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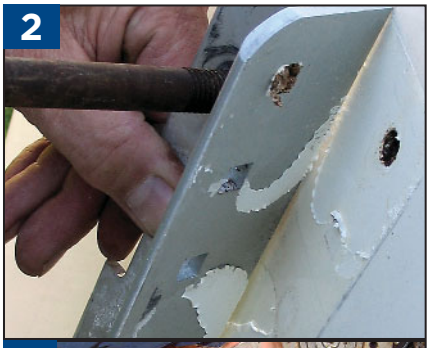
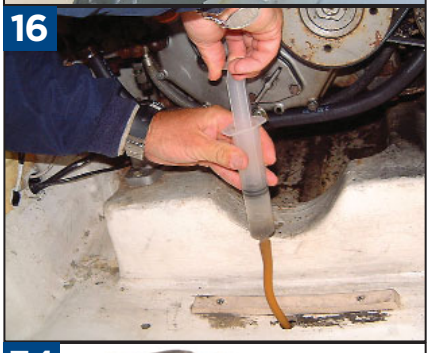




Currents

Edited by Jan Mundy

DIY WINNERS

Winner's of DIY's Product Information Card Giveaway from DIY 2003-#4 issue who received the 3M Marine Detailing Pak, are: Tom Hill, Limehouse, Ontario; Robert Thibert, Ste. Genevieve, Quebec; and Dale Woodruff, Crescent City, Florida. Winner's of DIY's Product Information Card Giveaway from DIY 2004-#1 issue who received a jug of 3M Marine Hull & Deck Cleaner, are: Leonard Franks, Highland Park, Illinois; Jason Harrity, Saint John, New Brunswick; and David Sheely, Norman, Oklahoma. 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 bottles of 3M Marine Restorer and Wax.

Seminar Pay-off

The magazine is a gem and the seminars shine bright. What we learned at the seminar translated directly into results when we redid the faded, chalky hull on our boat. She looks like a new boat now. You provided the know-how and we took care of the rest, with great results. We, and our boat, thank you.
Steve and Pam Haines, Boaz, Kentucky

***Ed:** DIY is conducting seminars at various upcoming boat shows. Topics include fiberglass repair, gelcoat restoration, painting, bow to stern checklists and more. For dates and locations log onto www.diy-boat.com and click on "Event/Seminars."*

What's This Silicone?

In your 2004-#1 article, "Leak-proofing Cabin Windows," reference is made to "…high flex glazer's silicone." What specific product(s) are being referenced? Can you give me specific brand names?
Wes Herdman, "pNeuma J," Ladysmith, British Columbia

***Nick Bailey replies:** Some of the high flex glazer's silicone products we use at Bristol Marine and who recommended them to us include: Dow Corning #795 Silicone building sealant recommended by Hunter Yachts, which beds its big windshield-style cabin windows with this stuff; Dow Corning #999A building and glazing silicone; GE SilPruf SCS 2000 weatherproofing sealant recommended and used by Sabre Yachts to bed its cabin windows; GE Ultra Glaze silicone recommended by Bomar to seal replacement hatch lenses. There are likely other products that qualify as glazer's silicone. Look for silicone with the ability to expand or contract 50% plus and excellent weather resistance and adhesion.*

Seal Failure on Racor

I read your solution to Doug Moore in the "Talkback" column on page 9 in DIY 2004-#2 issue, about his twin Caterpillar engines that suck air. I had a similiar problem and discovered it was caused by the Racor fuel filters. There is a primer pump on the top of the filter and the O-ring ring for the pump doesn't seal properly. When using the pump the leak allows the fuel to escape. I resolved it by taking the supply line out of the fuel tank and using an electric fuel pump and a short length of fuel hose (in a pint of fuel) pressurized the system one engine at a time.
Richard Douglas, "Orphan Annie," Ivy Lea, Ontario

Diesel FAQs

While reading the diesel column in DIY 2004-#2 issue, I was surprised to find someone was also having problems finding a decent selection of parts for their Perkins Prima 50. I was more surprised to find my name attributed to the question. Not two days later, a friend and mechanic from my local boatyard, who read my submitted question, told me about Trans-Atlantic Diesels of White Marsh, Virginia. I contacted the firm and the person I spoke with was not only very familiar with my engine but had all the parts I needed. Best of all was the firm's

FEATURES WEIGH BIG

"What do you most often consider first when purchasing new equipment for your boat?" was the question asked on DIY ONLINE last month. Of the six choices listed, "features" was surprisingly selected by 43% of respondents. Price and magazine recommendation tied for second with 18%. Nearly equal were brand (11%) and friend's recommendation (12%). Only 1% of respondents choose dealer recommendation for their equipment purchases. To enter DIY's current poll, log onto www.diy-boat.com.

Yes, You CAN Remove 3M 5200

I was somewhat skeptical when I first read the hype and manufacturer's claims about Debond 2000 Marine Formula, especially having tested, without success, other products that boast the ability to remove 3M 5200 polyurethane sealant. If you were to ask 3M Marine about how to remove 5200, the typical response is: "Why would you want to remove it? It's meant to be permanent." If you're really persistent, the contact might recommend passing piano wire between the bond line and hardware (slim chance!). On DIY's project boat (see DIY 2004-#2 for details), we needed to remove the existing outboard motor bracket I installed 12 years ago with 3M 5200 to install the new Garelick bracket. We ordered a 4 oz. (105ml) bottle of Debond. Voila! It worked fast, removing the bracket in less than 20 minutes. When you need to remove bonded hardware, buy this stuff. It's now available for purchase at DIY ONLINE at www.diy-boat.com. Just click on "MRT MALL." Sorry, U.S. orders only.

Smash, bash and brute force won't remove hardware that was properly bonded with 3M 5200.

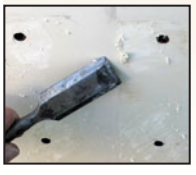
Start: Apply a thin coating of Debond to bolt heads and bond line around bracket. Wait a few minutes then saw along bond line where accessible to agitate the sealant.

5 minutes: Sealant is easily peeled off around bolt heads.

7 minutes: Bond breaks around bolt heads and bolts were extracted with Vice-Grips.

9 minutes: Apply a second thin coating of Debond around bracket edge. Wait 2 minutes. Bracket easily pops off using crowbar as a lever.

13 minutes: Pull off right bracket.



Finish: Scrape off old sealant and solvent wipe. Total time from start to finish was 20 minutes.

— Jan Mundy

Engine Service After Long Term Storage

Consequences of a three-year hiatus: (above) corroded engine fuse and (right) contaminated fuel filter/water separator.

After three years in drydock undergoing a complete refit (see "Fresh Look" in DIY 2004-#2 for details), we finally launched our boat this summer. To recommission the 150hp Mercury outboard (1990 vintage with carburetor not EFI), we decided to test run the engine before launching but it wouldn't start. Closer inspection found the engine fuse, the one hidden inside the black box (there are two fuses on this engine) completely corroded inside the fuse holder. This was an easy fix. With the sterndrive placed in a massive "bucket," we connected the fuel line to a portable fuel tank containing a "soup" of high-octane gas and two-cycle oil mixed at a ratio of 24:1 (1 quart to 5 gallons/946ml to 19L) rather than chance the three-year-old fuel in the inboard tank. Before running the engine we removed the old fuel filter/water separator. Horror! This filter was contaminated with water and thick syrup-like goo that smelled like varnish. After replacing it with a new one we ran the engine for 15 minutes on the "soup." So what was to be done with our 60-gallon (227L) inboard fuel tank that was merely a 1/4 full? Surely, it was full of water and stuff mechanics call "orange goo." Do we empty it and clean out the tank, which is the recommended action, or…? Along came Steve Auger, DIY's engine specialist, to the rescue. Steve's Plan B called for filling up the tank with 94 octane or higher fuel, double the fuel stabilizer quantity for the first tank and add two-cycle oil at a ratio of 200:1. To the existing fuel we added three 12 fl. oz (350ml) bottles of octane booster and 1/2 quart (473ml) "dry gas" (a.k.a. gas line antifreeze, a mixture of isopropyl and butyl alcohol, commonly added to automotive engines and as a rule, never added to marine engines as fuel stabilizer has the same affect), and then followed Steve's recipe. Many runs later and an overnighter and our engine just keeps humming.

— Jan Mundy

willingness to lend me the engine-specific tools to change the timing belt/chain. Thanks DIY!
Jim Westpfahl, Lindenhurst, New York

Pumping Action

Are you familiar with the reliability of bilge pumps (I think Rule makes one) that activate every few minutes or so and either pump out water that is present or immediately shut off if water is not at the pump's lower set point?
Larry Awalt, Ellicott City, Maryland

Ed: Rule makes the Automatic/Computerized Series Pumps that range from 360 gallons per hour (gph) up to 4,000 gph. The feature behind the pump is that they operate at an extremely low amperage draw and cycle every two to three minutes sensing water. When the impeller senses an increased resistance from the water, it activates the pump and turns it on. Now that the pump is on, it discharges the water. Once the water is discharged, the pump shuts off and goes back into its sensing mode. Power draw is low until the pump activates and turns on again when it senses water.

Boating's Surely Soul Food

"As we drove out of the harbor on our new SeaRay 420 Sundancer, we overheard several of the marina's full-time residents commenting on how "the other half lives," and sounding somewhat envious of the fiberglass opulence we appeared to enjoy. Their words made me think and I realized that it simply doesn't matter if you have a boat or a yacht or that its hull gleams with a new paint job or is dimmed by decades of exposure to the elements and use. We are all commonly bound by the magical lure of the water. For a few hours each weekend, you become the person your dog thinks you are. Kind to neighbors, willing to lend a hand or a tool, generous with your own food and drink, hospitable to the curious passerby who strolls about the docks, perhaps jealous of your boating lifestyle. It matters not how you earn your living, the car you drive or whether your children graduated with a PhD from Harvard or an A.A. degree from the community college. Instead, in the company of your fellow mariners, you swap tales of memorable dining experiences, the best place for fuel, tips for locking through the Trent-Severn and dreams of cruising the North Channel or wintering in Florida. Boating is a great equalizer and maybe one of the last safe communities where your kids can run free and boat hop, where you probably don't think much about locking up at night and where it's okay to lend a tool to a neighbor, knowing you'll get it back with genuine gratitude and, if you're lucky, a cold beer."

— Alan Wendt, commenting after the Sea Ray Rendezvous held in Belleville, Ontario.

MOTHER OF RIGS

John Payne, DIY's electrical consultant, is the commissioning manager for this BP Thunderhorse, the newly launched and largest floating semi-submersible in the world, shown here riding piggyback (yes, that ship is carrying this giant rig) from South Korea to U.S. When installed off the coast of New Orleans, Louisiana in the Gulf of Mexico, it will produce 250,000 barrels of oil a day. Some statistics: dry weight is more than 60,000 tons; size is 1,184' (110m) by 1,130' (105m) square. Height to upper deck is 187' (57m) and height to top of drilling derrick is 417' (127m). Draft when operational is 98' (30m). There are more than 746 miles (1,200km) of electrical and instrumentation cables and the Kongsberg Simrad Vessel Management System has some 16,000 inputs and outputs with networks of fiber optic cables. Additional oil production modules will be added in U.S., boosting the weight 20,000 tons.

Correction

DIY reader Pete Dubler of Fort Collins, Colorado, emailed us about an error in DIY 2004-#2. The article, "A Strong Case For Treated Sewage," states: "While federal law requires...bacteria count to be less than 1,000 per milliliter (ml), the bacteria count in the discharge from a Lectra/San is less than 10 per 100 ml…." Those two numbers are equivalent since 1,000 per ml is equal to 10 per 100 ml. From my years of conducting water pollution research, I recall that all the standards are expressed in terms of bacteria counts (colonies on a culture plate) per 100 ml of water. The 1,000 per ml should be 1,000 per 100ml. Additionally, B.O.D. is mentioned and defined as biological oxygen demand, then the term "B.O.D. 5" is used after that. BOD5 is the defined as the "five day biological oxygen demand."

DIY EZINE Gets Linked

Is it possible to link the web addresses

DIY boat owner the MARINE MAINTENANCE MAGAZINE

Publisher & Editor: Jan Mundy
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Sales: Don Robertson
Webmaster: Jeff Kalman
Circulation: Britton Hardy
Copy Editing: Patricia Kearns
Technical Advisor: Recreational Marine Experts
Cover design: Joe VanVeenen
Contributors: Steve Auger, Nick Bailey, Bob Smith, Susan Canfield, Peter Caplan, Roger Marshall, John Payne, Peter Pisciotta

BEST HAND CLEANER

Until I discovered Cupran Special, I'd always removed any residue on my skin with solvent, usually lacquer thinner, after painting or working with epoxy resin or sealants. This high performance hand cleaner is awesome stuff. It effectively removes oil-based paints, adhesives, glues, etc. Apply to dry hands and watch as the walnut shell scrubbers clean your hands. Skin is very porous and absorbs everything it contacts. When working with coatings and adhesives, be sure to wear gloves, apply a barrier cream to unprotected areas and wash up with this skin friendly cleaner. A 8.45 fl.oz. (250ml) bottle sells for $6.85 and should last a very long time.

— Jan Mundy

mentioned in your articles? For example, in the DIY 2003-#2 EZINE (web edition) the section on Harken on page 33 listed its web site but the link is not active. Ads are hyperlinked to advertisers sites and these work fine, thank you for that.
Larry Fischer, Belfair, Washington

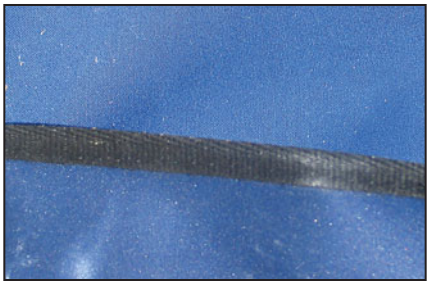
Ed: What a great idea. We've been publishing the EZINE for many years and until now no one thought about it. You'll find the text links working when the 2004-#2 issue went online. Thanks for the input.

WANTED

DIY reader David Cox is looking for information and specs on his US Yacht 25 (also known as a Bayliner Buccaneer). Contact him at davidcox@tampabay.rr.com.

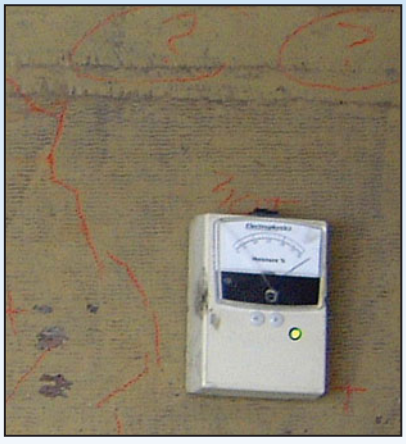
Fabric Source

In DIY 2004-#2 issue, you featured an '80s cuddy cruiser as a project boat. As one of your sources on page 56, you list a product called "Marilux" from Germany. I was just wondering if this is spelled correctly as I couldn't find anything resembling it on the web. Also, how does this product compare to Sunbrella in function, ease of manufacturing, cost, longevity?
Jerry Rose via email



***Ed:** The product is actually called Markilux (misspelled in article) and it's an acrylic fabric with a polyurethane backing, made in Germany. It doesn't breathe as well as Sunbrella, which means you need to keep a corner flap open for air, but it doesn't leak and remains watertight. It's also a much tighter weave, making it very durable.*

Will a moisture meter give an accurate reading on a boat that's afloat?



Metering shallow bilge of a modern racing sailboat. Suspect areas marked in red. Meter reads wet due to water in core and severe delamination.

Let's say you want to check the moisture content in the bilge area around the skeg or prop shaft where it passes through the hull but don't want to go through the expense and time of hauling out. According to DIY's Nick Bailey, it might be possible, depending on the characteristics of the particular moisture meter you are using. The popular GRP 300 model from J.R. Overseas will read to a depth of about 1/2" (12mm). If the hull is less than that thickness, the meter will go to full scale deflection (FSD) reading the water behind it. On the other hand, readings on a 1- (25mm) thick, cored hull in the water, may be artificially elevated but won't go all the way to FSD so, in that case, the meter can be used for useful diagnostics. As is often the case with moisture meters, the difference between one reading and another is more telling than the absolute percentage scale reading.

Cruising, Rendezvous Style

(top) Thirty-four boats, ranging in size from 21' to 48' (6.1m to 14.6m), made the four-hour cruise from Alexandria Bay, New York to Belleville, Ontario, for a long weekend in July. (bottom) Boaters gathered for a Sea Ray tradition, docktails at Meyers Pier where the two-burner gourmets onboard like to trot out their party creations to share.

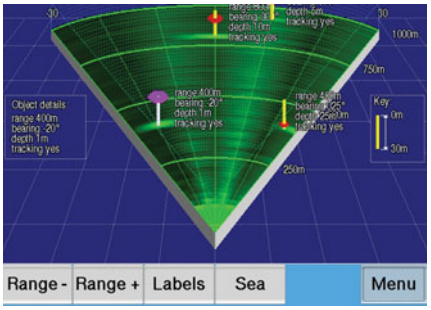
"From Sea to Shining Sea Ray" was the theme for this summer's Sea Ray Rendezvous held in cruising grounds across the country including Chesapeake Bay, Chicago, Illinois to Traverse City, Michigan, and Sport Boat Rendezvous on Lake Powell, Utah and Belleville, Ontario. Sea Ray dealers host these rendezvous for their customers in different locations each year. Rendezvous planners handle every detail from marina reservations, organizing themed dinners and other fun activities, right down to ensuring the marina has enough fresh fuel on hand for each fleet. Captains' meetings held about two weeks prior to departure help cruisers prepare for the events. Detailed itineraries, routes and brochures about each marina and destination help boaters and their crews plan their activities. Veteran cruisers often rendezvous at the location, while those newer to boating find a great deal of comfort and camaraderie running with the group. Not only do they sharpen their seamanship skills, they also know that, if a breakdown occurs, help is quick to arrive. Participating Sea Ray dealerships typically schedule rendezvous each summer and announce their calendars in January. Contact your local Sea Ray dealer or visit www.searay.com.

— Alan Wendt, Wendt Productions, Odessa, Florida

NEAT BOATING STUFF

By Jan Mundy

DIY editorial and sales team attended the Marine Aftermarket Accessories Trade Show (MAATS), held in Las Vegas in July. Below are some of the product highlights from the show. The first seven products listed won NMMA Innovation Awards for new products at the show. Six categories, judged by members of Boating Writers International, including DIY's editor Jan Mundy, ranged from aftermarket electronics to water sports equipment.

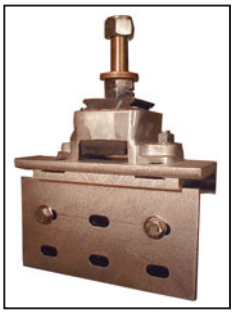


The EchoPilot Collision Avoidance Sonar System (CASS) is a wideband, forward-looking sonar that can "see," in real time, floating and semi-submerged objects up to 1,200 yards ahead of the boat. CASS also incorporates a GPS and solid-state gyroscope, so that targets on a collision course with the boat can be identified, and an alarm will be triggered. Retails for around US$14,299. (www.echopilot.com)

Vexilar's AlumaDucer is the only transducer to transmit through aluminum hulls with no loss of signal strength. It's designed to automatically compensate for the loss of signal strength that occurs with a standard transducer when mounted on an aluminium hull, a great plus for aluminum fishing boats. Comes with mounting adhesive and surface preparation kit. Retail is US$90 with a universal pigtail and US$20 extra for a specific sonar adaptor (200 KHz). (952/884-5291; www.vexilar.com)

Can't tell when your anode is worn?

Performance Metals' Wear Indicator Anode, a.k.a. the anode for dummies, is a sacrificial aluminum anode with a red polypropylene wear indicator embedded in the metal that lets you know when 50% has been used and should be changed. (877/612-5213; www.performancemetals.com)



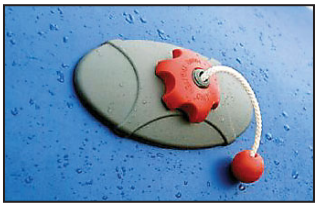
Planning on an engine repower? Need help with engine alignment? **8-way Anchor Adjustable Engine Mounts** (about US$80) simplify engine mounting using eight fore and aft adjustment points. It's a great time saver when setting a new engine or rebuilding existing engine mounts, as there's no need to worry about

how true the stringers are in your boat. (888/586-4455; Web: www.imperialquality.com)

If you like to stand at the helm, you'll appreciate **Skydex's Sea Shocks**. Made of durable polymers molded into spring-like shapes created by a former Nike shoe design engineer and originally developed for Navy SEAL boats, these floor mats utilize high-performance cushioning material to up to 75% of the impact experienced in rough seas. (303/790-4003; www.seashocks.com)

Couple-Mate (US$39.95 to US$49.95), a trailer alignment device from DuraSafe Locks, guides the trailer coupler directly over the hitch ball every time, helping prevent dings and scratches to the tow vehicle and eliminating the need to get in and out of the vehicle to check its position. The Couple Mate eliminates the arguments between the person backing the vehicle and the person guiding them to the trailer ball. (262/544-5615; www.couplemate.com)

When you need a Band-Aid for your inflatable, purchase a **Clam Seal** (US29.95) glueless inflatable repair patch. It instantly repairs small tears or punctures, up to 3-1/2" in length, in any inflatable or fabric, without glue. This device inserts into a tear and hand tightening of the nut brings the two halves together to stop leaks indefinitely until a permanent repair can be made. (www.bartonmarine.com).



Prop guards make good sense on some boats but are rarely seen. The **Ringprop** (about US$350) was invented in Australia as a performance prop and it has turned into a safety device. Sold in the '90s in the U.S. as the Stealth Prop, in 1995 it underwent a complete redesign. Available in February, 2005 in 15 models for 9.9. hp to 115 hp outboards, this aluminum prop offers superior maneuverability and acceleration. (www.ringprop.com)

Recipient of an Innovation Award at last year's MAATS show is the hand-held signaling horn (model #545-5000) from **Innovative Lighting**. A better "mousetrap" than conventional air horns, it's waterproof, floats, meets USCG requirements and is warrantied for 5 years. Powered by one 9-volt battery, there's no concern for leaking air canisters and a horn that doesn't blow when you really need it. Just carry some spare batteries. (800/949-4888/; www.innovativelight.com)

Dometic's Breathe Easy anti-allergenic air conditioning filters have electrostatically charged fibers to attract and retain micro-particles in the air, providing extra protection against dust, lint, pet dander, mold and mildew and reducing the effects of diesel fumes, bilge odors and other smells. Various filter sizes fit marine air conditioning units from 5,000 to 24,000 BTU. (www.marineair.com)

If your boat's plumbing allows the overboard discharge of sewage, the USCG requires that the thru-hull seacock be closed and locked in the no-discharge position when in no-discharge waters. **Forespar** has the perfect solution for you: optional locking plates that allow placing the handle in the closed position and a padlock used to securely lock the valve closed. These fit Marelon 93 Series seacocks in the 1" (25cm) to 2" (5cm) sizes. (949/858-8820; www.forespar.com)

Know the position of your **Bennett** trim tabs with the all-new **TPI**. Easy to install, replace the standard upper hinges with the TPI upper hinge sensors, drill a hole for the sensor wire, mount the TPI display and run wiring to the helm station. Works with all Bennett tabs. (954/427-1400; www.bennetttrimtabs.com)

Interlux has launched a new two-part polyurethane called **Perfection** that's specially formulated for the do-it-yourself painter. It replaces Interthane Plus, which was introduced more than 25 years ago. Perfection's newer technology resins contain flow aids to improve the paint's leveling. This results in a professional spray-quality finish when applied with a brush and roller. Unlike Interthane Plus, it rarely needs thinning when brushing and rolling but still needs to be thinned 25% to 35% for spraying. Perfection also uses a technology called HALS (Hindered Amine Light Stabilizers) to help protect the paint film from UV damage and fading. One of the big pluses for boat owners is the expanded color range and high gloss. (www.yachtpaint.com)

Seal of Good Boatbuilding

Is there a boating equivalent of the famous "Good Housekeeping Seal" or a consumer report for making comparisons before you buy? Companies that "do it by the book" guarantee you an extra measure of built-in safety.

By Pat Kearns

Most boaters believe that some official authority certifies the recreational boats they use and that some officious, safety-minded body approves the accessories, equipment, and services they access for their boating enjoyment. Boat shows and brokerage advertisements seduce prospective buyers with gleaming topsides and enticing interiors. Are all these boats built "by the book?" What are the ABCs for boat builders and service facilities? What about the plaques that proudly announce that the boat is "…built to USCG requirements…?" What does all this mean to the consumer?

Except for federal requirements for hull identification numbers, there are no U.S. Coast Guard (USCG) requirements for diesel-powered recreational boats 20' (6m) or more in length (sailboats, kayaks, canoes, inflatables and raceboats are excepted entirely). All other USCG regulations refer solely to recreational boats that have gasoline engines. Even these important regulations are limited to minimum requirements for load capacity, safe loading, maximum powering and minimum flotation (20'/6m or less only); ventilation of volatile vapors, fuel and electrical systems, and start-in-gear protection (gasoline only). These rules and regulations are published in the United States Federal Code of Regulations (33CFR), and they are the laws for every boat builder manufacturing boats for sale in the U.S. to the recreational user.

The USCG does not post "inspectors" in boat and equipment manufacturing facilities or boatyards. Industry self-certification to comply with these laws has worked extremely well. The Federal Boat Safety Act (FBSA) of 1971 set forth the successful cooperative USCG/marine industry methods for handling defect notifications and recalls campaigns that obviate the need for any enforcement tactics. Twenty-five years of steadily declining boating accident numbers, during a period of tremendous growth in boating, testify to the success of this system. Most boating accidents are due to operator error; bad boats are rarely the problem.

What about all those boats not covered by the FBSA and 33CFR? What about all those diesel-powered sailboats and cruisers we see at boat shows or the ones in brokerage ads? How can you compare them? Where's the pedigree? Well, it should be some comfort to know that 80% of the domestic recreational boats you see were built by manufacturers who rely on the voluntary standards and recommended practices of the American Boat & Yacht Council (ABYC). ABYC's "bible" of standards, *Standards and Recommended Practices for Small Craft*, contains more than 60 areas related to design, construction and engineering for manufacturers. ABYC standards are also the basis of the National Marine Manufacturer's Association (NMMA) blessing in its Boat and Yacht Certification Program. So, if you see a boat with the NMMA Certified sticker, you have at least one yardstick for comparison.

When you buy a house or have one fixed or remodeled, building inspectors enforce certain codes, and electricians, plumbers and other contractors must be licensed by the state (province) jurisdiction, and demonstrate their knowledge of the codes. You can't rely on the same level of assurance when you buy any boat or marine products and services. Compliance with USCG requirements may mean little, or, nothing if the law does not apply to the boat or product. Boatyards and service facilities are not regulated at all. You want more? Find out whether a boat or equipment manufacturer (service technician, boatyard, or surveyor) practices his craft by the "book."

There are other certifying bodies that are active in the marine industry, an entire alphabet soup of acronyms that include the Marine Industry Certification (MIC). This group is a third party certifier of businesses and individuals who have successfully met the requirements and acquired the competencies for MIC certification by taking courses offered by a wide range of training and educational programs. For boatyards and marinas and skilled technicians in diesel repair, fiberglass repair and other disciplines, this means courses from the American Boat Builders & Repairers Associations (ABBRA), the International Marina Institute (IMI) and the technician certifications from ABYC. There is also a global layer of certification in the form of the International Organization for Standardization, better known by its acronym, ISO (the alpha characters stand for the Organization's initials in French).

There are lots of "wonder words" out there (certified, approved, inspected, commercial, etc.) that are used to create an assurance of quality. I call them "wonder" words because they make you wonder what they mean. Most of the government and voluntary standards generating organizations have websites, as do the other certifiers and associations. You can start with ABYC (www.abyc.com). Its site includes links to the others.

Companies that know and use ABYC standards, and who boast other certifications and quality assurances such as those mentioned above, guarantee you an extra measure of built-in safety. When dealing with these companies you get the value advantage of a product or service that far exceeds the bare minimums required by law — from the ABC of the USCG all the way to XYZ of the ABYC, NMMA, MIC, ISO et al!

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 based in Naples, Florida.

Get Your Ducks in a Row Before Buying or Selling a Boat

Once you've decided you're ready for a new boat, you don't want anything to slow down the process. So before the wheeling and dealing begins, make sure to have all your loose ends tied up neatly.

BoatU.S. Members have access to a number of valuable online services such as FREE estimates of the fair market value of your boat as well as FREE insurance quotes and affordable financing.

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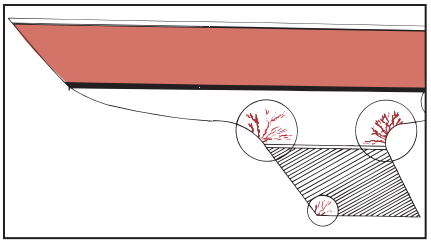
NOTE: DIY boat owner Magazine reserves the right to publish Technical Helpline questions in the "Talkback" column of both print and electronic (DIY EZINE) issues and on CD-ROMs.

Cracking Keel Joint

Q: The join between the hull and lead keel has a hairline crack in the fiberglass, which appears to be more cosmetic than structural. There is nothing that I can see that suggests an impact though glass is chipping off in places up to 1/4" (6mm) deep. I want the repair to ensure that no water will get between the hull and the keel.
Bob Griffiths, "Refuge," Parry Sound, Ontario

A: The crack you describe is a common sailboat maintenance problem and typical of boats with an external ballast fin keel. Most fin keel sailboats develop, to a greater or lesser extent, a crack at the cosmetic fairing putty at the keel-to-hull joint. If the crack gets big enough to see daylight through or you have a leak at a keel bolt, you should check for proper torque of the keel bolts. Regardless, it's good practice to tighten keel bolts to the proper torque specs every 10 years. I doubt the 1/4" (6mm) material you mention has any fiberglass in it or contributes in any way to the structure of the boat. Rather it's a layer of fairing putty put there to streamline the joint. Repairing it is a beautification project only and, for the rabid racers, a perfectly faired keel can mean a nanosecond of improved performance on the race course. Separation at the joint has no bearing on water getting into the boat and besides, it doesn't matter if water gets between the keel and the hull, only if it gets past the sealant at the keel bolts and into your bilge. If you decide to fix the crack and the loose filler, grind off or chisel away any poorly adhered filler and replace it with fresh stuff. You can mix up your own filler using polyester or epoxy resin and microspheres or buy a few gallons of premixed filler (VC Watertight, 3M Premium Filler). Trowel it on as evenly as you can and then sand smooth with a dual action sander or a professional 1,500 rpm sander/buffer that has a nice thick foam sanding pad and an 80-grit disc. If you are really fussy or you are going racing, the final shaping



Cracks along the hull-to-keel joint are common in fin keel sailboats.

should be done with a long sanding board. The problem is that, after doing all this work, in a year or two the crack will be back due to the natural flexing of the boat in this area. The only way to make it go away for any length of time is to overlap the joint with fiberglass tape about three layers thick. This adds resilience that the putty doesn't have but it's a whole lot of extra work. Regardless, this crack, provided it remains a hairline crack, is just a cosmetic problem.
— *Nick Bailey*

Bilge Ventilation: A Rodent Feast

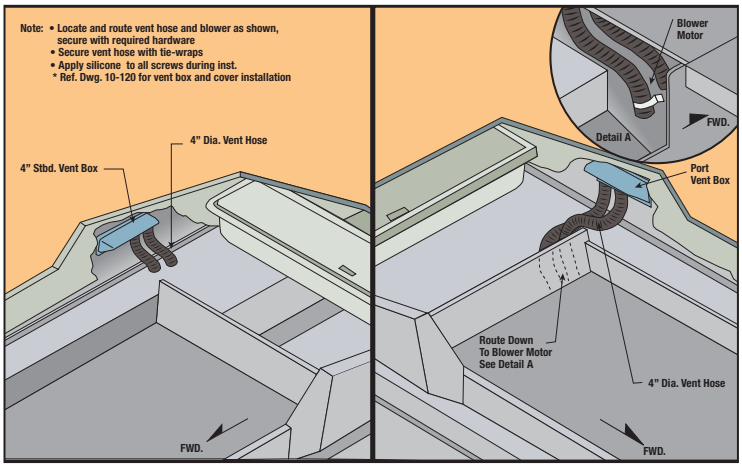
Q: Mice nested in the hull of my 1988 Sea Ray 250 Cuddy and ate all the bilge ventilation hoses. The only thing left is the hose ends with hose clamps attached to the vent barbs. There are louvered vents on either side of the hull, three transom vents and a bilge blower. How do I hook up the new hoses and how far down do the hoses extend into the bilge?
Lewis Reynolds, McHenry, Illinois

A: The powered ventilation system installed in an inboard gasoline engine space (or fuel tank space) is a critical safety system designed to dilute and/or purge potentially explosive fuel vapors that can come from leaks in the engine compartment or the fuel system. Dilution of the vapors reduces them to a state below their lower explosive limit, i.e., what can be ignited by a spark. Purging the vapors can remove them entirely unless they are forming continuously. While the USCG only requires one powered ventilation system motor, ABYC standards require one motor for each gasoline engine installed. All this must be accomplished without allowing water to enter the engine compartment through the vents. When upgrading this system, install the blower inline with one of the three inlet hoses. If there are three inlet holes then there should be three inlet hoses. The inlet hoses should extend into the bilge and be installed in accordance with ABYC H-2, which requires that blowers be mounted above the normal level of accumulated bilge water and that the ducts be permanently fixed, self-draining so that any water will drain from the ducting, be located in the lower one-third of the compartment with duct openings above the normal level of accumulated bilge water and positioned as nearly as practicable below the engine(s) that it (they) serve(s). While your nose is the best test for vapors, always run the blower for five minutes before starting any gasoline fueled inboard engine and run the blower anytime you are operating the boat below cruising speeds.
— *Steve Auger*

Why a Blower

Q: My best friend has a 40' (12m) Regal, powered by twin MPI engines and with a bilge blower that hasn't worked for a year. I've explained the danger but he refuses to listen. Please comment so perhaps he will believe me.
David Baker, Hendersonville, Tennessee

A: Just to be sure I contacted the American Boat & Yacht Council (ABYC) for clarification and received this reply from the technical director: "I think your friend



Ventilation schematic for Sea Ray 250 CC, courtesy of Sea Ray.

believes that since the engine does not have a carburetor or throttle body injection and is, instead, multi-port injection, that he may not need a blower anymore. I can't imagine a boat of this size with an engine space that is open to the atmosphere per ABYC Standard H-2.6, and as such, does not require a blower for each engine. He needs natural ventilation and a blower for each engine and, yes, they should be in working order!" This is also a CFR requirement (section 183.610), which differs only in that the ABYC standard requires a blower for each engine (including a generator). Unless the engine compartment is, according to the ABYC and USCG definition, open to the atmosphere, it needs blowers for powered ventilation. Aftermarket failures to maintain ventilation systems in operational condition will lead to an increase in accidents. The law (CFR) applies only to new boat and equipment manufacturers. It's up to us to make sure our boats are maintained to the safety standards to which they were built.

— Jan Mundy

Powerpilot Troubleshooting

Q: The previous owner installed A Navico Powerpilot PH8000 on my powerboat. The installation includes the PC8000 Power Pilot Control Unit and the H8000 Hand Programmer and was very carefully integrated into the console but unfortunately without a wiring diagram. In automatic pilot mode, the system drives the boat off course. The only identifiable fault that I have been able to find is that, while there are 5 volts (correct value) across the red and green wires on terminal block FB1 (feedback unit), the voltage swing on the blue and green was less than 2 volts yesterday and 3.1 today. The input voltage is 13 volts and doesn't change much between the on and off condition. Other known symptoms and facts: the readouton the hand programmer is correct and follows rotation of the sending unit. There is a Ritchie electronic compass on the same voltage source connected to the same isolator switch, which is across the red and black terminals on the Powerpilot unit. It responds only intermittently and not correctly, to its sending unit. Isolating both the positive and ground from the Navico unit does not appear to change this, nor does it correct the Powerpilot. I have an old back up GPS with a large LCD display. The display is barely visible (although it was adjusted in the shop by a certified technician last week). Isolating it has no effect on either the Powerpilot or the compass. There is no apparent (that I can see) corrosion anywhere in the system from the batteries forward nor is there any obvious damage to any of the wires. There is also no change in the symptoms whether the voltage source is the batteries alone, on the charger or with the engine running. The radar, primary GPS, anchor windless, bow thruster and other house functions appear okay. I'm guessing I have a low voltage problem but, except for the feedback unit, all voltages read okay on a standard voltmeter under both load and no load conditions.

Norman Thomas,
"Columba II," Owls Head, Maine

A: As you appear to be competent with a multimeter, I will advise the test procedure of the FB1, which I believe to be the problem. First, it is a "moving transducer" in the form of a potentiometer. As the pilot was installed by the previous owner then the working hours would be indeterminable. With age, it eventually wears out. (If it were a volume control on a stereo amplifier, it would be heard as crackling.) Your voltage readings indicate this may be the case. Voltage across the red and green is 5 volts. This is correct and is connected to either end of the potentiometer winding. Green is the negative side. Connect meter between green negative and blue. Blue is

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the wiper. With the rudder amidships, voltage between green and blue should be 2.5 volts. The FB1 has a notch to indicate amidships on the housing. As turning the wheel moves the wiper, the voltage should increase and decrease from 2.5 accordingly. The feedback has an electrical output angle of 90°. If you disconnect the FB1 arm and move it manually 45° either side of center, the output voltage on the green and blue should now change from 0 volts to the supply rail level of 5 volts. Each degree of movement, therefore, equates to 5 volts divided by 90 equals 55 millivolts per degree or 0.055 volts. The possible fix is to rapidly move the arm of the feedback back and forth in an attempt to clean the track and wiper contact. Carry this out and remeasure the terminals. If there is a marked improvement, then you are on the right track. You are looking for a smooth voltage transition from low to high between green and blue as the feedback is operated. An analog meter is best used for this but a digital will do if the resolution is set right. If you confirm the feedback is the problem and have trouble getting a replacement FB1, please advise. The compass issue is more complex because the pilot is using this information to move the rudder. You need to isolate FB1 problem first, as it the easiest to test. As for the GPS display, you do not mention make and model. However, the LCD screens do lose intensity with age. There should be a menu option to adjust contrast and brightness. Brightness refers to backlighting and people get the two mixed up.

— Frank Leyvraz Electronic Services Manager Quin Marine Pty Port Adelaide, Australia

Flo-Scans Verify Unequal Fuel Usage

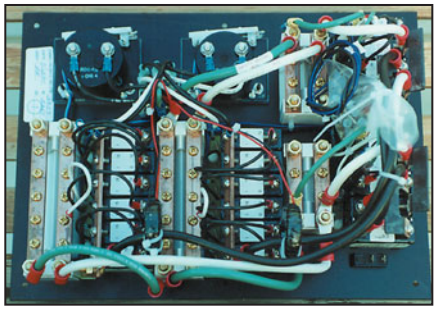
Q: I'm a devoted fan of DIY and finally have a question for which I am getting conflicting answers and need your opinion. My 1989 Bayliner 4588 has twin 220 Hino turbo engines with 1,200 hours and also Flo-Scan meters, which verify my problem. When filling up with fuel, I continually take 25 to 30 gallons (113.5L) more in the starboard tank. The Flo-Scans show a usage of 2 gallons (8L) on the starboard engine more when I cruise over 1,500 rpm. The gen-set and heating are separate. What could cause this problem?
Bob Claney, "Disconnected," Port Angeles, Washington

A: Twin-counter clockwise flywheel rotation engines never consume the same amount of fuel. It's typical for the right hand propeller rotation engine to consume slightly more fuel that the left hand propeller rotation engine. In order to transfer the output shaft rotation from counter clockwise (engine) to clockwise (propeller), the engine must drive an additional preloaded shaft, bearing and gear assembly inside the transmission. The left-hand rotation engine doesn't have to drive those extra parts and, therefore, the right hand unit consumes more fuel.
— Steve Auger

Intricacies of AC Panel Wiring

Q: I'm just getting to the electrical portion of refitting my boat and though I'm quite familiar with household wiring and have purchased your MRT *DC and AC Electrical Systems* CDs. I'm unsure of the proper connections to the four Paneltronics electrical panels: model 5306 main breaker; 5301 120 volt branch breaker; 5203 12 volt; and 5204 12 volt. House breakers are simple: wire to one side of the breaker and it connects to the bus on the other side. These pre-wired breakers have wires going everywhere. The main breaker has a "Shore 1" (three breaker), "Generator" (two breaker), "Inverter" (two breaker), "Shore 2" (three breaker) and "Parallel" (two breaker). Where do I connect the inputs from my shorepower and where do I take off power to the isolation transformers prior to returning to the main breaker? These main breakers all seem to be interconnected and the "Shore 1" even appears to ground to the panel.
Eamonn Flynn, "Stella Maris," Rockwood, Ontario

A: We contacted Paneltronics on your behalf and received a reply from Nestor Quiros: "General marine wiring practices are different than household wiring. We recommend you brush up on ABYC standards, section E 11. [Ed: Refer to DIY 1998-#4 issue or the MRT *DC Electrical*



What may appear as a maze of wires, pre-wired electrical panels from Paneltronics are relatively easy to install with tech help and wiring diagrams available at www. paneltronics.com.

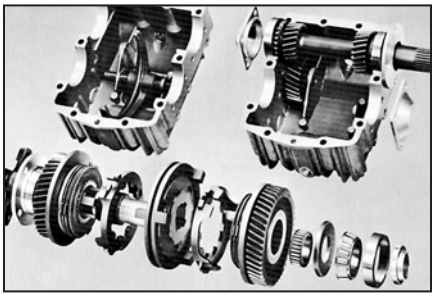
Systems CD-ROM for complete wiring details.] The input from each power source comes into the "Line" side (top of the breakers on model 5306) and the output is on the "Load" side (bottom of the breakers). All meters are pre-wired, so there's no concern there. Since you have isolation transformers, we suggest additional double-pole breakers to protect the primary of each transformer. From the secondary of each transformer, connect to the input of each shore main breaker on the 5306 panel. The shore mains may appear to be three-pole breakers but they are two poles to interrupt the hot and the neutral from each source. Our shore main breakers include a reverse polarity trip coil. It makes the breaker trip automatically upon sensing reverse polarity. This is a nice safety feature since not only is there an LED indicator but the breaker itself will not operate under reversed polarity. In your case, this will never happen, as you have isolation transformers and, since your boat is magnetically coupled to the dock, there will never be a reversed polarity condition onboard. The breaker itself is marked as to where to connect the hot and the neutral connections. Generator and inverter breakers are double-pole breakers and each will accept a hot and neutral from the corresponding source. On the parallel breaker, do not make any connections. This comes wired from our factory and is particularly useful when underway, or at a marina offering a single 30-amp cord. The paralleling switch allows you to safely parallel Bus A and Bus B, so that both are energized by one source. In order to wire the main AC panel 5306 to the branch breaker panel 5301, you need to "drop" a hot and neutral from the output of the first set of breakers to Bus A and, from the second set of breakers, to Bus B. Paneltronics

offers free technical support. If you have any questions, contact one of our techs on our toll free number 800/ 367-2635. Wiring diagrams are available for each panel at www.paneltronics.com."

Replacing Transmission Seals

Q: My 1986 Albin 27 has a Nissan diesel LD 28 with a Hurth transmission HBW 250 that apparently needs transmission seals replaced. I would like to remove the transmission myself and have a local shop replace the seals. Have you covered this process is a previous issue? What parts, seals, special tools and manual are required for this job?
John Bain, "Drifter," Hilton Beach, Ontario

A: If the rear engine supports are secured to the bell housing of the engine instead of being mounted on the transmission (the standard mounting since the Hurth doesn't have a secure mounting surface), you should have little difficulty in removing the Hurth 250 from your Nissan diesel. The Hurth 250 transmission mounts to an adapter plate bringing the engine mounting flange up in size to that of the Borg Warner transmission. To remove, disconnect the shift cable and shaft coupling. Slide the shaft aft about 2" (5cm) if possible. You probably don't need that much but more is better. This provides enough room to disengage the input drive flange from the drive damper. With the transmission disconnected, remove the six bolts holding the adapter to the engine bell housing. Now that the transmission is unfastened, it should slide off. I suggest that you send the Hurth unit to an authorized ZF Hurth service center. Don't attempt the seal change yourself. This unit is unlike many others, which have the seal assembly separate from the coupling end. It must be taken entirely apart to replace the seal.
— Bob Smith


Cutaway of the Hurth 250 transmission.

Surging Gen-Set

Q: My new boat has a 7.5 kW Quicksilver generator that surges when running. How do I adjust this?
Mark Cavanaugh, Eastlake, Ohio

A: Your generator is basically a Nissan motor hooked up to a Generac generator. I would advise you to order the service manual, part 90-813719 for gas models (about US$65), from any Mercury dealer. Assuming you have a gasoline model, your surging is likely a carburetor problem. You need an AC electrical frequency meter available from Electronic Specialties, Spring Grove, Illinois (tel: 815/675-1812), to correctly adjust the air/fuel mixture screw. With the genset warmed up, turn the air/fuel screw clockwise until the AC frequency starts to drop and then turn the screw counterclockwise, past the high reading, until the frequency starts to drop again. Finally, turn the screw clockwise until the highest frequency is achieved. If the engine continues to surge

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you have a carburetor problem. If it's a diesel engine, the injectors they are likely leaking and need servicing.
— *Steve Auger*

Getting Cushions Clean

Q: Can you suggest a way to clean vinyl cushion covers and the foam inside? Cabin and deck cushions are the originals supplied with my 1978 Cheoy Lee.
Brian McDowell, "Christina III," Vancouver, British Columbia

A: There are different products for cleaning vinyl. Some boaters have success with Soft Scrub, a household product. (Spot test first and never let it dry before rinsing off.) 3M Marine Vinyl Cleaner works well and has an UV inhibitor to prevent damage from UV rays. DIY recently tested Captain Phab Inflatable and Vinyl Cleaner on our powerboat's cabin cushions and it did an excellent job. To descent cushions, purchase a jug of Captain Phab Stain & Odor Remover (www.captphab.com), formerly known as Zyme Zapper. Soak the cushions with this solution and then work it through the foam, much like you're stomping grapes. Thoroughly dry the foam. It must be completely dry before stuffing into the covers or you'll have a moldy mess.
— Jan Mundy

Captain Phab Inflatable and Vinyl Cleaner did an excellent job of removing dirt, grease and mildew from our vinyl cabin cushions.

Filings in Gearlube, No Problem

Q: When I drained the lube from my 1988 Mercruiser Alpha One drive, I get a small "fuzz ball" of iron filings on the magnet of the drain plug. The lower unit was rebuilt in 1998 (gears and bearings replaced) and the drive appears to be working well. There's no water or brown oil in the drained lube. I run the engine about 30 to 50 hours a year and change the gearlube each year at end of season. How much, if any, metal filings are acceptable? Do I need a adjustment or overhaul of the lower unit?

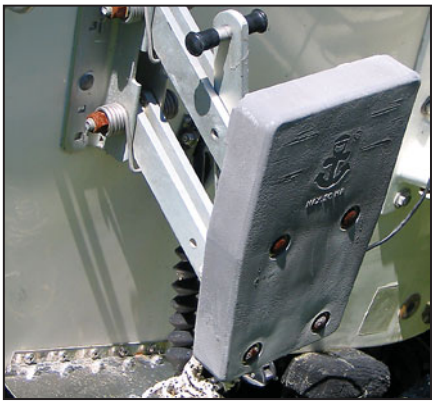
David Beach, "Knot Home, Waupoos, Ontario

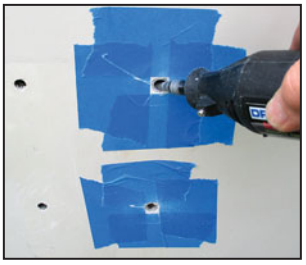
A: You can rest easy. Your photo shows normal metal accumulation on the gearcase fill screw magnet. Each time you shift from neutral to forward or reverse a small amount of metal (less than a hundred thousands of an inch) is removed from the clutch and gear. The magnet keeps this metal from getting into the bearings. Change the lube every 50 hours and use Mercury Hi Performance gearlube and the drive is good for 1,000 hours or longer before requiring major work. It's common to see hair-like fillings on the plug, a reason for changing oil annually. Something has to give considering that these engines are meshing aluminum with stainless steel components.
— *Steve Auger*

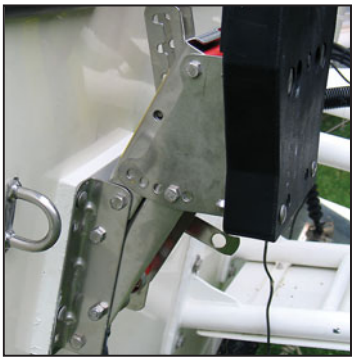
Replacing Outboard Mount

A: The outboard motor mount on my 1979 Pearson 23 has a lot of lateral play (probably worn rubber bushings). It also will not hold reliably in the up position with my ancient Johnson 9.9hp outboard. Add some wave action and the motor gets jarred into the down position. Is replacing the mount a big deal? Four screws mount it onto the transom.
Roger L. Wesley, "Champagne," Smith Mountain Lake, Virginia

A: Most of these auxiliary outboard motor brackets have the same basic design. The manufacturers seem to rate them for more horsepower than they can withstand when used on larger, heavy boats. This job can be tackled with basic hand tools and should not pose any real problems for the DIYer. I would advise you replace your original bracket with one rated for 20 to 25 hp. Follow the installation instructions with the new bracket. Brackets usually fasten to the transom with carriage-style through bolts. Be sure to use sealer on the stainless-steel bolts to avoid leaks. Also, torque the bolts with a torque wrench so you spread the torque equally over the four bolts.
— *Steve Auger*







Replacing outboard bracket might involve releasing the existing sealant bond with Debond (see page 2 for complete instructions), then solvent cleaning the matting surfaces, possibly redrilling new mounting holes and filling the old ones and then installing the new bracket with copious amounts of sealant (i.e. 3M 5200 or 3M 4200).

Tech TIP

FLORIDA WRAP

Plastic shrinkwrap film is much too airtight to cover a boat in tropical climates. A better choice is Shade Cloth, a 50% knit white mesh netting material available from International Greenhouse Company, Slidell, Illinois (Tel: 217/288-9337, Web: www.igcusa.com) in 20' (6') widths and sells for $3.60 per lineal foot (30cm).

Andre Garneau, "E VOILA II," Beloeil, Que.

RESTORE AGED FORMICA

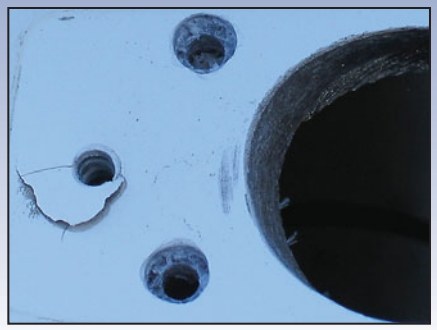
If you have a veneer countertop that's showing some wear, solvent wipe the surface, sand with 220-grit paper, solvent wipe again then paint with a one-part polyurethane paint, such as Interlux Brightside. Add a flattening agent to lessen the gloss.

MILDEW-FREE CUSHIONS

Once a year remove the foam (open cell only, not closed-cell foam) from your interior cushions and spray them with a mold and mildew preventative, i.e. 3M Marine Mildew Block or Captain Phab Mold & Mildew Preventative, and let dry. While you're at it, spray carpeting (do a spot test first), sails, showers, etc. to create an invisible barrier where mold and mildew won't grow.

VULCONIZE IT

A vacuum packaging machine, available from many hardware stores, is great for keeping food fresh and protecting it from pests. After you've blister packed your food, bag your clothing and bedding, cameras, handheld electronics, matches, safety flares and other gear to protect from moisture, you might want to individually bag your tools to prevent corrosion before tossing in the toolbox.



STOP SCREWS SPLITTING FIBERGLASS

To stop screws from splitting fiberglass, drill a hole of the appropriate size then countersink the hole opening.

TIGHT SCREWS

When a corroded screw refuses to budge, take a hot soldering iron (or hot knife) and touch the tip of the screw until the screw heats up and breaks free of the rust.

CURE FOR RUSTY TOOLS

To store tools onboard, give them a light coating of oil and put some moisture-retaining crystals (silica gel) in the toolbox to absorb the moisture and then individually blister pack the really special ones (see π).

BACKYARD BUILDERS

The U.S. Coast Guard publishes two documents that are available on-line: "Boatbuilder's Handbook" is geared toward regulatory requirements (Federal Law 33CFR183) and safety for boatbuilders but the information is essential for serious boatowners, especially when doing any electrical work on their boat. (www.uscgboating.org/regulations/boatbuilder/index.htm); "Safety Standards for Backyard Boat Builders (CG-466)," is geared towards the DIY boatbuilder. (www.uscg.mil/d8/mso/louisville/download.htm).

Al Corkins, Battle Creek, MI

MAST BARRIER

To isolate dissimilar metals on masts, Peter Linwick of Florida Rigging & Hydraulics (www.rigginghydraulics.com) recommends using Tef-Gel under the heads of all fasteners. For large surfaces, use PVC Tape.

ANT EXTERMINATION

For immediate relief from pests use an ant and roach killer in spray or bomb form. For long-term control, at the same time, sprinkle a ring of powdered cleanser, i.e. Ajax, were your boat connects to "ground" (power cords, dock lines, gangplanks, etc.). Make a paste of equal amounts of boric acid, powered sugar and yeast and place on waxpaper or a plastic cap on the ant trail.

WHICH END IS UP?

To quickly determine which end of a cover fastens where, sew small red and green patches on the inside of the top at the corners where they attach to the windscreen or stern. Match the patches and you're covered.

Doug McKenzie, Toronto, Ontario

TECH TIPS WANTED

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

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

Or Email to info@diy-boat.com

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

PRO SERIES

That Sinking Feeling

It's a fact that, at some point in time, most boats will develop a leak. The difference between the intrusion of a little rainwater and the inexorable progress of a leak below the waterline is the difference between a boat that floats and one that doesn't. This article looks at leaks below the waterline, how to find them and how to fix them.

By Nick Bailey

Although there are rare examples of the coveted dusty bilge, most owners expect to do a little dewatering on their boat occasionally. However, leaks from above and leaks from below are not created equal.

Discounting rainwater leaks, some boats are tighter than others and it's important to know what the normal bilgewater accumulation is for your boat. Mental calculations may be required to assess the "normal" state. Here's a good example. The stuffing box drips every 15 seconds, yielding .12 fluid oz. (4ml) in 15 minutes and translating to about 1 quart (946ml) every three days or so." Not a big deal. Even if a familiar leak cannot be described as "minor," many boaters are comfortable with the knowledge that the rate is constant and they are committed to a maintenance routine that keeps the boat afloat. If you know what is normal for your boat, you should be able to judge when a leak is getting worse. Just beware of the faulty logic that a leak ignored will eventually stop.

Unexpected water below the floorboards can be a scary surprise and a mystery leak should make you nervous. After all, you don't know if it's a minor issue, such as that pesky tapered plug on a worn seacock or the harbinger of doom, a critical component somewhere that is literally hanging by a thread and just waiting for the right Murphy's Law moment to let go. There can be no peace of mind until the leak is identified and fixed.

Leak Finding

Often, finding the leak is more time consuming and difficult than fixing it. This is why many repair facilities often suggest "You find it, we'll fix it." That can be money-saving advice.

Easy-to-find leaks occur at hull fittings. Tools required to find these leaks are simple: a roll of paper towels, flashlight and small mirror. Check the inside skin of the hull by hand for wetness trickling down from any thru-hull, rudder port (often visually inaccessible), the shaft log, stuffing box and strut fasteners. Other culprits are trim tab and swim platform mountings. If it feels wet, move in for a close inspection. Use the paper towel to dry off the hull and the fitting and inspect closely using the flashlight for illumination. Look for the first appearance of a trickle or drip. Dry it again and verify you are seeing the first point of emergence. Use the mirror to check the backside of the fitting. On a thru-hull, for example, it's important to determine if the bedding compound sealing the thru-hull is leaking or if it's an attached valve or hose. On a stuffing box or rudder port, you must discriminate between a routine drip at the packing gland, which can be controlled by an adjustment of the stuffing box nuts, and a more sinister leak from a cracked shaft log tube or from under the backing plate of a rudder port assembly. Finding a leaking keel bolt on sailboats requires that the bilge or keel sump be mopped perfectly dry so that the very first drop of water welling up from under a backing plate or worse, from a crack, can be positively identified. Powerboats with sterndrives most commonly suffer from leaks originating at the U-joint or the bellows. These can be hard to see but look for a slight trickle of water on the inside of the transom below the transom assembly. Many of the sources of the leaks described only become apparent when the boat is underway or "working," so to speak. Seeing them when the boat is quietly afloat in its berth or at the mooring may be impossible, so consider that the dynamic of movement may be required for this scrutiny.

What happens if all the below-the-waterline fittings on the hull check out as dry but the bilge keeps filling up with water? At this point, to find what is leaking and why, true detective work is required, employing a logical methodology to follow up any clues.

First Clue: When does the leak occur?

If, for example, water in the bilge stops rising at the same time the water tank is found empty, it's logical to conclude the two might be related. That's an easy one. Is the leak constant whether underway or at the dock? If it only occurs underway, does it happen at every outing, only in big sea conditions or only at certain speeds? Any intermittent leak needs to be caught in the act, requiring you to carry out testing underway to duplicate the circumstances under which the leak occurs. The waterline of any boat moving at displacement speeds peaks at the bow wave and the stern quarter wave. This can submerge thru-hulls that are well above the waterline at rest. Other intermittent leaks can originate at the engine cooling system or running gear and will only show up when the engine is running. If a sailboat only leaks when it's heeled, a keel bolt or keel sump crack leaking under load or a fitting on the leeward hull side siphoning into the bilge might be implicated. In this case, change tacks and observe what happens.

Second Clue: Where does the leak originate?

If the leak is constant, dry the bilge and identify the direction from which the first trickle arrives. This will at least narrow the search for the point of entry to port, starboard, forward or aft. However, leaks are devious and boats are built with hidden conduits and inaccessible compartments. The location at which the leak

exits into the bilge may be a long way from its entry point into the hull.

If the leak appears to originate from inside a closed compartment or from under the edge of a hull liner, it may be necessary to cut an access hole to facilitate the search and install an inspection port to close the hole later.

Leaks on sailboats with full keels and encapsulated internal ballast can be tricky to diagnose. These boats usually have two lines of defense against leaks originating from the keel. The hull skin itself is the first defense and is usually a very thick lay-up at the leading edge and keel bottom. Given the knowledge that boats with deep keels do occasionally run aground, the builder will usually cap the ballast with a secondary glass layer across the top of the keel (**Figure 1**). This secondary defense forms the floor of the bilge and will keep the boat dry in the event the hull skin is holed. It's safe to assume that if there is a leak at the inner skin there must also be a leak at the outer skin.

Powerboats, too, can often present discovery problems. Many have a double bottom filled with flotation foam or be otherwise arranged with liner moldings so that the inner skin of the hull cannot be viewed without destructive disassembly (**Figure 2**).

If the leak's origins are truly hidden, the best course of action is to haul the boat and search the outside of the hull for damage. It helps to leave the bilge full of water and look for the telltale trickle of water leaking out. You may be surprised by what you find.

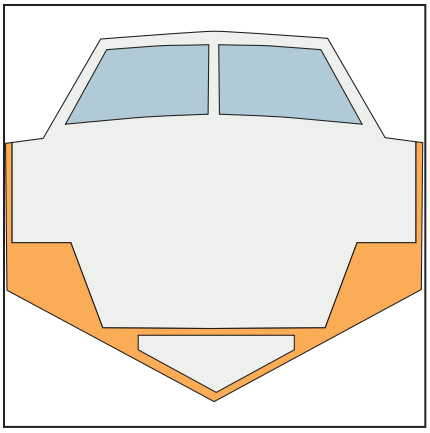


Figure 2 Foam flotation conceals the hull preventing visual inspection.

Fixing Leaks

Leaks at hull fittings, such as seacocks, valves, hoses, instrument senders and running gear are common and usually straightforward to fix. Generally, any leak at the bedding compound sealing a thru-hull or hardware bolted through the hull requires hauling the boat and complete removal and reinstallation of the fitting. Attempts to add "goop" to the outside perimeter of the fitting or worse, the inside, rarely succeed. Unfasten and remove any hoses or valves and then unscrew the clamp nut or individual fastening bolts securing the fitting. After cutting away as much old sealant as possible, a thru-hull can usually be pushed or knocked out from inside the boat. The old sealant will probably have a strong grip (despite the fact it's leaking) and it will probably be necessary to "gently" break the fitting loose with a dead blow hammer. This can be a wood

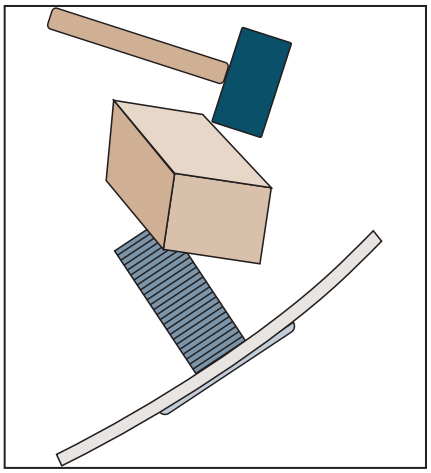


Figure 3 Removing a stuck thru-hull.

mallet or even a small sledge provided you use a softwood block to intervene between a steel hammer and the fitting (**Figure 3**). (Ed: To easily remove thru-hulls bonded with 3M 5200 using Debond refer to "Yes, You Can Remove 3M 5200" on page 7 in this issue.)

Thru-bolted hardware with an external flange such as a rudder ports or prop shaft strut will probably need to be wedged and carefully pried loose. A 2" (5cm) or wider chisel works well for this job. After removal, clean all the old sealant off the hull and fitting. Check the fitting carefully for cracks or excessive corrosion. Proper reinstallation requires lots of polyurethane sealant under the outside flange, on the edges of the hull opening and on the inside of the hull under the backing block. Replace any old wood backing blocks

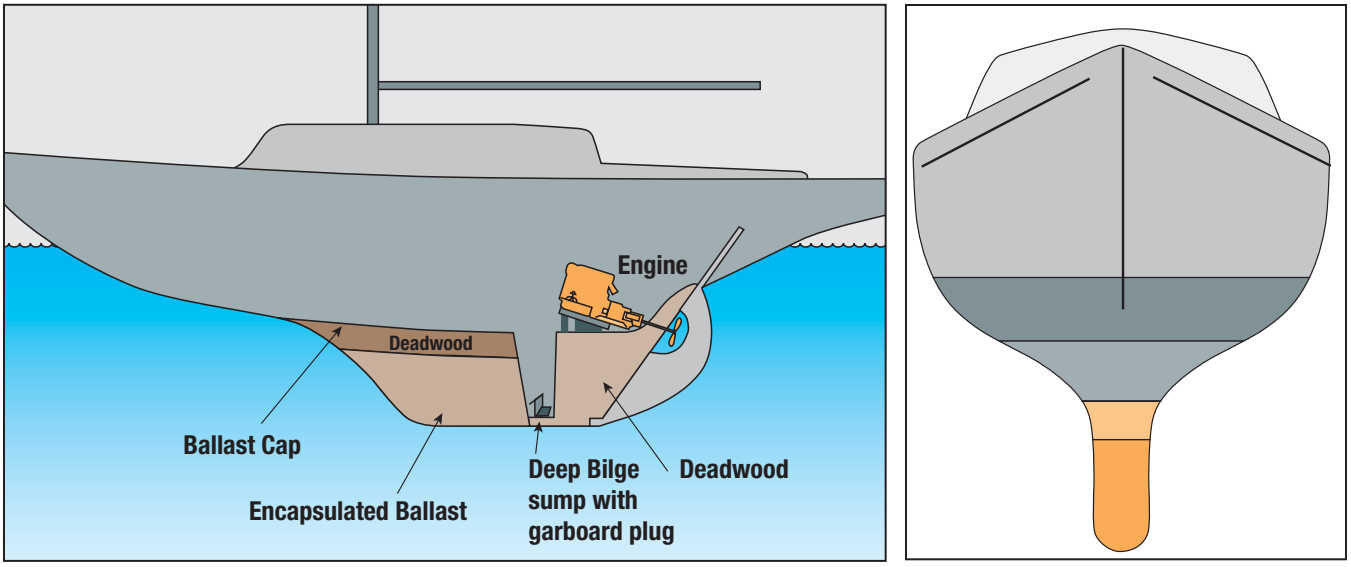


Figure 1 (left) Sideview-of a typical full-keel configuration; (right) Keel cross section.

with new wood or, even better, a piece of UHMW polyethylene or use some of your StarBoard scraps. Replace any corroded fasteners with new.

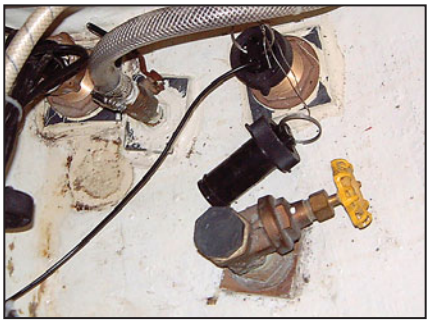
While you're at it (the four most expensive words in the English language) inspect the hose connected to the thru-hull. Replace any cracked, weathered or substandard hoses. If there is a garden-variety gate valve on a thru-hull, replace it with a quarter-turn ball valve or seacock that meets the material and testing requirements of ANSI/UL 1121 as specified by ABYC standard H-27.5.2. Provided there is enough room on the overlap when the hose is inserted onto the fitting hose barb, always use two hose clamps. [Ed: For an opinion on when to use one or two hose clamps see "Scuttlebutt" in DIY 2004-#1 issue.]

Hull Breaches

This category could be subtitled "emergency repairs." Small holes from things like errant drills or screws can be sealed from the outside, even underwater, by applying an emergency epoxy "stick" patching compound or Marine-Tex. This quick patch stuff usually doesn't work when applied on the inside because hydraulic pressure is working against it. Larger cracks or holes require haul-out and proper structural repair but that is an entirely separate topic for another writing.

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.

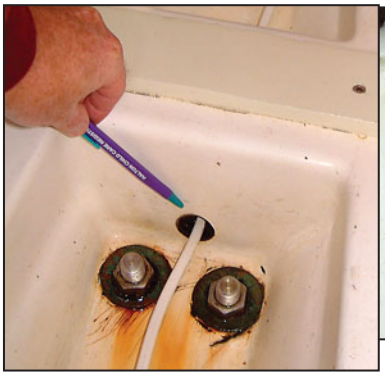
Use paper towel to thoroughly dry the fitting and surroundings.



Leaks at skin fittings are comparatively easy to find.

Fingertips are a superb wetness sensor and will often find a leak that is impossible to see.

Inner liner mystery leaks: water arrives via the limber holes and collects in the bilge sump but where does it originate?



Adding an inspection port in the liner or double bottom can open inaccessible locations.

Inaccessible spaces below the floor may hold water, requiring you to cut an access hole to get a pump in there. (Note pump improvised from a large syringe.)

This imbedded prop shaft strut is suspected of causing a hidden leak. The success of reglassing it will only be known after launching.

Any marine repair yard will have lots of examples of leaks that required true "gumshoe" work to solve. Here a few examples from Bristol Marine. Only the names have been changed to protect the innocent (or guilty).

Mysterious Bendit 23

This sailboat suffered an incident the previous season where it somehow fetched up on the boulders of a stone seawall in light winds. Routine repair work took care of the minor glass damage to the bow knuckle and rudder as well as the dings on the keel. The following year there were occasional complaints of water in the boat but the owner could not find a leak. When the boat returned for additional repairs, we found spaces between hull and liner full of water that could not drain to the bilge to be pumped out. A small access hole was cut, the retained water pumped out and the boat left undisturbed overnight. The next day a quick check revealed a dry bilge. We had the dreaded intermittent leak on our hands.The break in this case was noticing a water stain on the quarter berth bunkboard adjacent to the transom. Sure enough, when two people were in the cockpit (or the aft berth) the transom edge rested below the waterline and seepage began with most of the water disappearing between the inner liner and the hull. On this boat, the hull and the one-piece transom/deck are bonded together at the lower transom edge. Minor grounding the previous season had delivered a blow to the transom via the rudder and caused the bond at the transom bottom to crack slightly. A barely visible hairline crack in the flange edge was the only visual damage. Grinding out and rebonding the joint fixed the leak.

Lesson learned: To find an intermittent leak, duplicate the load conditions of normal use.

Puzzle of the Glue 26

Following a good run, this pocket power cruiser gave the owner fits by often depositing a gallon or two of water on the cabin sole at the bottom of the companionway stairs. The engine compartment, however, remained dry and the boat generally did not leak a drop when sitting at the dock. Eventually, during a test run, water was spotted trickling out from under the fridge. Removal of the fridge revealed a small, open thru-hull in the side of the hull at least 12" (30.4cm) above the waterline. The fitting was not connected to anything but was probably the icebox drain once upon a time before someone installed the fridge. Now, at a certain speed, it would catch a bow wave and funnel water into the boat. We solved the problem by capping the thru-hull.

Lesson learned: Just because a fitting is above the waterline when the boat is at rest, don't assume it will be so when underway.

Frustrating Farm 36

This well-equipped, full-keel cruising sailboat arrived by truck one day and was launched by the lift. Wait a minute, this boat leaks! (Owner says it didn't before.) Water visibly trickled down from under the inner liner from somewhere ahead of the keel on the starboard side. All seacocks and hull fittings proved to be dry. The boat was hauled and cradled and the hull examined carefully. There must be a hole in it somewhere but no hole was to be seen. Alas, we decided to again launch the boat for more leak tracing. This time interior things were dismantled and inspection holes opened. The rivulet was followed further back to the source: a completely inaccessible spot under a tank. This time we were waiting as the boat was hauled. Again, no sign of a hole but wait, what about under the lift sling? The boat was cradled yet again, the slings dropped, and there (hidden by the sling during the second haulout and by the cradle pad during the first haulout) was a tiny chip in the gelcoat through which protruded the shiny end of a stainless steel screw. This overlong fastener held an interior subassembly and was not supposed to be in contact with the hull. We speculated that one of the truck's cradle pads was placed in this location and the pad flexed the hull inward enough to allow the screw tip to work its way through the hull during trucking. In the end, it took hours of investigation and four haulouts to find a sneaky little problem that was cured by a minor glass repair.

Lesson learned: If all other hypotheses prove impossible, the only remaining one, even though improbable, must be correct. We were right the first time, there was a hole in the hull but it was hidden.

Scary Iceberg 37

This boat had been in the shop for a long time refitting for that cruise of a lifetime. Lots of new equipment and a new engine had been installed plus massive batteries, extra tanks, windlass and an all-chain rode, radar arch, etc. Now the work was done but things were behind schedule and there was no time for a shakedown cruise. A 20-knot wind on the beam set perfect conditions for an overnight passage down Lake Ontario. One item that had not been looked at during the refit was the electric bilge pump. ("It works fine," said the owner.) The pump's discharge thru-hull was aft on the hull side just below the sheer, ordinarily a perfectly good location. But this boat was heavily laden and being driven hard, frequently putting the leeward deck awash. Unfortunately, the quarter wave was big enough to keep the bilge pump discharge (on the leeward side) below water most of the time and unknown to the crew, water was siphoning back into the bilge. Some time after midnight the problem was discovered when the immersed batteries began to fail and, by then, the boat was feeling sluggish. The floorboards were awash by the time sail was taken in and the boat was (manually) pumped out. No leak could be found. Sailing resumed and finally, cold lake water could be seen gurgling from the submersible bilge pump deep in the keel sump. A check-valve solved the problem but the discharge thru-hull was later relocated to the transom. (Ed: ABYC does not recommend installing a check valve on a bilge pump discharge hose. Should it stick open, water will siphon back into the boat. Better to install a vented loop.)

Lesson learned: What is above versus below the waterline will vary considerably due to load and sea conditions.

Why Boats Sink, Part Two — Inboard/Outboards

In the November 2006 issue of BoatU.S. Magazine*, Part One of "Why Boats Sink, Outboard Powered Boats" appeared. This is Part Two, focusing on why inboard/outboards sink.*

Surprisingly, I/Os with leaking bellows accounted for 44% of sinkings at the dock.

Inboard/outboard (I/O)-powered boats and outboard boats are similar in design; some manufacturers sell the same boat with a choice of I/O or outboard power. However, research by *Seaworthy* on insurance claims revealed that the reasons for sinkings are vastly different.

While outboard-powered boats tend to sink at the dock due to cockpit arrangements that allow rain to accumulate faster than it can be drained by the scuppers, I/Os' weak link — 44% of the time — is the rather delicate connection between the inboard engine and the outdrive known as the bellows.

And while outboards sank underway 32% of the time due to taking water over the gunwales or, most often, the transom, I/Os sank underway 36% of the time due to striking a submerged object.

The bellows or boots — pleated, flexible rubber membranes — run between the engine (the "I") and partially submerged outdrive (the "O") to seal the transom where cables and shafts pass through. They work well, but have one weakness: Bellows have a limited lifespan. Many boats have more than one bellows (driveshaft, shift cable, exhaust, etc.), any one of which has the potential to sink the boat. The study showed that bellows leaks account for 44% of sinkings at the dock and 20% of the sinkings underway. A bellows that is over five years old is living on borrowed time.

All bellows should be carefully inspected for cracks at least annually, more often in a hot, sunny climate. If one bellows shows signs of wear, all of them should be replaced.

And don't take any chances with bellows clamps; replace them whenever the bellows are replaced.

Thirty-six percent of underway sinkings in the study were caused by boats hitting submerged objects such as a rock, a sandbar or a floating log. A woman in Florida hit an alligator with her 19-foot boat, which immediately started taking on water. Not wanting to sink near an angry alligator, she gunned the engine and made a mad dash toward shore. The boat sank a few feet from land, and the woman was able to walk to safety ashore.

Extra vigilance is required after heavy rains, when debris is most likely to wash into the water. On the flip side, lake drawdowns can expose such things as previously hidden stumps; reduce speed and check with the local water authority to find schedules. And slow down in unfamiliar areas; it's better to mangle a prop than tear off an outdrive.

The *Seaworthy* study also found that 15% of dockside sinkings were caused by water back-flowing through the scuppers into the boat. Rain will add a lot of weight quickly if the scuppers are clogged, and it is especially important with low-profile boats to use a garden hose to keep them clear and free-flowing. If you opt to wet-store your boat over the winter, plan on visiting frequently to make sure snow and ice aren't collecting in the cockpit. An alternative is to fit the boat with a snug cover that directs water and snow overboard. Finally, a high-water alarm is also useful, but make sure the battery stays fully charged so it can be heard.

One cause of sinking that isn't unique to I/Os are leaks from below-waterline fittings. Only bronze and Marelon fittings meet the American Boat and Yacht Council (ABYC) standards. A few sinking claims were caused by overheated engines melting rubber exhaust pipes. Anytime the engine overheats, exhaust hoses and clamps should be carefully checked.

Poor docking arrangements accounted for 11% of I/O sinkings. In some cases, a boat's outdrive snagged on the dock at low tide and then caused the boat to fill through the scuppers as the tide came in. These types of sinkings can be prevented by making sure lines to the boat are tight enough to keep the boat safely away from the dock, but also loose enough to allow for tides. Spring lines can help; so can flexible fiberglass mooring whips. Note that when all else fails, it may be easier to simply move the boat to a larger slip.

A few sinkings also occurred because *someone* forgot to insert the drain plug when the boat was launched. When that someone is likely to be you, a simple way to jog your memory is to tie the plug to your ignition key.

Because their transoms don't require cutouts, boats with I/Os aren't as vulnerable to taking water over the transom or gunwales as their outboard-powered counterparts (32% for outboards). But, I/Os aren't immune to swamping — 12% sank from taking water over the transom or gunwales.

— *By Chuck Fort*

Great Fall Reading — Seaworthy*, the 274-page book by editor Robert Adriance, Jr., collects the best true stories from 20 years of BoatU.S. insurance claims files. To order a copy, go to Amazon.com. Subscriptions to the quarterly magazine* Seaworthy *are $10 per year. For more information, go to BoatUS.com/Seaworthy or call 703-823-9550, ext. 3276.*

DIESEL

Lube Oil: The Blood Of Diesel Life

The leading causes of damage to a marine diesel engine are oil contamination, poor oil selection or improper oil level. Here's how to prevent such damage and select the proper oil for your engine.

By Larry Blais

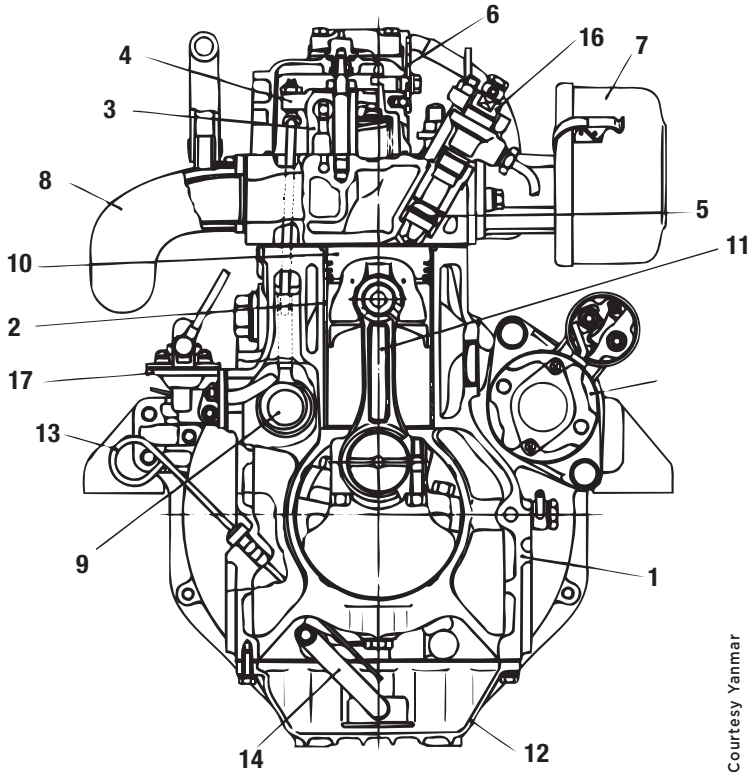
A diesel engine is put to its toughest duty in a pleasure boat. Not so much from use but from the lack of use. These engines often lay dormant for long periods and then start and run, usually at a temperature cooler than the ideal. Maintaining healthy engine oil under these conditions may be difficult but it's necessary to get the normal life from the engine. Rarely do marine engines wear out with use. They are just not run enough to die from exhaustion. They do, however, often wear out abnormally or suffer damage because of oil contamination, poor oil selection or improper oil level.

By far, the leading cause of oil contamination is water entering the engine through the exhaust. Seawater can back flow through an improperly designed or installed exhaust system or a leaking water jacket (for more details on exhaust systems refer to "Exhaust System Primer" in DIY 2004-#1). Over-cranking during engine starting can pump seawater into the waterlift in a wet exhaust system, eventually flooding the engine through the exhaust.

Condensation and Combustion

Another cause of water contamination is condensation. Since most bilges tend to be humid, moisture can enter the engine through the crankcase ventilation system when the engine is not running. This small amount of water is rarely a problem unless the engine is subjected to long periods of dormancy.

SIDEVIEW OF A YANMAR 2 GM (1985)



Courtesy Yanmar

Engine cross section: 1 Cylinder body; 2 Cylinder liner; 3 Valve rocker arm support; 4 Valve rocker arm; 5 Precombustion Chamber; 6 Decompression lever; 7 Intake silencer; 8 Exhaust manifold; 9 Camshaft; 10 Piston; 11 Connecting rod; 12 Oil pan; 13 Dipstick; 14 Lubricating oil inlet pipe; 15 Starter motor; 16 Fuel injection nozzle; 17 Fuel feed pump.

A far greater source of condensation is combustion gasses. When a hydrocarbon (HC) like diesel is burned, it is oxidized when the carbon (C) atoms are united with oxygen (O) atoms to form carbon dioxide (CO_2) molecules and the hydrogen (H) atoms are united with oxygen (O) atoms to form water (H_2O) molecules. The carbon dioxide is in the form of an expanding gas and the water is in the form of an expanding superheated steam. Both supply the force to push the piston down the cylinder inside the engine. However, some of these combustion gasses will leak past the piston and into the crankcase. Automotive diesel engines that are run regularly rarely have a problem with these "blow-by" gasses because the small amount that enters the crankcase remains hot enough to be vented out of the crankcase before it has much of a chance to condense. Marine engines usually run cooler, being thermostatically controlled to operate at temperatures below 160F (71C) to prevent minerals, phosphates, sodium, etc. from separating out of the raw water (especially saltwater) and collecting on the hot metal surfaces of the cooling system, thus hindering the transfer of heat to the cooling water. This colder running temperature results in a colder crankcase that in turn promotes condensation. On engines equipped with an oil cooler, the crankcase temperature may be even lower promoting even more condensation. Add to this the fact that pleasure boats typically experience greater blow-by because long periods of dormancy allow the cylinder castings to change shape due to internal casting stresses without the piston rings having the opportunity to wear enough to seal to the new shape and all this adds up to even more water condensing in the crankcase and contaminating the oil. A side note: most marine crankcase ventilation systems vent these gasses into the engine's air intake. Engines with excessive blow-by may run rich, as these inert, blow-by gasses displace needed oxygen in the air intake, especially at higher power settings.

Cold Start-up

Another way marine engines suffer from long periods of dormancy is bearing damage at start-up. The longer an engine sets without turning, the more the oil tends to drain out from between the crankshaft and the main and rod bearings, between the cam and the lifters, between the pistons and cylinders, etc., leaving a thinner and thinner film that may not keep the metal surfaces from colliding and rubbing when the engine is cranked and started, resulting in metal loss from these surfaces. If boat owners had any idea how much damage is done when starting an engine that has sat for more than a few weeks, they would not hesitate to install a pump to pre-lube the engine before turning it over.

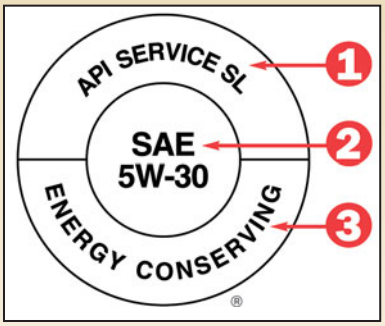
Reducing Soot

Soot is another major oil contaminate that can be easily reduced in most pleasure boat engines, especially sailboat engines. Soot is created when diesel fuel is not completely oxidized in the combustion chamber. Diesel fuel is designed to ignite at about 250F (121C) at normal atmospheric pressure and, under pressure, the ignition point is somewhat higher. The temperature required for complete combustion in the combustion chamber is very high, over 1,000F (535C). Most soot that contaminates engine oil is the result of improper warm-up and operation. Diesel engines generate the most soot when under no load because the gasses inside the combustion chamber will never reach the temperature needed for complete combustion even when the cooling water registers 160F (71C). Running a diesel in neutral at the dock for long periods produces lots of soot that will foul the combustion chamber and contaminate the oil. Running in gear at the dock will lug the engine, which can be even worse.

In most engines, this soot can be sharply reduced by following these simple practices. Run a diesel without heavy load as little as possible. This means, start and warm up the engine at the dock just long enough to be able to maneuver without heavy clatter or the engine dying. Once in open water, slowly increase the power over a five-minute period until the engine reaches full throttle. (Note that this will only be possible if the propeller is properly pitched to the boat and the engine just reaches the upper rpm limit of the governor at full throttle in gear.) Run at full throttle until the exhaust becomes perfectly clear. This indicates that the combustion has gotten hot enough to burn diesel fuel completely and has burned out the soot that accumulated during warm-up. If the exhaust doesn't appear clear in 15 minutes, there is probably something wrong with the engine and it should to be checked. Now, throttle down the engine to cruise. If the engine is to be shut off, such as on a sailboat where the sails are to be hoisted, the engine should be brought slowly down to an idle in gear over a period of about 10 minutes before it is turned off. This allows the engine to cool evenly.

Need for Oil Analysis

Needless to say, engines produce small amounts of wear metals during normal operation. Some of these are too small for a full-flow oil filter to catch. At some point, as these wear metals accumulate in the oil, the oil must be drained and replaced. Oil analysis will reveal the amount of these wear



API Service Symbol (1) Performance level: oils designed for diesel-engine service fall under API's "C" categories. (2) Viscosity: the measure of an oil's thickness and ability to flow at certain temperatures. (3) Fuel economy rating for oils intended for gasoline engines only.

metals contaminating the engine oil, which will help determine when the oil needs changing or if the engine is in trouble and needs to be inspected. (For more information on oil analysis refer to "Oil Test: Troubleshooting with Oil Analysis in DIY 2003-#3.) Fleet operators often extend their oil change intervals beyond the manufacturer's recommended interval with the aid of oil analysis. Sometimes, by fitting engines with fine micron by-pass filters and running premium oils such as synthetics, operators can extend their oil change intervals even more.

What About Synthetic Oils?

In short, the hydrocarbon molecules in a good synthetic oil are designed and chemically created (usually by joining short chain hydrocarbons into long chains) to posses certain superior qualities of lubricity, anti-oxidation, etc., especially at very high temperatures, while conventional oils are mostly hydrocarbon molecules extracted from crude oil plus some impurities and some enhancing additives. Few topics about engines seem to excite so much passion and debate as the topic of synthetic oils. One of the few things that everyone seems to agree on is that the current synthetic oils on the market are not even close to being the same. In normal operation, some have proven to be far superior to even the best conventional oil and others are actually semi-synthetic blends of mostly conventional oil. In abnormal circumstances, such as starting after long periods of dormancy or seawater contamination, some synthetics have proven to offer more protection than conventional oils, others less.

Unfortunately, the typical pleasure boater hasn't been able to take advantage of the longer oil change interval of a good synthetic oil mainly because of oil contamination from blow-by, etc. Also, boaters simply do not run their engines enough in a lifetime for the engine to really benefit from the superior lubricating properties of a good synthetic oil. In practice, a quality conventional oil of the proper type and weight has proven to be adequate in most marine engines. [Ed: Only use oil that is specified in your owner's owner.]

Selecting Oil

Here are two easy steps to select the best oil for your engine and for the conditions that you will be running it in. Almost all modern engine oils are classified by the American Petroleum Institute (API) by their API Service Categories,

Diesel Engines

Category	Status	Service
CI-4	Current	Introduced September 5, 2002. For high-speed, four-stroke engines designed to meet 2004 exhaust emission standards implemented in 2002. CI-4 oils are formulated to sustain engine durability where exhaust gas recirculation (EGR) is used and are intended for use with diesel fuels ranging in sulfur content up to 0.5% weight. Can be used in place of CD, CE, CF-4, CG-4, and CH-4 oils.
CH-4	Current	Introduced in 1998. For high-speed, four-stroke engines designed to meet 1998 exhaust emission standards. CH-4 oils are specifically compounded for use with diesel fuels ranging in sulfur content up to 0.5% weight. Can be used in place of CD, CE, CF-4, and CG-4 oils.
CG-4	Current	Introduced in 1995. For severe duty, high-speed, four-stroke engines using fuel with less than 0.5% weight sulfur. CG-4 oils are required for engines meeting 1994 emission standards. Can be used in place of CD, CE, and CF-4 oils.
CF-4	Current	Introduced in 1990. For high-speed, four-stroke, naturally aspirated and turbocharged engines. Can be used in place of CD and CE oils.
CF-2	Current	Introduced in 1994. For severe duty, two-stroke-cycle engines. Can be used in place of CD-II oils.
CF	Current	Introduced in 1994. For off-road, indirect-injected and other diesel engines including those using fuel with over 0.5% weight sulfur. Can be used in place of CD oils.

Courtesy American Petroleum Institute

Listing of current API Service Categories. Refer to your owner's manual before using any oil as oils may have more than one performance level.

which are then displayed on the oil container in a circle shaped label. Check your owner's manual for the right classification for you engine. Most four-cycle diesel recreational boat engines call for CF-4, CG-4, CH-4, and/or the new CL-4 service categories. If your engine is older, the classification my have become obsolete and replaced by a new category. Check the chart above for the current category(s) that can be used in place of the obsolete ones.

In the center of the API Service Symbol (above) the SAE viscosity grade appears. For years we were shown charts that indicated what grade (or weight) of oil should be used when the ambient (surrounding) temperature was within a certain range. A straight 40 weight was shown to be appropriate in ambient temperatures from about 63F (17C) to 120F (49C) and a straight 30 weight was shown to be appropriate in ambient temperatures from about 36F to 95F (2.2C to 35C), etc. This implied that a lighter weight (or more viscous) oil was needed in colder climates to allow the starting motor to crank the engine and a heavier weight oil should be used in hotter climates. In the actual use of most oils at various temperatures, the chart has turned out to be quite misleading. This was due in part because the original Society of Automotive Engineers (SAE) test to determine the grade number had nothing to do with ambient temperature. The oil and apparatus was heated to the boiling point of water before a measured quantity of oil was timed to see

how fast it could empty through a capillary tube and then this time in seconds was rounded to the nearest grade number. The grade indicates the viscosity of the tested oil at 212F (100C), not at any ambient temperatures shown on the chart. Since different oils thicken as they get cooler and thin out as they get warmer at different rates, this test does not reveal the true viscosity of the tested oil at either the cranking temperature nor the running temperature, which in a marine engine usually hovers around 160F (71C) but can range from below 50F (10C) due to an oversized oil cooler in cold water to over 212F (100C) in an engine that needs an oil cooler. In 1997, SAE implemented new testing procedures that it improved in 1999 to more accurately represent an oil's qualities under various conditions. The biggest improvement concerns what we now call multigrade oils.

What's in "W"

Multigrade oils have two grade numbers with a "W" between. The first grade number represents the results of SAE cranking and pumping tests at very low temperatures. For example, the 10W grade cranking test is conducted at a -25F (-32C), the pumping test at -30F (-34C). Most of these oils contain additives (usually polymers) to help them attain these low temperature qualities. The grade number after the "W" is determined by the minimum kinetic viscosity at 212F (100C). Single grade oils have just the one grade number and it's determined by a range of kinetic viscosity at 212F (100C). Mainly because of the limited mature of the SAE tests, other organizations have developed their own methods of grading oil viscosity. Unfortunately, they are virtually unknown to the general public.

Oil Sense

With all this said, what a marine engine really needs is an oil that will lubricate during cranking without overloading the starter and will still adequately lubricate at running temperature. Experience has shown that a high quality straight 30 weight conventional oil of the proper API service category will do this job quite well in most marine diesel engines regardless of the ambient temperature. How is this possible? What if the ambient temperature is cold enough that the chart recommends a 20-weight oil? Just remember that it is very hard on a diesel engine (and usually futile) to attempt starting it in ambient temperatures below the range of a straight 30 weight without heating the engine in some way. If the engine is equipped with a heater such as a block heater, the heater must raise the temperature of the engine up into the range of a straight 30 weight if it has any hopes of helping the engine start. If the ambient temperature is high enough that the chart recommends a 40-weight oil, just remember that the temperature of the oil inside a warmed up engine, where it is really doing its job, will normally be about 160F (71C), close to the temperature of the cooling water thermostat, regardless of the ambient temperature around it.

Once an oil has been selected and installed in the engine along with a good quality oil filter, don't forget to check the dipstick regularly and then change the oil and filter at least once a year.

ELECTRONICS

ELECTRICAL FAQ

John Payne, DIY's electrical advisor provides solutions to questions concerning batteries and 12-volt power systems submitted to DIY's Technical Helpline

Edited by Jan Mundy

Note: Due to an illness, John was unable to prepare the scheduled article on "Isolating Multiple Battery Banks." This will appear in an upcoming issue.

Demystifying Battery Options

Q: My boat has four batteries, one each for starting the twin main engines. The remaining two start the genset and provide 12-volt power when away from the dock. The main engine batteries are group 27 combination starting/deep-cycle batteries as are the house/genset batteries. With the flip of a switch the main engines charge the start batteries while underway and the house batteries can help start one main engine in an emergency. I also have a parallel switch to provide emergency starting power between port and starboard engines. Presently, the two house batteries are hooked up in parallel and I need to replace them. The battery sales people I have spoken to aren't much help from a technical perspective and I'm getting mixed opinions from other boat owners. So far, there is lead-acid verses gel, 12-volt verses 6 volt hooked together in series, Group 27 verses 31 to improve capacity or just replace with Group 27 deep-cycle, lead-acid batteries. I'm unable to make an informed decision based on function verses cost.
Ron M. Gabriel, "Obsession," Newport, Rhode Island

A: You are actually correct in looking at cost benefits and the decision very much depends on the type of boating you do. You do not say how long the existing house batteries lasted. If you really have a capacity problem, then upgrading is a good idea. In most cases, capacity problems can be resolved with improved charging systems. If you don't have a problem and your boating use pattern is not changing, then keeping the same capacity is sensible. The use of two 6-volt golf cart type deep-cycle flooded cell batteries is one option provided regular maintenance isn't a problem and, you are using a high quality marine battery charger while dockside. With a good regulator to ensure complete charging, these are fairly bulletproof and should have a long life, depending on usage. AGM batteries offer some advantages over gel but they are expensive. To keep costs low, my first recommendation is two Group 27 deep-cycle batteries. Next option is two 6-volt deep-cycle batteries for more power if you need to upgrade. Option three is to purchase Group 27, AGM batteries, for a straight change out. Remember that your battery charger must be able to be set to charge the type of batteries you are using.

Link Charging Multiple Batteries

Q: I have bought a Link 10 battery monitor and would like some info as to the best way to install it on my 1989 2557 Bayliner Command Bridge. The alternator gives 52-amps output and there are two 160 Ah deep-cycle batteries and a one-two-both master switch. I would like to dedicate one battery to starting and one to house loads. How do I wire the Link to charge both batteries?
Alex Loudon, "Argyll," Johannesburg, South Africa

A: The Link 10 monitor manual contains information that you should consult. The main use for a Link 10 is on the house battery bank and the Link 10 not rated to take the starting currents used by engine starter motors. The common starting and charge line generally goes to the "common" of the battery switch. You select position one for starting and then switch to both when running to allow both batteries to charge. Finally, switch to position two for just house bank charging. The Link 10 amp meter shunt input goes into the house bank switch output (usually you select position two as the house battery output) to the battery and this then takes the current input and output to the house battery bank. I presume that, in your arrangement, the start and charging line are single cable back to the battery and not two separate lines.

Sizing Battery Switches

Q: I have two 200-amp batteries and cannot find a switch to handle this setup. I have found a heavy-duty switch with settings for one, two or both that handles 360 amps. If I have it on "both" that would be 400 amps. An on/off switch won't work, as it doesn't allow me to charge a selected battery. Any ideas?
Steve Camp, "Argo," Athens, Greece

A: The switch should be more than enough to meet your needs. Switches are based on the maximum current carrying capacity and you have to verify whether this rating is continuous or intermittent. The switch is not rated for the battery you install but must be rated for the current that will flow through it and the attached cables. While the battery may be a 200-amp hour (not

amps) and the cold cranking amps (CCA) may be around 500 plus, this is not the criteria. A starting motor typically draws 60 to 100 amps, so a switch must meet this value, as should the cable, as a minimum. The switch rating is normally 360 amps for either set of contacts being maximum rating for any combination of one, two or both. Even if a 200-amp battery is connected to one and two, the maximum current that is liable to flow through the 360-amp rated switch contacts is 100 amps, if starting motor uses that much, though it can momentarily peak higher in the initial starting surge for a fraction of a second but this is not an issue.

Limiting Outboard Charging

Q: My new boat has two AGM batteries and is powered by two Yamaha 9.9 hp four-stroke outboard motors with an output voltage of 15 volts. Such a high voltage can result in overcharging of the batteries. The problem is that only one wire is used between the engine starter charger and the battery(s) and current must be able to flow in both directions. How do I install a battery charge controller (or regulator) that allows two-way current flow and disconnects motor charging voltage when the AGM batteries have become fully charged and still maintain a connection to the battery for starting? Though this boat uses separate starting and house banks, charging must support both batteries and can be changed via switches. At the moment, a separate AGM-sensitive charger that operates from shorepower is used to charge the batteries but is bypassed when motoring.
Herbert King, "Tango," Belleville, Ontario

A: There is no way to regulate or control the output where the output is using the same line. In most cases, as the charge output is connected internally, the best way is to have a technician separate the charge output line within the outboard. A new and separate line is then used to bring charging out to the batteries. There are charge control devices that can then be used within that charging line that will limit the voltage to the battery and some dual output units can enable a cross-connected system between each of the batteries. For an AGM battery, you will have to come back to around 14.3 volts maximum. An alternative is to install a diode in the charge line output to reduce charge voltage to 14.3 volts. It's highly unlikely that you will cause any overcharge of the batteries given the relatively small charge output and large battery size. For the dual battery setup, the charge line from each outboard can simply be split through a small diode isolator to each battery so you get some overlapping redundancy. This dispenses with the requirement for switches

Battery Picks for Battery Banks

Q: I'm replacing the house battery bank in our 43' (13m) sailboat and will be installing four or five batteries hooked up in parallel. I'm aware that it's important to use batteries of the same type, age and condition. Since I want to limit the depth of discharge of the bank, is it also important to use the same size of batteries, i.e. all 4D, so that all the batteries in the bank are discharged the same amount?

Frederick Feldbauer, "Temerity," Willsboro, New York

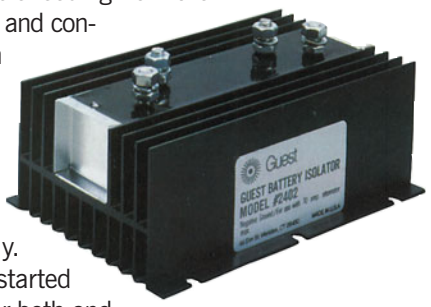
A: It's necessary to work out a system based on the load requirements of your boat. You should aim for a maximum 50% discharge before recharging and use a charge setup, e.g., an alternator rated to the required charge. This would be coupled to a quality alternator controller. Any setup in a boat like yours will have the start battery and house batteries, ideally consisting of two battery banks. Each of these two banks would be around 210 amp hours (Ah) each (i.e. two 105 Ah batteries in parallel), one bank carrying electronics, etc. and the other larger for powering electrically more demanding or "noisy" loads. Ideally, they would then charge off the same power source via an isolator system. Planning any system is an exercise in analyzing all the requirements and balancing them. In practice, you will find that one of the house banks will discharge more than another and this is not a problem if the charge configuration is simple and effective.

Installing a Battery Isolator

Q: I want to install a battery isolator together with an extra battery in my ski boat. How do I do this?

Richard Bidleman, "Xta-Sea," Bethel Island, California

A: This is an easy task. Install the new, additional battery adjacent to the existing battery in a suitable battery box. Install the battery isolator close by in a protected position. Take the existing cable feeding from the battery to the engine and connect to the common of the switch. Install a new cable from each battery to the one and two terminal of the battery switch respectively. The engine can be started from either battery or both and, when charging the battery bank, stays on both. The house power supply to electronics, etc., should go off one battery and the supply should be connected to the new battery terminal two on the switch. When you leave the boat, turn the stitch to off and all circuits are then disconnected.



Sweet Water

A boat owner's guide to potable water tanks, piping, and the prevention and correction of odor and taste problems.

By Sue Canfield

Are potable water quality problems a continuing irritant aboard your boat? Do you avoid drinking the water from your storage tanks? Do you begin every weekend afloat by carrying gallons of bottled water onboard? If so, it's time to take the "Sweet Water Challenge." The rewards for doing so are well worth the effort.

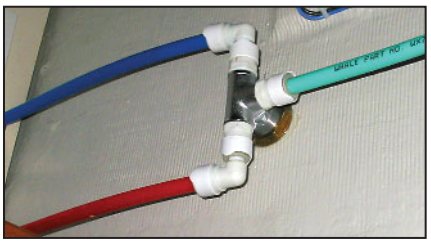
When diagnosing onboard water quality problems (taste, odor and color), start with your water source ashore. Ensure that your boat carries a drinking water safe, Food and Drug Administration (FDA) approved garden hose and use it to fill your tanks whenever possible. Let the water run long enough to completely flush the hose, then taste, smell and observe the color of a water sample before filling your boat's tanks. If the quality of your usual water source is sub-par, install an appropriate onboard water treatment system much as you would at home.

Water treatment systems can be used to remove taste and odor as well as sediment, rust, algae and other microscopic solids. Point-of-use (POU) systems treat water at a single faucet. Point-of-entry (POE) systems treat water as it's drawn from the storage tanks or enters the boat via a municipal water inlet. The efficacy and cost of filtration units varies widely. Before you buy, review the product's Performance Data Sheet, which lists the contaminants the unit has been certified to remove and to what percentage. Compare both initial product and replacement filter costs. For consumer information on water treatment systems, visit www.epa.gov/safewater. For a list of certified products and a comparison chart of leading brands, go to www.waterfiltercomparisons.net.

Based on my experience as a boat owner and marine surveyor, I'd have to say that most water quality problems are not source related. More often, they stem from poor water system design or installation practices, the use of inappropriate system components and/or improper system maintenance.

Design and Installation

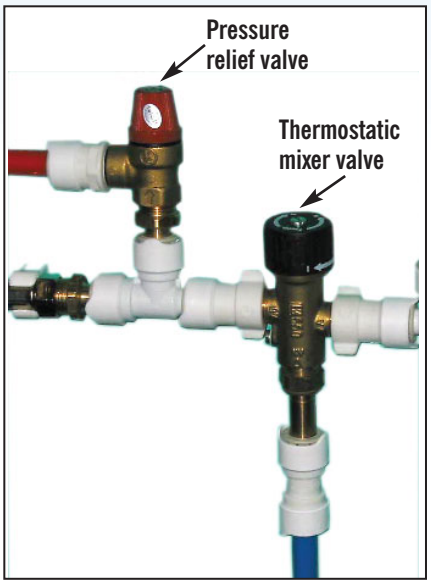
System design and installation practices are key to minimizing the potential for contamination. Among other things, the American Boat and Yacht Council's recreational marine industry standard, "H-23, Installation of Potable Water Systems," requires drinking water systems to be totally separated from any contact with water used for other purposes. For example, H-23 prohibits the use of a Y-valve to allow a potable water pressure pump to also function as a bilge, sump or saltwater pump. It requires all potable water system components (including piping) to be installed above the normal bilge water level. It also requires that storage tank vents be designed to prevent contamination by excluding overboard water, insects and other foreign objects.



Quick connect plumbing: Cut tubing, insert into fitting and push together. Tubing is rated for extreme cold or hot temperatures. Connectors and hose can be reused.

If your boat has water contamination problems, check to ensure that its water system design and installation are consistent with the ABYC standard. If you own a sailboat, ensure that the storage tank vent is not located in the hull topsides where it may be subject to immersion when the boat is heeled. Water tanks can be safely vented inside a boat if the vent fitting is located above the level of the storage tank inlet. A copy of the ABYC standards book is available for reference at the customer service desk at many marine stores; individual copies of H-23 can be purchased online at www.abycinc.org.

Reinforced potable water hose is opaque rather than clear to prevent algae growth, which leads to off-taste and foul smelling water.



Thermostatic mixer valve inserts into the coolant feed line to the heat exchanger from the engine. Sensing bulb attaches directly to the upper side of the hot water tank.

Key Components

ABYC and FDA require that materials in contact with potable water be non-toxic and corrosion resistant and not impart any undesirable taste, odor or color. So, let's consider those system components that are key to water quality, starting with what H-23 calls the "storage tank inlet." (Marine stores typically call them deck fills or deckplates.) To prevent contamination from entering the tank, the inlet should be located as far as practicable from fuel tank fill and sewage pump-out

PLUMBING

Vetus water heater has a double copper wall to transfer heat fast and keep it hot longer.

Reinforced hose is used to plumb this shower sump.

Replacement water pressure pumps, like this Flojet Sensor8, deliver superior performance, quiet operation and water on demand regardless of the number of open faucets (no more cold water bursts while showering).

Vetus flexible tanks make ideal replacements for deteriorated metal tanks or carried onboard for extra water capacity, then rolled up and stowed when not needed.

fittings, preferably in a vertical plane, and have a liquid-tight screw cap fitted with some type of tether to prevent its loss overboard. The inlet should be permanently and clearly marked "Water" to minimize the possibility of contamination with gasoline or diesel fuel. Believe me, it happens. I once had a crewmember inadvertently top off my boat's diesel tank with potable water.

Many boats also have a separate municipal water inlet. By connecting a drinking-water safe hose between a municipal water inlet and a faucet on shore, you can have a continuous source of pressurized water without having to fill your tanks or operate the water pressure pump. Municipal inlets too should be clearly labeled "Water" and have a liquid-tight screw cap.

The 1-1/2" (38mm) ID hose typically plumbed between the deck fill and storage tank should be labeled "FDA-approved" for use in potable water systems.

Water storage tanks on boats are most commonly rotomolded plastic (linear polyethylene) or welded stainless steel (preferably corrosion-resistant type 316L or 317L). Although not acceptable to ABYC, given their propensity to corrode, aluminum water tanks are used as well. A relatively small number of boats have fiberglass (composite) tanks made with resins not approved by the FDA for potable water storage. If your boat's aluminum or composite tank is still giving good service, however, it need not be replaced simply because it is ABYC or FDA non-compliant.

When a replacement water tank with a capacity of 50 gallons (189L) or less is needed, FDA-approved rotomolded polyethylene is typically your best and least expensive option. These tanks are lightweight, come in a wide variety of shapes and sizes and won't corrode. If properly cared for, they'll last for the life of your boat. Since it's technically difficult to include full baffles in rotomolded tanks, large tanks, say 50 gallons (189L) or more are usually custom-welded polyethylene or stainless steel. Welded polyethylene tanks have been known to burst their seams, so look for an experienced fabricator who warrantees its product. A recent Google.com search for "marine plastic tanks" yielded a number of custom fabricators.

FDA-approved flexible bladder tanks, which can be rolled up and stowed away when not in use, are an attractive option for boatowners seeking additional water storage capacity. A flexible bladder may also prove to be the most suitable replacement for an oddly shaped, deteriorated metal tank.

Storage tank vent lines, normally 1/2" (12mm) or 5/8" (16mm) ID hose, should be labeled "FDA-approved." While clear or reinforced clear FDA-approved PVC hose is frequently used for this purpose, it's far better to use hose that's opaque. If no light can get into a potable water system to promote the growth of algae, its contents should remain clean and drinkable almost indefinitely. Be sure that the vent hose runs on an upward slope to the vent fitting. Any low spots can trap water that will block the air trying to get into the tank as water being drawn out, thereby causing suction problems at the pressure pump. Flexible bladder water tanks do not have to be vented since they can readily collapse without being damaged.

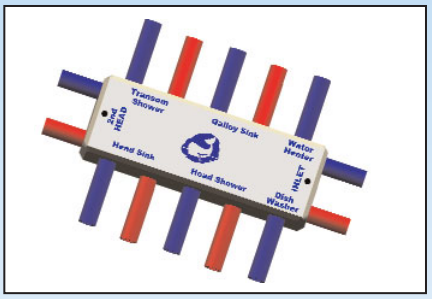
Raritan water heater is available in 6, 12 and 20 gallon (23L, 45L and 75L) models for engines with or without heat exchangers.

Seagull IV X-1F undersink water purifier from General Ecology removes foul tastes and odors, and meets EPA Federal Standards for microbiological purifiers for water-borne organisms. It works without the use of electricity, added chemicals or producing wastewater.

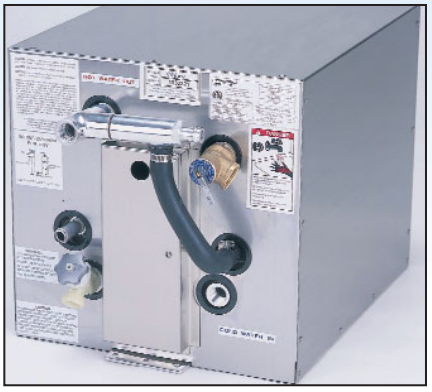
Water distribution lines should be labeled "FDA-approved" and opaque, given that systems plumbed with clear hose will be prone to water quality problems. If you're upgrading the potable water system on an older boat, use one of the new quick-connect plumbing systems from Flair-It, Flojet, Sea Tech or Whale. Flexible red and blue color-coded piping can be readily cut to length with a sharp knife and the system assembled using quick-connect fittings that require no additional tools. Copper tubing will also work well, but it can corrode, is far harder to work with and costs more too.

CALORIES BURN HEAT

In some parts of the world a water heater is refered to as a "calorifier," which comes from the word "calorific," meaning to produce heat, and "calorie." Websters defines a small calorie as the amount of heat needed to raise the termperature of one gram of water 1C and large calorie refers to 1 kg of water 1C. Translating this to heat, 1 gram calorie/second equals 14.286 BTU per hour. Hot stuff!



Water manifold reduces number of thru-hulls and resultant holes drilled below the waterline in your boat.



Force 10 6 gallon (23L) water heater.

System Maintenance

Potable water systems require minimal maintenance, especially if assembled using appropriate materials. Be sure to carry spare deck plate O-rings, a replacement deckplate screw cap or plug and extra stainless-steel hose clamps. Lubricate deckplate O-rings and check water system hose connections and clamps annually for evidence of leaks and corrosion.

Always disinfect your boat's potable water system at the start of each boating season. Before starting, ensure that the water heater is turned off at the electrical panel. Icemakers should be turned on to allow the feed line to be disinfected. Remove any POE or POU filter cartridges as well as any aerators at faucets. Flush the entire system with potable water and then drain it completely through every faucet. Next, fill the entire system with a chlorine solution having a

Chlorine Calculator

ABYC H-23 recommends that potable water systems be disinfected using a chlorine solution with a strength of at least 100 parts per million. Unfortunately, H-23's chlorine calculator uses 1% sodium hypochlorite rather than household bleach (typically 5% sodium hypochlorite). Instead, I use the U.S. Navy's Manual of Naval Preventive Medicine chlorine calculator, a portion of which is excerpted below:

For 5% Liquid Sodium Hypochlorite

Quantity (gal/litres)	50PPM	100PPM	200PPM
100/379	13oz/384m	26oz/769ml	52oz/1538ml
50/189	7oz/207ml	13oz/385ml	26oz/769ml
25/95	4oz/118ml	7oz/207ml	13oz/385ml
10/38	3Tbsp/44ml	3oz/89ml	6oz/177ml
5/19	5tsp/25ml	2oz/59ml	3oz/89ml

The complete table can be viewed at www.vnh.org/PreventiveMedicine/Chapter6/6.25.html
For a discussion of the Navy's tank cleaning procedures, visit www.vnh.org/PreventiveMedicine/Chapter6/6.22.html

strength of at least 100 parts per million (see "Chlorine Calculator" above). Allow this solution to stand for at least 1 hour. Drain the entire system again, flush it thoroughly with potable water and discard the first two buckets of ice generated by the icemaker (if installed). Fill the tanks with potable water, clean the sediment filter installed to protect the pressure pump, install new treatment system cartridges as appropriate and replace any aerators at faucets.

If your boat's water tank is stainless steel, open the access port at the end of the boating season and inspect the interior with a bright flashlight. Look for evidence of corrosion that typically starts at welded seams and baffle plate welds. If there's enough corrosion present to materially affect the taste, odor and/or color of stored water, replace the tank during the off-season. Given the difficulty and expense that can be involved in replacing corroded metal tanks, it's no wonder many boatowners procrastinate or install a taste/odor filter as a stopgap measure. However, it pays to be proactive. Water leaking from pinholes in the sides or bottom of a metal tank can produce significant damage in adjacent structural members (and wood veneers) over time.

At the end of the boating season, check your water heater and icemaker owner's manuals for the manufacturer's recommended winterization routine. Drain the water system completely. Then, with all drains and faucets open, use an air pump to blow any residual water out of the system. Alternately, pump a 30% to 50% non-toxic (propylene glycol) antifreeze solution through the system. Marine stores typically offer an assortment of winterizing accessories, such as water heater bypass kits, hand pumps and blow-out adapter plugs that fit your boat's municipal water inlet (if one is installed).

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

POWER BOAT RIGGING

Decommissioning Your Sterndrive Power Package

An organized approach to preparing your sterndrive-powered boat for lay up over the winter or for long-term storage.

By Steve Auger

Materials

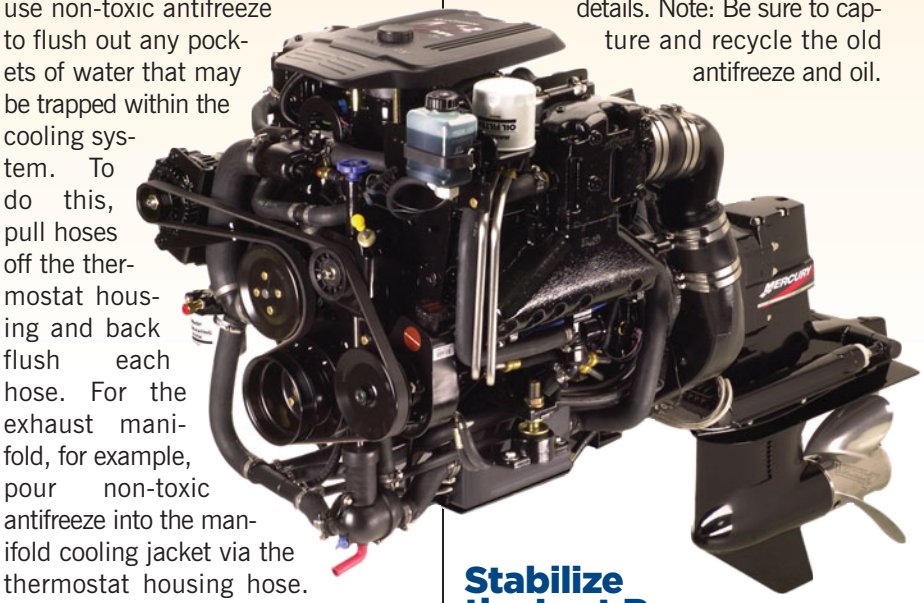
- Anti-corrosion spray
- Engine storage seal
- Ethylene glycol antifreeze
- Fuel stabilizer
- Marine engine oil and filter
- Non-toxic propylene glycol antifreeze
- Service manual
- Sterndrive unit gearlube
- Two-cycle motor oil

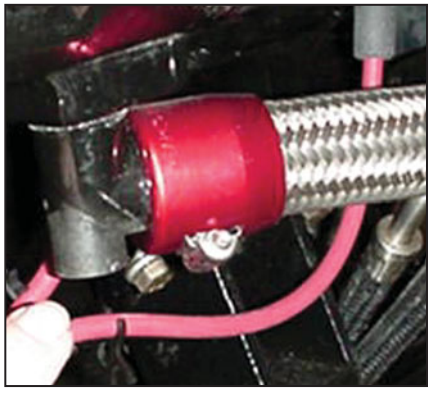
I'll not dwell on a step-by-step procedure for laying up your sterndrive as this varies for each manufacturer. Instead, I'll discuss the boat care products you're going to need and their basic applications, followed by the service procedures in the order I would normally proceed with winterizing.

Mandatory is a service manual for your specific power package. Besides detailing complete procedures, this publication will warn you of the personal safety hazards associated with each procedure. A service manual also identifies all drainage points for the cooling system and supplies the fluid capacities of the different systems. Follow the procedure for each process as outlined in your service manual and the chances of a surprise when you relaunch are greatly reduced.

De-Freeze with Antifreeze

You'll need 1 gallon of the non-toxic propylene glycol antifreeze (3.78L) for each small engine (2.5L through 4.3L engines), 2 gallons (7.57L) for V-8 engines. Never use ethylene glycol for winterizing the raw-water cooling system, as it's a highly toxic environmental pollutant. You do not have to fill the engine block with anti-freeze. Instead, use non-toxic antifreeze to flush out any pockets of water that may be trapped within the cooling system. To do this, pull hoses off the thermostat housing and back flush each hose. For the exhaust manifold, for example, pour non-toxic antifreeze into the manifold cooling jacket via the thermostat housing hose. You'll first see water flushed out then the non-toxic antifreeze appears. Once you see the antifreeze reinstall the manifold drain plug and reconnect the hose to the thermostat housing. Follow this procedure for each component of the cooling system. Using this procedure reduces or eliminates dumping antifreeze into the water on engine startup when relaunching the boat.





Location of manifold drain plug on this engine.

Engines with closed cooling require ethylene glycol antifreeze. Drain and replace the coolant every two years or 300 engine hours. Modern closed cooled (also call freshwater cooled) sterndrives, 1998 and newer, use antifreeze, called Dex-cool. This product can be used for up to 5 years or 500 hours before replacing. Each engine manufacturer has a specific procedure for draining and refilling the closed cooling system. So, you guessed it, refer to your service manual for details. Note: Be sure to capture and recycle the old antifreeze and oil.

Stabilize the Last Run

Adding fuel stabilizer retards the degradation of the octane in the automotive gasoline used in modern marine engines. Automotive fuel doesn't have a very long shelf life in a vented tank before the octane level starts to drop below the minimum acceptable 87 octane rating for marine engines. Refer to the stabilizer instructions for fuel-to-stabilizer ratios for both summer usage and off-season lay up. Add fuel stabilizer using the off-season storage ratio to the tank prior to running the engine for the last time and bring the engine up to operating temperature. This gets the stabilizer through the entire fuel sys-

Preferred liquids for long-term storage.

Outboard tank containing "storage soup" connects to fuel inlet on engine.

tem before the boat goes into storage. Adding it to the tank later only protects the fuel in the tank but not the remaining components of the low-pressure delivery fuel system.

Feed the Fuel System

Mix two-cycle outboard motor oil at a ratio of 24:1 with premium fuel in a 2-gallon (7.57L) portable outboard motor fuel tank. Add fuel stabilizer and you have an electronically fuel-injected fuel system winterizing "soup." This replaces the fogging oil used on carbureted engines in the past. This mixture protects both the high-pressure EFI fuel system and engine internals unlike fogging oil, which never addressed the fuel system and has become the most common area for failures after recommissioning. Remove the fuel line running from the boat's built-in fuel tank to the engine fuel inlet fitting and plug the hose temporarily (cover with a plastic bag and seal the open end). Now connect your outboard tank fuel line to the fuel inlet on the engine. Before taking the next step, be sure to ventilate the boat to remove all gasoline vapors that may have accumulated as you opened the fuel system. Start and run the engine at idle for 10 minutes. Shut down the engine and remove the outboard tank and line. Reinstall the boat fuel line to the fuel inlet on the engine and tighten the clamp. Your fuel system is now winterized. This process can be performed in the water or with the water intake on the sterndrive on a flushing device. When you're finished with the "soup," store the container properly, never on the boat.

Engine storage seal is added to carbureted models only. This process can be performed in the water or running on

Evacuate engine oil via the dipstick using a vacuum oil change pump and replace oil filter, lubricating the seal on the new one before installing. Be sure to protect the engine with anti-corrosion spray.

a flushing device. Inject storage seal into a warm engine idling at 1,000 rpm directly through the carburetor during decommissioning to protect engine internals. Never use storage seal on EFI engines. It plugs up the idle control valve and creates a stalling problem.

Oily Facts

Automotive oil or filters are not meant for marine engines. Use only oils recommended by your engine manufacturer and stay away from cheap oil. Instead, purchase a brand name, e.g., Mercury or a name brand as advised in your owner's or service manual.

Warm the engine to operating temperature and then shut it down. Use a vacuum pump (available from most marine retailers or DIY ONLINE at www.diy-boat.com) to remove the engine oil via the oil dipstick tube. Remove the oil filter and replace it with a new one. Lube the oil filter seal with a film of motor oil (do not use grease) and hand tighten the seal on the engine. Pour 2/3 of the correct motor oil into the engine oil fill. Start and run the engine at idle for 60 seconds. Using the oil gauge (dipstick) as a guide, add small amounts of oil until the oil is up to the full mark on the oil gauge (dipstick). Be sure to capture and recycle the engine oil. This process can be performed in the water or on a flushing device.

Once you are done working in the engine compartment, coat the entire engine with a film of silicone anti-corrosion spray protectant. This reduces corrosion of the engine compartment components while the boat is in storage.

(top) Hand pump with threaded end (shown attached to an outboard gearcase) makes easy work of changing sterndrive gearlube. Always fill gearcase from bottom. (bottom) Modern sterndrives typically run on a high performance gearlube.

Drive Maintenance

There are two types of oil for the sterndrive unit, hypoid and semi–synthetic, also known as High Performance gearlube. Once again, stay away from the cheap stuff. Pay the extra money for the gearlube that is specified in your service manual. It has the additives that prevent water from mixing with the oil to reduce the damage caused if water gets in the drive. It's a "pay me now or pay me later" investment. A replacement drive starts around $6,000. Some older OMC drives are electric shift and require specific oil. Modern Mercruiser drives use High Performance gearlube. When purchasing gearlube, invest in the 1 quart (946ml) bottle and the hand pump accessory. If you have a current sterndrive, this allows you to fill the drive from the bottom (drain screw) until the oil pours out the vent screw at the top of the drive without having to switch to another bottle as you would if you used the squeezable tubes of gearlube. If your drive requires more oil, you can simply unscrew the bottle from the pump and install a new bottle without the oil running out of the drive. Older sterndrives have up to four different reservoirs for gearlube. Once again, your service manual is the best source of information for the correct draining and refill procedures for your drive system.

Service Procedures

Here is the order in which I would normally proceed with winterizing. Again, refer to your service manual for specific instructions and safety hazard warnings.

Step 1
Fill fuel tanks with fuel and add the correct amount of fuel stabilizer. Start and run the engine(s) until operating temperature is achieved.

Step 2
Shut off engine and change engine oil and filter.

Step 3
Close the fuel shut off valve (if so equipped) and install your fuel system winterizing mix (in the outboard motor tank) and run the engine for 10 minutes.

Step 4
Run the engine on a flushing device.

Step 5
Clean flame arrestor and PCV hoses, if equipped.

Step 6
Lubricate all grease fittings as recommended in your service manual. If your drive has universal joints, give them a shot of grease as well. Don't forget to purchase a drive gasket installation kit, if required.

Easy dispenser pump attaches to marine lubricant to grease zerk fittings (shown with an outboard).

Check service manual for location of seawater drain plug.

ADDITIONAL READING

"Stern Drive Lay-up and Start-up," DIY 1999-#3 issue
"Stern Drive Alignment," DIY 2002-#2
"Common Winterizing Mistakes," DIY 2003-#3

Step 7
Drain the seawater section of your cooling system. Your service manual will guide you to these drains as they are usually well hidden.

Step 8
For freshwater cooled engines, check your closed coolant, with an antifreeze tester. It should read a freeze temperature of -35F (-37C) or colder. If the coolant needs replacing, follow the guidelines in your manual for draining, refill and bleeding the air from the closed-cooling system.

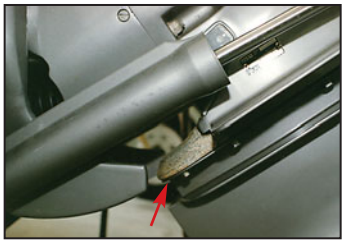
Closed coolant tank.

Step 9
Drain and refill the sterndrive unit with gearlube recommended in the service manual. Alternatively, you can store fully charged batteries onboard provided they are checked monthly and charged as needed. A discharged battery will freeze, which renders it useless.

Step 10
Remove and charge batteries. Store in a warm (above 32F/0C) location.

Step 11
Clean and paint any exposed metal on the drive and or transom assembly.

Step 12
Replace sacrificial anodes if 50% or more consumed.



Drive anodes come in various shapes. Carry exact replacements for your engine.

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.

ELECTRONICS

Satellites At Sea

Iridium Motorola 9505 satellite phone has a small antenna, which can be a nuisance on board but is easily replaced with a factory-installed cone antenna attached to a stern rail or post. With a usage rate of US$1.20 per minute, using compression software (details at www.uuplus.com) accelerates transfer time.

Watching TV, surfing the web, e-mail and phoning from your boat while at sea has become a reality.

By David Anderson

Hockey, baseball, the Weather Channel, news and the latest movies ... over 200 channels of entertainment can come streaming into your boat via a marine satellite antenna, all while you're still at sea, even in the roughest waters. As your boat pitches, yaws or rolls, fast-acting correction mechanisms adjust antenna position to keep the antenna locked on your chosen satellite. Even a small system can maintain a reliable satellite link in heavy seas and high winds.

A tracking antenna controller makes acquiring the right satellite service easy and lets you keep up with new services as they are added. To receive a picture, simply enter your current position, pick a satellite and the system does the rest. Alternatively, the system will search the sky for you. All you do is sit back, relax and watch TV, just as you do at home.

Sea Tel (www.seatel.com) offers a range of direct broadcast satellite (DBS) and direct-to-home (DTH) systems with radome-enclosed dishes ranging in size from 18" to 48" (48cm to 122cm). Model 1898 is for boats 30' (9.1m) and longer, model 2498 for ships 50' (15.2m) and up and model 3098 for boats over 60' (18.2m). All three models feature full stabilization, high performance, CONSCAN tracking, marine durability and ultra-quiet operation. When properly mounted, there is minimal interference from a sailboat's rigging and a perfect picture is often possible, even when the dish is partially obstructed by the mast. The principle difference between the systems is that the larger dish sizes provide for greater coverage area while at sea and have less attenuation due to rain, fog, snow and ice.

Designed for power and sailboats as small as 30' (9.1m), the 1898 unit features an above-deck radome that measures 21" (53cm) high by 20" (51cm) in diameter, contains an 18" (48cm) diameter antenna dish and weighs 33 pounds (15kg). Below decks, the 1898 connects to 12-volt DC current and features a small (3" x 5"/7.6cm x 12.7cm) panel-mounted control unit for operating the system. In the U.S., model 1898S uses circular polarization and works equally well with DIRECTV, USSB and Dish Network. In Europe, model 1898E uses linear polarization and receives all the new digital services from Astra, Eutelsat and Orbit. Suggested list price is US$5,395.

What about Voice and Data?

A variety of maritime voice and data products and services are also available. With a maritime satellite voice and data system, you can send and receive telephone calls using a satellite network. When all other forms of communication fails, a satellite phone works flawlessly, even in storm conditions. Using a WaveCall antenna system mariners can access Internet-at-Sea services through a simple click of an icon or pick up the phone and place or receive a call from virtually anywhere in the well-traveled world.

You can connect an ordinary telephone to WaveCall with the standard phone cord in the same way you do on your home telephone line. The data connection is equally simple with no additional modem or network card required. Basic configuration of a Windows operating system allows the computer to access the Globalstar constellation of 48 low-earth-orbiting satellites (LEOs). In North

(top) Sea Tel model 1898 is designed for power and sailboats as small as 30' (9.1m). (bottom) Interior of 3918 Sea Tel antenna.

America, the earth station gateways are equipped with a dedicated high-speed Internet connection allowing you to use Globalstar as an Internet Service Provider (ISP) to connect to the Internet or to log onto your existing ISP account.

System Components

Typical system components include a radome assembly containing both a transmitter/receiver and an antenna, a below-decks interface assembly to connect the radome assembly to a telephone and computer, a 12-volt DC Power supply capable of sourcing at least 3 amps to provide the operating power required by the radome assembly via the interface assembly that has a display/control panel. You'll also need a two-wire telephone, a computer with a standard serial (COM) port for 9600 bps (baud per second) Internet data, e-fax and e-mail usage, interconnecting antenna and data cables and components to ground the radome and interface assemblies in accordance with

proper grounding practices for marine electronics equipment.

Basic Satellite Information

Satellites move and are "visible" for about 10 to 15 minutes. Because you don't know what part of the sky the satellites will be in, you must be in a location where the antenna can see as much of the sky as possible. The Radome assembly should see the entire sky down to 10° above the horizon all the way around the antenna.

Satellite systems use high frequency microwave signals that are strictly line of sight. This means they do not go through or around dense objects like a mast or superstructure and they won't pass through or around objects adjacent to your boat, such as buildings and hills. If something gets between the satellite and your antenna, your phone won't work until an unblocked satellite is received or you move to a better location.

Radome Mounting Location

On small boats, selecting a mounting location for the radome is usually a compromise. This will usually be atop an arch or a cabin roof. The antenna must be at least 5' (1.5m) away from other transmitting antennas that can generate signals that interfere with the radome. Although radio and radar interference is not common, the further the radome assembly is from these other antennas the less impact their operation can have on it. The radome assembly should be rigidly mounted to the boat.

Telephones

If you provide your own telephone, choose one that employs standard DTMF tones (industry standard tones), not pulses, for dialing. In addition, your telephone must use standard tip and ring wiring. For optimal results, your telephone should have good voice quality. Sound quality is determined both by the telephone, and the signal reception. You may need to try several phones before achieving the best result. You can have the equivalent of extension phones, sharing a line but make sure that the total REN (ringer equivalency number) of all connected phones does not exceed a REN of 5.0.

Computers

To use the data capabilities of the system, you will need a computer with an available COM port. This port connects directly to the data port on the below decks interface assembly using a standard DB-9 serial cable. The computer needs to be properly setup for packet data operation to work with the system and you will probably want to install some special SatSpeed software that significantly enhances data throughput. SatSpeed is an Internet Compression Service exclusive to WaveCall that allows users to upload and download files 3 to 5 times faster. For example, using SatSpeed software a 9.6 kbps-rated modem operates like a 56K landline modem.

Airtime Rate Plans

A variety of rate plans are available for the continental U.S. and the Caribbean. With no roaming or long distance charges on calls to or from Canada or Mexico, Plan 400 is popular with cruisers.

Other Options

KVH Industries also offers a line of marine satellite television and telephone products. With antenna dishes ranging in diameter from 18" to 32" (46cm to 81cm), KVH Tracvision products are compatible with all modern TV satellites. KVH offers a full range of Inmarsat airtime services. More information is available at www.kvh.com.

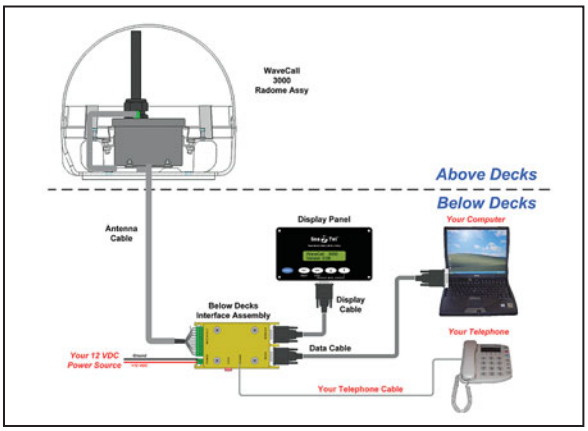
The low-profile design of the TracVision C3 satellite TV antenna from KVH is ideal for hardtops, houseboats, workboats and canal boats. It works with any high-powered DIRECTV and DVB-compatible satellite in North America and Europe.

Globalstar offers a range of products and services to support voice or data communications for all sizes of marine vessels. Service areas currently extend over 200 miles (322 km) or more off virtually all-coastal areas in North and South America, Europe, Australia and East Asia. Service has recently been expanded to cover most of the North Atlantic and broader reaches of the northeast Pacific. Globalstar mobile satellite phones allow for communications both at sea and on land. More information is available at www.globalstar.com.

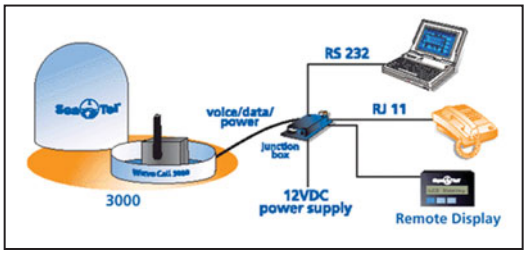
The Iridium Satellite System provides a range of global mobile satellite voice and data solutions with complete coverage of the Earth (including oceans, airways and Polar regions). The service is well suited to mariners wishing to communicate while crossing oceans. More information is available at www.iridium.com.

With these products and services, Satellite TV entertainment, voice communications and Internet access truly are available virtually anywhere you choose to go.

Photograph illustrates a typical sailboat mounting arrangement atop a stern arch.



Typical system components.



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

Besides knowing a boat's age and engine hours, here's what you need to consider, including boat type and usage, hull construction, structural problems and mechanical damage, before refitting or restoring a fiberglass boat.

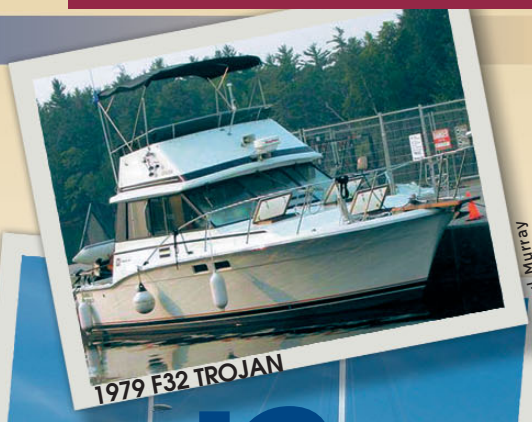
Beauty or Beast?

By Nick Bailey

The refit or restoration of an old boat is one of those endeavors that appears to have no practical value but can be very satisfying emotionally to the appreciative eye. Everyone takes notice of a gleaming mahogany runabout or gaff-rigged wooden sloop that typify the world of antique and classic boats. Nonetheless, fiberglass has been around for over 50 years and has become the recreational boat builder's material of choice. Now that some are old enough to qualify as "classic," old glass boats sporting impeccable urethane paint jobs are beginning to get their share of the oohs and aahs.

Despite the fact that wooden boat restorers wear their heroic mantle proudly and snort at the notion that an old glass hull could present serious refit obstructions, in comparison to fiberglass, the nature of wood construction simplifies hull repairs. Wood hulls may be made from biodegradable materials but at least they have replaceable parts. The restoration of a wood hull can be carried out one plank or rib at a time. If the ongoing replacement of degraded parts is carried out diligently, there is no theoretical upper time limit to how long a wood boat will last. Nelson's flagship at Trafalgar, "HMS Victory," is about to undergo a multi-million dollar refit using oak grown from acorns planted at Nelson's orders 200 years ago.

Unfortunately, a fiberglass hull is practically monolithic, a "one shot" deal and, if the hull is just plain tuckered out, what can you do? There are a few options for structurally repairing the whole hull but none of them are easy and may make a refit impractical. You don't usually get the option of just slipping it into a new hull. Like wood, glass hulls are not immune to the forces of nature but, in this case, it's not biology but chemistry and physics working against them. The two destructive agents at work on a glass laminate are: moisture, which can attack resin or seep into cored laminates, and flexing, which not only breaks individual glass fibers but also causes layers of glass or core to de-bond and separate, an evil known as "delamination."


1979 F32 TROJAN
Paul Murray


TRANSWORLD 42
Richard Asztalos


1970 MFG EDINBORO
Dino Pinch


1968 CASCADE 29
Donald Boone


1973 ALBIN 25
Bert Small

ABOUT POLYESTER CHEMISTRY

Polyester is manufactured by pressure-cooking a mix of glycols and dibasic acids to form long chains of multiple ("poly") ester molecules. These molecules have multiple reaction sites to bond and form strong cross-linked chains with each other. However, not all the reaction sites are used up so the resulting solid material is said to be "unsaturated" or capable of further chemical reactions. The quality of this original cooking process has a lot to do with just how unsaturated the polyester resin is while in service. To make a liquid resin, this solid unsaturated polyester base is dissolved into a monomer, usually styrene. The styrene monomer is also unsaturated and is designed to react with the polyester base in the presence of a catalyst. The boat builder mixes the catalyst with the resin during the lay-up process and the result is a solid, relatively saturated or unreactive resin. I say relatively, because the cross-linking process that takes place when conventional polyester resin cures at normal room temperatures is normally only around 80% complete. Poorly manufactured resin or improper catalyzing can result in a higher percentage of unlinked reactive sites. Many of these open reactive sites are quite happy to take up stray water molecules that find their way into the layup and this allows hydrolysis to begin. Today, more production boat builders are using dicyclopentadiene (DCPD) polyester or vinylesters. The high-end builders routinely post-cure epoxy hulls under vacuum in an autoclave. All of these approaches yield a more water-resistant hull.

The heavy solid glass hull of this classic mid-60s Cheoy Lee is a good refit candidate.

Minor osmosis is no immediate threat but shows hydrolysis is at work. Time for a barrier coat before things get worse.

Blisters Casebook

Once upon a time people thought fiberglass hulls were inert in contact with water. Glass fibers are but, over time, some polyester resins proved to be surprisingly soluble (see "About Polyester Chemistry," left). Water molecules penetrate into a susceptible laminate by seeping through the gelcoat and wicking along the glass fibers. Once in contact with the resin,

They don't build 'em like this anymore with 2"- (5cm-) thick solid glass!

Wet core below the waterline means major repairs.

Repairing a delaminated area on the hull of a lifeguard rescue skiff.

the water can react with soluble polyester components (mostly glycols and dibasic acids that are not fully bound or cross-linked into the polyester), a process known as hydrolysis. The hydrolytic process picks apart the polyester molecules and the resin begins to leach away. A microscopic droplet of leachate solution (consisting of water and those pesky polyester components) collects in one of the tiny voids or air bubbles that exist in all glass laminates. Additional moisture is drawn in by osmotic action, the droplet grows and eventually a blister forms. As the process continues, the hull develops a classic case of osmosis blisters. A minor case of blisters is a cosmetic problem and affects only the gelcoat. A severe case forms big blisters deep inside the laminate, which can lead to major hull delamination and weaken the hull to the point of being unseaworthy.

Blisters can be repaired but the cost is high and the prognosis iffy. The conventional blister repair technique of drying the hull, removing the gelcoat and, in the worst cases, layers of leached laminate, finally re-skinning the boat with new laminate and/or an epoxy or vinylester barrier coating usually works. This traditional repair strategy does not correct any problems with the fundamental resin chemistry but concentrates on repairing the existing damage and denying moisture access to the laminate from the outside. Moisture can still get into a susceptible laminate from inside the boat via condensation, bilge water etc. and, unfortunately, there are hard cases out there that refuse to stop blistering even after a good conventional repair.

In theory, weak resin chemistry can be improved. The patented HotVac (www.hotvac.com) technique uses heated vacuum blankets to suck the moisture out of the laminate while simultaneously heating and post-curing the resin. The elevated temperature of the post-cure cycle reactivates the polyester to form additional cross-linked molecular bonds. Theoretically, this means less soluble leftovers to get involved in hydrolytic reactions.

Core Contents

Cored hulls can suffer from hydrolysis and the resulting osmosis blisters are at risk of a far more dramatic problem resulting from poor workmanship or abuse. If the core lay-up is not well sealed during construction and/or someone drills a hole for an aftermarket thru-hull below the waterline and does not seal it properly using the potting technique, water will seep into the core. It may take years on a quality hull to saturate a significant area. In cold climates, the process is accelerated by frost heaving that can debond the core from the inner or outer glass skin. All core materials are degraded by water absorption but balsa wood core is particularly vulnerable to long-term saturation. If caught early, while the balsa is still sound, it may be possible to dry the core, otherwise major surgery is required. This involves removing either the inner or outer skin, digging out and replacing the old

core material and re-skinning the repair area. Depending on the extent of the problem and the quality of the boat, this sort of repair can be more expensive than a blister repair but on a great boat may still be worth doing.


1970 SWAN 40

Sue Canfield

Hull Flexing

The other great killer of fiberglass hulls is flex (stress). Motorboat hulls take a constant beating and are built as lightly as possible to encourage quick planing. Over the years, the mechanical characteristics of the hull laminate degrade as each wave impact (or pothole encountered while trailering) bends the laminate and breaks another tiny glass fiber or knocks it loose from the grip of the resin. Gradually, the hull loses stiffness and becomes more and more flexible. Stress cracks appear at stringers, bulkheads and running strakes. Eventually, delamination occurs as the bond holding the individual laminate layers together fails. A delaminated powerboat hull won't survive long in normal service. Major cracks extending deep into the laminate will soon appear and with them the risk of a catastrophic hull failure. This usually occurs when the edge of an athwartship crack snags the high-speed water flow on the bottom and a piece of the hull is instantly peeled back. At a time like this, you are lucky if the missing chunk is just an outer layer of a multi-layer laminate.


1975 GULFSTAR 41


1975 C&C 24


1963 RHODES RANGER 28

Sue Canfield

Sailboats can also suffer from accumulated mechanical damage inflicted by years of use and abuse. Everything from bashing through a short chop on the way to a weather mark to improper cradling can contribute to a global loss of stiffness in a hull and eventually to areas of delamination. The good news is sailboats don't suddenly rip open very often. Mechanical damage to hull laminates can be repaired but can be a daunting job, technically and financially. It's just a matter of grinding out delaminated areas and laying in new fiberglass, plus filling and fairing etc. If the whole hull is tired, in other words just too flexible throughout, you are faced with a job that is equivalent to building a new hull using the old one as a male mold.

Selecting a Refit Candidate

So, it seems that a fiberglass hull can slowly dissolve and/or get beaten to death. Is this the fate that awaits them all? If so, when? No one really knows how long a glass hull will last. It all depends on an almost infinite number of variables and the answer will be different for each boat. If you are planning to refit any glass boat, it should be surveyed carefully. You need to make an educated guess about the hull longevity of your potential refit candidate before going to all that time and expense. Get a surveyor to help with this assessment.

Despite the fact that glass hulls vary widely, you can make some educated calculations based on the following factors. First, is the quality and type of original construction. Generally thicker and heavier is better than thinner and lighter. Many early glass boats were built to the same thickness as their wood predecessors. Other than hydrolysis and blister issues, not much goes wrong with these old heavy hulls . A hull from a high-end builder will usually last longer than one from a budget boat builder. Everything else being equal, you get what you pay for. High quality cored construction (if properly maintained) is much stiffer than solid glass of the same weight and can hold up very well in the long term, provided the core stays dry. One of the first successful balsa cored hulls, “Red Jacket,” was designed by C&C and built by Bruckmann to win at SORC in the late ‘60s. “Red Jacket” is still in top condition today, recently winning season championships in the Toronto, Ontario area. Nonetheless, be careful of old racing boats that feature an ultra-lightweight hull. These are very strong and stiff when new, but some were experimental and were never designed for a long haul.

Second is the boat's age, hours, history of use (or abuse) and maintenance experience. A boat that was hauled periodically will be less waterlogged and prone to osmosis; likewise for a boat with a good barrier coating. Beware of planing powerboats with high hours. Anything from the ‘70s has probably been beaten to death. Avoid all planing powerboats coming out of commercial, police or military service. Even a high quality hull can be thrashed in a few years by 2,000 hours of service annually. It would take an enthusiastic weekend boater five to 20 years (depending on the latitude) to put those hours on a hull.

Lastly, is the type of boat: power versus sail, high speed versus moderate speed. There are always exceptions but, to summarize, cruising sailboats and displacement powerboats age better than lightweight racing sailboats and planing powerboats.

Any glass hull can be repaired and renewed. It's just a question of whether it's worth it to do so. If Nelson’s "HMS Victory" or the "USS Constitution" had been built of fiberglass, I’m sure ways and means would be found to carry out the necessary repairs today. Some boats deserve to live forever be they wood or glass.

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

ADDITIONAL READING

"Buying a Used Boat," DIY 2002#2 issue
"Cored Hull Repairs," DIY 2000-#3
"Delamination: Diagnose, Cure, Prevention," DIY 2000-#3
"Hinging and Crack Repairs," DIY 2000-#3
"Repairs to Wet Decks," DIY 2002-#3

SAIL BOAT RIGGING

Leaking Keel Bolt Fixes

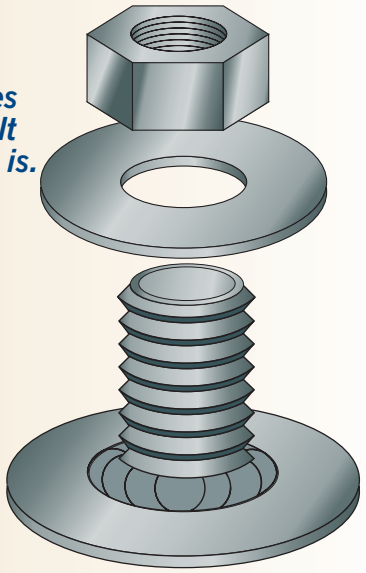
Once you've isolated the leaking offender you have three repair choices and they proceed from easy to difficult depending on how persistent the leak is.

Story and photos by Nick Bailey

There are three ways to repairing a leaking keel bolt — tighten the bolts, recaulk the bolt or drop and rebed the keel.

First, tighten the bolt(s). To tighten the keel bolt(s), a large socket wrench or torque wrench is required. (Refer to table on facing page for the torque recommendations). This may require a trip to your local tool rental emporium. This job is best done on the hard with the weight of the hull resting on the keel but it's initially worth trying while the boat is still in the water. Consider yourself lucky if the leak stops after the keel bolts are tightened.

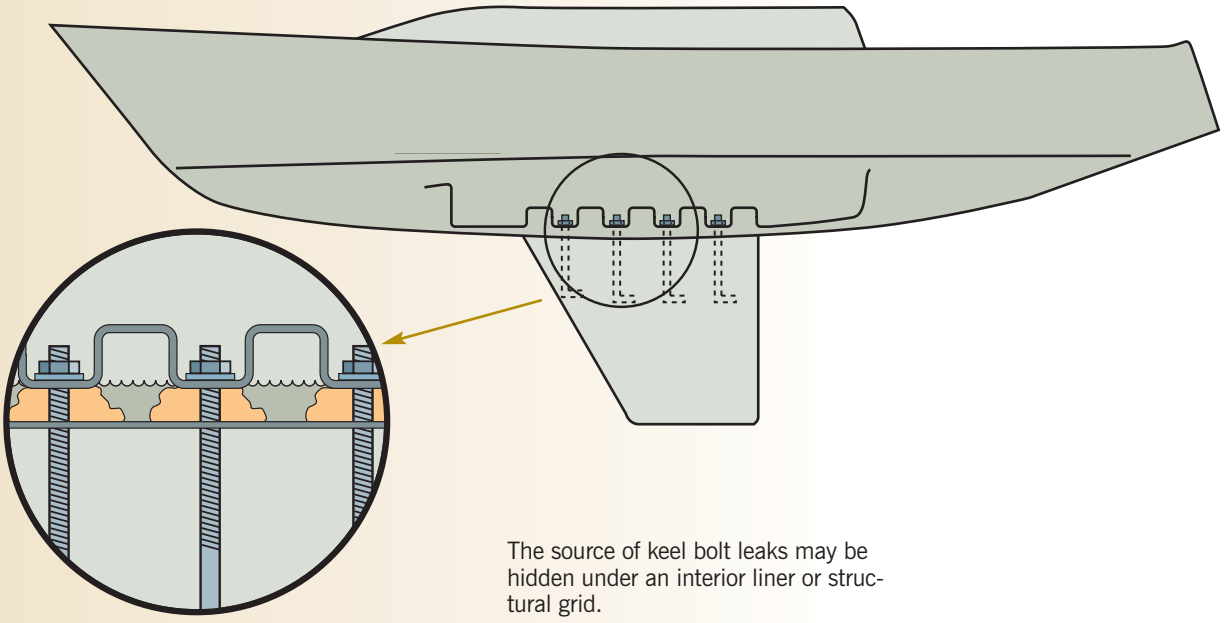
If tightening fails, the next step is to attempt resealing the leaking bolt(s) by adding caulking at the bolt and under the keel bolt washer on the inside of the hull. Remove the nut and washer from the keel bolt stud (or the bolt itself). Clean off the old caulking and jam paper towels around the keel bolt to absorb the water seeping in while you prepare to recaulk. Unfortunately, simple recaulking rarely works because the hydraulic pressure behind the seeping water is enough to push through uncured sealant and establish a leak path before the sealant cures. The trick here is to speed up the sealant cure and/or create a "cofferdam" that will hold back the leak long enough for the sealant to cure. This can be done in a couple of ways. One traditional method



Should retightening fail, try the inside reseal with 3M 5200 Fast Cure.

Typical top-end installation with backing plate and washer.

Adding sealant on the inside of a keel bolt may not always work.



The source of keel bolt leaks may be hidden under an interior liner or structural grid.

Keel Bolt Torque Specifications

Use this table to tighten stainless-steel studs in lead keels. Torque specs for other types may be different.

Bolt Diameter	Foot Pounds	Socket/Nut Size
0.50"	80	0.75"
0.75"	250	1.125"
1.0"	350	1.50"
1.25"	450	1.875"

Fin keel dropped ready for new selant and chocking epoxy.

is to extrude a bead of slow cure polyurethane sealant into a pail of hot water. This “shocks” the sealant into a semi-cured state and allows the bead to be picked up and handled like a sticky O-ring and wrapped around the offending bolt. The washer and nut are quickly reinstalled and the torque applied. If possible, the keel bolt is kept immersed in hot water to accelerate the cure. The newer method (sometimes used in combination with the hot seal technique above) is to cut a circular neoprene gasket about the same circumference as the keel bolt washer but with a center cutout large enough to allow a bead of fast cure polyurethane sealant, i.e. 3M 5200 or 4200 Fast Cure, between the neoprene and the bolt. When the steel washer goes on top and the nut is tightened, the compressed neoprene conforms to and seals against the hull like an O-ring and provides the required back-stop or cofferdam to retain the polyurethane adjacent to the keel bolt until it cures.

Realistically these two techniques can only be considered temporary solutions. In fact, they don’t work 50% of the time but are worth trying only because the next (and final) step to fixing a persistent keel bolt leak moves you into the category of major repairs.

When all else fails, it's necessary to remove the keel and rebed the matting surfaces. Rebedding the keel can be a big job but it always works. These steps to the cure include a haul out, unfastening all the keel bolts, dropping the keel and completely rebedding the keel. (Ed: For step-by-step details on rebedding a keel see "Replacing or Supplementing Keel Bolts" in DIY 2000-#1 issue and “After the Grounding” in DIY 2003-#4 issue).

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

Keeping the Log, Trip by Trip

"An ounce of prevention is worth a pound of cure." This trusted adage clearly describes the need to document all navigational and operational data onboard your boat. Recording your boat's aches and pains in a trip log can identify troublemaking before it advances to a major problem, thereby reducing operating costs and improving confidence in your boat, engine and equipment.

By Peter Pisciotta

As a professional delivery captain, I log about 12,000 nautical miles each year, frequently on newly commissioned boats with plenty of documentation aboard but precious little historical operating experience and information. When I step aboard, I can only guesstimate important information like average speed in calm and rough seas, fuel consumption at various speeds, oil consumption, electrical system capacity and equipment condition. Even when historical data is available from an owner, it may not be accurate. Fuel consumption assumptions, for example, are often low because they include lots of slow and idle time.

Commercial operators log all activities because it pays. A dutifully developed log spots emerging issues early, while they are easier to resolve. Like a patient's chart in a hospital, the information encapsulates detail that may not seem significant until sometime much later, when it fits as key part of a puzzle of symptoms. Not only does due diligence in log keeping reduce operating costs but a log also improves owner/operator confidence.

Preparing an underway trip log has consistently paid-off during recent deliveries I completed. Read on for some of the log entries.

"Twin engine motor yacht noted unusually low voltage, 12 volts instead of around 14 volts, with batteries charged and both engines running, which owner stated was normal. Generator was not operating correctly and, rather than leave with all electrical systems suspect, I repaired the generator. As it happened, the 12-volt wiring was a problem and we needed the generator."

"New 42' (12.8m) sailboat and a no-wind delivery that dictated lots of motoring. Owner's manual stated 60 gallons (227L) of fuel capacity. Measured tank and calculated 75 gallons (284L) thus enabling me to bypass a fuel stop and shave a day off the delivery."

"A delivery of a 57' (17.4m) trawler yacht from California through the Panama Canal. Because fuel consumption had been carefully monitored, I was able to put on only minimum load of fuel in Acapulco where fuel was expensive. The tanks were topped off in Panama with cheap diesel saving over US$700."

SAMPLE LOGS

Simple Chronological Log Monterey CA to Port Ludlow WA

DATE	TRIP LOG	POSITION LAT	POSITION LONG	TIME UTC	TIME LOCAL	Engine Hours	Comments
4-Jul-04	1191.6	36 36.150	121 53.405	0301	2001	270.7	Monterey - pre-departure inspection
							Yellow Paint Bait mark cleaned outside port pilothouse door
							All engine fluids checked - OK. Main #1 low fresh mark
							Minor salt water on deck port side of main engine
							Groceries - $53.72
				0400	2100	270.7	Depart Monterey
							Link pin between steering ram and rudder tiller arm. Tightened
5-Jul-04	1370.4	37 47.997	122 53.263	1804	1104	285.1	Suggest thorough check for bushing condition
	1284.1	37 69.690	123 01.965	2018	1318	287.3	Port propane bottle empty. Switched to starboard.
	1290.7	38 06.922	123 04.236	2123	1423	288.4	Compass light inoperable
				2200	1500		GENERATOR - Dinner 12.8 hours start
							GENERATOR OFF - 56.1 hrs
	1330.5	38 17.242	123 10.943	0405	2105	295.5	GPS Locked up - power cycled.
6-Jul-04	1383.1	39 25.7	123 48.5	1230	0530	306.4	Arrive Ft Bragg
							UPDATE: Traced port side engine room leak to leaking wing stuff box. Attempted to tighten - no results. Recommend repack at later date
8-Jul-04	In Port						
							Dishwasher Leak - Noted wrong tubing (non-reinforced vinyl hose) on HW supply. Hose is severly bulged. Recommend replace it with re-inforced hose adequate for HW installation.
15-Jul-04	DEPART	39 25.7	123 48.5	2300	1600	306.4	Depart Ft Bragg. Trip log non-op. Boat speed non-op.
							Noted two small leaks: Diesel on top of SUPPLY tank; Oil on head fitting
16-Jul-04	Log non-op	39 54.2	124 07.2	0330	2030	309.9	
							UPDATE - Repaired trip log. Pulled paddle wheel and cleaned fouling
17-Jul-04	1383.1	42 45.5	124 39.5	0350	2050	309.9	
							UPDATE - Repaired DH leak. Will test with HW tomorrow when generator is running
18-Jul-04	1446.5	43 39.567	124 32.391	1130	0430	341.4	GPS Locked up - power cycled.
19-Jul-04	1629.2	46 05.9	124 12.8	1100	0400	364.8	4.0 gph @ 1900 RPM - 30 minute consumption test
	1709.4	46 23.2	124 44.3	0230	1930	381.7	Cape Flattery
	1765.3	46 22.8	124 07.7	0600	2300	394.2	Neah Bay - $39.95 Moorage
20-Jul-04	1765.3	DEPART NEAH BAY		0900	0200		
							Inserted 2 rings of packing in Wing stuffing box. Recommend monitor for heat and leak.
20-Jul-04		Ran Generator 3 hours - laundry, dishes, etc.)					
20-Jul-04	1861.9	Arrive Port Ludlow				383.2	ARRIVE (Estimate) PORT LUDLOW
TOTAL HOURS						122.5	Average, 7.22 knots

FORMATTING A SIMPLE CHRONOLOGICAL UNDERWAY LOG

This journey was a relatively short seven-day, 900-nautical mile delivery from Monterey, California to Port Ludlow, Washington, near Seattle. An hourly navigation log (not shown) was hand written in addition to this combined log. All activities were combined. Note the minor repairs made and logged: replace stuffing box for wing engine while underway, replace leaking water hose for dishwasher and pull and clean the speed meter paddle wheel. For relatively uncomplicated vessels or short duration trips, a simple chronological log works fine.

What is an Underway Trip Log?

An underway trip log is simply a journal of salient data points, including mechanical information (engine hours, operating temperature, etc.), repairs, observations, weather and navigational data. It's periodically updated (perhaps hourly) because single data points are less useful than trends, so an ongoing log becomes more powerful as time goes by. In short, an underway trip log documents important shipboard activities in a manner that facilitates analysis.

There are three main categories of information in an underway trip log: navigation, mechanical and operational.

You may not need extensive information for all three categories or the boat may not have comprehensive data sources available (very few boats have fuel flow meters, for example). Decide what you need and see if you can find a way to measure it.

Navigation Log Keeping

There are three main reasons to gather navigation data: dead reckoning in case of electronics failure; planning landfall to avoid night-time arrival or avoid adverse tides or currents and accumulated mileage to calculate fuel consumption or speed over the bottom, a critical factor in all navigational data recording.

Most GPS and chart plotters have trip logs (I like to reset this to zero for long trips.). On an hourly basis, record the trip log, current time, latitude, longitude, course and speed. Now that electronic navigation equipment has mostly replaced the compass, you can chose to use degrees magnetic or degrees true. (I prefer degrees true, especially on north/south trips, but it means the compass heading will be up to 18 degrees different from electronic readouts.) If you are cruising internationally, make sure your GPS is set to the correct datum. Also, for trips that cross multiple time zones or time changes, consider using Universal Time Coordinate (UTC), also known as

Greenwich Mean Time or Zulu. Single side band and HAM radio schedules, Coast Guard radio broadcasts and weather fax schedules are often in UTC, so it's helpful to have one clock set to UTC.

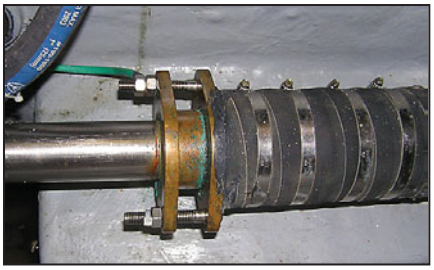
Consider reading "course" from the autopilot rather than a GPS (It should be the same but may vary slightly). The autopilot likely reads out the bearing for the entire course leg rather than a momentary bearing and the most likely fault condition is accidentally switching-off the autopilot. It can be quickly reset to the original course, if necessary.

If all electronics fail, the navigation log will be pressed into service. It needs to be written rather than on a computer where it could be lost to the vagaries of reliable electrical power. Even though hourly readings may be taken on the hour, let crew know that, if they are late making the log entry, they need to note the actual time the position was taken, not the time it was scheduled.

Systems Data

There are three primary goals for inspecting and logging mechanical and operating systems. First, trend "consumables." Make sure there is adequate fuel, water and oil to last the duration of the trip. Adjust that inventory as necessary. Second, identify abnormal operating conditions and record early detection of trouble spots, such as chafe, wear, leaks, vibration,

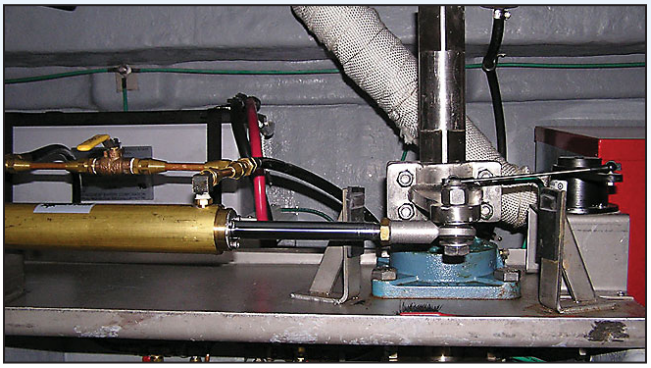
Rough oil check while engine runs.



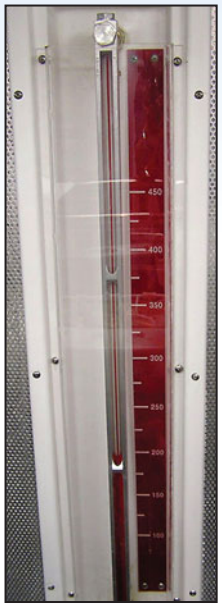
Feel for heat build up on the stuffing box.

Every hour, check sight bowl for water in fuel filter/water separator.

Look for chafe on hoses.

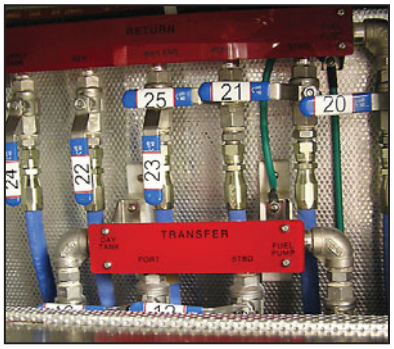


Check for leaks on rudderpost and steering hydraulics at connections.

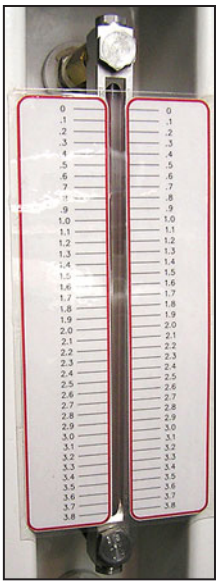


Sight Gauge Fuel Tank

Well marked fuel tank.



Always log changes when switching fuel tanks.



Calibrated fuel tank gauge simplifies daily fuel checks.

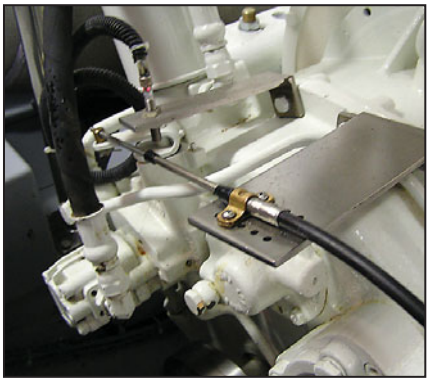
Check for crud in water intake strainer.

Check coolant level in overflow reservoir.

A dry bilge that persists beneath the engine verifies no leaks.

Check pressure in hydraulic stabilizer.

Lift floorboards and check for debris.



Check control cable linkages.

overheating, etc. Third, keep a maintenance log.

By far the most important tools for checking mechanical and operational systems are the five senses: sight, smell, touch, hearing and taste. [Ed: For additional details see "5 Senses of Boat Maintenance" in DIY 2003-#4 issue.]

Look for leaks, chafe, etc. This is where it's important to have resolved all leaks before leaving. The fastest way to identify a leak is when a bilge that is known to be dry and clean becomes wet and/or fouled with fuel, oil or the mix of fluids. Often, the first indication of something going wrong is an odor (burning oil, fried electrical panel, etc.). Excess heat is an indication of abnormal wear. For example, a stuffing box should never be too hot to touch. Be alert for different sounds. A change in rpms could mean a fuel filter is plugged with contaminants. See a small puddle of clear water on the cabin floor and wonder if it's fresh or salt? Taste it but be careful, there are a lot of toxic chemicals in an engine room. You get the idea.

Establish a routine on what gets checked and how often. Log any adjustment or hint of change. Long passages under power present interesting opportunities. For instance, shutting down a perfectly operational engine in mid-passage and hoping the starter will not choose now to die presents an interesting potential for a dilemma. If you have kept impeccable records, you will know what the oil consumption is and you can proactively add oil. Sometimes the dipstick can be pulled while the engine is running and the level checked, albeit not very accurately. Again, prior baseline efforts are key.

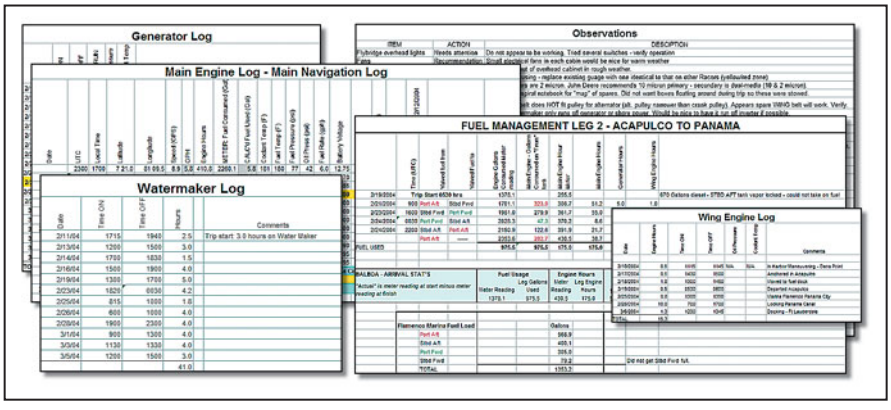
The Payoff

Keeping accurate records is important. More than just a standard log, an underway trip log provides detail that will improve maintenance and cut costs through proactive troubleshooting. Subsequent owners are impressed with comprehensive record keeping. It doesn't take much time and you will gain confidence in your boat.

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

Ed: Have an interesting approach to underway logs? Maybe a unique experience? Drop Peter a note at peter@seaskills.com.

Complex Logs by Functional Group



Tables show multiple logs for a 25-day, 4,500-nautical mile passage through the Panama Canal. Detailed logs for fuel management, generator, main and wing engine, and watermaker were kept for each major piece of equipment, plus a hand written hourly position log filled out by each watch. A separate log was kept for observations, repairs and recommendations. Had the simple format been used, the clutter would have overwhelmed the data, so conclusions and actionable items would be difficult to prune. Extremely precise data was available due to the new-generation, electronically controlled diesel. The owner of this vessel wanted detailed information so all possible information was collected. [Ed: Peter's six logs were too large to reproduce in print but are available on DIY ONLINE at www.diy-boat.com.]

Sample Comprehensive Mechanical Checklist for Larger Inboard Powered Yachts

HOURLY

Secondary fuel filters	Check for increasing vacuum indicating clogging filter
Hydraulic stabilizers	Check hoses, pressure, temperature
Engine leaks	Oil, water, coolant, transmission
Oil pressure	Check for change
Voltmeter	Should read about 14 volts when batteries fully charged
Ammeter	Depends on load (especially with inverter)

EVERY 2 - 6 HOURS (MORE OFTEN, IF PRUDENT)

Stuffing box	Check for heat, leaks
Steering linkage	Tight but not binding
Throttle linkage	Tight but not binding
Shift linkage	Tight but not binding
Steering lines/hydraulic fluid	Check for leaks
Autopilot pump chafe	Check for leaks
Hydraulic steering	Check for leaks
Cable steering	Check for frayed ends
Engine room temperature	Check ventilation fans
Running rigging (Sail)	Check for chafe
Standing rigging (Sail)	Check for frayed ends
Window/port leaks	Check for spray intrusion
Belts	Visual when underway
Chafe	Check all hoses and wires
Coolant	Check level

DAILY OR AS NEEDED

Thrusters	Check before needing them
Controls	Check for free movement
Alarms	Check at start-up
Fuel level	Sight gauge, dip tanks, fuel gauge
Fuel transfer	Log every change of tank or fuel transfer
Fuel consumption	Check daily where possible
Fuel tank size	Confirm, measure if possible
Rudderpost packing	Check for leaks
Thru-hulls	Check for leaks
Oil level	Possible to check underway
Running lights	Check daily

PROJECTS

Rod Box Project

Follow these steps to build an innovative, theft-resistant box for stowing your fishing rods. It won't stop a determined thief but it will slow the progress of a brazen bandit or discourage the light-fingered amateur or casual passerby from borrowing your gear.

Bob Hammee, Elizabeth Town, Kentucky

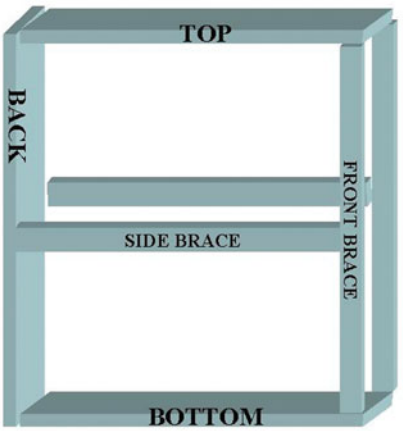
I always worry about the security of my fishing rods when the boat's docked overnight at the marina and I'm tucked away in a motel room. Similarly, on the way to the water, rods stored in an open towed boat or in the bed of a pickup truck can disappear if unattended during pit stops. You can't be 100% sure any measure you take will work all the time, as improvements in security devices are always met with correspondingly clever methods to overcome them. We can deter some would-be thieves by making our property more difficult for the hit and run robber to lift easily and escape unnoticed.

The rod box I've built is basically a wooden box with a secure door that I've built to help me safeguard as well as organize and transport my fishing rods and reels. The box holds about 12 rods, ranging from heavy saltwater gear to light freshwater rigs. It accommodates rods to 8' (2.4m) long with casting, trolling and spinning reels. The rods extend through a slot in the top of the box, reducing the box's size and making it possible to carry the box more easily with rods inside. Reels are secure inside the locked door. A slot in the box top prevents rod and reel removal because the reels attached to the rods can't be pulled through this slot. Filled with rods, the box can be chained or cabled to the inside of a pickup bed, onboard to a cleat or rail or at the dock to a piling or dock cleat for security. One lock secures the box door and hasp and can secure the box to a chain or cable.

The box is built of 1x10, 1x4 and 1x2 pine, 1/8" (3mm) plywood and common hardware. Building mine took about 5 hours, mainly because I had to decide on dimensions that would accommodate thick rods with long handles and heavy reels. The average DIYer could probably build the box in about 2 hours.

Step 1
Build the Box Frame

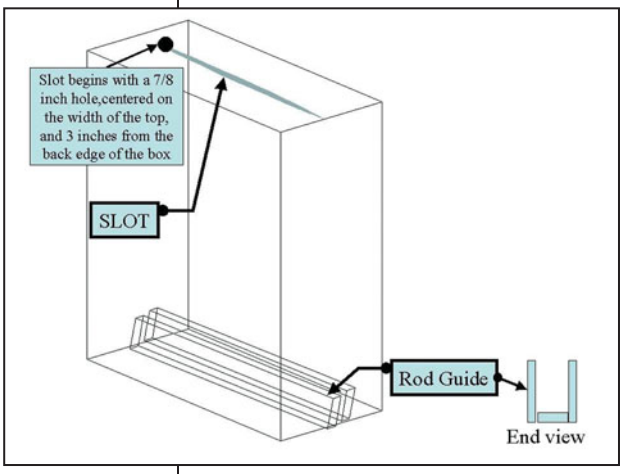
Construct top, back and bottom pieces of 1x10 pine. Top and bottom are equal length and 23" (58cm) long. Back measures 28" (71cm) long and front braces are 26-1/2" (67cm) long. Side and front braces are made of 1x4 pine. Back and the front braces butt join to the bottom and top. Side braces butt join to the front braces and back. Use a 1-3/4" x 5" (44mm x 12.7cm) joiner plate to reinforce the side brace to front brace joint and corner braces to reinforce the side brace to back joint. Cut all pieces to length and assemble using glue [Ed: Although you can use white carpenter's glue, epoxy resin glue works best. You could also substitute StarBoard for plywood.] and finishing nails or brads (copper, if available). A nail gun makes assembly quick. To make the sides, lay the assembled frame on its side on a piece of 1/8" (3mm) plywood and trace around it. Use the side you cut out as the pattern to make a matching side. The sides attach to the box bottom, back, top, side braces and front braces with glue and copper finishing nails or brads.



Box Frame

Step 2
Top Slot and Bottom Rod Guide

To cut the slot, begin by marking the start position for the slot near the joint of the top and the back. The slot begins with a 7/8" (22mm) hole, centered on the width of the top and 3" (7.6cm) from the back edge of the box. Drill the hole. With a straight edge, draw lines to the front edge of the top from each side of the hole. Keep the lines parallel. Now, cut out the slot using a jigsaw and then sand all edges of the slot smooth.

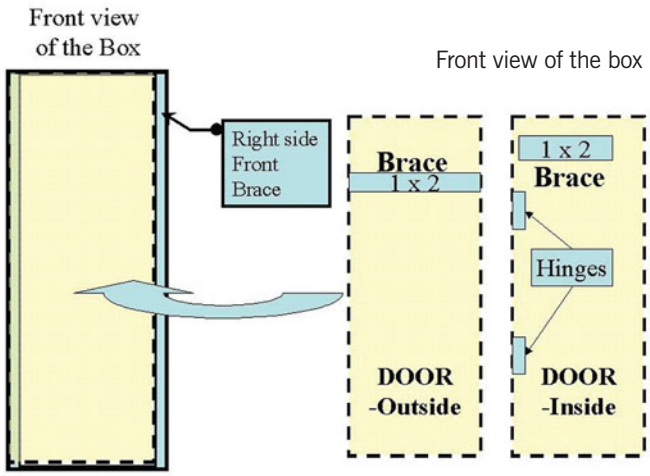


Slot begins with a 7/8" (22mm) hole, centered on the width of the top and 3" (7.6cm) from the back edge of the box. (inset) End view of rod guide.

Assemble the rod guide from two pieces of 1x4 pine and a piece of 1x2 pine for the bottom of the rod guide. Assemble with glue and finishing nails or brads. The rod guide assembly should run from the box's back to the front edge of the bottom. Center the rod guide on the width of the bottom and install with glue and nails or brads.

Step 3
Build and Install the Door

Cut a piece from 1x10 pine, 26-1/2" (67cm) long and 8-3/4" (22cm) wide. Cut a brace from 1x2 pine. Mount it on the outside of the door using glue and



Front view of the box

finishing nails or brads. Position it 6-1/2" (16cm) from the top of the door. This brace is the same length as the door and keeps the door from warping.

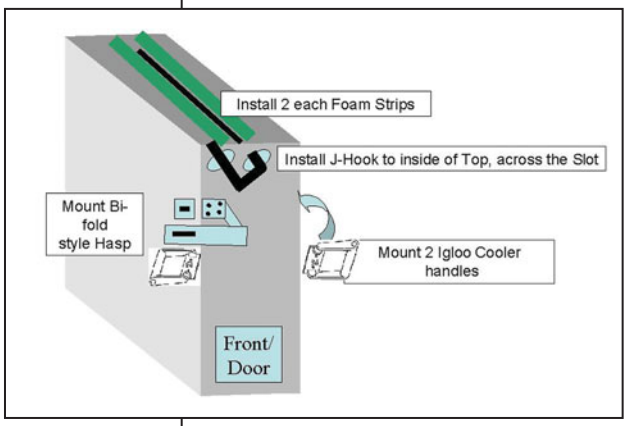
Cut a second brace from 1x2 pine, 7-1/2" (19cm) long. This mounts using glue and nails or brads on the inside of the door to help prevent it from warping, which it will do if you don't brace it. Facing the inside of the door the brace mounts 1" (25mm) from the door top, 1/8" (3mm) from the left inside of the door edge and 1" (25mm) from the right inside edge of the door.

The door fits to the box with two door hinges. Install the hinges on the inside so the mounting screws can't be removed when the box is locked. Mark corresponding positions for the hinges on the right side front brace and the left inside edge of the door. Recess the hinge, so the door mounts flush to the front braces and top. When installed, the door aligns with the outside edge of the left front of the box.

Step 4
Installing Hardware

Mount two Igloo cooler handles on the outside of the box. Align them on the front edge of the box and center on the box's height. This mounting position allows the box to be carried with the back towards the ground and when filled with fishing rods.

Mount a bifold style hinged hasp to the door and the side of the box. Install a sliding door J-hook, available at most hardware stores. It mounts inside the box, on the top and astride the slot. The J-hook is important and keeps the open end of the slotted top from being pried apart when the box's door is locked shut. With the door locked shut, the J-hook can't be disengaged from the outside. The door protests the J-hook from being opened and the J-hook keeps the slotted top from being pried open. Install foam strips to the top of the box on either side of the slot to keep rods from moving around or rattling. The strips run the length of the slot, each is about 2" (5cm) wide. Position the strips so they meet in the middle of the slot and then secure them to the top with a staple gun.



Mount bifold style hasp, install two foam strips, install J-hook across slot top (inset) and mount handles (right).

Step 5
Finishing Touches

Choose a stain for the exterior and apply. Seal the exterior and interior with three to four coats of marine grade spar urethane. Finally, to protect your decks or carpet and the wood on the box, install either self-adhesive felt pads or nail chair leg protectors/slides to the four corners of box's bottom and back. By doing so, the rod box can be positioned upright or on its back. Onboard, I stand the box with rods inside upright to conserve deck space. When transporting in my pickup bed, I lay the box on its back with the fishing rods parallel to the ground.

Completed rod box.

Shrinkwrapping Afloat

Fifteen years of shrinkwrapping friends' boats and his own Endeavor 42 have taught this former liveaboard a few things about the process. Here are a few ideas on building a custom shrinkwrapped cover for sailboaters wintering afloat.

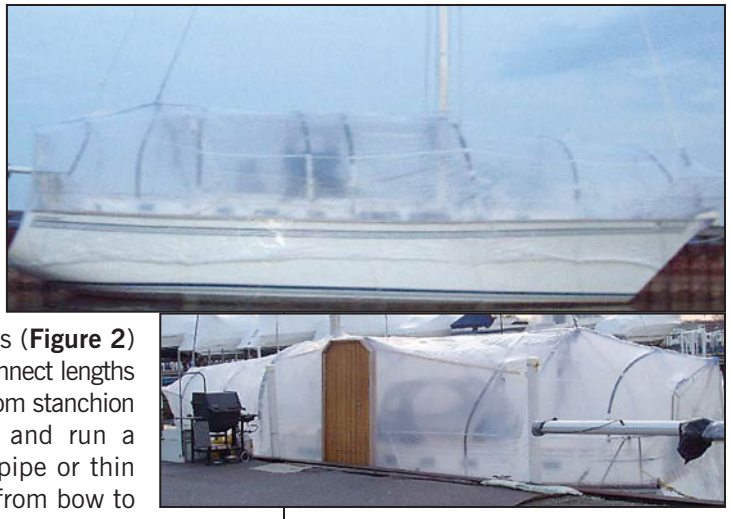
Richard Asztalos,
Mt. Clemens, Michigan

Shrinkwrapping is one task where experience is sometimes the best college of knowledge. Mistakes with shrinkwrap made during seven years of living aboard a sailboat have resulted in some well-learned lessons on how to make shrinkwrapping easier.

"Shrinking" a boat when it's in the water is a little different from covering a boat on land and takes more forethought. Since I'm aboard "Charisma" a lot in the winter, I like to use the clear shrinkwrap film, which lets in more light than either blue or white. Clear film burns through easily and is not as forgiving as the opaque films when shrinking. So, if added light is not needed, you're better off with the blue or white film. I also keep my mast up, which makes it more difficult to build the cover around the shrouds and stays.

Tools that I use include (**Figure 1**): a torch on a 15' (4.5m) hose connected to a propane tank, which sits in a milk crate; a small self-igniting propane torch with a flaring end attached; welding gloves; six large plastic clamps; razor (utility) knife; sharp letter opener for slitting the shrink wrap; one roll of shrinkwrap tape, one roll of webbing line, one roll of shrinkwrapping plastic, 20' x 45' (6m x 13.7m); permanent marker felt tip pen; and a measuring tape.

To begin, tie all lower shrouds to the uppers to keep from making more splices in the framework. Run webbing line (or low stretch clothesline) underneath the hull from stanchion to stanchion and secure.



Using a dinghy, run a horizontal line around the topsides. Securely tie the vertical lines from the stanchions (**Figure 2**) to this line. Connect lengths of PVC pipe from stanchion to stanchion and run a ridge line of pipe or thin wall conduit from bow to stern on top of the PVC. Next, tie webbing from bow to stern on top of PVC to keep it from moving and to give the frame strength (**Figure 3**).

Measure the length of shrink film, allowing some extra for overhang. It should stretch from the bow to stern over the PVC frame. Mark a line down the center of the film with a felt pen. Be careful not to walk on or scratch the film before it goes on or those tiny scratches will cause holes when you heat it with the torch. You'll need at least one extra crewmember to give you a hand to carry the shrink aboard and drape it over one side from the gunwale to the mast

FIGURE 1

Slit the film at the bow to accommodate the forestay and then, using clamps to hold the film, shrink the film around the bow pulpit (**Figure 4**). Line up the center mark with the boom, make a cut from the mast to the edge of the film and then clamp it to the shrouds to hold it in place. On the opposite side, cut the film for the shrouds, cutting to the edge. Cut the slit for the backstay and secure the film with a clamp. I prefer to make this cut towards the corner. This allows a nice overlap and plenty of

FIGURE 2

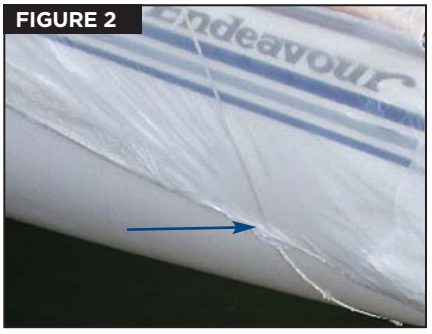


FIGURE 3

FIGURE 4

FIGURE 5

Ed: Although the author uses a roofing torch (left), I prefer Dr. Shrink's special heat tool (US$295.55) shown in the right photo. Weighing only 2.2 lb (997 grams), its lightweight makes easier shrinkwrapping and comes with a 25' (7.6m) hose, training video and 18" 46cm) extension for long reaches. This gun puts out 300,000 BTUs. Output is fully controllable with the adjustable trigger-controlled regulator, a great bonus to reduce burn through.

FIGURE 6

film to shrink around the stern in one neat piece.

Now is the time to weld all the seams that were cut. Don your welding gloves and have your helper hold the two pieces of film together and heat the seam with the small torch holding it at a 40° angle to the film. Work from top to bottom, passing the torch quickly so as not to burn through the film. As the film starts to become transparent, it melts and bonds the two seam pieces together.

Next, you and your helper get into the dinghy with the torch and propane tank. While one person folds the excess film under the horizontal webbing line, the other heats the film to weld it to itself and shrink it to secure it from blowing off.

While you're still in the dingy, heat up the perimeter and shrink as much as you can reach, passing the torch from lower edge towards the ridge line. Always wear gloves when using the torch and work away from yourself, heating away as you move forward, keeping the torch moving at all times and at an angle (**Figure 5**). Be sure to leave cutouts for all docklines (**Figure 6**).

Adding a door gives easy access for routinely checking the boat. First, tape on a plastic door and then cut out the shrinkwrap. It's not necessary to weld the two parts if you use the specialized shrinkwrap tape. I made a custom cedar door that opens inward because, in the winter, the water level drops and it would be difficult to go in or out through the cover when the toerail is below the top of the dock (**Figure 7**).

No matter how careful you are, holes happen. To repair, cut a circle or oval patch from scrap film, tape it over the hole and then lightly shrink using the torch (**Figure 8**).

Always consider wind direction when shrinkwrapping. Best condition is a low wind day, a rarity. Always work with the

FIGURE 7

wind direction. On windy days, first shrink from inside the boat to get the material to a reasonable size and then finish from the dinghy or dock. Be careful! Heat rises and high temperatures will melt the shrinkwrap quickly, burning holes. Finish shrinking on a calm day. Never shrink on a rainy day. Water drops boil from the torch heat and you'll have a mess. Have a fire extinguisher nearby when shrinkwrapping. Since your swim ladder will be covered with shrinkwrap, put a ladder in the water in case someone falls in (**Figure 9**). It's clever practice to write your phone number on your cover for neighbors or marina staff to contact you if there's a problem like power outages or any other emergency (**Figure 10**).

In wintry climates, you'll need to bubble the boat to prevent ice build up around the hull. If the marina doesn't do it, drop an Ice Eater in the water at the bow (**Figure 11**). It works well and supplements the bubbling systems in some marinas.

[Ed: Refer to DIY 2003#3 issue for complete step-by-step instructions on shrinkwrapping powerboats and sailboats.]

FIGURE 8

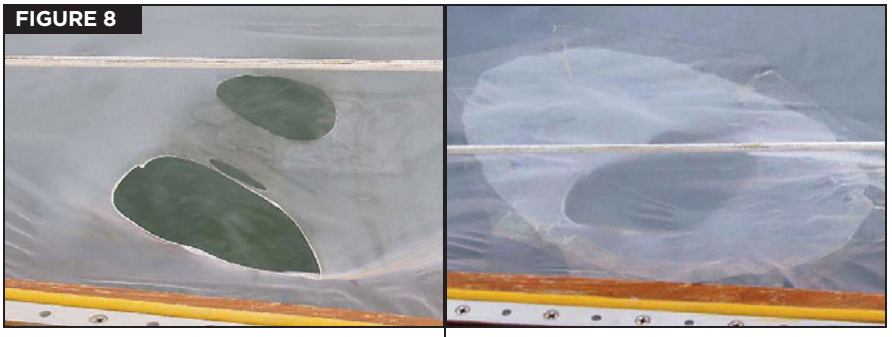


FIGURE 9

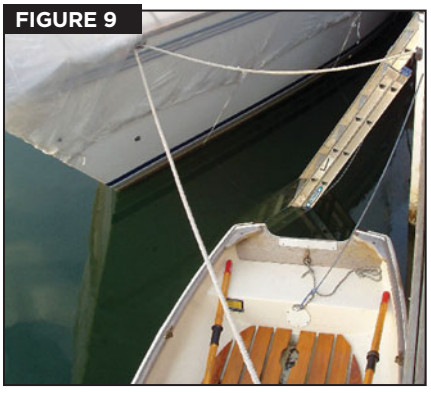


FIGURE 10

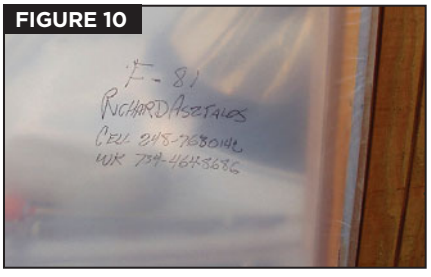


FIGURE 11

Just Add Air and Peat

This boat-tested composting head may be just what you're looking for.

By Robert Hayes, Kent, Washington

After living aboard for seven years and cruising for the last three, the time had come to find a solution to the traditional marine head and holding tank issue. My wife and I spend most of our time at anchor and having enough holding tank capacity and locating pump out stations, seemed a major challenge. After much research, we decided to convert to a composting toilet system. The one that seemed to best fit our needs was the Air Head Dry Toilet from EOS Design (Tel: 740/392-3642, Web: www.airheadtoilet.com).

Head Fundamentals

We wanted a toilet system that would allow the two of us at least a months' use, without needing service or dumping. Our 35' (10.6m) catamaran was built in South Africa and had minimal holding tank capacity at best. I was in the middle of building an additional 35-gallon (132L) holding tank when I started seriously looking at other options to resolve the problem. After searching the Internet and other sources, I narrowed my choices to the Air Head. Like other composting toilets, it's a waterless operation but this unit functions differently than other systems. It separates the liquid from the solids and thus doesn't need electricity to remove excess liquid. In addition, the unit is constructed of plastics, stainless steel and rubber, making it good fit for the marine environment.

Measurement checks showed that the Air Head would be a challenge to fit in our boat's head compartment but it could be done. Consideration needed be given to not only the footprint of the toilet, but also the necessary vent line and the location of the crank handle connection point. To order the Air Head, you'll need to know where the best vent connection is located (right or left rear) and the connection point for the crank handle. This handle is only connected

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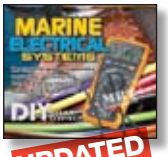

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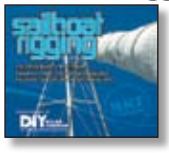

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to agitate the tank contents. It's not connected to the tank at all times. Talking to Geoff Trott, the designer and company owner, and seeing the unit at the 2002 Miami Boat Show offered further reassurance. Geoff, a former packaging engineer/project manager for a pharmaceutical house, developed the concept for what would become the Air Head while living aboard his own anchored out boat, which, due to space limitations, had a portable toilet. After a few dinghy trips to empty it, he decided there had to be a better way. Geoff now has an Air Head set up in his home and utilizes it rather than the conventional toilet. He says it gives him a great opportunity for R&D.

Installation

Upon receiving the unit, I verified all measurements and confirmed how to route the venting. After assuring that the installation plan was good, the work began. Instructions included with the Air Head are easy to follow. Here are the steps I followed.

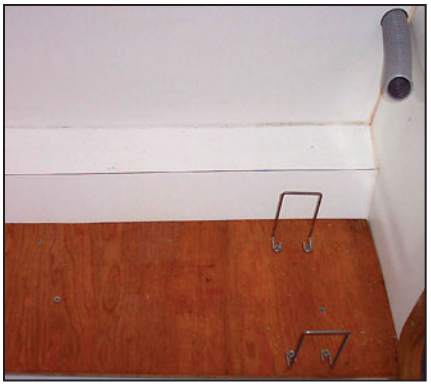
First, remove existing head and plumbing. Before starting, make sure your holding tank is pumped, all lines are drained and the thru-hulls closed. Each removal will be different. In our case, I disconnected the supply and discharge lines and removed the head. Some time was then spent removing all other lines and cleaning up the area.

Installing the new head started with building a platform to give the unit enough base area. Our existing head was in a small inset adjacent to our shower tub/floor. I cut a plywood platform to fit and coated it with three coats of epoxy resin to protect the wood from moisture and seal it and give it a smooth surface for cleaning.

Now, position the Air Head and locate the vent line holes, which are then drilled after assuring there is nothing behind the bulkhead. Route the vent line and wire the 12-volt vent fan. Part of your planning includes laying out the location and routing of the vent so you can order the toilet with a vent line cutout. Be sure to position the crank handle base, so you can access it after the toilet is installed. With the vent line completed, install the hold down brackets. Mount the Air Head in the hold-down brackets, connect the vent line and the installation is complete.

This shows the area where the existing marine head was located. It is set down into a depression by the bath tub/floor combination.

This is the same area with the head removed. The removed hatch is for access to the thru-hull for seawater supply to the head.



New head platform made of epoxy-coated plywood, with vent hose and Air Head hold-downs in position.

To use the Air Head follow the directions for moistening the peat moss prior to putting it in the tank, fasten the liquid tank in position, assure that the vent line is connected and the vent fan is running and it's ready (for you) to go.

This photo shows the space required to comfortably use the head. Length from rear bulkhead to the bulkhead in front of the author's feet is 36" (91cm). Width of the platform is 14" (36cm). Air Head itself measures 19" deep x 16" wide x 19.5" high (48cm x 41cm x 50cm).

Crank attached (top) and crank disconnected (bottom).

Beyond Odor

There has been virtually no odor in the head area, as the low draw fan in the vent hose seems to draw enough air to not allow fumes to accumulate in the head area. We also have good ventilation in this area, which helps. Odor from the Air Head itself has been nonexistent. Our vent line is 9' (2.7m) long and ends near the stern. Usually, the air moving around the boat carries away any odor before we are aware of it. On the few occasions that we have been becalmed or with a very light

DIY BILL (U.S. Funds)

Air Head, which includes 5' (1.5m) of vent hose, hose connectors, vent fan, liquid tank, hold down brackets, peat moss, 50 paper liners and mounting hardware	$850
4' (1.2m) additional vent hose at $2.45 per foot	$9.80
Extra liquid tank	$28
Outside mushroom vent cap	$69
Miscellaneous wood, epoxy and fittings needed for our installation	$18
Total	$974.80

Air Head installed in hold-downs and ventilation hose attached. The liquid container is not in place.

breeze blowing toward the cockpit from the vent opening, the odor can best be described as tropical forest or wet dirt. The only time we have had any odor that hinted of sewage was during the first couple of days of use on a new (empty) tank. This is because the composting action had not started yet. Adding enough peat moss to cover fresh deposits can control this odor.

Waste Disposal

When offshore, outside the no-discharge zone, we dump the solids tank overboard. This is easy to do. Simply remove the thumb bolts that hold the top section to the bottom section (solids tank), set the top aside, unclip the tank out of the hold-downs, carry it to the stern and dump. A couple of thumps on the tank and all the contents drop out. If you are ashore, dump the contents into a heavy garbage bag and drop it in the dumpster. It's generally cleaner than a disposable diaper. The tank contents will not have fully broken down to dirt if you dump shortly after use. To fully compost the contents, Geoff recommends ordering a second tank. That way you can remove the full tank, cap it with the included lid and let it “work” for three summer months (longer if cool weather). It could also be stored in a garbage bag, or other sealable container.

Power Supply

The only draw is for the fan in the vent line and this in negligible — the load doesn't even show up on my Link 2000 monitor. The instructions indicate that the fan draws approximately 50mA at 12 volts. Testing with a multimeter confirmed this. Geoff recommends running the fan continuously. We've had no problem doing this, even though we operate from solar panels most of the time and really watch our electrical usage.

Seal of Approval

We are very satisfied with the Air Head and find little difference between using this head and any other, except there is no pumping. When defecating, drop the paper liner into the bowl, open the trap door using the lever on the side of the tank and the liner and waste drop into the solids tank. The liner also keeps the bowl clean. Close the trap door to the tank, close the lid and crank a half turn or so and you’re done. For urine collection, there are two holes in the front area of the basin that route the urine to the holding tank. For a man who prefers to stand, you don’t really need to even aim at the holes, as the design directs the flow toward the liquid tank. The liquid tank needs empting every two days or less

with two people using the head. To extend liquid capacity, one option is to store it in the boat's original holding tank. Since the tank is for liquid only it would last much longer than it did previously before needing a pumpout. Other options are to carry the liquid tank ashore and dispose of in a restroom, or dump it off the boat if you are in an allowable discharge zone. We ordered a second liquid tank and it has come in handy on a number of occasions.

Because you must dump the liquid daily, or have it plumbed into a holding tank, owners need to be more involved in their sewage systems than most marine toilets (except portable toilets). All in all, the entire process is much simpler than dealing with holding tanks and pumpouts.

After nine years living aboard "Manx," a 35' (10.6m) Aero Rig catamaran built in South Africa by Fortuna Boats in 1995, and cruising for five years, Bob Hayes and his wife relocated to Seattle, Washington and are now land cruising in an RV.

Building a Custom Hardtop

Rather than use traditional fiberglassing materials, this strong, lightweight hardtop for an Egg Harbor was built of foam, epoxy resin, fiberglass cloth and peel ply. Here's how.

By Mike Myers, Baton Rouge, Louisiana

Before buying the 1974, 38' (11.5m) Egg Harbor that was to be our second and last cruiser, I told my wife (who loved the boat) that I would build a hardtop. The boat was truly beautiful but had a huge bimini over the flybridge with only two hard attachment points, both of which had some decay at the mount points, and four corner attachments with straps. The whole assembly flapped and

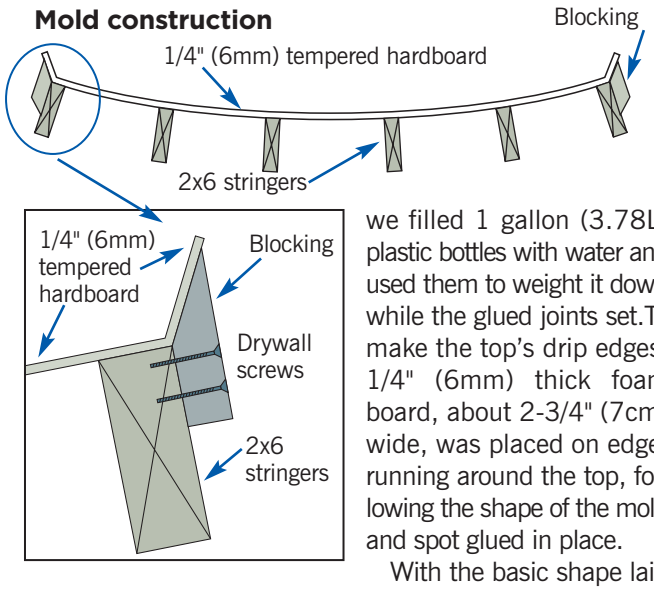
shook when underway.

I had already built a fiberglass swim platform (article appeared in DIY 2000-#4 issue) and figured I would use the same methods and materials for the hard top. I began making the mold. However, a friend who had made a composite airplane suggested that the top would be very heavy and a better method is to build it like an airplane using epoxy resin with proper resin-to-glass ratios for a very high strength-to-weight ratio. This was convincing, especially since he agreed to help, so I decided to change the plan with the mold about 90% complete. I decided to build it from the foam core out to each finished side, that is, from the center out. The plan was to lay Klegecell foam in the mold and then lay up the exposed or underside of the top using epoxy resin and fiberglass cloth, flip it, then lay up the top.

Mold Construction

The original mold was made of 1/4" (6mm) tempered hardboard with 2 x 6 stringers that run fore and aft and are positioned so that the top would have a crown. The top leading edge is radiused to follow the shape of the flybridge with an angled panel on each side and a straight panel on the centerline. The top trailing edge is curved downwards; sides are straight. This is a female mold, originally designed to start with gelcoat and then lay up the layers of laminate, foam core and polyester resin. When we changed the design, the only thing that wasn't done was to fillet the edges.

The next task was to lay the foam into the mold. Since the mold was roughly 10' x 10' (3m x 3m), it was necessary to piece the foam, gluing the joints with epoxy thickened with micro-balloons. Visqueen (20mil plastic sheeting) was placed underneath the joints to prevent sticking in the mold. As the foam was too stiff to follow the curve of the mold,



we filled 1 gallon (3.78L) plastic bottles with water and used them to weight it down while the glued joints set.To make the top's drip edges, 1/4" (6mm) thick foam board, about 2-3/4" (7cm) wide, was placed on edge, running around the top, following the shape of the mold and spot glued in place.

With the basic shape laid into the mold in foam, the next step was to lay up the upward facing working surface, in this case, the bottom (the side that shows when you look up from the flybridge helm position). The foam still didn't follow the curve of the mold so, from beneath the mold, wood screws were inserted to hold the foam to the shape, and then the milk bottles removed. Before starting the layup, I made some mahogany blocks for what I called "hard points" to reinforce areas on the top for hardware mountings. There was one on each corner, another on each side about 2' (61cm) from the back corner, one for an anchor light mount and one for a future radar mount. These blocks were glued on, cutting the foam to fit. They were either the same thickness as the foam or, in the case of the support mount points, were thicker, with edges smoothed to blend down to the foam thickness.

Lay Up One Side

First, spread a mixture of resin and micro-balloons, with the consistency of honey, over the exposed foam as a base for the less thick, but denser epoxy that followed. Before that set, we laid in cloth that had been precut to rough size. I opted for an 18oz double bias +45°/-45° knitted bias weave. Next, we laid in a layer of 6oz cloth, which was then covered with peel ply and the excess resin was squeegeed out. The peel ply is then throughly wetted out and left in place until the layup is dry. Since our mold was bowl shaped, we cut a hole at the low point and, with a bucket underneath, squeegeed to the hole. After the layup completely sets, about 24 hours or more, remove the peel ply, which leaves a surface ready for another layup with new peel ply (you cannot reuse it) or paint. Peel ply is the real key to the whole assembly, because, as you scrape excess resin off and work out the bubbles, the peel ply stays in place and protects the glass from pulling with the squeegee. Also, the longer working time of epoxy compared to polyester resin makes it easier though, on such a large piece, we were still in a rush. My wife mixed batches of epoxy while my friend and I worked as a layup team.

It's important to note that we had no real technical analysis of what the lay up should be. Rather, we had an idea of what we thought would be strong enough. If it didn't turn

out to be strong enough, we would simply add more to the layup, something the peel ply would allow us to do without sanding. One side completed; one to go.

Prep: Side Two

We then made supports to reinforce the top when we flipped it over since it was quite flimsy with only one side glassed. The inverse support structure was put on sawhorses and we flipped the piece. Before the lay up could begin, troughs were cut in the foam for electrical wires, for an anchor light, cockpit light, two VHF radio antenna cables, GPS antenna and TV antenna. The radar block was in place but no cable cut to it, as I didn't know the size. The openings were cut with a 3/4"- (19mm-) round rasp chucked into an electric hand drill. I made some wood blocks and strapped them to the drill to hold it upright and at the right cutting depth (I don't own a router).

These cable troughs were all cut from wherever I envisioned the device would mount to the top. At the point of convergence, which was one of my mahogany mounting blocks, a 2-1/2" (63mm) hole was cut, so that all cables could be routed through a single opening that would ultimately be covered with an aluminum double junction box plate for access as a pull point. Once the troughs were cut, plastic flex cable conduit was laid in the trough. Also, just in case some of the epoxy made its way into the conduit, I put a stainless-steel pull wire through the conduit. These would also be used for snaking electrical wire once the top was finished. Finally, the plastic conduits were glued in the trough with thickened epoxy and the remaining trough filled until level with the foam core.

With the electrical conduits in place and their troughs faired to the top of the foam, we laid up the top side with the 18oz knitted fabric, 6oz cloth, epoxy and peel ply as we'd done for the first side. My friend advised that epoxy doesn't reach full strength unless it's heated to about 130F (54C) and he suggested that we cover the piece with black plastic and leave it in the sun for a few days. We did.

Fairing and Painting

The suggestion that the finished product would require little fairing since the excess resin and air bubbles had been squeegeed out was what persuaded me to go with this layup method. My friend, however, had never done such a large piece. Compared to a polyester layup, it was quite fair but it wasn't ready to paint. The real work was to begin. Sand, fair with thickened epoxy and sand again, over and over. My friend mysteriously disappeared for this phase of the work. The trick to fairing, which I hadn't known until a few weeks before fairing began, was to hook the orbital sander to a Shop Vac.

My friend was correct about the strength-to-weight ratio. The unpainted top weighed about 60lb (27kg) and would support a person standing in the center of it with the top being supported only on the four outside corners and allowing only about 3/4" (19mm) deflection. I was amazed.

Once fair, I primed the top and applied a rough finish coat of paint. However, I wasn't comfortable with my spray painting skills for the final coats. I paid US$200 to an acquaintance with auto body experience to spray the final coats of Interlux Brightside polyurethane. He made two trips, one for each coat. I sanded between coats and applied fairing putty to eliminate small imperfections. [Ed: Polyurethane paints are high in VOCs (volatile organic compounds) and demand using a self-contained breathing apparatus.]

Assembly

Now, I had to get the hardtop to the boat and the mounting aluminum structure fabricated. I borrowed a trailer, carefully strapped down the painted top and slowly drove to the boat. Once there, with the help of three friends from the marina, we hoisted the top onto two sawhorses that were covered with protective carpet and built to the near-finished height. After leveling it with shims, the top was strapped down to await fabrication of the aluminum tube structure.

Meanwhile, I had found a firm from Houma, Louisiana, that would do onsite fabrication at the marina. It specialized in T-tops and tuna towers and I had visited the shop to see its work. Satisfied, I gave a $400 advance on material and struck a deal for $80 per hour for the work. This included all equipment, the foreman and a helper, plus hotel costs (and a steak dinner on the credit card I loaned them). They arrived on a Saturday afternoon. The boss studied the boat (with the top temporarily mounted) and then showed me his design, which he had drawn on his palm. They worked about 4 hours on Saturday and 10 hours on Sunday to fabricate and temporarily

Hardtop details: (from the top) close-up of radiused ready-made mounting pads; back view; finished underside; side view.

assemble all the pieces and put them in place. As the fabricators left, the foreman complemented me on the hardtop and said: "You saved yourself some money. If I had done this job it would have cost you $20,000."

I instructed the fabricators to buy ready-made pads, whereas they had wanted to make them on site. I reasoned that off-the-shelf pads would be less expensive but, when they ran out and needed one more pad, they made it very quickly. In any event, the ready-made pads were nicer with radiused edges. I was amazed by how the fabricators worked. All cuts were made with a band saw. Very few measurements were taken. Instead, they would rough out a piece and mark the ends on the boat for cutting. Only a few cuts had to be redone. To get the bends consistent, they measured from the base of the bender to it's shoe (how much the bending shoe had pushed down). Their air-operated bender was the size of a table saw and had special shoes so as not to scratch the polished aluminum tubing. Each completed weld (32 welds were made) was coated with aluminum paint from a small can with applicator top.

I did the final finishing work, including bedding the mounts, pulling the wires and mounting the antennas, lights etc., in a day and a half. Being at the boat made the work fun and, after that seemingly endless sanding and fairing, "fun" is a very relative thing. The final cost was about $5,000, spread out over about 6 months. I was pleased with the results, considering that I had absolutely no idea what I was doing (or getting into) when I started. The moral of the story is that if I can do it you can, too.

[Ed: DIY 2000#4 issue features a comprehensive article on the building of the fiberglass swim platform Mike Myers constructed for a 1970 31' (9.4m) Chris-Craft he previously owned.

DIY BILL

Fiberglass supplies were purchased from Fiberglass Coatings (tel: 800/xxx-xxxx; web: www.fiberglasscoatings.com). Not included is the cost of aluminum tubing and mounting pads, miscellaneous supplies, such as brushes, rollers, plastic flex cable conduit, masking tape, gloves, etc. Final bill was about US$5,000. All prices are in U.S. funds.

1 4x8 sheet, 3/4" (19mm) thick, 5lb (2.3kg) density Klegecell foam	$131
1 4x8 sheet, 1/4" (6mm) thick, 5lb (2.3kg) density Klegecell foam	$52
Phenolic microbaloons, 5lb (2.3kg)	$16
Epoxy, 1 gallon kit (3.78L)	$80
Double bias +45*/-45* bias weave, 50" (127cm) wide, $9 per yard (91cm)	$150
Fiberglass cloth, 6 oz, 60" (152cm) wide, $6 per yard (91cm)	$80
Peel ply, 2.7oz Dacron, 66" (167cm) wide, $4 per yard (91cm)	$53
Interlux Brightside, 2 quarts (946ml) white	$60
Aluminum fabrication of mounting structure, including travel and hotel	$1,400

View from the **Stern**

The Zen of Boat Restoration

Is it possible to find the perfect boat to restore? It's a question even this seasoned boater can't answer.

By Roger Marshall

Having finished the restoration of an 18' (5.4m) SeaCraft that I bought for US$800, I am looking around for another project. Just last week I looked at a sad old Bristol 40 sitting in a parking lot. I asked myself, "Do I buy it and invest in bringing it back to its original glory?" Do I really want to spend all that time sanding fiberglass and wood? Ripping out wiring installed when Nixon was president? Exploring the oil stained, fungi laden netherworld under the engine? Finding deck leaks that bloomed before Woodstock. My answer to this one was "Not I!" But the lure of rejuvenating a fading beauty still beckons. Maybe I'll find a gem in the rough, a boat that I can enjoy once I've finished working on it. Then again, maybe I won't.

These days the urge to get into a restoration project is limited by the time I can put into it. There's about a morning's worth of work left on the SeaCraft before it can be launched. And about a day's worth of work to be done on my 22' (6.7m) custom sailboat before it too can be painted and launched. With both boats in the water, the driveway will be free for the next project. A project that might never see the light of day (or night, which is often the only time I get to work on it).

With both boats in the water, time disappears even faster. We have to enter the sailboat in a race, says the elder son. We've got to go fishing in the SeaCraft, says the younger son. No time to take on any other projects, cut the lawn, paint the house or attend to the Honey-Do list. Maybe they've shrunk how many minutes there are in an hour and didn't tell me but these days it seems as if boat restoration takes a back seat to everything else and that's a shame because there's nothing quite like stripping away the refuse of years and finding a pearl under all the grunge.

Is there a pearl under all that grunge?

Having said that, I am going to consider the next project very carefully. It will be a 44' to 50' (13.4m to 15m) sailboat or maybe it'll be a powerboat. I haven't quite decided yet. The wife says power because she's tired of trying to stand up on a deck that heels 20° at the slightest puff of wind. The kids say sail, because they want to go and see the deep ocean in the solitude of a wind driven ship. I've always sailed and like the idea of a sailboat but power has its virtues too.

One thing is certain. The boat will be beautiful when it is finished. That means identifying the diamond in the rough as it sits forlornly in the corner of an abandoned boatyard or field. It will be the boat that I can pour my heart and soul into and know that I will have the boat I want. It will be a sailboat, in spite of the family desires, for that's what I prefer and it will be my labor that makes it whole again.

But will I ever find a boat that merits the effort I shall put into it? Maybe, maybe not. Quite possibly, I'll have to design it myself. Will I build it if I design it? I doubt it. A boat of the size I want will need about 7,000 to 8,000 man-hours of work. With 168 hours in a week, at least 40 of which must be devoted to work, another 30 to 35 to sleeping, plus 20 to 25 to eating and hygiene, that leaves around 65 hours a week for boat building or restoration — that is, as long as I totally neglect the family, the house, the lawn, the garden, the dog and everything else. In truth, I'll probably get about 20 hours a week to work on the boat project. Assuming the project takes 7,500 hours, it will take 375 weeks to build the boat. That's more than seven years of building and labor. Is it any wonder then that many building projects are started and never finished? Maybe I should spend my time writing a best selling book and use the proceeds to buy a boat. How about the Zen of Boatbuilding and Restoration for a title?

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.