboat installation. A dry running seal becomes extremely hot, as high as 400F (204C), so never touch one for a heat check. You might detect a burning rubber smell as the carbon flange comes in contact with the bellows. Note that when connecting the cooling water hose, it doesn't matter whether it's teed into the hot or cold water side of the heat exchanger. What's critical is that the water supply comes from as low in the system as possible and before any pencil zincs. Pencil zincs erode and could conceivably plug the water intake hose or hose barb and destroy the seal. On twin engine installations, plumb the seals may be to draw water from either engine in case one engine fails.

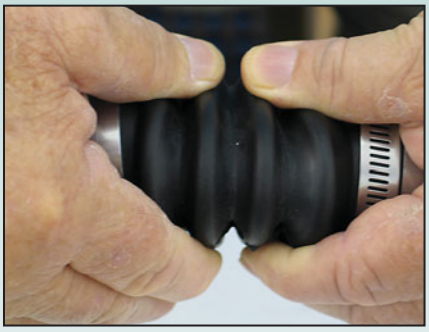
TIP



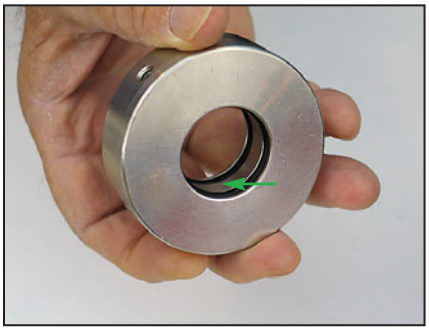
No Lock Solutions

Never use Loctite or other petroleum-based products when fastening the four stainless-steel setscrews in the rotor.

Problem: How often do I need to replace the bellows?
Solution: Proactively, replacing the bellows at least every eight years is a good practice, regardless of condition. At least once a year, pinch the bellows while installed and using a good flashlight check for small cracks. Any deterioration and it's time for replacement.



Problem: Does a seal that's saltwater cooled require routine checking for salt deposits in the hose?
Solution: Cooling water flows under pressure so it keeps salt deposits from clogging the intake hose. Check that the clamp securing the hose to the hose barb is tight and there are no leaks. Be careful when working around the seal. Stepping on this hose barb fitting could break it.



Problem: When do the O-rings need replacing?
Solution: Nitrile O-rings in the rotor are static in relation to the shaft. As the shaft, O-rings and rotor all move at the same speed there's no wear on the rings. Once installed, they require no maintenance even a shaft misalignment won't cause O-ring wear; however, always replace O-rings and setscrews any time the rotor is removed from the shaft.

The PSS Shaft Seal is surely an improvement over the conventional stuffing box. But like any thru-hull fitting it's important to be aware of its idiosyncrasies. With periodic visual inspection this shaft seal will deliver years of trouble-free service.

TIP

Routine Checks

Every time you run your engine, check that there are no leaks at the hose clamps or water dripping or spraying from the seal. On powerboats, check that water flows into the hose barb on engine startup and inspect the cooling water intake assembly after every use. Other than annually checking the bellows for small cracks, there is neither adjustment nor maintenance required. When hauling the boat for long-term storage, loosen the rotor and lubricate the mating surfaces with a little soap and water. Remember to tighten and recompress the bellows before relaunching.

ELECTRICAL

No Hassle Charging

These devices connect two or three battery banks to a single charging source and isolates the battery banks during discharge. When properly sized and installed, they are trouble-free.

By John Payne

Ever since the engine starting battery was supplemented with a second battery to run house service loads, charging them both satisfactorily has been a problem. The common practice of connecting batteries in parallel to enable charging from a common charging source often leads to problems. The most basic battery combiner is the familiar large red master switch with "off/1/2/both" positions. Many boaters have accidentally left the switch in the "both" position causing the paralleled bank to discharge. Another familiar scenario is the accidental switching to the "off" position of the switch, which promptly blows the alternator diodes. There are also other problems of reliability that come with poor switch contacts and high resistance. These factors inspired the search for a method to overcome these drawbacks and led to the emergence of isolators and combiners.

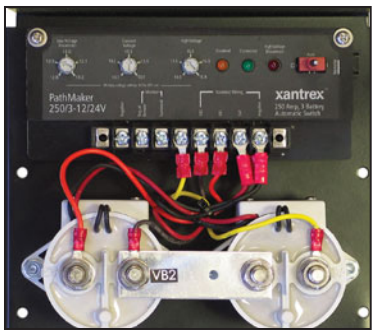
The earliest "automated" combiners involved a high current relay or heavy-duty solenoid that was activated from the ignition switch. These solenoids or relays had high quality low resistance contacts. Of course, the terms battery combiner and battery isolator are functionally similar but they employ different concepts. The diode isolator is, in effect, also a battery combiner for use when charging two batteries from a single source. The diode isolator had a few drawbacks, one being the inherent voltage drop across the diode, which required compensation with the alternator voltage regulator, and the heat that it generated under high loads. The two main advantages were that it was passive and reliable and had few components that could fail.

New Generation Combiners

The smart relay or battery combiner interconnects both batteries during charging. When the ignition switch is turned off, the relay coil de-energizes and separates the batteries. This isolates the start and house battery banks to prevent discharge between the batteries.

Smart relays or battery combiners have evolved into the smart voltage sensed relay. Voltage sensing means that the combiner does not activate and close until a preset voltage is attained. The control circuit senses this voltage and voltage builds up across the main alternator charged battery as it starts to charge. Typically this can be in the range 13.5 to 14 volts when the control circuit outputs a voltage to the solenoid or relay to energize the coil and close the main contacts, which is considerably more sophisticated from these basic relays. The solid-state relay found on some units is, in effect, a large power transistor mounted on a heat sink along with appropriate control circuits. This allows the reduction in size, however, ratings selection and mounting in properly ventilated areas to dissipate heat is essential for reliability. The battery combiner is also versatile in its applications. Use it to charge off outboard engines, which is an area where diode isolators were never very good. Or use it with shore-powered battery chargers when the boat is in the marina or ashore.

The term "smart combiner" is generally applied, as these devices are microprocessor controlled. Essentially, this means the device includes a more sophisticated voltage detection and control circuit. When a charge voltage is detected that exceeds the preset voltage; for example, 13.5 volts the unit activates. When the charging either reaches a certain preset maximum or charging ceases and the voltage falls to typically around 12.7 volts, the combiner opens, isolating the batteries to prevent discharge between each battery bank. These more sophisticated units have temperature monitoring and indication outputs or lights to show when the unit is combined. Some units also have a manual activation switch to allow parallel connection of batteries where they are needed to start an engine.

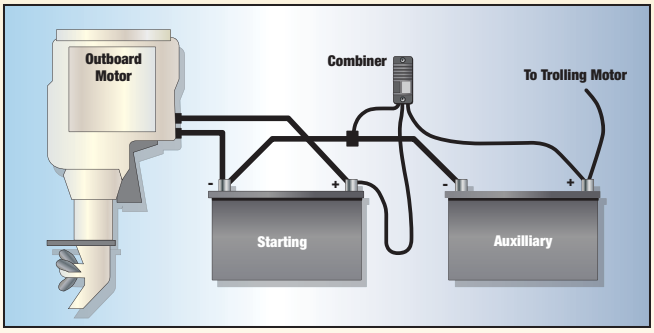


PathMaker 250 has user-selectable connect and disconnect voltages and a toggle switch to manually parallel battery banks for emergency starting power.

When voltage drops below the pre-set charging voltage, the BlueSea BatteryLink ACR opens to prevent accidental discharge of a battery bank.

The Battery Mate electronic isolator is the ideal accessory to a non-adjustable alternator to maintain the output voltage at a constant level.

Newmar Battery Integrator allows the single charging output of an inverter-charger to maintain both the start and house battery banks. Batteries are isolated during inverter operation so current draws from the house bank only.

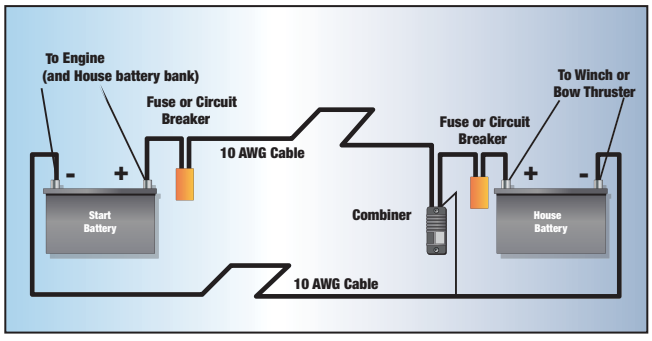


Joe VanVeenan

Sample installation of combiner and a two battery bank system charging from an outboard engine.

The battery combiner is also known as a charge distributor, equalizer and integrator, such as the Newmar Battery Integrator, a diode isolator that acts as a "smart" switch to connect battery banks only when a charging source is present. Smart combiners on the market include the Xantrex PathMaker 250, which allows charging of two or three batteries from one alternator or battery inverter-charger. There is also the Isolator Eliminator from Ample Power, which is a multi-step regulator that controls charge to the second battery bank, commonly used for engine starting. This is temperature compensated like an alternator control system and effectively functions as a secondary charger. The Battery Mate from Mastervolt is a charge splitter that can supply three batteries, without voltage drop. Another system is the AutoSwitch from Ample Power, which is a smart solenoid system. An electronic sensing circuit will enable the setting of the different operating modes. The Hell Roarer is another system, as is the DualPro ProXtra II. Both are found on bass fishing boats. These reduce the chances of overcharging secondary batteries such as the start or trolling motor battery. Some smart battery combiner units incorporate operating status indication and user adjustable cut in and cut out settings.

It is important to understand selection criteria, which primarily revolves around the correct amperage ratings. Some units are heavy current devices that can be used to parallel batteries for discharge applications like engine starting; however, this is a different application from the main charge distribution function. You must be careful not to mix the applications. If you do, make sure the device is rated for the heaviest duty it will be expected to perform.



Joe VanVeenan

A trolling battery connects through a Hellroaring BIC-75150 combiner to the starter to charge while charging the starting battery.

Rating Systems

Correct selection for the anticipated charge load is very important. Combiner ratings should at least match the maximum rated output of the alternator although, in practice, this maximum will never be reached. In many cases, the combiner is rated considerably less than the alternator output. Caution dictates the configuration of the unit in your charging arrangement. Even the heavy-duty solenoid or relay can be a point of failure if incorrectly rated for the job. If they are underrated for the current they will carry at full loads, excessive voltage drop and the resultant high resistance and overheating will occur.

Installation Guidelines

As the house battery bank is normally the one that receives the greatest current flow, this should be the bank connected directly to the alternator supply. The start battery bank generally doesn't need a great current flow and so the rating requirement is smaller as it is fed from the house bank through the combiner. It's a big mistake to install the system with the start battery bank as the primary connection to the alternator. With the higher capacity house bank then connected, under-rated combiners can fail due to the overload.

It's also critical that cables and connection terminals that interconnect the batteries through the combiner are rated for the maximum current they will carry. Undersizing the cables is also a common error in a new installation.

Troubleshooting

When your battery combiner will not operate the most common cause is that the voltage doesn't rise to a high enough value to activate the combiner switch-on circuit. On an alternator with integral regulator, the most common causes are as follows:

- The engine speed is too low and the alternator doesn't reach cut-in speed. In other words, it won't work at idle speeds. A slipping drive belt produces similar symptoms.
- The battery banks are discharged so low that it takes time for a charge voltage to build up across the batteries and reach the switch on voltage. This is common on boats with large deep-cycle battery banks.
- The alternator is faulty. Usually this is because some or all of the output bridge rectifier diodes have failed.
- If the battery combiner is a smart type with an overvoltage shutdown protection, the alternator regulator may have failed, outputting a high voltage that causes the combiner to open up. Some combiner indicators will alert to this condition.

A battery combiner simplifies the connection of additional batteries to a single charging source. When correctly selected and installed, it delivers trouble-free service. Combiners have many applications, including connection of wind generators, solar panels, AC-powered chargers and inverter-chargers to batteries for no hassle, worry-free charging.

About the author: John Payne, DIY's electrical consultant, is the commissioning manager for BP Thunderhorse, the world's largest semi-submersible oil platform installed in the Gulf of Mexico.

Overhauling
A Gusher Pump

Manual bilge pumps are the last line of defence in crises. Follow these steps to service a Whale Gusher 25 to ensure yours works when it's needed most.

By Peter Caplen

A manual bilge pump is a simple device. It passes large lumps of debris while moving significant amounts of water but, despite its simple design, it is mechanical equipment that needs occasional servicing to ensure reliable function. The pump shown in these photos is about 15 years old and has probably never been dismantled for inspection and service.

The pump is mounted in the accommodation beneath the dinette seating alongside the water manifold thus allowing it to clear different bilge areas at the turn of a valve. [Ed: Note use of gate valves. These should be replaced by marine-grade metal or plastic ball type valves or seacocks that, though more expensive, are more resistant to failures from corrosion, failures that cause the valve to be inoperable, either opening or closing.]

Dressed Hose

Always use spiral, reinforced hose on the inlet side of any bilge pump as suction can collapse non-reinforced hose.

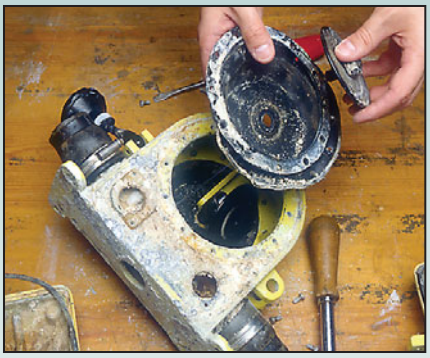
Initial examination of the internal condition can be performed with the pump in place. To open the covers, unscrew the large retaining nuts and swing them clear of the securing brackets, in this case, revealing years of corrosion and crud.

As it was clear that the pump needed overhauling, it's dismounted by undoing the securing nuts and bolts that hold it to the bottom of the compartment. Once lifted up, it became evident that the pump was in poor internal condition and needed removing for a complete overhaul so the hoses were now disconnected.

Remove the center bolt that connects the two diaphragms together via an internal threaded rod.

The pump is shown here laid out ready for repair with the appropriate Whale service kit (US$95) alongside. This kit uses nitrile rubber components that are impervious to diesel fuel. Service kits for most makes of pumps are available from marine chandlers. Being a double-action pump, there is, in effect, one pump on each side of the body. All repair procedures are identical for each side of the pump.

Covers are completely removed by undoing the holding bolts and nuts that secure them to the pump body. Flapper valves are removed and nylon valve bodies unscrewed ready for later removal. (They can be removed at this stage if required). Next, remove the machine screws securing the ring that holds the diaphragm. These need cleaning with a wire brush before reassembly.



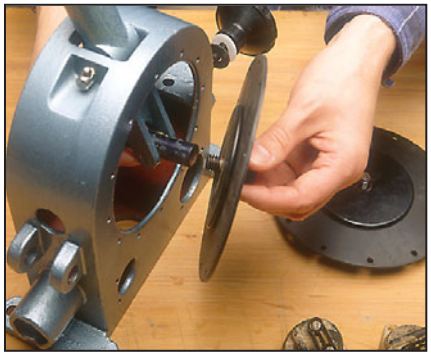
Lift away the diaphragm, ring and outer center plate. The inner center plate that sandwiches the diaphragm is visible inside the pump body.

This completes the dismantling process for one side of the pump and the parts are ready for cleaning.

Wire brush all metal parts to remove corrosion and to allow proper examination of their condition.

Fill corroded areas of the pump with an epoxy filler. Once cured, carefully sand smooth to ensure a proper seal on reassembly. Paint the pump with your favorite rustproof paint (e.g., Tremclad, Hammerite).

Glue the new nitrile seal into the recess in the cover using the supplied adhesive. Press the seal into the recess and trim it to length with an angle cut ensuring the two ends butt tightly together to make a perfect seal.

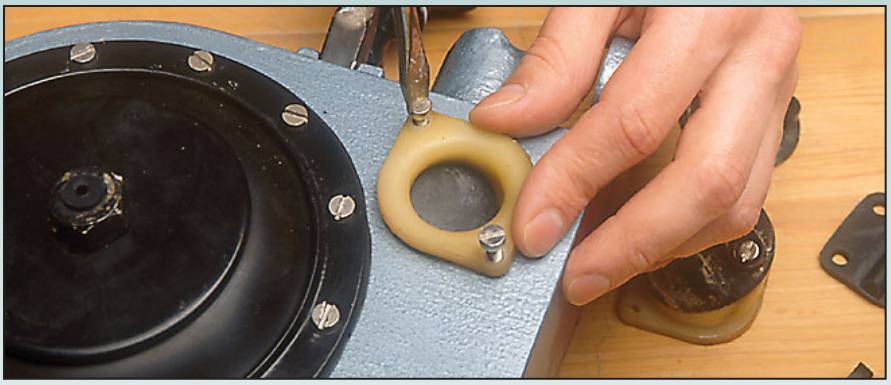


Fit the new diaphragm together with the sandwiched plates.

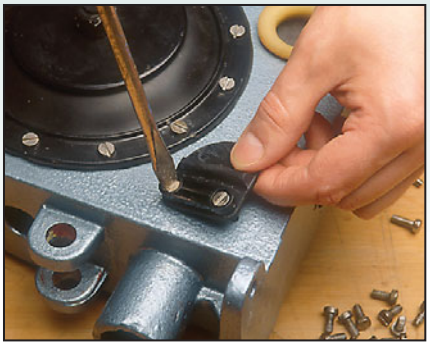
Now, fit the outer securing ring with screws. A new rubber stopper installs in the center bolt end.

Remove the old flapper valves from the nylon mounts and follow with new flappers fitted to each mount.

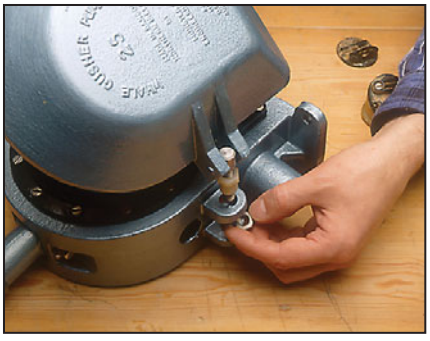
Install a new O-ring into each nylon mount prior to refitting.



Install the nylon mount assemblies into the pump body.



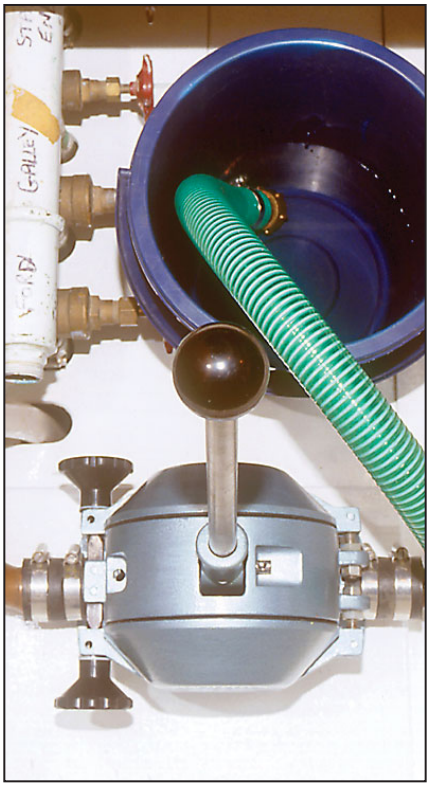
Now install the flapper valves.



Refit the covers to the brackets on the pump body, ensuring the nylon spigot washers are correctly oriented.

Check the seal is still in position before closing the cover.

Secure the cover firmly shut with the retaining nuts.



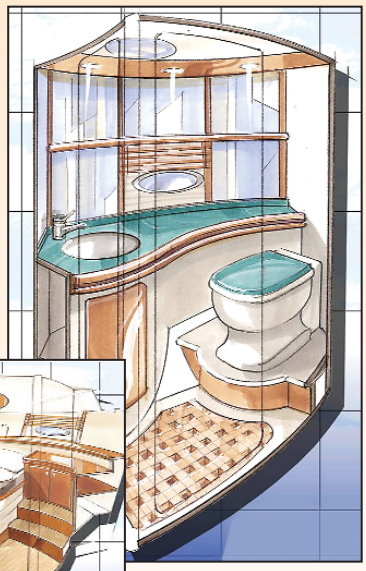
Place the pump in position and connect the outlet hose. Test for leaks by placing the inlet hose into a bucket of water and activating the pump.

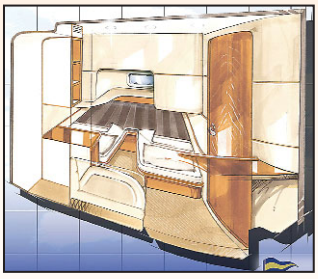
If the pump is leak free, reattach the mounting brackets and piping. Clip the operating handle neatly into position next to the pump ready for use. This job took about four hours, excluding filling and painting the pump housing.

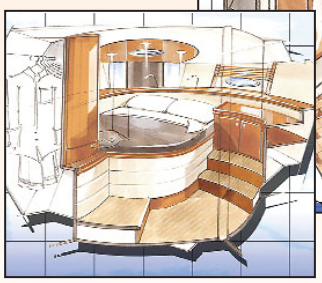
About the author: UK-based Peter Caplen is a mechanical engineer and technical writer with nearly 30 years experience in building, maintaining and renovating mainly powerboats.

Smart Cabin Interiors

Is your boat's interior a little drab and in need of refreshing? Here is a DIY collection of ideas, innovations and projects for your next cabin refit.







Courtesy Tony Castro; Elan Power 35

Story and photos by Jan Mundy

Trends change, colors change. Every few years you renovate rooms in your home so why not refurbish your boat "rooms?" Interior decorating can be a perfect remedy for revitalizing an older boat.

Renovating your boat's interior requires careful planning. Decide what you want to achieve, study the space and create a design using cardboard or plywood mock-ups. Most importantly, don't allow creativity to be limited by the location of existing fittings and furnishings. It's not extremely difficult to remove an icebox, sink or stove to create a more functional galley or to rework a U- or booth-shaped dinette to an L-shaped settee to gain space and improved function. Here's your chance to tailor the boat's interior to reflect your personal tastes and lifestyle. Whether it's to improve aesthetics, comfort or functionality, the styling options are limited only by your budget.

Remodeling a boat's interior doesn't need to cost a fortune. Replacing curtains with pleated shades, adding upholstered valances or new upholstery and some exciting accent cushions are all inexpensive redecorating projects to modernize and brighten an otherwise dated interior. More extensive remodeling may involve replacing worn floors with any of today's new synthetic laminates or textured carpets. Perhaps you intend to renew dark, teak cabinets with high gloss, light colored laminates or cover walls with wallpaper in rich, neutral colors or add some tile to accent a galley or install new headliner panels with recessed lighting. There are also comfort items to consider in your refit. Most boats lack suitable sleeping accommodations. You don't sleep on a foam cushion at home and you don't need to endure one on your boat. Innerspring mattresses, custom made for your boat, are pricey but well worth a good night's sleep and the investment in that quality will pay off when you someday sell the boat.

Obviously, the more complex the project the higher the price. If you have the skills and tools, you can likely handle most interior projects yourself. If not, you'll have to contract a professional marine interior designer. To have a professional remodel a 40' (12m) cruiser with new window treatments, linens and upholstery can cost upwards of US$13,000. Replace the carpet, wall coverings, headliner and lighting (these are the expensive items) on the same size boat and you could drop US$50,000.

Whether you have a liveaboard, weekend getaway, a floating office, an entertainment pen or a sportsman's fancy, the goal is to create a comfortable and functional living space with all the toys you desire to enhance your boating enjoyment. Remodeling a boat's interior begins with the main cabin. Let's get started.

Mixing too many colors and patterns makes this cabin appear cluttered. White headliner trimmed with varnished wood beams blends the best of old and new.

A nice blend of rich neutral colors, patterns and textures. Ultraleather upholstered seating converts to a double berth. Furniture is designed for both comfort and durability.

(top) This array of contemporary natural hues, patterns and textures are warm and add so much comfort to the berth. (bottom) Colorful, textured, interchangeable pillows accentuate white bedding and add flashes of detail.

Main Cabin Conversions

A place for eating, entertaining, leisure or refuge, the main cabin or saloon is truly the heart of any boat. The key is to keep the design simple. Don't clutter the cabin with too many patterns or different woods, which make a small cabin feel crowded. Use lighting, mirrors and pictures in proportion to the space. Recovering furniture with contemporary colors and fabrics or covering dark walls with 100% contractor-grade vinyl wallpaper are all budget friendly ways to add your personal touch and revitalize the existing space. To apply wallpaper, first clean the walls, sand, then fill any imperfections and apply paper with clay base glue. Paint trim so it matches the wall covering.

If space is an issue, consider replacing the square dinette (booth style or U-shaped) for an L-shaped settee and drop leaf table. This single modification can really make the space more inviting. Small, folding side or drop leaf tables make perfect temporary workstations or counters without sacrificing space. When sleeping accommodations are limited, consider making a fold-up pipe style berth for the younger guests. Reworking a layout or replacing furniture is also an opportunity to shed some weight. Replace solid plywood furniture structures with lightweight composite panels of balsa, foam, honeycomb or polypropylene core. Deco-Lite, Nida-Core, Nomex, Tricell and QuietPro acoustical panels from Soundown (www.soundown.com) all offer cored panels sandwiched between thin veneers of fiberglass, decorative wood or laminates.

Floors take a lot of abuse. Materials must be durable and moisture resistant. For high-traffic areas, carpet is your best choice. Select a low-pile textured carpet made of nylon, Olefin or wool. Real teak and holly adds a traditional flare but is high maintenance. Pre-finished laminated flooring that snaps together, Corian, Amtico and even tile are more durable choices for reconstruction projects. Amtico is a 100% easy-maintenance vinyl with a ceramic, marble, stone or wood simulated finish. Assembly is easy and fast. Simply cut and glue. "Using tile requires adding some flex to overcome vibration

Marine Accents

55' (16.7m) Hatteras before (top) and after remodeling (bottom) that involved adding an overhead soffit with halogen lighting, hardwood upholstered valance and side panels to contain and prevent blinds from slapping, newly designed L-shaped settee, Corian countertops and new fore and aft headliner panels with recessed halogen lighting.

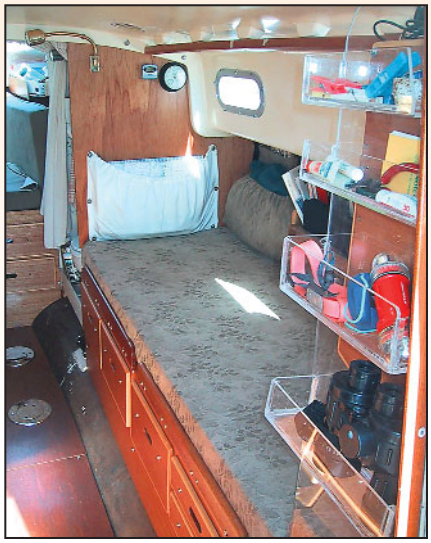
that would otherwise crack tiles," cautions Judy Prestia of Marine Accents (www.marine-accents.com). With offices in New Jersey, Maryland and Palm Beach, Florida, Judy's specialty is sportfishing boat interiors. "I coordinate all the materials and fabrics with the boat owner and then work with a boatyard or ship builder to decide the layout and space planning," Judy explains. "I make all the upholstery, bedspreads and soft window treatments and

(top) White walls and a mirrored ceiling reflect light to create an illusion of space making a small head compartment appear more spacious. (middle) Solid-core counter adds a modern touch. (bottom) Wooden towel holder is functional and easy to make.

Marine Accents

(left) Before and after (right) renovations. This master stateroom in a 60' (18m) Hatteras is tastefully decorated with mirrors, pleated shades, upholstered valances and new bedding ensemble with accent pillows.

(top) Stylish pleated shades are ideal for portlights and small windows; (middle) Roller blinds provide total privacy; (bottom) Wood blinds enrich a light wood interior.



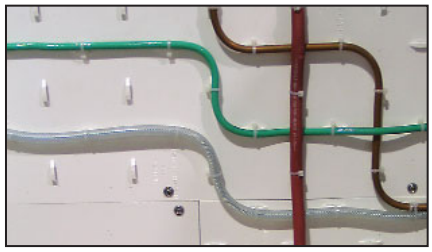
Sandy Tumey

(top clockwise) Dark teak surfaces, minimal galley space and dark fabrics on a Contessa 26 typify the interiors on late '70s sailboats; Cabin is completed gutted; Remodeled port-side includes a bright mix of light woods, lots of counter space, sink, freshwater and raw water taps and plenty of drawer storage; Custom-made Plexiglas shelves and drawer storage on the starboard side are certainly more practical than lockers.

Lightweight Thinsulate easily conforms to fit between wooden grid on headliner and is tacked in place with spray adhesive.

hire subcontractors for everything else." To install tile, Judy specifies laying it over Treadmore, a high-density thin rubber crumb underlay, using glue with elasticity and finishing with grout applied the standard way.

If you've grown tired of a carpeted, perforated vinyl or "bunny fur" headliner commonly found in older boats, replacement might be a worthwhile project. This is a popular upgrade on larger yachts, where individual panels are placed on a fore-and-aft grid, sometimes with decorative wood beams between panels. "We cut Luann plywood to fit the grid, glue on 1/8" (3mm) foam for padding then wrap each panel in fabric (ultraleather is her favorite)," Judy says. Heavy-duty, self-adhesive Velcro is stapled ("don't rely on just glue") to the back side of the panels, which are then pressed onto the overhead. Velcro is the perfect fastener for this application. It can hold 35 pounds per in^2 (16kg per 6cm^2), fully inverted, and offers easy access to wires and lights. It's common for a headliner project to also incorporate a lighting upgrade. At this point in your project, you can hide light assemblies behind the headliner. In this instance, the headliner is dropped slightly to accommodate built-in lighting boxes with flush mount halogens or other low



King E-Board saves time, materials and eliminates screw holes.

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West Advantage PLUS Rewards™ *In Partnership with* BoatU.S. THE ASSOCIATION

Visit BoatUS.com to find a Marine Center location near you. For your West Advantage Plus Rewards balance, call 877-937-8238.

A nice blend of light wood and fuchsia colored settee invites you to make yourself comfortable.

Marine Accents

Custom cut and bound carpet is installed over teak and holly sole (floor) 4" (10cm) away from vertical surfaces. Low-voltage rope lighting accentuates high-gloss finish on sole.

Marine Accents

Renovations on this 63' (19m) Ocean Yacht included custom overhead soffit, 2" (5cm) blinds set into a lambrequin, individual headliner panels to allow easy access to lighting, original teak cabinetry replaced with high-gloss laminate, custom, sculpted carpeting and ultraleather sofa.

voltage fixtures, the lights of choice. Using quick-disconnect connectors from Ancor (www.ancorproducts.com) enables easy removal of light fixtures for servicing or replacing. “On larger yachts the addition of custom overhead soffits nicely hides rope lights and other accent lighting and provides space for extra halogens,” suggests Judy.

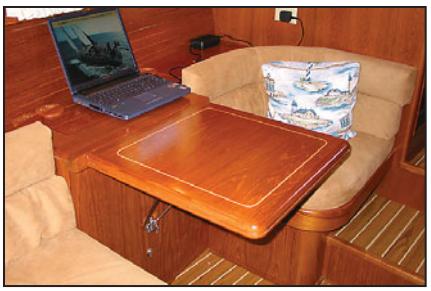
When fastening wires, cables and hoses, you'll save time, materials and eliminate screw holes using King E-Board. This polymer panel neatly organizes these items and also increases safety by securing wires to a non-conductive surface. It attaches to most surfaces using fasteners or 3M 5200 (or equivalent polyurethane adhesive sealant) with the optional adhesive-ready backing.

Thermal comfort is key to a dry, comfortable cabin. Homes are insulated so why not do the same on boats? Boats have similar inherent problems with varying heat zones, moisture and condensation. 3M Thinsulate insulation (yes, the same stuff sewn into winter wear) is gaining popularity with boat builders for use in interior applications including bulkheads, engine rooms, overheads and accommodation spaces. Thinsulate is a hydrophobic (doesn't absorb or wick water) polymeric polypropylene microfiber used to improve thermal efficiency and interior acoustics. This means sustained temperatures, condensation control and better interior climate control efficiency. Should it become wet, it won't mildew

(top) Coordinated color scheme blends upholstered wood panel valance with same material as curtains and color matched upholstery and cushions. (bottom) Fabric upholstered valance and side panels actually contain the blinds from slapping.

and, once dried, it resumes its shape. Albeit installation is more difficult to accomplish on a finished boat, refitting a new headliner provides the ideal opportunity to insulate the overhead to reduce solar loading and heat zones. To know if your boat has hot spots do this test. Sit (or stand) in the cabin. If your head is warmer than your feet consider insulating the overhead.

Unlike working with fiberglass insulation, Thinsulate is clean (no respirator needed to keep dust out of your lungs) and easily cut with scissors or utility knife. Howard Creel, applications and product development specialist at 3M Marine, recommends spray tacking in place. "Spray on Foam Fast Adhesive 74 or High Strength Adhesive 90 and then press firmly against the overhead," Creel says. "It's best to install battens for headliner and attachment points for lights and then conform the Thinsulate to shape," recommends Creel, "otherwise, cut slits in the material for existing hardware." Don't compress the insulation. It should remain fluffy for maximum R-value.



Folding tables make a great office nook.

Pale blue patterned fabric contrasts with dark wood interior and white headliner to project a nautical theme.

BETTER BOATS:

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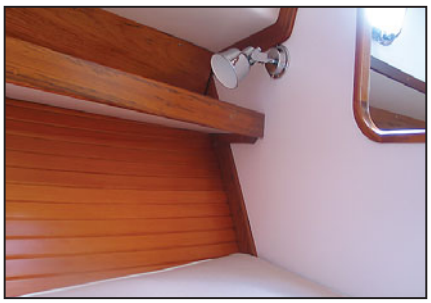
Rollaway pipe berth is the ideal solution when there are more overnight guests than available berths. This one folds under a shelf when not needed. Photos show the end attachments for the pipe.

Creel suggests using the thickest insulation as headroom permits. “Thinsulate, 2" (5cm) thick, has an R-value of 6 but two layers moves up the R-value to 12,” says Creel. The added weight is negligible for 2" (5cm) material weighs 21 ounces per 10.8 feet square (600 grams per meter square) or five times lighter than some fiberglass insulation.

When gutting and reconstructing an entire cabin, you can achieve a quieter living area by using Thinsulate to insulate drains, air compressors and the interior hull at the waterline to eliminate wave slop (never use this product in the bilge). “A saloon that's been insulated with Thinsulate has a very comfortable feeling and is an acoustically quiet environment,” Creel says. More expensive than fiberglass or foam insulation, Thinsulate comes in a 90' (27m) minimum roll in 30" (76cm) and 60" (152cm) widths.



Side shelves makes use of otherwise dead space to add storage to the vee-berth.

Quick Storage Fixes

Storage compartments and racks made of StarBoard are easy to make, require no finishing and offer a clean, contemporary look.

Tall, narrow space in a corner of this galley countertop works as a deep, trash bin.

Plates, glasses, mugs and cutlery all need a dedicated space where they cannot shift or become airborne in rough weather.

(Check 3M's website at www. mmm.com for dealers who will cut custom lengths.)

Galley Concepts

The minimalist's single-burner stove, icebox and sink galley of yesterday has been modernized with many amenities found in your home kitchen. A stove with oven, double sink, freezer and built-in microwave are standard on lots of boats today. Add a trash compactor, icemaker and dishwasher and you've got the makings of a small apartment kitchen. Where space allows, you can add some of these cook's aids. At the very least, you'll want secure storage for dishes and cutlery so they stay put. Spice racks, knife storage, liquor cabinet, wine glasses and bottle racks add utility and tasteful touches. Dry goods storage and trash disposal is an important consideration for liveaboards and weekend cruisers alike. A solid surface countertop, such as Corian, or stainless steel adds a modern touch on newer boats while a tiled countertop might suit a classic boat or appeal as a traditional look. Unlike conventional laminated countertops (e.g., Formica) these materials are heat-resistant to damage from hot dishes just out of the oven.

A galley renovation demands attention to managing air flow, increased power demands and weight. Adding powered vents or a range hood removes heat created from cooking and reduces conden-

A few inches were taken from under counter galley drawers to make this handy knife holder.

Double sinks are practical and Corian countertop with a cove edge looks elegant.

Galley attractively appointed with tile. Small tile size makes a galley (or head) appear more spacious. Spice jars are in plain view for quick selection. Your jars will determine the size and depth of the shelf.

Range hood exhausts cooking heat and odors to control humidity and ventilate the cabin.




Everything has a place in a well-planned galley: (top, clockwise) Wire rack shelving and below stove drawers; plastic tubs built into the cabin sole; Pantry for storage of dry goods; Plastic and foil wraps are easy to access yet cleverly mounted so they are hidden from view.

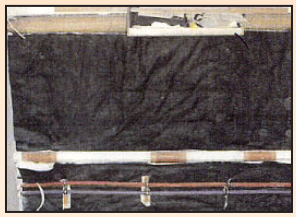
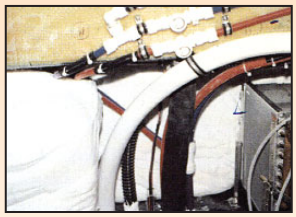
sation build-up in the cabin. The equipment you add depends on not only space but also power and weight considerations. Increased power demands may require a larger gen-set and/or wiring and control panel upgrades. Adding large appliances may also increase the overall weight onboard that could affect a boat's performance.

For safety, keep a fire blanket in a handy compartment to throw over a fire. Fire fighting equipment should always be within arm's reach in every galley and not tucked away inside a locker where it can be buried from view.

Changing the Rags

Styling options for boats are, for the most part, influenced by color trends in homes. Redecorating with updated colors and fabrics are elements where you can let your inner creative spirit shine through. From upholstery to accent pillows, to sheets and towels, to blinds and carpet, the possibilities are unlimited and the results can be stunning without spending a lot of money. There are some rules of thumb to follow when choos-

TIP

Absolute Quiet

Part of the thrill of boating is the noise and vibration created when you're underway but, when docked or at anchor, many boaters enjoy more tranquil, serene surroundings for reading, listening to music, watching TV or sleeping, without the hum of a compressor running. After insulating the headliner with 3M Thinsulate, use any remaining scraps to line the AC enclosure and wrap air-conditioning hoses or cover the refrigeration air compressor to increase efficiency and reduce cycling and noise. You can even use it to line a shower stall or a head compartment to dampen water noise or the inevitable human sounds that can emnate from these places.

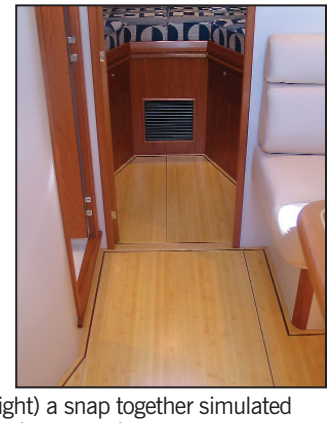
Storage for liquor, wine and glassware makes use of unused space and adds a touch of class to your “floating” bar.

ing colors and fabrics and they're based on the type and color of the interior woodwork.

For dark wood interiors, use warm colors. “Light green, tan, sage and even coral accentuates dark woods but doesn't contrast,” Judy explains. “White or other light color offers too much contrast, especially with light-colored headliners, which are typically shades of white.” Pale-blue walls, for example, embellished with tan and cream upholstery bring out the richness of dark wood. Light wood interiors look best with a subtle background color, such as yellow or buff that can be spiced up with pale blue or sage upholstery and colorful, patterned pillows. By layering the colors, with little expense, you can replace cushions when you tire of the colors.

Fabrics are available in an array of colors, patterns and textures that offer both function and aesthetics. Jacquard, leatherette,

Classic teak and holly wood floor enriches any boat's interior.



(left) Parquet laminated floor or (right) a snap together simulated wood laminate floor are durable and water resistant.

Marine Accents

Custom tiled floor in head blends nicely with color matched carpet.

Marine Accents

Custom Amtico simulated wood flooring in pickled oak coordinates with eye catching textured carpet.

Striking custom inlaid sole in galley...utterly awesome!

ultraseude and ultraleather are all durable fabrics that are fade, soil and stain resistant. Window treatments are no longer confined to curtains. Pleated shades, silhouettes and roll-up blinds enrich even an elderly boat and these coverings protect interiors from UV damage.

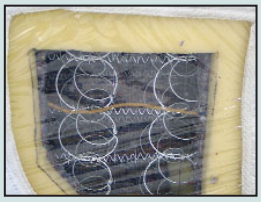
Herein lies the end of any similarities between boats and homes. Unlike a house, the monetary return on your cabin remodeling project may be nominal. Your investment in comfort and function, however, will return 100% in the enjoyment of your boat.

About the author: Jan Mundy is editor of DIY boat owner Magazine.

Achieving Sleeping Comfort

Boat berth cushions are usually polyurethane, a mixture of air and foam. The more foam added to the mix, the firmer the cushion, a firmness that can translate "firm" to unbearably hard for sleeping; more air than foam makes for a soft cushion that soon breaks down, providing little support for a resting body. Either way, most foam berth cushions are no comparison for the innerspring mattress you sleep on at home. You can bring home sleeping comfort onboard with custom-made mattresses but how do you know what to buy? To learn the ins and outs of mattresses, I spoke with Greg Palmer of Palmer Bedding. Greg is the third generation in a family business that has been building custom marine mattresses for 20 years. Palmer offers custom made marine innerspring and latex mattresses in thicknesses ranging from 6" (15cm) to 10.5" (27cm) and in varying degrees of firmness.

How do marine innerspring mattresses differ?



Knowing that the mattress is going to be in a marine environment, we coat the coils with a flexible primer paint to prevent against rust and corrosion. The biggest concern is to keep moisture out of the mattress. Outer fabrics are all breathable cotton and, where a mattress will be in contact with the boat structure, usually on the bottom and sides, we provide a moisture-proof barrier.

Why would I choose a latex mattress?

Latex rubber is an all-natural product that is processed from rubber trees and has been used in the home bedding industry for years. A latex rubber mattress has no springs. The result is a spongy mattress available in different densities for people who want to sleep on foam. It won't mildew or mold, won't absorb odors and comes with a lifetime guarantee. It's a good choice for a vee-berth as it can take the abuse of continually climbing over at the same spot.

How much money will I spend?

Queen size mattresses start at US$1,100 and range up to US$2,700. A vee-berth, depending on style, thickness and options, ranges from US$1,400 to US$3,000. A quarter berth costs between $595 and $1,400. The low range is for a mattress thickness of 6" (15cm); 10.5" (26.6cm) thickness is top of the line. Our most popular mattress is the 8" (20cm) pillow top, which gives you the advantage of a pillow top without added thickness. As boats are shaped differently, all mattresses are custom made from start to finish. Custom shapes incorporate angles and bevels transferred from the hull contour to paper patterns, a skilled labor intensive process. We offer a lifetime guarantee against manufacturer's defects and a 10 to 15-year guarantee against sags and body impressions, depending on the product specifications.

Who makes the patterns?

It depends. We have representatives along the East Coast and in Florida who come to your boat and make the templates and we also provide a template kit along with step-by-step instructions for making the patterns yourself.

How do you handle a bulky mattress when there is storage beneath the berth?

We run a hinge in the mattress, either from side to side or head to toe so that the mattress can be more easily lifted to gain access to storage spaces beneath a berth. The hinge can be positioned anywhere that it's needed, except on a diagonal. It's a US$100 option regardless of design or size.

POWER BOAT RIGGING

Sterndrive POWER STEERING MAINTENANCE

Power steering is one of the most overlooked systems in a boat's routine maintenance schedule. Here's a look at the basic theory of operation, inspection points and what is required for basic steering maintenance.

By Steve Auger

The power steering system on most sterndrive-powered boats is made up of four major components: mechanical rack and pinion helm and steering cable assembly; engine-driven high pressure hydraulic pump; power steering oil cooler and oil lines and a power steering control valve and piston assembly.

So how does it work? The steering wheel connects to a pinion gear. As the wheel is turned from side to side, the pinion gear pushes or pulls a rack, which is a movable metal tube with gear teeth along the top inside a large stationary tube that serves as the housing. A mechanical steering cable assembly, consisting of a solid inner wound cable and an outer wound tubular housing, connects to this assembly. The inner cable attaches to the rack and the outer cable housing attaches to the stationary tube. Turn the steering wheel and the rack and pinion assembly pushes or pulls the inner cable.

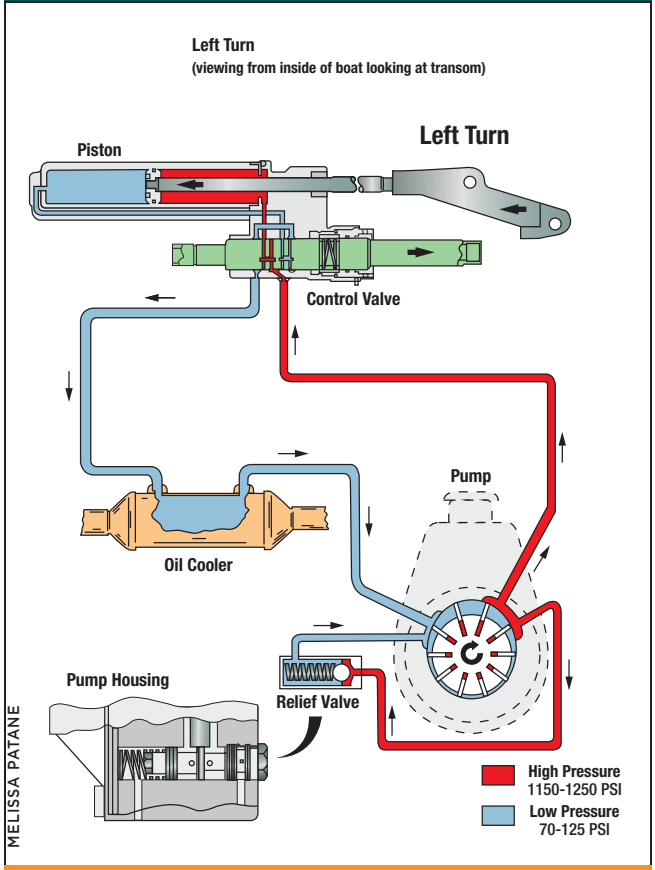
The engine end of the outer steering cable attaches to a power steering control valve and the engine end of the inner core attaches to the stern drive tiller arm. When the steering wheel is turned to the right the inner cable pushes against the tiller arm that, in turn, causes the outer cable to push the control valve in the opposite direction. The control valve then routes oil under high pressure (1,200 psi) to one side of a cylinder containing a central piston and rod that are connected to the tiller arm. By controlling the flow of oil out of the other side of the steering cylinder, the control valve provides a smooth easy feel at the steering wheel. This happens because the high pressures used in the steering cylinder overcome the steering torque produced by the sterndrive. When the steering wheel is stationary, the oil pressure on both sides of the piston in the steering cylinder is equal and static. This holds the piston (which, in turn, holds the sterndrive unit) in a stationary position until the wheel is moved again. Oil exiting the control valve is then routed through an oil cooler and back to the reservoir in the pump.

There are five areas that require routine inspection and maintenance: steering helm and cable; pump and drive belt; oil cooler and lines; control valve; gimbal ring, bell housing and tiller arm.

Steering Helm And Cable. Start by checking that the nuts and bolts that attach the steering head assembly to the helm are tight. With the engine off, see if the steering wheel has excessive play back and forth before resistance is felt. Any more than a couple of inches of free movement indicates the cable is worn. Check the entire length of the steering cable to see if the plastic casing is cracked. If the casing is cracked, replace the cable. Cracked cable casing will allow moisture to attack the cable and cause it to seize. Inspect the last 3' (91cm) to 4' (122cm) of the cable where it attaches to the control valve. Ensure that no wires, harnesses, hoses or cables are strapped to the last 3' (91cm) of steering cable. Check the fastener that connects the cable to the control valve to ensure it's tight. Finally, have someone turn the steering wheel from lock to lock and ensure the steering cable does not come in contact with anything in the engine compartment as it pivots on its fulcrum.

Pump And Drive Belt. Inspect the oil in the reservoir. It should be a clear red color and be filled to the level indicated on the dipstick on the oil pump cap. If the oil is burnt, it turns a cloudy brown color and smells burnt. If the oil appears the color and consistency of a strawberry milkshake, the oil cooler is leaking water into the oil and it's time to replace the cooler and the power steering fluid. Check the

Later Model (DHB) Power Steering System



Left turn

pump externally for oil leaks. Inspect the belt for cracks or wear and check for correct belt tension per the service manual specifications.

Oil Cooler And Lines. Remove the water hoses from the power steering oil cooler and make sure there is no debris blocking the water tubes inside the cooler. Ensure that the high-pressure line fittings are tight, using a line wrench for this job or you will damage the fittings with a conventional wrench. Check the hoses for chafe, cracks or leaks. Check the hose clamps on the low-pressure line to ensure they are tight.

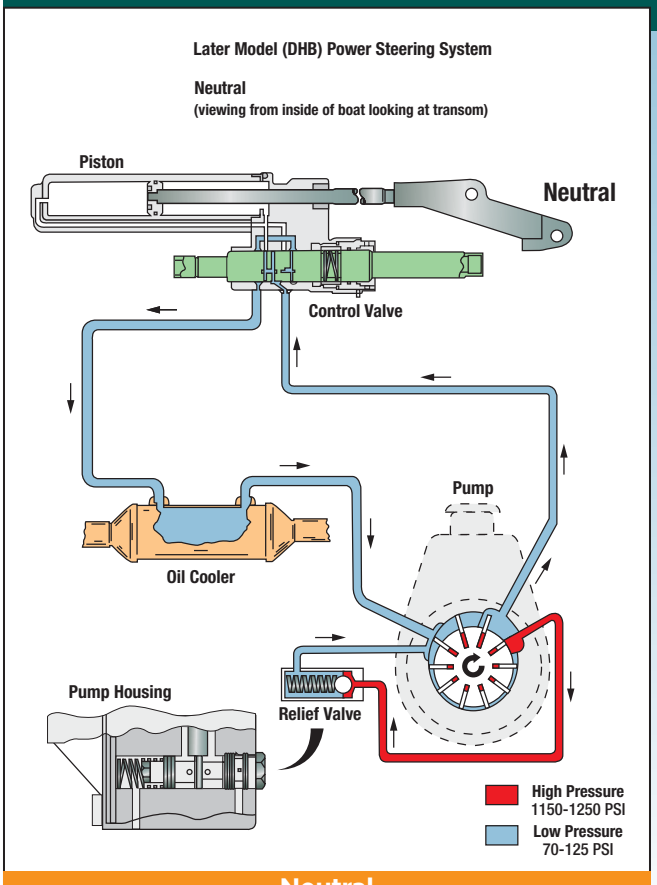
Control Valve. Inspect the control valve mounting bolts for tightness and ensure the mounting bolt locking tabs are bent over. Check the control valve and cylinder assembly for leaks. If there are leaks, replace the control valve. If you have a newer sterndrive with a DHB control valve, ensure the flats on the cable guide tube are at 90° to the tiller arm. If they are not, loosen the steering cable attaching nut and, while holding the tube with a wrench, tighten the cable attaching nut with the flats of the tube at 90° to the tiller arm. If the steering cable is equipped with a grease fitting, completely retract the cable (hard left turn) and grease the cable with Quicksilver Lube 101 or equivalent.

Gimbal Ring, Bell Housing and Tiller Arm. These components are used in manual and power steering equipped sterndrives and require inspection and maintenance. Check the tiller arm for tightness. There should be no up or down movement and the arm should be tight on the steering shaft that connects to the gimbal ring. The gimbal ring has a U-bolt or thru-bolts that have to be loosened and retorqued annually. See your service manual for details. If this is not done, you could face a very expensive repair since the gimbal ring to steering shaft assembly will wear out prematurely. Check the bell housing to ensure there is no excessive up or down or side-to-side play. If you are able to see movement, you may want to check the hinge pins for wear. Replacement of the gimbal ring or bell housing is a job for only the most experienced DIYer or for an authorized dealer.

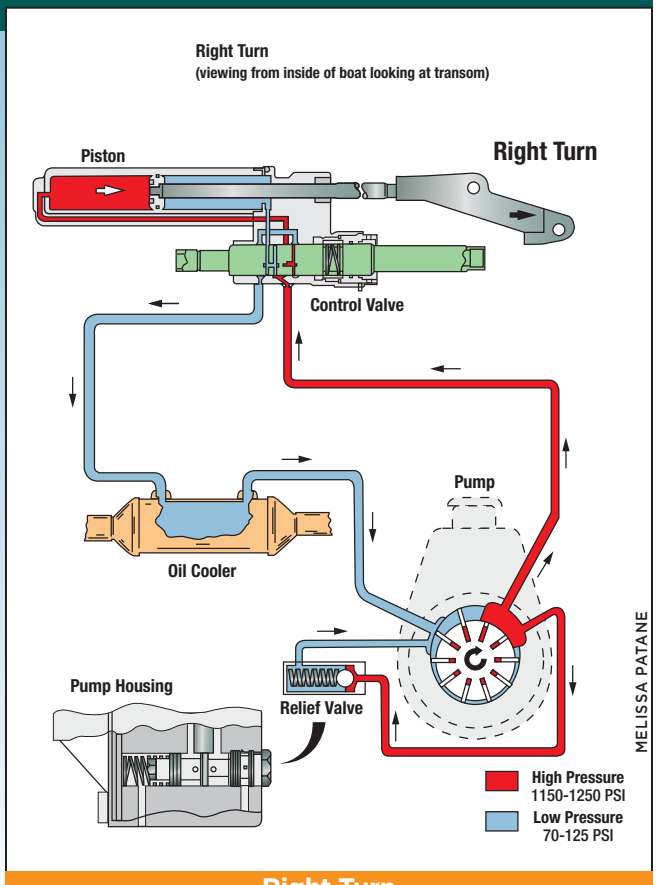
Performing these inspections and maintenance as outlined in your owner's manual will keep your steering system in good working order; ready to perform when you need it. Overlooking this system can result in a failure that could turn a great day on the water into an emergency situation.

About the author: Steve Auger has more than 35 years experience servicing all makes of outboard and sterndrive engines. He is DIY's engine technical advisor and service training instructor/ Mercruiser product support specialist at Mercury Marine.

Note: All views from inside the boat looking at the transom.



Neutral



Right Turn

Bulkhead
Repair And Replacement

Water collecting in the bilge, leaking chainplates on sailboats and chronic deck leaks all contribute to the death of plywood bulkheads from rot and delamination. When this happens, a fiberglass hull looses its internal structural support. Here's how to replace your boat's bulkheads or repair isolated damage.

Story and Photos by Nick Bailey

For a long time after fiberglass became the hull material of choice for production boat builders, boat interior structures retained many things from the old ways of wooden boat construction. In other words, everything inside the boat was made of wood. Skilled craftsmen would custom fit plywood bulkheads to the empty hull, tab them in place with fiberglass secondary bonds (a.k.a. tabbing) and then attach the rest of the wood interior furniture to the bulkheads.

Few fiberglass hulls larger than dinghy size are rigid enough to do without internal support and bulkheads serve to tie the whole hull and deck assembly, as well the interior furniture, together as a rigid unit. On sailboats, the main bulkheads also provide the crucial anchor point for the shroud chainplates and are responsible for transmitting much of the rig loads to the hull. As time went on and labor costs grew, the internal structural elements, as well as furniture, became less custom fitted wood and more molded fiberglass modules. Nonetheless, even in today's production boats, wood bulkheads still have a role to play, though appearances can be deceiving. What may appear to be varnished marine ply may be a thin wood veneer over an advanced epoxy/graphite laminate, cored with Nomex honeycomb. In the case of some modern boats, where the role of internal structural reinforcement has been shifted entirely to bonded glass modules, don't be too surprised to find that some remaining wood bulkheads may consist of a veneer over glorified particleboard. Here the bulkheads have devolved from important structure to mere furniture and are only going along for the ride.

The general rule of thumb is the older the boat, the more important the role of wood in its interior structure. This may warm the heart of the traditionalist but, from the refit standpoint, we have to contend with the grim reality: wood rots. In so many cases, an older boat with a good glass hull and deck will have problems with deteriorated interior wood. This means bulkhead problems, the most common being moisture absorption along the lower edge. This in turn results in rot and delaminated tabbing, resulting in a global loss of hull rigidity. More dramatic things can go wrong. Sailboat chainplates are a notorious source of leaks that lead to rot where the chainplate fastens to the bulkhead. A sudden failure here is not subtle. The rig usually goes over the side and the insurance company may not pay if the failure is the result of lack of maintenance.

Visual and Manual Inspection

Bulkhead problems begin when plywood remains wet for long periods of time. All wood is biodegradable and moisture promotes the growth of the fungi and other microorganisms that cause rot. The best composting environments aboard are damp, poorly ventilated areas, such as the bilge, hanging lockers, settee storage lockers, the head, etc., where the lower part of the bulkhead is at risk of deterioration.

Bulkhead deterioration begins in damp poorly ventilated areas.

Leaking chainplates are a common problem. Look for telltale dark stains.

Check for rot with a sharp probe.

Water leaking from above can also lead to problems at the chainplates and deck tie-downs as well as any location under a chronic leak.

Look for any telltale dark water stains on any bright finished plywood (varnished or oiled) or, if the plywood is painted, look for signs of the dreaded brown stain left by water seeping from rotten wood and/or rusting metal fittings. Also, beware of cracked or peeling paint, another sign of moisture. Delaminated fiberglass secondary bonds (or tabbing) should also be obvious. If in doubt, tap the bond with a hammer and note any loose or hollow sounding areas. If possible, remove the chainplates, or any other fitting that might hide rot, to allow direct inspection. Look for signs that the chainplate has shifted or you see elongation of the fastener holes. It may be necessary to pull the bolts to check the holes but it's worth the effort.

To confirm the condition of a suspicious area, poke and prod it with a pointed metal probe (ice pick or small flat-

blade screw driver). Rot damaged wood will put up little resistance to the entry of a sharp probe and will crumble if handled. It's a good idea to poke and prod all the bulkheads throughout the boat, especially at the lowest point there is accessible wood, usually just above any fiberglass secondary bond or tabbing that may exist.

If you have access to a moisture meter, it can be used to identify damp plywood at risk of future deterioration. However, a high meter reading does not necessarily mean immediate repairs are required. If otherwise sound, the plywood may simply need to dry. You will still need to track and eliminate the source of the water intrusion.

Repair Versus Replacement

Assuming you (or the surveyor) have located bulkheads in unacceptable condition, what can be done? This is a fairly demanding DIY project. You will be required to employ a cross spectrum of the traditional shipwright's skills, beginning with pattern making and carpentry through to glass work, fairing and finishing. The first thing to decide is whether or not any part of the bulkhead is salvageable or the complete bulkhead must be replaced. In most cases if there is more than 50% of the plywood bulkhead delaminated it may be best to replace the entire bulkhead.

Replacement Method

To avoid creating distortions in the hull, make sure the boat is properly supported in its cradle if it's blocked ashore. If it's a sailboat, unstep the mast. Sailboats also require a cradle arrangement that plants the keel firmly on the ground with the majority of the boat's weight resting on the keel. Cradle pads or jack stands should apply only enough pressure to stabilize the hull. Remove and replace one bulkhead at a time. The new bulkhead should be marine grade plywood, which ensures waterproof glues. The best

Delaminated tabbing at the base of this main bulkhead has been removed with a grinder. Note plastic sheets for dust protection.

marine plywood carries BS (British Standard) 1088 certification indicating void free construction.

Begin by removing any joinery attached to the bulkhead. You may also want to shroud off the rest of the interior with plastic to protect it from dust and set up forced air ventilation. Wear a respirator and Tyvek hooded coveralls for protection from extremely irritating fiberglass dust and proceed to grind away any glass tabbing (secondary bonds) joining the bulkhead to the hull or deck. Use a grinder (full-size or mini) with a 36-grit disc and make sure to completely remove the old tabbing to free the old bulkhead. Prep the adjacent fiberglass surface for the new bond tabbing (clean, solvent wipe, sand with 80-grit). [Ed: For additional details on preparations for fiberglass repairs refer to "Saving the Grid" beginning on page 17.]

If it looks as though the bulkhead won't fit through the companionway, it's safe to presume it was probably installed before the deck went on. Removing the deck is not usually a practical option so it will likely be impossible to remove or replace the bulkhead as a single piece. If required, cut the old bulkhead into removable pieces with a jigsaw or saber saw. Knock it loose with a mallet but don't smash it to bits for it can provide a template for cutting the new one. If dimensional information is lost because part of the old bulkhead has crumbled into compost, you will need to make a pattern from cardboard or wood scraps glued together. Presuming it won't fit through the hatch, the new bulkhead will be scarfed together in the boat from two or more manageable chunks. This requires careful dry fitting and plenty of

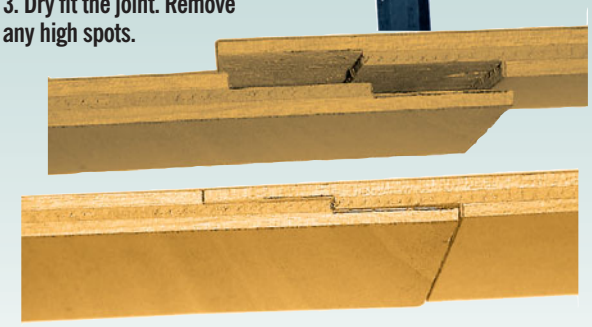
trips up and down the ladder to the woodshop. The usual scarf technique is to router back half the thickness of the ply over a few inches on each sheet to create an overlapping joint (see photos below). Remember to allow for the overlap distance when you are cutting out the new bulkhead pieces from the sheet of ply. Epoxy glue and clamp together (or bolt/screw) the joint to form a single sheet after it's been carefully dry fitted in position.

Steps to make a plywood scarf joint.

1. Mark a scarf ratio of 8:1 (length to thickness) on both joining pieces.

2. Chisel away waste material.

3. Dry fit the joint. Remove any high spots.



4. Mix epoxy thickened with microballons, apply to both mating surfaces and clamp boards together. (Refer to DIY 1999-#4 issue for complete details on joining plywood.)

Once the bulkhead is assembled and the dry fit is good, bonding can begin. First, pack any gaps between the edge of the ply and the hull with a thick paste of chopped fibers and resin (either polyester or epoxy but not both), thickened with cabosil, colloidal silica or wood fibers. At the same time, use thickened resin to create a fillet with a radius of 1/2" to 1" (12mm to 25mm) along the edge of the bulkhead where it meets the hull (or deck). A tongue depressor is a good tool for this. This fillet bridges the joint to create a smooth curved edge, making the lay-up of the secondary bond easier and avoiding a bubble in the new glass where it's forced to make an abrupt 90° turn. With the bulkhead fixed and with the fillets in place and (preferably) still tacky, apply the new secondary bonds. This consists of one to three wet layers (depending on the size of the job) of 1.5 oz glass mat and your resin of choice. Note: If you are

using ply with teak veneer, strip the teak veneer at the glass bond location to ensure better adhesion. The oil in teak can prevent a durable bond.

New bulkhead piece in place and ready for filleting. Gap at bottom has been packed with thickened resin.

A fillet fills the gap between the joint, strengthening the bond at the joint and supporting the secondary bonds. To form, apply a thick paste of epoxy resin and spread with tongue depressor.

If you are using unwaxed polyester laminating resin, the last laminate layer should contain some Air Dry wax or Duratec or alternatively, paint the new glass tabbing to match the hull interior with an Air Dry gelcoat (if using polyester resin) or paint (if using epoxy resin).

Repair Procedures

If an oiled or varnished bulkhead is rotted or delaminated in one area but still mostly intact, it may be practical to cut out the damaged area, router out half the thickness above that for a few inches and splice in a new piece using the same scarf techniques outlined above. If the damage is at the bottom of the bulkhead, you will also need to remove and replace any tabbing at the bottom of the bulkhead (also outlined above). It's important to make straight, accurate cuts when removing the damaged piece. The extra time spent making a cutting jig and clamping or fastening it to the bulkhead will pay dividends later. A good jigsaw with a relatively fine blade will serve the purpose but a Dremel style high-speed rotary cutter may yield the cleanest cut.

It's always difficult to find a new piece that matches the grain of the remaining original bulkhead. If the cosmetics of a spliced bulkhead leave something to be desired, it may possible to fasten a new piece of 3/32" (2mm) teak or mahogany ply (or other hardwood suitable for a bright finish) over the most visible face of the bulkhead. The application of a complete new veneer is also possible but it's difficult to get flat without a vacuum bag setup.

In a location where the joint between the old and new is out of sight or on a bulkhead that will have a painted finish, a simple butt joint may be an acceptable option. In this case, the new piece and old are in contact but are not scarfed back and do not overlap. For added strength, an additional piece of ply can be simply screwed and glued over top of the joint. This sister piece should be large enough to cover the joint and overlap a few inches beyond onto the old ply. This technique is a bit crude but it's strong enough. An alternative for more conspicuous locations or in areas that are covered by new tabbing is to use a glass secondary bond to join the new to the old. The joint gap is first filled with thickened resin (epoxy is best for wood-to-wood glue joints). The filled joint is allowed to cure and is then dished out with a grinder to allow a 2" to 4" (5cm to 10cm) wide strip of fiberglass to be laminated into the shallow recess. This glass overlay minimizes the chance of cracks developing later. The repaired bulkhead is then finished by filling, fairing and painting or by the application of a veneer.

Ongoing bulkhead repair ready for tabbing. Note butt joints ready for glass overlay.

Finished bulkhead repair after tabbing with a glass overlay applied to the butt joint and painted.

Repairs on a varnished bulkhead will be difficult to hide.

About the author: Nick Bailey is DIY Magazine's repair specialist and has spent 26 years in the boat repair business.

Cabin Perils:
Are you at Risk?

Fuel-burning appliances, carbon monoxide and oxygen depletion form a dangerous cocktail when mixed together in a boat's cabin.

By Susan Canfield

With fuel-burning appliances, carbon monoxide (CO) is not the only threat to life. Oxygen depletion can be just as deadly. Burning fuels consume oxygen and give off both carbon dioxide (CO_2) and water vapor. In a small, closed space like a boat's cabin, the available oxygen can be consumed quite rapidly. Insufficient oxygen will cause the fuel to burn inefficiently, which will produce increasing amounts of CO in lieu of CO_2. If adequate open ventilation is not maintained, the combination of oxygen depletion and CO buildup can be fatal. If the products of combustion are vented to the boat's exterior, CO buildup is less likely. Oxygen depletion then becomes the greater threat.

The big plus with fuel-burning appliances is that they allow boaters to operate "off the grid," independent of shorepower. The most common fuel-burning appliance is the galley stove. Fuel-burning cabin heaters, water heaters and refrigerators are less common, although they're quite popular with serious cruisers. The fuels burned by these appliances may be solid (coal, wood, charcoal), liquid (alcohol, kerosene, and diesel oil) or gaseous as in liquefied petroleum gas (LPG) and compressed natural gas (CNG).

When evaluating potential CO and/or oxygen depletion hazards that may be associated with one of these appliances, you need to ask the following three questions.

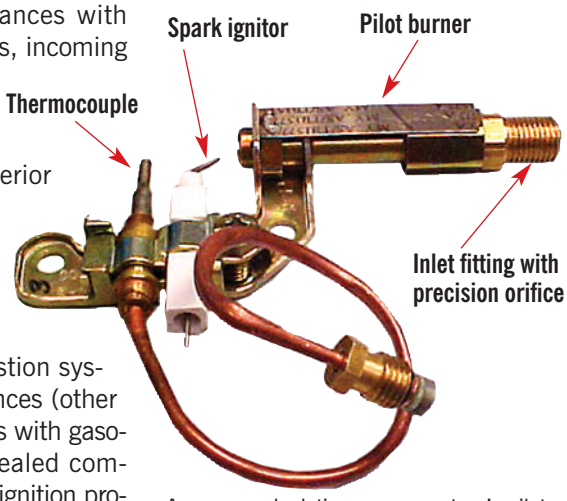
First. Is the appliance vented directly to the atmosphere outside the boat or is it one that does not require venting? American Boat and Yacht Council (ABYC) standards require that all permanently installed fuel-burning cabin heaters, water heaters and refrigerators be vented to the boat's exterior via a smoke pipe or stack and cap designed to minimize back draft and prevent exhaust re-entry through other hull openings. Solid-fueled galley stoves, given their propensity to smoke, must also be vented. Liquid and gaseous-fueled stoves need not be. The requirement for venting is based largely on how a given appliance class is used. Cabin heaters, water heaters and refrigerators may operate frequently or for prolonged periods of time without any human intervention or attendance. Galley stoves are normally used intermittently for shorter periods. Hence the ABYC requirement for a warning label on, or immediately adjacent to, fuel-burning galley stoves: "Warning! Open flame cooking appliances consume oxygen and produce carbon monoxide. To avoid asphyxiation, or injury or death from carbon monoxide, maintain open ventilation when using these appliances. Do not use this appliance for comfort heating."

Second. What is the source of the air for combustion? In appliances with sealed combustion systems, incoming air, the combustion chamber itself and outgoing combustion products are sealed from the boat's interior (**see illustration on page 50**). Manufacturers may use terms like "direct vent" or "balanced draft" when describing their appliances with sealed combustion systems. Fuel-burning appliances (other than galley stoves) on boats with gasoline engines must have sealed combustion systems. That's an ignition protection issue.

Boats with a non-sealed appliance must install a CO detector.

A non-sealed combustion system typically draws air from the space in which it's located. Hence the ABYC requirement for a warning label on, or immediately adjacent to, non-sealed combustion system cabin heating units and other appliances: "Warning! Open flame heating appliances consume oxygen and produce carbon monoxide. To avoid asphyxiation, or injury or death from carbon monoxide, maintain open ventilation." ABYC also requires appliances with non-sealed combustion systems (except those burning solid fuels) to be equipped with an oxygen depletion sensor (ODS) that will cut off the fuel supply to the burner if the ambient oxygen level falls below 95% of normal. In addition, boats with a non-sealed appliance must install a CO detector.

Third. Does the appliance require an operator for ignition, or is ignition automatic? The first is known as an "attended appliance" in ABYCspeak; the second is an "unattended appliance." Attended appliances are normally

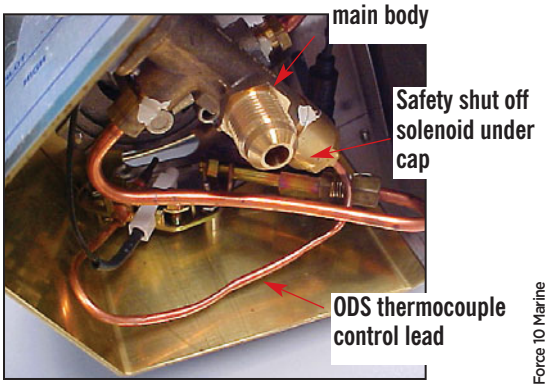


An oxygen depletion sensor system's pilot burner, thermocouple and control lead.

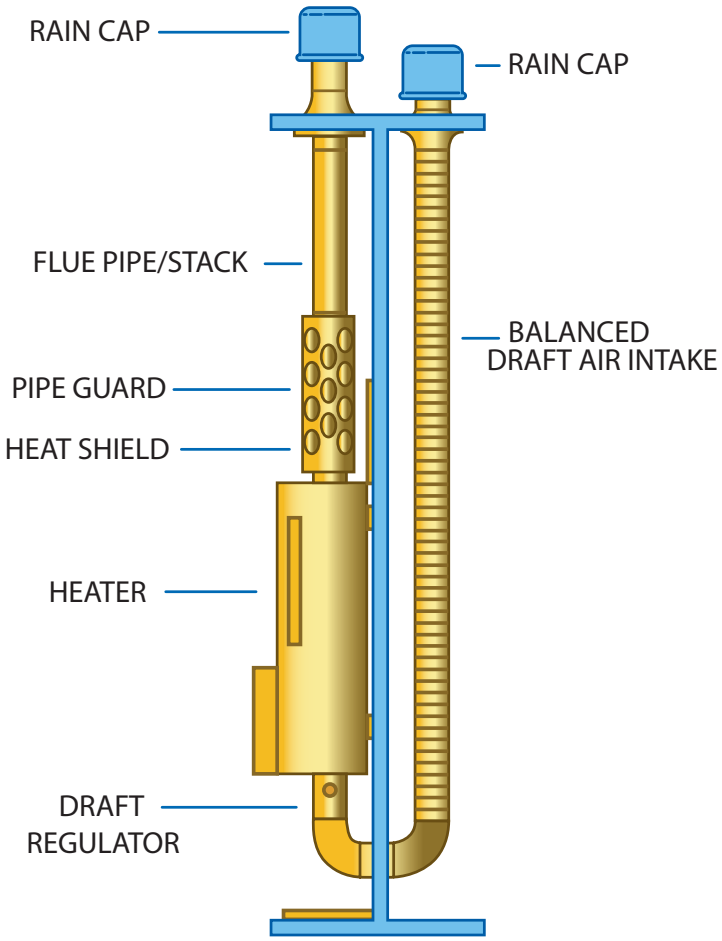
installed in a boat's accommodation (living) spaces and used when the occupants are present, e.g., galley stoves, tank-less (instantaneous) water heaters and cabin heaters. Unattended appliances are designed to function without frequent attention by an operator, e.g., thermostatically controlled heating systems, water heaters and refrigerators. ABYC requires that all unattended LPG and CNG appliances have sealed combustion systems.

Unfortunately, quite a few fuel-burning appliances in use on older boats are not ABYC compliant. These are voluntary industry standards, after all, and they may not have been in effect when many of these appliances were built and installed. Does this mean you should replace a non-compliant appliance on your own boat or avoid buying a boat with one installed? Not necessarily but you do need to be aware that non-compliant appliances carry greater inherent risks. You need to be especially vigilant about maintaining adequate ventilation and you should certainly install a CO detector. Don't leave a non-sealed combustion system burning when you go to sleep. Diesel cabin heaters and thermostatically controlled heating systems are a case in point. None, to my knowledge, are fitted with an oxygen depletion sensor; few have sealed combustion systems. Older propane fueled refrigerators and tank-less water heaters, built primarily for the RV market, also lack sensors and sealed combustion systems. In recent years, manufacturers have begun to offer appliances with sealed combustion systems as standard or optional equipment. In some cases, sealed combustion systems can be retrofitted on older units.

It's easy to tell if an appliance has a sealed combustion system. Look for air intake and exhaust pipes running to and from the combustion chamber. To determine if your propane appliance has an ODS, first consult your owner's manual and then look at the unit itself. The ODS system has three components: an oxygen-sensitive pilot burner, a thermocouple positioned in the pilot flame and a "spring-loaded normally closed" safety shutoff solenoid valve (see photo on page 49). When a propane heater (see photo above) is operating in a cabin with a normal oxygen level (20.9%), the pilot flame is in contact with the ODS thermocouple, which in turn generates the millivoltage needed to hold the solenoid safety valve open. If the oxygen level in the cabin drops to about 18.5% or 18%, the pilot flame will move away from the thermocouple, causing it to cool to the point that it no longer generates the millivoltage needed to hold the safety valve open. When the safety valve closes, the gas supply to the burner is cut off and the appliance shuts down.



ODS installation in Force 10's popular Cozy Cabin heater.



SACHA, adapted from a drawing in the Sigmar owner's manual

A bulkhead-mounted heater with sealed combustion system.

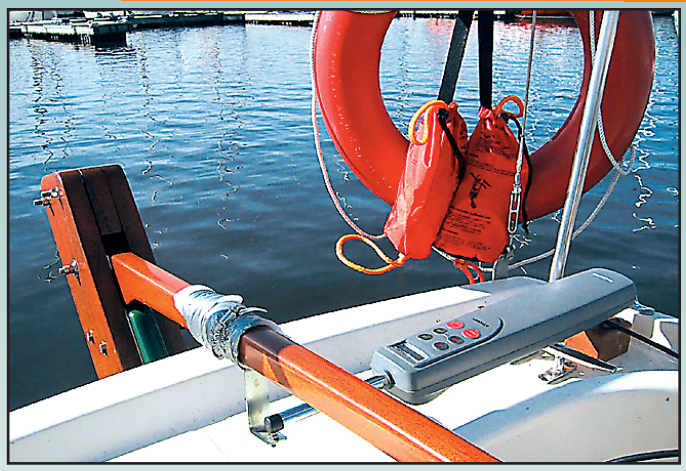
About the author: Susan Canfield is a marine surveyor in Annapolis, Maryland. A frequent DIY contributor, she also teaches "Surveying Fiberglass Boats" at the WoodenBoat School in Brooklin, Maine.

Resources

ABYC Standards and Technical Information Reports for Small Craft: A-3 Galley Stoves, A-7 Liquid and Solid Fueled Boat Heating Systems, A-24 Carbon Monoxide Detection Systems, A-26 LPG and CNG Fueled Appliances, TH-22 Educational information about carbon monoxide; www.abycinc.org.

SAIL BOAT RIGGING

Steady On Course



Typical installation for a tiller-mounted autopilot shown on a Contessa 26.

An autopilot connected to your steering system makes corrections to your boat's heading based on either compass, wind, or GPS/Loran information. Here's how to select the right size autopilot for your boat.

Story and illustrations by David Anderson

Autopilots are outstanding at holding a steady course in light to moderate conditions with minimal helm corrections. Autopilots don't get tired and have an infinite attention span. They will reveal opportunities to use your boat that would otherwise be missed due to lack of crew or lack of time. Because they steer so accurately, they save fuel and get you to your destination faster, especially when interfaced with a GPS.

Autopilots consist of three main components: a heading sensor, logic and power circuits and a drive mechanism. Advances in electronic technology have enabled very inexpensive autopilots to have sensors and logic similar to the most expensive autopilots. The drive mechanisms vary most among autopilots. Operation is simple: you put the boat on the desired heading, hold the course for a few seconds, press “auto” and release the helm. The autopilot locks the course in memory and responds with rudder corrections to keep your boat on this course. Modern autopilots have various methods of maintaining a more accurate course than their predecessors: auto-trim, auto sea-state and integration with GPS or Loran. (See "Pilot Sense" on this page for details on these functions.)

When it's difficult for you to steer, an autopilot will generally have similar problems. This is true when a sailboat's helm is not balanced due to poor sail trim, being overpowered by too much sail area, the boat yawing in following seas or when a spinnaker is creating excess weather helm. Autopilots cannot see, so they cannot avoid obstacles or other boats or the shore. You must always maintain a watch so that you do not end up on the beach. Autopilots cannot hear the cry of "man overboard" and cannot change course without human intervention. If you are single-handing, you must always be tethered to the boat with your personal safety harness. “Man overboard” is never an option for the single hander.

Performance Factors

When sizing autopilots, manufacturers sometimes engage in a bit of "specsmanship" by recommending undersized autopilots for some big boats. Consumers tend to under buy on price considerations and the result is pilots that underperform. The easiest job for an autopilot is to steer a boat under power in calm seas. A small autopilot, like the Navico TP100, could steer a 75' (23m) ocean racer under these conditions but that example is horribly misleading, since you'll want to use your autopilot under more demanding conditions.

In addition to boat length and displacement, there are three aspects of boat performance to consider when selecting an autopilot. One is the heaviness of the helm. How much force does it take to hold the helm when going upwind in a blow? Remember that a tiller-mounted pilot is trying to steer about 12" (30.4cm) away from the axis of the rudder. The second aspect is how fast the helm needs to be adjusted to get the rudder to react. Downwind, autopilots have to throw the helm over to counteract overtaking seas. A sail-

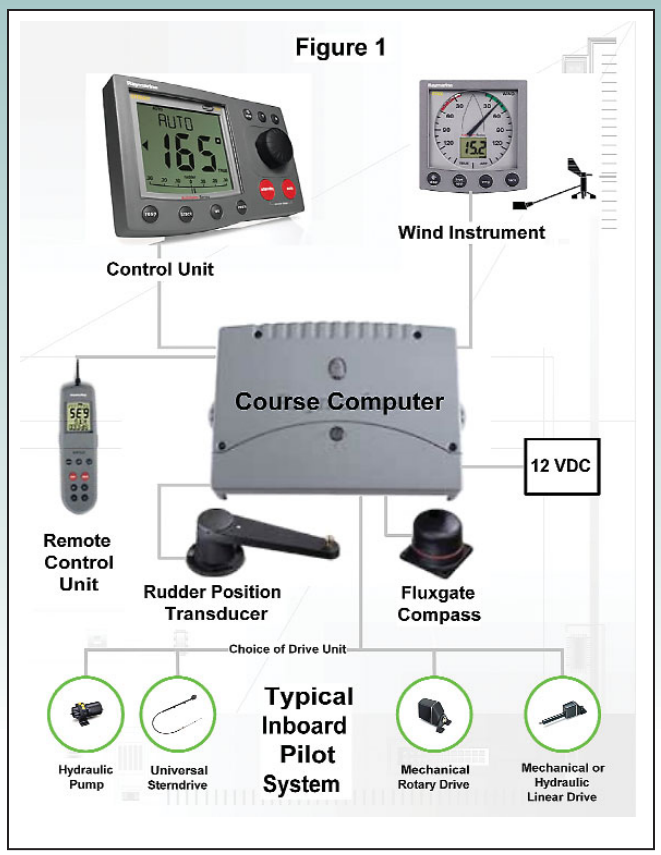
Pilot Sense

Auto Sea State reduces the amount of unnecessary helm movement in choppy seas. Most boats will wander to port and starboard when moving at an angle against head seas. These movements are cyclical and the autopilot will not appreciably improve the course accuracy by moving the rudder. Auto Sea State tells the autopilot to ignore repeated course deflections to reduce power consumption and increase drive mechanism life.

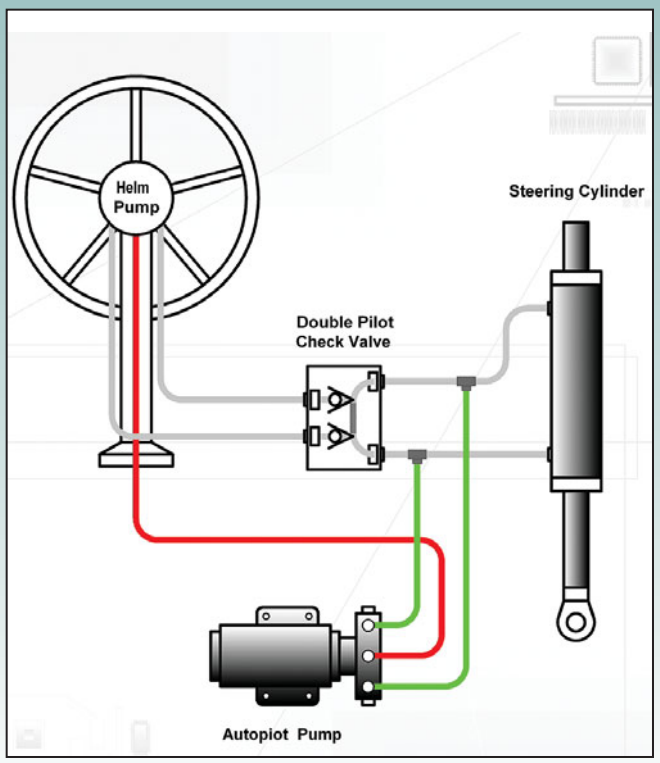
Auto Trim corrects the center location of the helm for consistent heading errors. For example, if a sailboat experiences an increase in wind speed, it will require more rudder deflection to hold a course. Rather than return the rudder to straight ahead, the autopilot induces a steady port or starboard correction.

Auto Wind is the ability of an autopilot to steer to an apparent wind course, tempered by the stability of the compass course. Since apparent wind sensors tend to be buffeted by erratic wind flow, modern autopilots use a long averaging period of wind data and alter the compass course slowly to correct for wind direction changes.

NMEA interfaces instruct an autopilot to steer toward a waypoint stored in a GPS or Loran. In general, these interfaces examine the cross-track error and alter the autopilot's course to bring the cross-track error to zero.



Typical inboard pilot system.



In a hydraulic autopilot system, the autopilot tees into existing steering system. Double check valve allows wheel to override the autopilot pump.

boat with a spinnaker up really needs to have fast response, since delay can lead to round-ups or worse, an unintended jibe! The best way to measure the speed of an autopilot is in the number of degrees per second of helm correction, not hard over time, which may include more or less throw for different models. I suspect that a 25' (7.6m) boat may require 15° per second; a 40' (12m) boat may require 10° per second and a 70' (21m) boat may require 5° per second. The third factor is how far the helm has to be turned. Some sailboats hardly notice a 10° helm correction, due to their inefficient or undersized rudders, which means that their pilots have to have a long throw and work harder at making a correction.

If the Pilot Fits

Start with manufacturer's recommendations and don't exceed them. Yes, I know I told you they don't always work but begin by finding out which autopilot is recommended for your type of boat. If you are near the upper limit of the manufacturer's recommendations, especially in displacement, go up a size. Remember that your boat's displacement may increase by 20% when loaded for cruising. Are you going to race your boat? Are you going to fly a spinnaker? Select a fast pilot and don't undersize or you'll end up sideways. Are you sailing across oceans? Buy a below-deck pilot. Period.

Tiller-steered boats use linear push-pull models like those from Navico and Raytheon. Some models have a separate compass/control unit that can be mounted where convenient. Note: Don't try to extend the push rod length more than 8" (20cm) with extensions.

Sailboats to 40' (12m) with mechanical wheel steering use either the Navico or Raytheon cockpit wheel pilots. They are easy to install and have adequate performance for most conditions. Again, for open water, offshore use, we'd upgrade to a below-deck pilot.

For 35' to 70' (10.6m to 21m) sailboats with mechanical wheel steering there are many great choices from B&G, Navico and Raytheon using a drive unit mounted below deck and connected to the rudder shaft by an Edson tiller arm. There are two styles of drive mechanisms: electrical/mechanical and electrical/hydraulic. The electrical models use an electric motor to drive a series of reduction gears that push and pull on an actuating arm. This system is inherently more efficient. The electric/hydraulic models use an electrically driven pump that actuates a hydraulic cylinder that pushes and pulls on an actuating arm. Both systems work well.

Medium length sailboats with hydraulic steering use a small to medium hydraulic autopilot like the Raytheon ST5000 Plus or Navico PowerPilot PH500. The pump motor simply connects to the hydraulic steering lines and starts pumping when the Auto button is pressed. A rudder sensor provides information to the autopilot's “brain” so that it knows where the rudder is at all times. The smaller pump motors require smaller power switching circuitry due to the low power requirements.

Reliability: Read This

Probably the biggest problem with autopilot reliability is that long-distance sailors frequently buy small, cockpit-mounted autopilots and then expect them to operate flawlessly. When their autopilots need repair and it’s not an “if,” it’s a “when,”

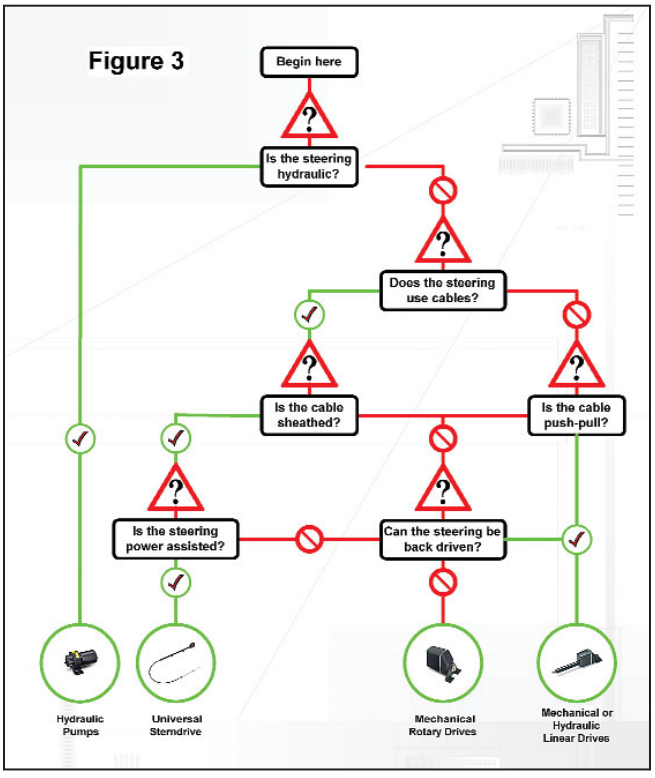
our customers are often in a location where it's difficult or impossible to get the pilot serviced. Since it's common to sail short-handed on long cruises and to depend on the autopilot for much of the steering, it can ruin a cruise when the pilot fails. Therefore, I don't recommend cockpit autopilots for long-distance sailing unless one of the following applies: you have a backup autopilot in case the first one fails; you have a wind vane and are not dependent solely on the autopilot and you love steering by hand for long hours. A below-deck autopilot will give you a better chance for a successful cruise. They are far more powerful, more reliable and steer your boat better.

Recommended Additions

Autopilots can be interfaced with the boat's instruments and use the wind angle information from the masthead sensor. This allows the pilot to follow a course relative to the wind direction, yet use the compass to smooth out heading changes. Interfacing a pilot to a GPS provides corrections to the pilot so that it heads directly for a waypoint. This is especially helpful when wind or current would otherwise cause the boat to go off course. Interfacing to a GPS may require a separate interface box or might be built into the pilot.

Most autopilots have optional remote hand controls for controlling the pilot from a distance. Some provide remote compass or instrument readouts; man overboard functions, course dodging and the ability to change the steering characteristics of the pilot.

About the author: David Anderson is a professional engineer with an extensive knowledge of boat systems and has more than 40 years of sailing experience. He operates Stand Sure Marine (www.standsuremarine.com).



Selecting a drive unit for an inboard pilot system.

Poor Man's Bow Thruster

Nothing in boating exudes seamanship skills more than slipping a boat into a tight berth. It's a choreographed maneuver where control of the boat shifts between captain and crew. The concepts are simple. All it takes is a long line and practice.

By Peter Pisciotta

I recently watched a couple bring a 50' (15m) trawler into a fuel dock. It was a single screw boat and they had no bow thruster. To complicate matters, a strong breeze was blowing them off the dock. They were successful where others had failed because they took their time and used a springline, a.k.a. a warpline, to predictably control their boat.

A springline is simply a line used to maneuver (or warp) a boat in close quarters. One end is connected to the boat, the other to a shoreside pivot point, typically a dock cleat or piling. When the boat is put in gear, a lever/fulcrum effect is established and the boat is forced to rotate. It's an age old seagoing skill that is too often neglected by recreational boaters.

What you Need

First, you'll need a long warping (spring) line. The crew remains aboard throughout the maneuver, so the line needs to loop around a piling, cleat or other fixed structure and return to the boat so the crew can control both ends. Light, 1/2"(12mm) three-strand nylon line is great for most boats up to about 50' (15m) because the added stretch is helpful. The ends should be whipped and free of loops, knots and splices.

You'll need strong cleats on both the boat and whatever is to be attached to ashore. Because the line is so stretchy, a broken cleat will become a lethal projectile. Sailors often use primary winches instead of a stern cleat. Never, ever use a lifeline stanchion or a deck railing for this job.

Lots of large fenders are must haves. At least one large round ball fender serves as a perfect pivot point for departing maneuvers. A fenderboard also works well. If you have the good fortune to own a boat with substantial rubrails, you may wish to forego fenders, especially when working around wooden docks and pilings.

Once you have the proper equipment, set aside some time to practice a few typical routines using warping lines to approach a dock, depart a dock and if you live in an area where backing into a slip is customary (or necessary), backing into a slip.

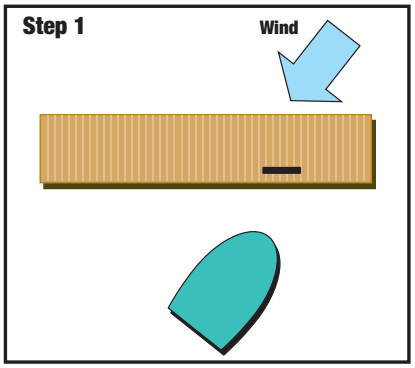
Two Ways to Approach a Dock

As in the opening example, most boats chose to dock at an end-tie, bow first, but adverse winds or currents can force the bow to blow off the dock before the boat can be secured. Even lightweight, twin-engine powerboats have trouble with a strong wind blowing off the dock.

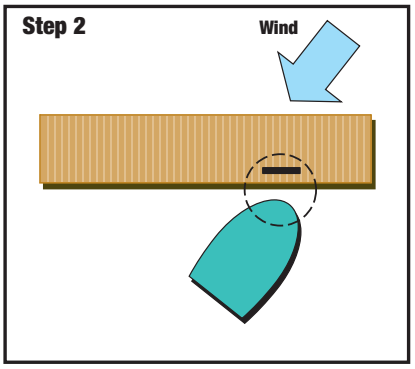
A solution to this is to approach dead into the wind, loop a line around a dock cleat or piling and power either forward or backward against the line forcing the boat to rotate toward the dock through judicious rudder usage and a gentle hand on the throttle. You can approach the dock either bow first or stern first. Which is best? It depends on your boat. Generally, backing into the wind is easier than trying to hold the bow steady into the wind (the boat actually wants to be broadside to the wind). For boats that are either very difficult to control in reverse or have poor stern access, approach bow first.

Stern-first (backing-up) approaches generally use a very short warping line and the boat just powers forward once

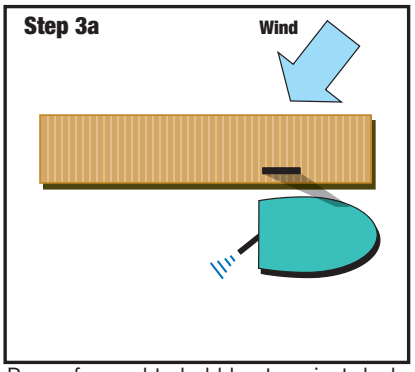
Approaching a Dock Bow First



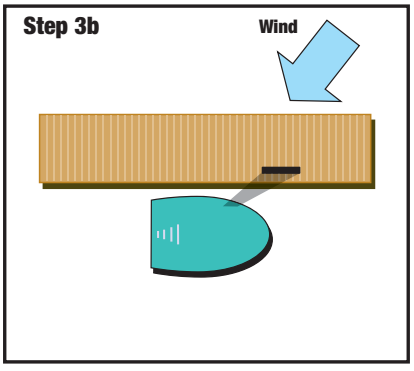
Approach directly upwind and line up bow with dock cleat.



Loop line around cleat.



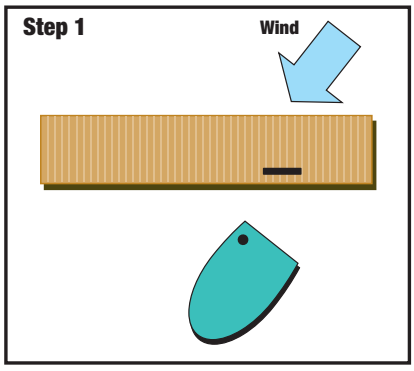
Power forward to hold boat against dock OR...



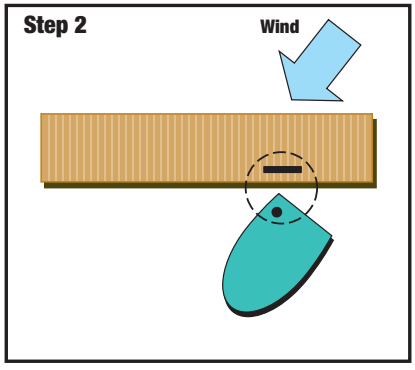
Joe VanVeenen

...power in reverse. This may require using a midships cleat.

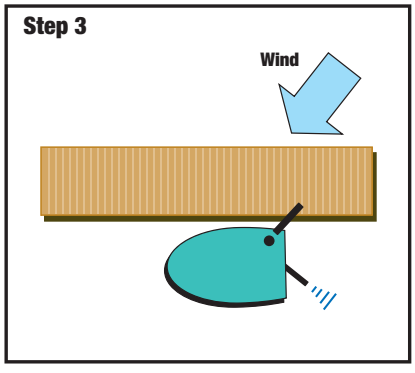
Approaching a Dock by Backing Into The Wind



Back directly into the wind. Line-up stern quarter cleat with dock cleat.



Crew loops line around dock cleat.



Captain powers forward and moves rudder to force boat against dock.

the line is made fast to the dock. Bow-first approaches must use a much longer line and can either power forward so the line becomes a spring-line when the maneuver is complete or back-down on the line so it stretches ahead of the bow. Backing down is usually more predictable but there may not be room for this maneuver. Also, if the cleat is very close to the centerline of the boat (right at the bow for example), the boat may not rotate toward the dock. Try attaching the warping line to a midships cleat instead, in which case the crew stands at the bow to catch the dockside cleat, then walks the line back to the midships cleat

Approaching a Dock

Twin engine and most single engine boats backing into the wind.

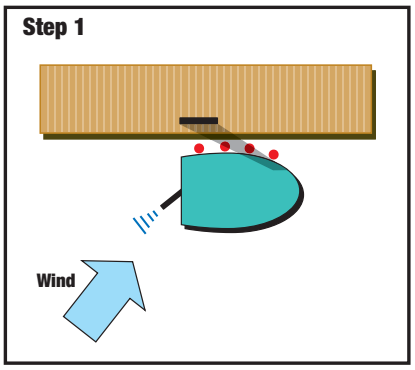
Step 1

The helmsperson (herein referred to as captain) communicates with the crew and prepares equipment and dictates its positioning. Decide whether to approach the dock bow-first or stern-first and connect a free end of the warping line to the appropriate deck cleat. Discuss what the shoreside target will be.

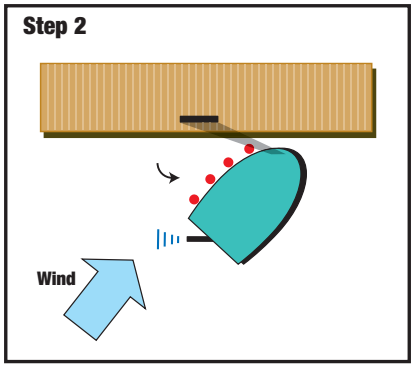
Step 2

Approach directly into the wind or current. Where there are both, estimate a compromise vector. The wind moderates boat

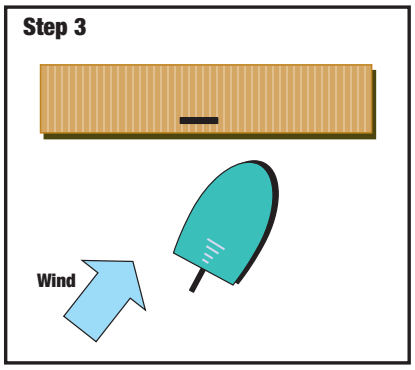
Departing a Dock



Set springline.



Shift rudder and rotate boat.



Put engine into neutral, line goes slack, crew retrieves line. Captain backs away.

speed and controls your approach. For bow-first approaches, the captain will be unable to see the cleat so the crew must guide the captain with hand signals. Form a wide, open, drooping loop in the line by holding it between outstretched arms.

Step 3

Crew loops dock cleat or piling. Once the crew has looped the cleat, the captain motors against the line to gently take up slack. Once the line is tensioned, the captain puts the gear in forward (throttle setting will depend on the force needed to move the boat) and leaves it there for the rest of the maneuver. Captain uses the rudder to maneuver against the tensioned warping line. When the boat is against the dock, leave the transmission in gear to hold it in place until the crew secures additional docklines.

Departing a Dock

What if the wind is blowing onto a dock and you need to depart? You can use the same technique in reverse to rotate the boat away from the dock.

Step 1

Set a springline (it will become a warping line once the maneuver is underway) from the bow leading aft to a dockside cleat at least half a boat length aft of the bow. Simply loop the line around the dockside cleat and return the free-end to the bow so the crew can easily retrieve the line from onboard. The captain gently powers forward with the rudder hard over away from the dock taking up slack in the line. Once the line is tensioned, leave the gear in forward and the boat will find equilibrium against the dock.

Step 2

The captain slowly shifts the rudder to rotate the boat away from the dock. Don't rotate past the eye of the wind. If the boat can rotate until it's perpendicular to the dock with the stem (bow outside) pressed against the dock. There is a risk of damage to the stem if the dock is rough or unprotected or, with a sailboat, if the bowsprit overhang interferes with dock structure. Use your best judgment.

Step 3

As soon as the captain puts the boat in neutral, the long warping line goes partially slack. The crew then unfastens one end and pulls the long line aboard. The crew signals the captain as soon as the line is clear and the captain backs away.

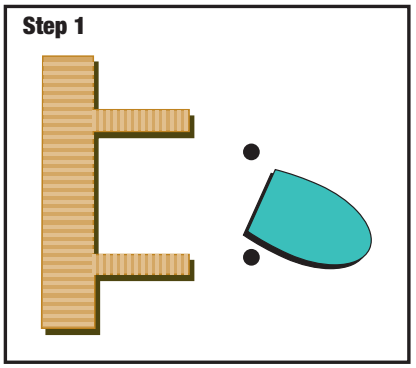
Backing into a Slip

Boats are frequently backed into their slips. Typical slip configuration is two pilings at the head of the slip where bow lines are attached. These pilings are usually wooden and flex nicely when a boat is laid against them. Here's where having solid rubrails pays off. Follow these steps for perfect execution.

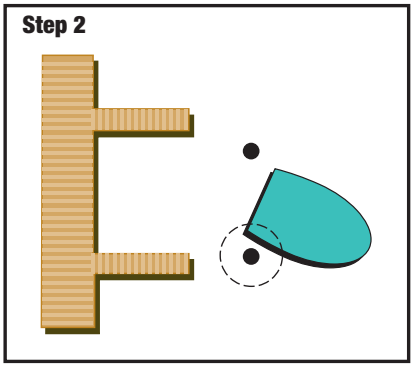
Step 1

Line up on the slip. Essentially, you will make a J-turn so the stern is lined up with the slip. The boat itself will probably be cockeyed, but the stern should be between the two pilings.

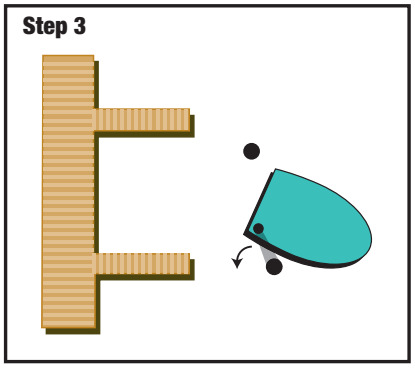
Backing into a Slip



Captain lays stern quarter against piling.



Crew loops line around piling, prepares to snub line.



Joe VanVeenen

Captain backs boat while crew snubs line forcing stern to rotate around piling

Key at this stage of the maneuver is to know which direction the stern drifts in reverse and lay that stern quarter near or against the corresponding piling. You may need to shift the rudder around and give short blasts of forward thrust to maneuver the stern sideways.

Step 2

Crew loops piling. Start with one end of the warping line fastened to the stern deck cleat. Once the stern quarter is against the piling, the warping line must be looped around the piling. You can practice various lasso techniques or use a specially designed device but the crew needs to be fairly crisp getting the line around the piling. Crew brings the free end back to the same stern deck cleat and takes a couple wraps around the cleat in preparation to snub the line as the boat backs into the slip.

Step 3

Backing and snubbing. Once the piling has been looped, the captain begins to back the boat. It makes no difference where the helm is because the turn is controlled entirely by the crew snubbing the warping line.

Spending a few quiet hours practicing when there is no audience on the dock will result in increased confidence to venture into unknown areas and explore new harbors. Even if you have a bow thruster, warping a boat is an excellent skill to have in your arsenal.

About the author: Peter P. Pisciotta is 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.

7 Tips for Success

Patience. **Take time to set up your maneuver. Try to set your approach directly into the elements. Take up slack gently to avoid snapping the warping line. Once the line is under load, keep it loaded by leaving the boat in gear with a controlled application of throttle. Common sense prevails. Bow-first approaches require very long warping lines. The longer the line, the faster the boat rotates toward the dock.**

Prepare. **The warping line will often be a 100' (30.4m) coil of line and can be somewhat unwieldy the first few times maneuvers are practiced. Make sure it runs free of all obstructions including stanchions, rails and rigging.**

Communicate. **Warping a boat is a choreographed maneuver. Both captain and crew must be on the same wavelength. Take a few moments to fully discuss the maneuver.**

Practice. **Warping a boat is not particularly difficult, but it takes coordination and timing. Every boat responds a little differently so try many different permutations (backing-down and going forward or bow, stern and midship cleats).**

PROJECTS

A Trouble-Free and Legal Waste System

After years of broken valves and clogged pumps, this resolute boater was determined to find a better way to manage waste onboard. This plumbing upgrade can challenge a weak stomach but the results are well worth the effort.

Log entry. January 1996. Marathon, Florida. We've been offshore and have set the Y-valve to discharge head sewage overboard. On entering Boot Key Harbor in the Florida Keys, the valve handle breaks off in my hand when shifting to the holding tank mode.

Log entry. March 1996. Midway between Galapagos and French Marquesas. Several squalls on my watch. Awake in middle of night to find Captain Ollie in middle of salon floor with macerator pump parts spread all about. Much mess resulting from clogged pump. Pretend to not notice, continue to sleep and let him finish.

Log entry. August 1998. Upper Ohio River. We've cruised almost 500 miles (804.5kg) upstream on the river over the last two weeks and have not seen a head pumpout station the whole trip. We have a full holding tank and no way to empty it.

Log entry. September 1998. Tennessee River. Rainy day and looking for a project. Decide to rinse the head tank and find an accumulation of nearly 2" (5cm) of almost solid gooey accumulation on the tank bottom. Spend a long time on my knees trying to agitate the stuff into a pumpable slurry.

Log entry. July 1999. Frenchman's Bay, Canadian side of Lake Ontario. Rinse whole system and install macerator pump and new Y-valve.

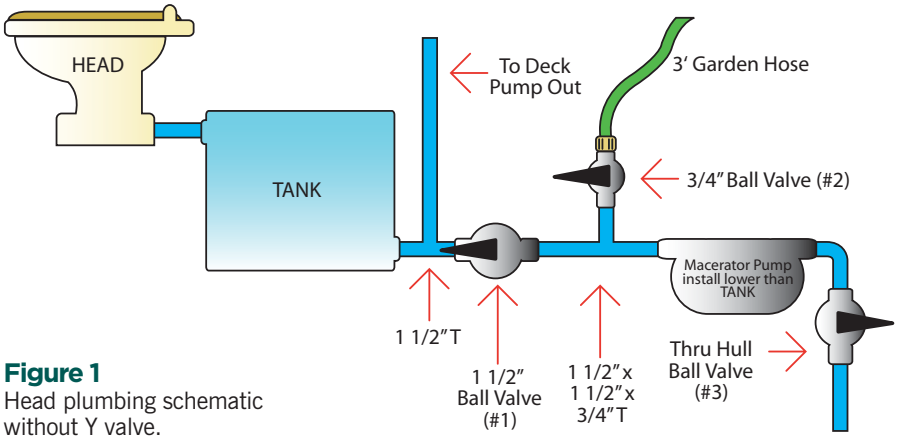


Figure 1
Head plumbing schematic without Y valve.

Log entry. June 2000. South River, Chesapeake Bay. Macerator pump clogged, blowing fuses, holding tank full and no pumpout available.

Log entry. August 2001. Ottawa River, Ontario and several other locations. Repeat of above.

It became my mission to find solutions to our boat's waste storage and disposal system. First, a macerator pump installation is a must for cruising boats when faced with necessary overboard discharge where no other option is available. If you go very far, this will happen, even in inland rivers and along coastal waters. We consulted West Marine's Advisor section in the catalog on plumbing and heads and liked the suggestion of all the waste all the time going into the holding tank. This way, we are never in direct violation of rules, and if boarded and required to submit to a dye tablet going down the head, the plumbing setup will not release the dye overboard. This still leaves the occasional problem of the macerator pump clogging, usually at inopportune times, like with a full tank and no pumpout stations immediately accessible. Surely a method must be available that would leave the pump in a condition where it would, with certainty, work the next time it's needed.

What causes this little used device, which must spin to operate, to fail to do so? Since solids are continually descending upon it, smaller solid particles continually displace larger ones, until finally the pump is packed full of solids, with very little liquid left in the suction head of the pump. Then, needing to spin to work, the force required to displace the solids is too great, stalling the pump and blowing a fuse or burning out the motor. The longer we comply with discharge regulations and continue to pump out using pumping stations, the larger the buildup of solids in the tank bottom and the more likely the pump and/or fuse will fail. What's the solution?

Figure 2 Every three to four months, the macerator pump is removed and cleaned.

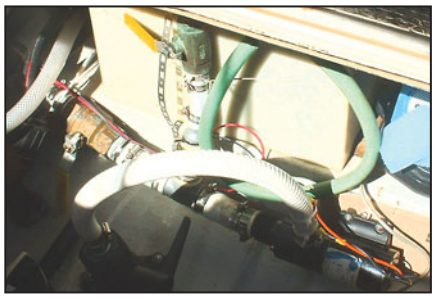


Figure 3 After reassembly, valves #2 and #3 are opened and the pump thor-

Now, one might think that if the pump filled with settled solids, why not mount the pump above the tank? Been there, done that! Then the tank bottom rather rapidly filled with a thick gooey accumulation of the same nasty solids that were nearly impossible to reliquify and pump out, particularly at a dockside pumpout station. I looked for a way to leave the macerator pump in pristine condition, guaran-

teed to work tomorrow, next week or next year. Also, I wanted a way to leave the troublesome Y-valve out of the system entirely.

Figure 1 illustrates my solution. You'll notice that all the waste goes directly into the holding tank all the time. In my boat, it's a short run of 12" (30cm) of straight pipe. This way, any time we might be checked with a dye tablet we are in conformity. Downstream from the bottom of the tank extends a 1-1/2" (38mm) tee positioned with the tee horizontal. (Note that for clarity's sake, this is shown on the drawing as vertical.) The outboard side of this tee goes directly to the deckplate for marina pump outs. The inboard side of the tee turns 90° toward the stern of the boat and enters a 1-1/2" (38mm) bronze ball valve. Plastic valves would work but, when we put this together, bronze was all we could find. This valve allows the holding tank to be isolated, so that, in the worst-case scenario, a short piece of 1-1/2" (38mm) pipe full of sewage is the most we will have to deal with. Just beyond the ball valve is first a reducing tee, 1-1/2" x 1-1/2" x 3/4" (38mm x 38mm x 19mm), with the 3/4" (19mm) end pointing up. Into this inserts a 3/4" (19mm) ball valve, topped off with a male hose thread adapter and finally about a 3' (91cm) section of garden hose, which is open on the discharge end. The macerator pump mounts lower than the tank and attaches to the downstream side of the 1-1/2" (38mm) tee. The pump's discharge side is plumbed into the appropriate thru-hull fitting. This project is one best undertaken in spring with a more or less clean system. Several 10% bleach rinses before disassembling should fairly well disinfect things.

For normal operation, all valves are closed and all waste goes into the tank all the time. To evacuate at a pumpout station, simply attach the suction pipe and pump out. Make sure the vent is open and/or open tank top cover to allow air into the tank. To pump overboard using the macerator pump, open valves numbered 1 and 3 and actuate the macerator pump. We use an old ignition button switch that must be held down to operate. Here is where the elegance of the system comes into play. If we simply stop here, the pump is left with lots of accumulated solids from the bottom of the tank and may fail to operate the next time it's needed. Right then, or shortly later, perhaps at the end of that cruising day or the beginning of the next, close valve number 1, isolating the tank from the downstream piping, then open valves 2 and 3. Place the garden hose end in a bucket of water and operate the macerator pump until the bucket is empty. Then, close all valves. This rinses the pump, leaving it full of only clean water and absolutely ensures successful operation the next time. [Ed: This method of flushing the pump may not comply with the letter of the law since what's left in the pump is technically sewage. Consider doing this job immediately following the pumpout and you can "rinse" the pump while the system is still connected to the pumpout facility.]

Once a month, flush the tank bottom with several rinses of water from a hose nozzle to agitate the solid material that accumulates on the tank bottom. Remove the resulting waste at either a pump-out station or overboard (where legal). Remember though, it's hard to lift those accumulated solids with suction and a high lift. It will be more effective to agitate and dilute the solids and pump overboard if possible and legal. About every three to four months, we remove the macerator pump from the system, remove the four nuts and pull off the suction head then remove any buildup of organic material from the cutter blades. With the pump

mounted on a small piece of plywood and wired with quick connect male/female wire ends this is an easy and clean five-minute job (Figure 2). Then, reassemble the pump and rinse it again in a bucket of water by running the pump wide open to flush it (Figure 3).

Using this flushing system, we haven't had a pump operation failure or big stinky mess for several cruising seasons. When we return annually to our former home on Vermont's Lake Champlain, where even the potential for overboard discharge is prohibited, it's a quick, clean, simple matter to remove the macerator pump and its discharge hose, store it in another location and we're legal. Lake Champlain, by the way, is the only jurisdiction we've ever cruised where boaters are routinely boarded and their plumbing systems inspected. Fines for non-compliance are steep and not disputable. As of fall 2004, the fine for non-compliance was US$360!

Dennis Bruckel and his wife Esther have been cruising part-time on "Sadie B," an Albin 27, for the past 10 years. They have completed the Great Loop as well as cruised all of the Tennessee, Cumberland, Ohio and Potomac rivers. Dennis is the program coordinator for West Marine Trawler Fest.

Homemade, "Admiral" size bimini scrounged from castoff tubing and an acrylic tarp nicely fits this P-424.

Make a Bargain Bimini

When you're on a beer budget scrounge around for used parts just might result in a champagne top.

I generally look to my friend in Florida, who owns a sistership to our Pearson 424, for ideas on how to improve the quality of life aboard. When the pathetically small bimini that came with "Clairebuoyant" decided to accelerate its demise by impersonating a spinnaker, I asked my friend for advice. P-424s have rather large cockpits and not being big on sunburn, he had a custom bimini built to cover the entire cockpit. It's pretty close to being a permanent part of the boat. This is okay, since in Florida, the hot sun is pretty much a permanent fixture.

I can't say how much he paid for that bimini but I'm pretty sure that I've bought cars for less money. It is, however, a very pretty piece of canvas art. My friend had set the mark. My job, per the "Admiral," was to get as much shade as our friends have but leave enough money in the kitty for other toys, as well as for food.

Fancy biminis have a lot of heavy-duty zippers. Theoretically, this is so that you can take them apart. In reality, with a large bimini, it still takes a couple people to remove or install the canvas on the tubing framework. Taking a large bimini off any boat is a bit of work. I think that the real reason that zippers are there is to be devoured by UV rays so in a couple years they need replacing. My Florida friend had this done recently. In fact, I think that the only time he used the zippers was to take the bimini canvas off to have the zippers replaced. So, for our bimini, no zippers. This leaves the canvas, actually, blue Sunbrella acrylic and stainless-steel support frames.

The frames were easy. It seems that every sailing community has a pile of second-hand bimini frames. Picking the right frame depends on a few things. First, for a big bimini (10'/3m fore and aft on the P-424) you need a four bow, double frame and two parts, one to support each end. Second, the frame must be wide enough. There is a little flexibility in this, maybe 6" (15cm) or so. Finally, it has to be high enough to clear your head, and low enough to clear the boom. Usually, high enough is not a problem since many biminis are from powerboat flying bridges. Sailboat biminis generally attach to the deck or pushpit and don't need to be as high. Too high is not a problem, the tubing cuts easily with a hacksaw. Used bimini frames are cheap; buy only stainless steel, not aluminum. Mine cost US$150 and I spent about US$75 more to replace some fittings and ratty straps. The best fittings are stainless steel and you might find them second hand as well.

Initially, the canvas appeared to be a challenge. Of course, the sewing that goes into it is a big part of the cost of a custom bimini. While shopping the Internet for a cheap source of Sunbrella, I found a better solution. Sold at www.outdoortextiles.com are Sunbrella tarps with 2" (5cm) hems. A 10' x 10' (3m x 3m) tarp cost about US$160. Mine cost less as I ordered it without grommets. Biminis are rectangular, except for the corners where the frame slants back. We carefully slit open the inside hem of the fore and aft ends of the tarp, a few inches from the corners. We then slid the frame tubing through the hems. A few snaps were installed in the corners of the tarp and the frame tucked together nicely.

Here are some other details. We added an additional support fore and aft to con-

nect the inner bows. We also bent the bows to add a bit more crown to the bimini to avoid the truly astonishing amount of rainwater that this size tarp can hold. A leather chafing kit trims the cutout for the backstay, stitched into a slit cut in the fabric. We could have made the support bows more vertical, but the angle makes it stronger and makes egress from the cockpit much easier.

Total cost was about US$400, give or take a few dollars, about what my friend paid for his first zipper replacement. It keeps as much sun off and is just as hard to remove as the custom made bimini.

Marine surveyor Quent Kinderman has 40 years sailing experience and has restored myriad cruising sailboats from 25' to 42' (7.6m to 12.8m).

Stay in Touch with PocketMail

Whether travelling by land or sea, this handy messaging device makes email communications easier than finding an Internet café and is certainly more compact than a laptop.

With PocketMail and a land or cell phone, you can maintain email connections from almost anywhere worldwide.

With all the recent advances in communications technology, travelers have many ways to maintain regular contact with business associates or with family and friends. Those who look for simple solutions will appreciate PocketMail (Tel: 800/390-5034, Web: www.pocketmail.com), a mobile email system that is hard to beat for convenience and reliability. Cruising friends enthusiastically recommend it and, last summer, it was often visible at telephones along the roadways between Maryland and Alaska.

A truly pocket-sized gadget, the PocketMail Composer allows you to send and receive emails to and from anywhere in the United States and Canada by calling a toll-free number. Even where a cell phone does not function, you can always find a land phone. (Access is available worldwide,

though such calls may involve an added fee.)

Using PocketMail is easy even if you don't normally use email. Just buy the Composer and, for a monthly fee, set up a service agreement with the company When you want to send an email, enter the recipient's regular email address. Type your message on the Composer's miniature keyboard, then press "Done." The unit saves all outgoing messages until you get to a phone. When ready to send messages, dial the 800 number. A voice prompt tells you to "Push the PocketMail button" on the back of the Composer as you hold the unit against the phone receiver. The Composer starts to squawk (a distinctive modem sound) and a series of tiny red lights starts to blink. Soon messages are transferred, both out and in. (The system saves incoming messages in your mailbox until you call in.) A specific sequence of beeps tells you if transmission was successful. In addition, a letter "S" appears in front of the title of all sent messages. Check your inbox and read your mail. That's the basic usage.

Those who like to use all the extras on such toys will find familiar capabilities. Like standard email, the PocketMail Composer has "reply," "forward" and "address book" features and it can be used to send a fax. There's an added charge for each fax but the fee is reasonable, currently 25 cents in United States and 45 cents in Canada for a local number, or US$1 (CDN$1.45) for International.

Maximum message size is 6,000 characters so long messages are discouraged for ordinary use but, if a "split message" feature is activated, a long message can be received in sections). A spam blocker can be activated. Text attachments may be inserted into a message but separate attachments, (e.g., a photo) cannot be opened. However, a note will tell you an attachment has been sent and it can be accessed later through a computer. PocketMail messages can also be accessed from anywhere using the company's website.

PocketMail Composer is sold with some usage time but the price translates to about US$100 for the unit and US$10 to US$16 monthly for usage. The specific monthly fee depends on the number of months in the contract.

Authors of numerous boating and children's books, for many years David and Zora Aiken wrote the "Good Boatkeeping" column in DIY. This past summer they took a land cruise to Alaska and communicated exclusively via PocketMail.

Projects **Wanted**

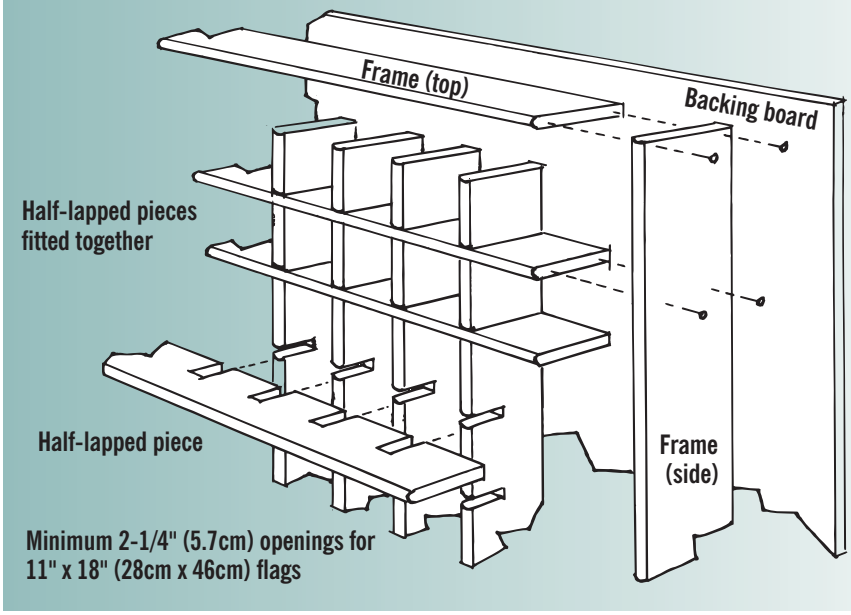
If you would like to share one of your own boat-tested projects, send your articles to DIY PROJECTS via mail or e-mail. Include a brief explanation and photos and/or sketches (don't worry, we'll redraw the art). Also, please include your mailing address and a daytime phone number or email address. If we publish your project, we'll send you between $25 and $150, depending on the published length.

MAIL:
P.O. Box 22473
Alexandria, VA 22304

Email: info@diy-boat.com

Build a Custom Signal Flags Case

With some creative figuring any space can be utilized for flag storage.



A practical addition to any boat, organized signal flag storage adds a colorful, nautical accent to an otherwise dark corner of your boat and also provides another means of signaling in an emergency. Flags can be used to "dress" your boat for sailpasts, rendezvous, boat shows, etc.

This case is easily constructed with half lap joinery and can be configured to fit into any shape that you have available. To arrive at the proper dimensions for where you want to install the case, measure the available height and width. Flag sets usually contain 40 flags: 26, A to Z; 10, 0 to 9; three alternates; and one answering flag. For a set of 11" x 18" (28cm x 45cm) flags, you'll need 40 compartments measuring at least 2-1/4" (5.7cm) square. Divide the height and width accordingly to arrive at the number of compartments that fit the chosen area. Be sure to allow for the thickness of each compartment into

Materials

1 package 5/16" x 4" (8mm x 10cm) cedar tongue-and-groove wall paneling
1/8" or 1/4" (3mm or 4mm) thick plywood backing to fit
1" (25mm) finishing nails
Wood stain and filler
Varnish
Stainless-steel screws for mounting
Set of 40 signal flags

your measurements. For example, the space available in my boat measured 18-1/2" (47cm) square, which gave me seven compartments across and seven down for a total of 49, 2-1/2" pigeonholes. Extra spaces are used for special flags. Other boats might be better suited to one line of 40 or two lines of 20 compartments across overheads, or 3 lines of 14 or 4 lines of 10 or 5 lines of 10, with the center shaped around a porthole or light.

It's a good idea to purchase your flag set first to ensure that the flags fit the planned pigeonhole when folded.

Identify flags with self-adhesive labels and always fold flags so the identifying letter or number is visible.

Construction is simple and all pieces are half-lapped together to form individual spaces. Refer to illustration for details. I made mine with 5/16" (8mm), 4" (10cm) clear cedar tongue-and-groove wall paneling available at most lumber centers. First, cut off the tongue and groove to a width of 3" (7.6cm) on a table saw. Round one edge with a router or hand plane. This becomes the front edge. Dry fit everything together and then disassemble and sand, stain and varnish all parts. This makes the finishing job easier. Now, assemble all pieces using glue and finishing nails. A 1/8" or 1/4" (3mm or 6mm) plywood backing adds strength and completes the job. Set nail holes and plug with filler that's stained to match the finished color. Mount with stainless-steel fasteners, label the compartments and fill with flags.

Bert Small restored "Sea Eagle," a 1940 Navy lifeboat converted into a pocket cruiser by a previous owner.

The Two Happiest Days:

Buy The Boat;Sell The Boat

Buying is boat is an exercise in satisfying a lust driven by the same emotions of romance and passion that drives our pursuit of the love of our life to marriage.

By Roger Marshall

How do you buy a boat? Look at it carefully and decide if you can afford it? Does it fit on your mooring? Will your spouse like it? These are the subjective tests. Maybe you are more objected and you do your homework by checking websites, reading books and articles to find your dreamboat? Is taking possession of your new boat one of the happiest days of your life?

Some folks go for a sail and others for a stretch.

Let's face it. Buying a boat is not a rational decision. For many people, the emotional factors the combine to drive the boat buying process are the biggest drivers in the decision. After all, what sane person enjoys getting soaked, sitting on hard seats at a 20° to 30° heel? What rationale is there for buying a boat that will rearrange one's anatomy as it slams over waves at 75 mph? Who, except someone made irrational by emotion, would spend a small fortune to cook in a galley that makes a New York apartment kitchen look like it was designed by Emeril? Mariners tend to be a strange lot. Getting wet on an exhilarating afternoon cruise with a warm summer wind blowing across our faces is the reward for our lust for a life on the water. Boating is a love affair of the most passionate kind and even a cold slap in the face of water driven by wind cannot chill the heat of the ardor for a boat.

Having said that, what do you need to know about buying a boat? First, you need to know how to find a suitable boat within your price range. Once you have found the boat you must have, you work with a seller (individual, dealer, broker) whose actions are also driven by emotions, albeit a different set of them. You agree on the price. Your initial offer is likely to be below the asking price and also depends on the condition of the boat, your bank account, perhaps your spouse's mood. Done? Not! That was just Cupid's boat arrow piercing your bank account.

Second, you need to know how to get it properly surveyed. Just as you wouldn't buy a business without an audit or a home without an inspection or even a used car without having your favorite mechanic having a look, you shouldn't consider buying a boat (even a new boat) without a survey. Armed with the survey information, you may want to renegotiate the price. "Armed" is the key word here because this stage can truly feel like a battleground. The flaws in the character of the beloved boat choice are revealed to you and they can embarrass and infuriate the boat's current lover. Having survived the wounds of renegotiation, you now own a boat. Have you told your spouse that you aim to spend every waking minute on it? You want it to look perfect, so you buy polish, wax, touch-up, non-skid, stain remover, teak restorer, a host of applicators, rubber gloves, sandpaper, and dust masks. How do I know this? I have a garage full of these items, many of them unopened. Plus, I own two boats and my teenagers own two more each. When summer comes around, nothing gets done around the homestead!

The euphoria of buying a boat lasts for a couple of seasons and the kids get bigger but, unlike the kids, your boat doesn't. You need a bigger boat. For most people, the right new boat is one that is 3' (91cm) longer than the boat they presently own and the purveyors of boats have a way of squeezing every last dime out of you, so a few people go to 4' (1.22m) or even 5' (1.5m) longer than their current boat. Let's assume that your present boat is 30' (9.1m) long, so 3' (91cm) more adds 10%. For many purchases, 10% bigger means 10% more expensive but not in the boat business. A boat that is 10% longer is also 10% wider, 10% deeper and 10% taller and, for sailboats, a 10% taller mast carries sails that are at least 10% larger. Consequently, the price you pay is the value of a 30-footer plus 10% plus 10% plus 10% plus. That's a gazillion more dollars than you thought it would be. It's just the way it is.The odd thing is that, although you pay so much more than expected to buy a new boat, you often get a lot less than expected when you sell one you have. Part of the reason is that the buyer has also read this column and he and his surveyor are now checking everything out with a magnifying glass. If you're lucky, by the time you decide to sell your current boat, this column will have long ago been filed away with the millions of other words of boating wisdom that I crank out in my more lucid moments.

Hopefully, the joy of being afloat is well worth what you pay for it. There may be one major catch. You've now spent so much time on your boat that the "honey do" list of home projects is now so long that the cost (and time) of doing everything on this list dictates selling your boat in order to repair the house. No wonder the happiest day of your life (and/or your spouse's) is the day the boat is sold but this too shall pass. Once the chores are completed, you'll likely be checking the boat listings again.

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.