2002 ISSUE #1 –
DIY boat owner the MARINE MAINTENANCE MAGAZINE

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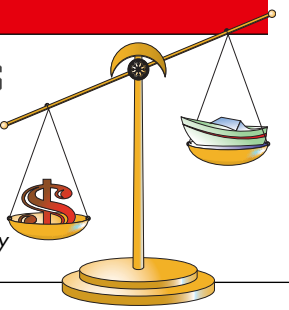
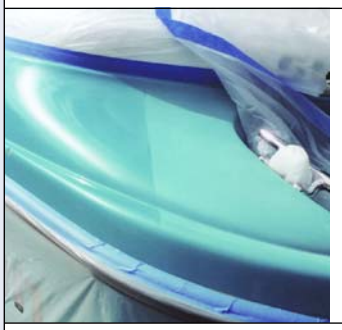
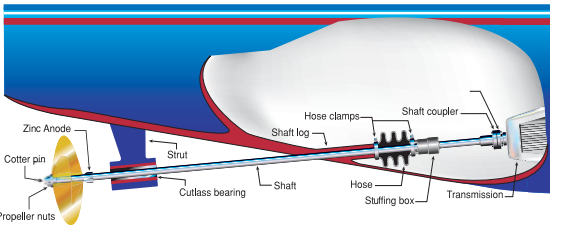






Currents

[EDITED BY JAN MUNDY]

Fuel Harmony

The article on testing fuel additives ("Fuel Testing," DIY 2001-#3) provided a fair and accurate analysis of the problem of water in fuel tanks. Results of the author's tests duplicated similar tests conducted by our company. A product not mentioned in the article that will totally emulsify water in the fuel is MDR Gasoline Water Zorb.

William O'Brien, V-P sales and marketing, Marine Development & Research, Merrick, New York

Comfort Zone

Your magazine is like a Vegemite sandwich to an Australian. Full of nourishment and good taste!

Maxwell Hazelwood, Clearwater, Florida

Likes 24/7 Access

As someone who is living on their boat, I appreciate that DIY has the foresight to offer the web availability of their magazine.

Amanda Glickman, "Darwin's Passage," San Diego, California

Comment: DIY's electronic version, DIY EZINE, is available online at www.diy-boat.com. Cost is US$15/CDN$22 for a one-year subscription (7 issues.)

Simple Look Up

Please snail mail a copy of the DIY Editorial Index. I have been a subscriber since the beginning and have all the issues and refer to them constantly. Keep up the good work and continue to assist us boaters by supplying the necessary know-how so we can continue to enjoy our hobby.

Brian Arrol via email

Comment: Readers can review or print a copy of the complete 1995-2001 Editorial Index online. Just go to www.diy-boat.com and click on "Archives." Or call us toll-free at 1-888/658-BOAT and we'll mail a copy.

Questioning Splash-Stop Install

I always look forward to receiving your magazine and learning something new to help me maintain and improve my powerboat. When DIY 2001-#4 arrived I was pleased to see two articles featured that are on my list of tasks to complete this spring, namely "Windows, Hatches, Ports" and "Cure for Diesel Spills." Although my boat is gasoline powered, I was most interested in reading the latter article to obtain a solution to my ongoing spill problem. I was quite surprised to see that the installation of the Splash-Stop was completed within the boat's electrical compartment. Electricity and fuel just don't mix! While diesel is not as flammable as gasoline, I find it somewhat distressing that an installation location such as this would be featured. Should an electrical fire occur or a fuel leak develops, it wouldn't take long for the plastic and rubber components to burn with predictable results. You may wish to reconsider this installation. As a final note, boaters experiencing vent spills while refueling may wish to look into a simple solution from Davis Instruments, the No-Spill. This simple device temporarily attaches over your fuel vent with suction cups and catches any fuel spills, which can be poured, back into the tank. Most recently this product was awarded "Best New Environmental Product" at the annual CASBA awards in Toronto, Ontario.

Mike Gridley, Barrie, Ontario

Drive Trends

The keep-it-simple doctrine is certainly evident in the 2002 MerCruiser lineup. Plug and play electrical systems, self-draining systems and computers that talk are some of the high-tech advances that simplify routine maintenance and servicing.

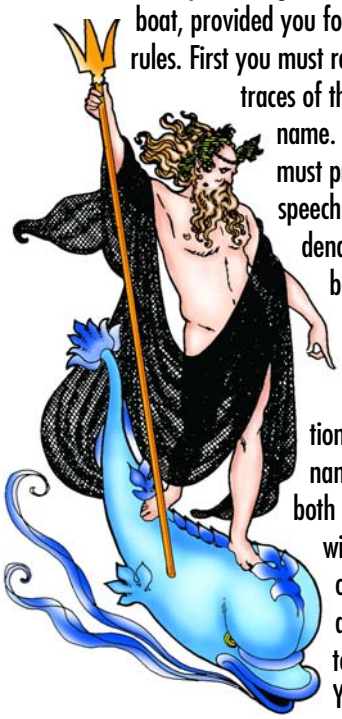
Smartcraft is an optional engine management system that allows the boat operator to monitor and extract information from a variety of systems, such as engine speed paddlewheel and pitot hull speed; fuel, water and waste tank levels, fuel consumption and distance-to-go calculations, engine oil pressure and temperature, coolant temperature, block coolant pressure, battery voltage, stern-drive steering angle plus input from a GPS and more. New engines are Smartcraft compatible.

Many models are now equipped with a single point cooling-water drain system. No more pulling out brass drain plugs when winterizing, when flushing saltwater out of the block, or probing the drain port to remove sand and silt. Engines are offered with a manual drain, a mechanically operated valve mounted by the gearlube monitor (expansion tank), or a hand-held air pump that drains the raw-water system. And a new easy engine oil drain system saves the DIYer time, or reduces labor fees if serviced by a dealer.

An audio warning system announces when a low oil and overheat condition exists. And if you mess with the engine or cause damage that requires dealer servicing, a computer stores the events that occurred prior to shutdown and tells all. For product or dealer information log onto www.mercurymarine.com.

Comment: The issue here is not the fact that the fuel lines or components of the fuel system are run through an

Boat Renaming Protocal



It's not unlucky to change the name of a boat, provided you follow certain rules. First you must remove all traces of the original name. Next, you must prepare a speech that first denames the boat, and then renames it, but be sure not to mention the old name. Conclude both ceremonies with a libation over the bow and drink a toast (or two). You'll need a couple of witnesses for the swear-in and toasting.

DIY reader Bert Small, who resides on Salt Spring Island in British Columbia, sent us a copy of the de naming and naming ceremonies for his boat. Follow his example and you're sure to appease the gods of the sea.

"As the new owner of this vessel, I call upon the Sea God Neptune, God of the Wind Aeolus, Gods of the Tides, the Storms and Precipitation [select any gods you want], to listen, while I thank them for their protection of this vessel over the last 50 years and to hereby strike from their records the name "Dixie Chicken." I now ask for their indulgence in extending their goodwill and protection to the vessel in her new name that will be revealed in a separate naming ceremony to come. I offer this libation to make the ceremony official and complete."

"I now put forth a new name for this vessel, which we trust will serve us well, and ask Neptune and all the Gods of the Sea to grant their protection under the name "Sea Eagle." I now offer a libation in thanks and recognition of this protection."

"electrical compartment." The issue should be whether the lines meet the appropriate ABYC standard for gasoline or diesel fuel lines (ABYC H-24 for gas; H-33 for diesel). The fire resistance performance requirement for the fuel lines in either case is the issue. No flexible fuel line can resist heat or fire indefinitely, but the minimum ABYC requirement for fire resistance is, at the very least, deemed acceptable. Where the requirement specifies Type A-1 or A-2, hose (flexible fuel line) must be able to withstand the 2-minute fire test as prescribed in the regulation. Where B type hose can be used, the fire test is not required. The other factor, ignition protection requirements, would come into play in a gasoline-powered boat. If all the applicable standards were met, this installation would be considered in compliance. ABYC doesn't prohibit installing batteries in an engine space. The battery installation standard does provide for securing the batteries and protecting the terminals against accidental arcing, in addition to a requirement for venting battery vapors.

Help Yourself Online Support

Electronics systems manufacturer Raymarine (formerly the marine electronics division of Raytheon) launched a 24-hour online support for technical questions or product inquiries at www.raymarine.com. Browsers can search a base for answers to commonly asked questions.

Passing Grades

Cobalt, Crownline, Grady White, Ranger and Sea Ray, ranked among the highest for customer satisfaction in a survey of 36 different bass boats, runabouts and center console boats conducted by J.D. Power and Associates.

The study provides detailed evaluations of quality and customer satisfaction with the vessel's interior and exterior, features and controls, ride and handling, comfort, convenience and engine performance and maintenance. Among problems most frequently cited by the nearly 6,000 boatowners who responded were difficulties starting the engine, the engine idling rough or stalling, gauges not working properly and emblems and pinstriping peeling. The survey also shows that many consumers were not satisfied with their boat dealer's service department.

To find out how your powerboat rates, check out the 2001 Marine Quality and Performance Study online at www.jdpower.com/boats.

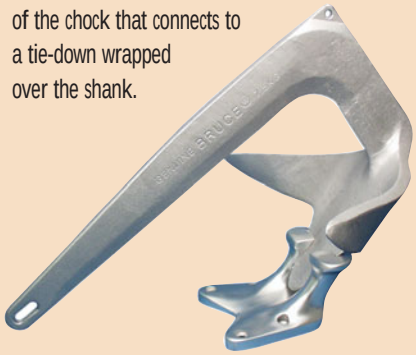
Back to Basics

Many clubs and marinas organize courtesy examinations and invite volunteers from the Coast Guard Auxiliary or Power Squadron to inspect members' boats for compli-

Product Reviews

Bruce Keeper

Boat builder-supplied bow chocks, platforms and anchor rollers are just not designed to mount a Bruce anchor. Because of its high and narrow shank profile, a Bruce requires custom fastening with bungee cords or line to secure it from jostling around in standard bow rollers. And forget storing it on deck unless you have a custom Bruce chock. The BA100 (US$155) deck chock fits 5kg to 15kg (11lb to 33lb) anchors. To prevent loosing the anchor overboard, consider mounting a padeye on each side of the chock that connects to a tie-down wrapped over the shank.



Looking for a pump cycle meter?

It's makes good sense to monitor bilge pump operation. Knowing how often the pump runs while you're away from the boat helps to isolate a small leak before it becomes worse, and prevents battery drains. DIY contributor and electronics' specialist Larry Douglas has a solution. The CycleStat (US$79.95) operates on 12-volts DC and counts the number of times a pump (or other cycling device) closes to operate its load. It incorporates a one-second delay to eliminate false readings, and a red LED displays only when there is activity. Pressing a button shows the accumulated count, pressing another resets the count to zero. Manufactured by ESC Products (Tel: 360/681-6904; Web: www.cyclestat.com).

ance with certain safety equipment required by law. Instead of waiting, you can conduct your own self-inspection online at safetyseal.net.

Hosted by the National Department of Vessel Safety Checks (VSC), you download a survey (requires Adobe Acrobat Reader) to use as a guide while performing the onboard inspection. After completing the self-examination, you can request an examiner to perform a safety check. You receive a copy of their evaluation along with recommendations for mandatory and good-to-have equipment. There are no obligations and you won't receive a citation should your boat fail. Boats that pass can display the VSC decal. This won't exempt you from boarding by a law enforcement agency, but increases your chances for a more positive encounter.

Pump Wins Award

Flojet Sensor VSD water pressure system pump received the 2002 Innovation Award from the U.S. based National Marine Manufacturers Association. DIY profiled this high-tech, multi-fixture pump in "Install a Modern Water System," in the 2001-#4 issue.

SPARE PARTS

South Shore Yachts in Niagara on the Lake, Ontario, has the original build file for every production **C&C** yacht constructed at the Ontario plant, plus various replacement parts such as toerails, stanchions, cleats, window gaskets, tiller handles and most items your boat needs. Check out its website at www.southshoreyachts.com.

Masthead

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VP Sales & Marketing: Steve Kalman

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42 Volt DC: A Solution or Problem

The impending introduction of 42 volts DC in the automotive industry and the ever-increasing power demands of boaters have generated considerable interest in the boating world. Essentially designed for automobiles, 42 volts provides greater power from the engine to power the many electrical systems on a vehicle when running. In addition, significant improvements in fuel consumption will be realized, along with a corresponding pollution reduction. This is significantly different from marine scenarios that are often based on drawing power from charged batteries with long time periods between recharging.

There are considerable factors that affect the implementation of 42-volt marine systems. The first is the battery. This requires a bank of three 12 volt, or six 6 volt cells similar in principle to four 6 volt for 24-volt systems, and four 8 volt (they are available) for 32-volt systems. In practical terms, the physical size of the battery bank reduces in size, which may give weight savings. Electrical cable sizes are also reduced, although practical limitations will probably follow instrumentation cables with minimum sizes. Though quality cables are already approved and rated to 50 volts, all cables must have insulation dielectric strengths to suit the higher voltage, most of which, at present, do not. Double insulated cables must also become standard rather than optional. Short circuit protection of cables requires appropriately rated circuit breakers, which may require new ratings and approvals.

Circuit configurations also change. This means an insulated return system, and the end of the more common grounded negative arrangement, which also ends so many corrosion concerns. Higher voltage, however, significantly increases leakage risks, and installations will ideally have line leakage and ground fault monitoring, a standard in commercial shipping systems.

As in 32- and 24-volt systems, a major barrier in 42 volts will be the availability of equipment that operates with these voltages. It's probable that DC-to-DC converters (already available) will be required resulting in dual voltage systems so common already. More practical in the short term, is to use 42 volts as a central power system to sub-panels. This offers many advantages, such as weight savings and reduced voltage drop problems. One area that requires careful planning is the installation of cables near electronics cables or sensitive power supplies. Interference problems from 42-volt systems will be more pronounced with the increased field strengths generated.

While greater power will be derived from existing alternator frame sizes, many motors will physically remain the same to suit pumps and other equipment, as is the case now in 24-volt systems. A major step forward would be the availability of 42-volt windlasses, powered winches and thruster motors, all of which require large cable runs, and are very voltage drop sensitive. Thrusters are already used on 48 volts with series connection of 24-volt battery banks.

The implementation of 42-volt systems requires many changes, both in design principles and in equipment manufacturers. Changes will not be rapid and will certainly require careful consideration.

— John Payne, author of "The Marine Electrical and Electronics Bible."

Further to your comment in DIY 2001-#4 to a reader looking for a **Trojan** wiring schematic, these as well as plumbing and parts' diagrams and some hard-to-find obsolete parts are available from MarineTech (Tel: 717/684-4145).
James Eric, Bowie, Maryland

CORRECTION

In the "Good Boatkeeping" column in DIY 2001-#4 issue, a tip in the sidebar "Anchoring Tricks" was incorrectly credited to the authors. The Aikens don't recommend that boaters "…anchor upwind of the crowd," for two reasons. It's considered impolite to anchor "on top" of another boat. And more importantly, because of shifting winds and/or currents, it's not possible to assume that the relative position of the boats in the anchorage will remain the same all night long.

Talk Back Q&A

HELP LINE 1-888-658-2628

When to Change Oil, Hoses

Q: I have a 1993 5.7l MerCruiser. The oil is changed at the end of the season. How often during the season should it be changed? Also how often are engine hoses changed?
John Plachtyna, "Kick n' Back," Branford, Connecticut

A: Check the oil regularly and change it when it's dirty — when you can no longer read the mark on the dipstick. Change hoses when

they become chafed, cracked or brittle, though this may not be obvious. A good service rule is to change hoses every 10 years, even if there are no visible signs of deterioration.
— Jan Mundy

Patching Pitted Ports

Q: I'm restoring a 1966 9.4m (31') Uniflite. Years of saltwater boating have badly pitted the aluminum window frames that sit on stainless-steel tracks held in place with stainless screws. I plan to fill the holes, then reinstall the side and top channels using a layer of 3M Marine windshield installation tape and stainless screws, and bed the bottom channel in either sealant or use the tape. Is there a better method?
Alan Brown, "Portland," Oregon

A: According to Eric Atkins of Atkins & Hoyle (877/415-5167), manufacturers of cast aluminum hatches and davits, to prevent corrosion you need to isolate the aluminum and stainless. To do this, if your windows are sliders, insert a thin plastic runner of the necessary tolerance between the two materials and glue to the frame. Plastic makes a better isolation barrier than a bedding compound, which may eventually wear through. Install stainless screws with a carbon fiber washer against the aluminum. For fixed windows, use an adhesive between the two metals. Use a silicone adhesive if windows are acrylic so it can expand and contract. To ensure the silicone sticks to the acrylic and aluminum track, clean all surfaces first with toluene followed by an acrylic primer. For glass windows, you can use a polyurethane sealant and get better adhesion, but will need to prep with the proper primer. After filling the pit holes, Atkins suggests treating frames with aludine, a chemical etch available at an anodizing shop, which allows painting without a primer. For the topcoat, Atkins suggests using an inexpensive body shop paint, warmed to 93°C (200°F) in the oven so it soaks into the pores as it cools to get better adhesion.
— Jan Mundy

Bonding Lexan

Q: I want to bond two Lexan strips at right angles lengthwise. These are not load bearing, so ruggedness is not a major criteria. What is the best glue to use and what surface preparation is needed?
John Hinshaw, "Seahawk III," San Diego, California

A: Lexan, a polycarbonate, is difficult to glue because of a rubberized agent on the surface. Provided the material is thicker than 6mm (1/4"),

DENNIS ANGLE

use IPS #4, a solvent cement available from many plastics' suppliers. If the pieces were cut with a saw, no preparation is necessary as the glue runs into the joint through capillary action. A more secure fastening method is to cut a wooden cleat that fits the joint and mechanically fastens the two pieces.
— Jan Mundy

A4 Cousin

Q: My C&C 38 has an Atomic 4 Stevedore and I was told that the only difference between this and an Atomic 4 is a restictor in the intake. If so, can it be removed?
Dennis Ommen, "Aquilla," Plymouth, Minnesota

A: You are correct. The Atomic Stevedore is an Atomic Four with a restrictor pressed into the intake manifold throat to lower the horsepower. The only other difference was some Stevedore models had small #19 main jets in the carburetor. To check if the restrictor is still intact, remove the carburetor and look into the intake manifold entrance. It looks like a small doughnut pressed into the intake throat at the flange that joins it to the carburetor. To remove the restrictor, detach the manifold, and while supported on the bench, chop out the restrictor with a cold chisel. Make sure the engine has a #21 or larger main jet, the optimum main jet size fitted to the Atomic 4 made after about 1977. In most cases removing the restrictor makes little difference in power, since the propeller in a displacement hull boat with a direct-drive Atomic 4 restricts the maximum rpm of the engine to way below the maximum horsepower rpm anyway.
— Robert Hess

It's a Mansfield, But not Jane

Q: Our 1982 CS33 has a Mansfield manual marine toilet,

model 751, that needs a rebuild. Do you know where we can obtain a repair kit?
Don Klitsgaard, Dowling, Ontario

A: Mansfield Plumbing was the predecessor of SeaLand Technology, which bought the company's marine products division in 1984. SeaLand made only manual toilets for a few years — first the 751, then the 752 — and finally discontinued all parts for both more than 10 years ago. SeaLand continues to make the VacuFlush and the 911-M28 Marine Traveler as well as gravity toilets and SaniPottie porta-potties, and none of them differ very much from the original Mansfield versions. Parts and tech support are available from any authorized SeaLand Service Center or directly from SeaLand (Tel: 800/321-9886, Email: *sealand@sealandtechnology.com*; Web: *www.sealandtechnology.com*.
— Jan Mundy

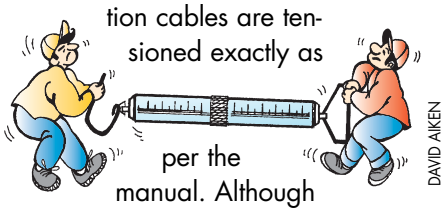
Steering Cable Tensionometer

Q: I'm refurbishing a 1989 Bayliner Ciera Command Bridge 2557 with a Chevy V-8 engine and OMC power-assisted steering. When I bought the boat the lower station steering cable was disconnected. It apparently had seized solid and was not operational. When I tested the upper station, it moved, but it was extremely tight and had excessive play. It would turn a full quarter turn before any response was noted. I have refitted new cables and steering boxes, however, the power steering unit only works at the lower station. When I disconnect one and try the other they both work separately. I've checked fluid levels and the centralized power cylinder as per the OMC service manual, but it's still a no go. Is there something I'm missing?
Alexander Loudon, Johannesburg, South Africa

Talkback Q&A

HELP LINE 1-888-658-2628

A: Based on your description it appears that your problem is in the cable adjustment, and not the power assist unit, otherwise it wouldn't work at all. The unit functions by sensing the push and pull pressure of the steering cable and responds accordingly. If one of the bridge or the lower station cables has play, the system doesn't respond properly. The first step is to isolate the two systems and determine if the lower station cables are tensioned exactly as per the manual. Although cables are spring-loaded, it's possible the springs have lost their tension. An easy way to check tension on both the push and pull sides is to use a fish scale with a rating of at least 22.6kg (50lb). First disconnect all the cables from the power assist unit, and then hook the end of the scale on the unit. With the motor running, carefully pull the scale and record the pressure required to move the steering. Reconnect the lower station and hook the scale somewhere in the middle of one of the cable's travel. With the motor running, pull the cable toward you until the unit responds and record the pressure. Do the same on the other side. Both sides should show equal pressure. If not, adjust the cable linkage accordingly and repeat the test. Next, disconnect the lower station and connect the upper station making sure that the cable is wound around the drum exactly as the lower station. Repeat this test and compare the readings. Adjust the upper cable until both station cables read the same pull pressure needed to move the power unit. Connect the lower station. Most likely your problem is solved.



DAVID AIKEN

— Harry Swieca

Three's Battery Set-up

Q: Factory set-up on my 1980 twin engine 9m (30') SeaRay is two banks with one for the start battery, and two batteries for house and the second engine. There is a 1-2-Both switch for bank 2, and a combiner on-off switch for banks 1-2. A three-bank charger uses only two of the outputs. What is the best set-up for this boat when used for cruising and fishing, usually at anchor?

Michael Patria, "Fish N Bones," Stratford, Connecticut

A: The best battery set-up for your boat is a slight variation on what you already have. I'd alter your set-up to include a single house bank comprised of deep-cycle batteries (total capacity sized for your situation), and then install two dedicated start batteries. All house loads come from the house bank, and all charging sources go into the house bank. Installing a single bank system monitor (Link 10 or equivalent) provides everything you need to know about that bank. The combiner you already have should temporarily join all three banks (house and two starting) under the influence of a charging source (alternators or dockside charger) to keep the start batteries topped up.

— Kevin Jeffrey

Reconditioning I-6 Mercs

Q: I'm about to embark on the process of reconditioning twin MerCruiser 165 engines for my 1980 Bertram. As I have some mechanical knowledge, I plan to outsource the tougher jobs, but do all the reassembly. Are there any special considerations? Also, I have had continual problems with the electrical shift changing system. When I bought the boat, this was not connected and the wires from the shift unit had been cut.

Mark Joyce, "Billabong ," Berkeley Vale, Australia

A: Model 165 MerCruiser (six cylinder inline) was replaced by the 4.3L V-6 in the mid-80s. Parts to rebuild the longblock assembly are readily available through any authorized Mercury dealer. You'll also need two manuals: 1980 165 Service Manual, part number 90-95693; and 1980 MC1 Drive Service manual,

part number 90-86137. There are three possible shift switch configurations used on your engine. A shift cutout switch mounts under the shift cable on the transom assembly and connects to the distributor breaker point wire at the negative connection of the ignition coil (black wire) at one end, and engine ground at the other end. This switch should stall the motor when shifting out of gear only. Alternatively, a reverse lock switch connects in series to the "up" circuit on the power trim pump (blue wires). This switch mounts on the reverse lock valve on transom assembly and prevents trimming up the drive while shifting into reverse. The third configuration is an electric shift kit, offered in the 1980s for boats with very long remote control cables. Since parts are no longer available, kits must be replaced with traditional remote control and cables.

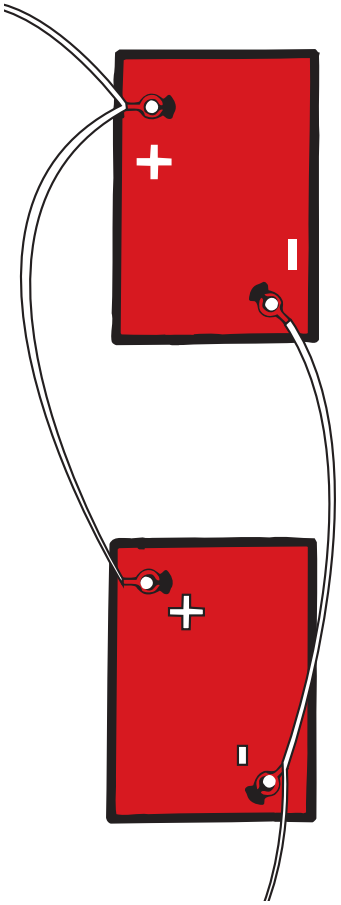
— Steve Auger, Mercury Marine

Trickle Charging Multiple Batteries

Q: During storage I want to hook four boat batteries to a single battery charger to keep fully charged. How should they be connected?

Thomas Stevens , Plymouth, Massachusetts

A: If the batteries are the same voltage and roughly the same capacity, vintage and condition, you can connect them in parallel (positives joined together and negatives joined together) and charge them as if they were one battery bank. There's no need to keep the charger on all the time, as all you are trying to do is replace the losses from periodic self-discharge. Here's the routine: once a month connect the batteries in parallel, top them up to full capacity with a regulated battery charger, then disconnect the positive wires so they are electrically isolated during the time between charges. If the batteries are of different capacity, vintage and condition, however, it's better to top up each battery individually once a month or so.



— Kevin Jeffrey

TECH TIPS

LOCKING HITCH: To guard against theft of your trailer, or the hitch assembly when not connected to the trailer, drill a hole in the end of the hitch pin and attach a heavy-duty lock.
Ben Owen, "Dolphin," Oshkosh, Wisconsin

BILGE DRAIN: Wooden boats were commonly fitted with a garboard plug, which is a thru-hull fitting with a removable threaded plug

positioned to drain the bilge dry when the boat was "on the hard." This is one useful item entirely overlooked in fiberglass boats. Installing the plug before launching is the key to preventing sinking the boat.

RUST-CHECK WRAPPER: To prevent tools from rusting, apply a thin coat of light oil then wrap each individually in plastic wrap.

SEACOCK ID: There won't be any guessing onboard after you tag all seacock connections. Easy to make, these paper labels are laminated, then cut into strips and securely attached to the seacock barrel with common cable ties.

HANDY NUT KEEPER: To lessen the chance of losing a large nut or oil filler plug into the lower recesses of the engine compartment, use a holder. In the bottom of a 500ml (17oz) plastic tube (i.e. margarine container), cut a hole slightly larger than the nut. Hold the tub securely under the nut when removing or reinserting. Drill a small hole in the tub's side and hang it on a cup hook near the engine.
Bert Small, Salt Spring Island, British Columbia

A LINE WHEN NEEDED: A quick-to-grab line organizer is a lot better than sorting through a tangled web of lines in the bottom of a locker.

HOSE BAND-AID: To temporarily repair a leaking plastic hose or a cracked plastic hose barb, dab on some 3M 4200 Fast Cure. Routinely check the fitting when operating and replace as soon as possible.

A STEP UP: When the stern rail is just too high to reach from the transom add a step. The folding step pictured is Garelick part number 27515, mounted on a Shannon 47.

NOT PRETTY, BUT IT WORKS: When your runabout doesn't have center cleats to anchor a mooring cover, and the now shrunken canvas cover doesn't overlap the gunwale anymore, a few large plastic bottles half-filled with water should hold the "wrapper."

CABLE TIE-UPS: Use quick-release Velcro ties to securely mount coiled cables, wires or lines.

TECH TIPS WANTED

If you have a boat-tested tip you'd like to share, send complete information along with your name, boat name and home port to:

DIY Tech Tips,
P.O. Box 22473,
Alexandria, VA 22304
Or email to info@diy-boat.com

SHOP TALK

GELCOAT SPRAY TECHNIQUES

Follow these simple steps for a professional sprayed finish to your fiberglass repair.

Gelcoat is the pigmented polyester resin used as a surface finish for most newfiberglass boats. Though gelcoat resin has slightly different properties than the type used for laminating, like all polyester resins it requires the introduction of styrene monomer to alter it into a usable form. This gives the resin its liquid properties and the familiar smell.

Liquid gelcoat resin is applied by brushing or spraying. For scratches, gouges and other small "spot" repairs, brushing is fast and doesn't require a major equipment clean up. Larger repairs are best finished with sprayed gelcoat.

The chemical process that occurs when gelcoat turns from a liquid form to a hard, brittle plastic is known as polymerization. Polymerizing plastics requires that you observe a few simple concepts when working with this material. Chemicals pose a health risk, and you should read and heed all manufacturers' data sheets for safe handling. Catalyzed polymers react with chemicals to initiate the curing process, resulting in the liquid resin becoming "set" into a hard plastic. Heat is the by-product of this process, and the temperature of working conditions affects the rates of cure (polymerization). Cured resin is impervious to most chemicals. Therefore, you must clean up your tools and equipment prior to the plastic curing.

There are two varieties of gelcoat resin. Boat manufacturers spray an air-inhibited gelcoat into a mold. Following the gelcoat application, the laminates are laid in place. This effectively seals the gelcoat from the atmosphere, where the resin cures in the absence of atmospheric gases. Conversely, in repair applications, gelcoat resin is the finish coat. Therefore, you must use an air drying gelcoat that allows the resin to fully cure when exposed to air. Failure to use the correct resin or to account for this "air dry" and polymerization will not occur, despite doing everything else correctly.

Resins are also formulated with varying percentages of styrene. Less styrene means the liquid is more viscous. This works well for brushing applications. More styrene means a thinner mixture, suitable for spraying. Therefore, be sure to purchase an air-drying spraying gelcoat formulation.

Spraying gelcoat resin requires the following tools and materials: safety gear including respirator, safety glasses, gloves and apparel; mixing equipment, including pots (impervious to styrene) and stir sticks; quality masking tape (i.e. 3M 233+), masking paper or painter's masking film; gelcoat resin in the appropriate color, styrene, methyl ethyl ketone peroxide (MEKP), fiberglass cleaner, and PVA (poly vinyl alcohol used as an air inhibitor) and air dry (both optional); spray equipment; acetone, lacquer thinner, and rags for clean up.

Simple and cheap small disposable self-contained sprayers work best for gelcoat resin. Higher quality spray equipment used primarily for paints have a flow needle size that is too small for gelcoat. If you decide to use such equipment, you'll need the largest fluid flow orifice/needle the manufacturer provides for that gun. Experimentation may be necessary to achieve the best results.

Successful gelcoat spraying demands proper preparation of the repair zone. Most important is removing all contaminates on the surface. After filling and fairing the repair, mask the surrounding area, and repeatedly clean the surface to be sprayed with fiberglass prep cleaner. Many people use acetone or lacquer thinner for this step. Just be careful to do this a number of times, using a clean rag each time, so that contaminates are actually removed, not just spread around on the surface.

Inexpensive siphon spray guns, Badger model 250-4 (left) and Canadian made Critter model 118, both cost US$40 or less, are the best choice for gelcoat repair jobs. Catalyzed gelcoat is sucked up the tube by the air passing over the venturi, creating low pressure. Varying the height of the venturi increases or decreases the flow rate.

DeVilbiss guns, a siphon feed touch up gun (left) and a small gravity feed gun with a regulator for setting compressor output, costing $200 to $300 each, are better suited for paints as they clog easily and easily ruined by poor cleaning.

Prepare your gelcoat for spraying. Proper spraying consistency depends upon the equipment you are using. Gelcoat is generally thick and viscous. Thinning may be accomplished in a number of ways. Styrene is the thinner of choice, since it's a major component of the resin anyway. Since acetone is a diluent that decreases the viscosity of the gel, but is really a foreign substance to the finished product, it's not recommended. Acetone flashing out of sprayed gel may be responsible for pinholes left in the surface upon curing.

Shop Talk

Resist the temptation to sand spot repairs with your hand or fingers, or hurry the job using a power sander. Always sand with a backing block of rubber, wood or hard felt.

Cover and protect untreated surfaces when spraying gelcoat with 3M Marine Scotch Ready-Mask, a convenient pre-taped plastic film.

After wet sanding, buff the repair using a rubbing compound, then wax.

Mix enough gel to properly meter out the appropriate amount of hardener (catalyst). A common mistake is to use a very small quantity of gel and overcatalyze the mixture. Calibrate your mix beforehand to prevent this. A simple method would be to take a known unit of measure (a calibrated pill cup works well). Using the MEKP dispenser, count drops into the pill cup until you have registered a marked quantity. Divide the quantity by the number of drops to come to a quantity per drop figure. This allows you to accurately determine the number of drops of MEKP you require for the amount of gel used. The importance of this cannot be overstated. The most common mistake is overcatalyzed resin. For spraying, 2% MEKP by volume is recommended.

The significant variable not mentioned is that of temperature. Since the reaction is exothermic (a chemical change that releases heat), ambient temperature creates major differences in cure rate. Colder temperatures require a higher percentage of catalyst. This increases the temperature of the cure, allowing it to proceed properly. Conversely, high temperatures require a decrease in catalyst percentage. Manufacturers of resin publish recommendations for catalyst ratios based on temperature. Never attempt to spray gelcoat at less than 15.5°C (60°F).

A syringe allows accurate measuring of the amount of MEKP required to catalyze the gelcoat resin.

Preval, a disposable spray gun available at auto-body supply shops and some BoatUS stores, comes with its own supply of propellant, thus eliminating the need for a compressor.

When mixing MEKP into gel, be very careful not to splash it onto yourself. Eyes are particularly vulnerable to the danger of this chemical, so be extra cautious. Mixing should be complete. The major difference in viscosity between the MEKP and gelcoat requires that you be diligent in stirring it around sufficiently to ensure good mixing.

Once mixed, you have limited time to complete the application and clean up, so be sure you are 100% ready before mixing the resin. Cure time varies, depending on the resin system, from one to two hours for a thinly sprayed film. Don't waste any time getting your equipment cleaned. The stuff left over in your mixing pot or spray gun will generate more heat and cure significantly quicker than the sprayed repair. Leave any excess resin in a fireproof container to fully cure.

Gelcoat resin has a property known as thixotropy. This means that it will become more liquid as it's agitated, and more gel like when undisturbed. Spraying creates a thixotropic transformation in the resin, which becomes thicker and more sag resistant once it hits the repair. This property allows spraying on a very thick layer of gel without incurring sags. This also means that orange peel (bumpy surface) is a natural condition for sprayed gelcoat. Luckily, wet sanding and buffing when fully cured achieves a high gloss paint-like finish.

Spraying is not difficult. It requires sufficient pressure and volume of air to get the liquid out of the gun and onto the repair. Excessive pressure results in lots of over spray, as the gel bounces off the repair. Disposable small compressors easily provide sufficient pressure, probably 30psi to 40psi. Larger repairs require greater quantities of everything, including air volume supplied by larger compressors.

A product called Patchaid by Cook Composites, allows reducing the viscosity of the gel to the point where it's sprayed much like paint, with minimum surface defects (such as orange peel); an appealing option in certain applications.

Styrene in gel is disastrous to some plastics used on boats, particularly polycarbonate or acrylic windows. Make absolutely certain that you contain over spray or prevent it from contacting windows, vinyl tape, upholstery and anything else that may be attacked by solvents. If you should get over spray on adjacent gelcoat, wipe it off with acetone or lacquer thinner before it cures. (Don't use acetone or lacquer thinner on any other types of plastic though.)

Leave your repair to cure overnight, then wet sand with 400 grit paper, followed by 600 then 800, then buff and wax.

About the author: Wayne Redditt has 20-years experience in design, construction and repair of small craft built of wood, composites and metals. He teaches engineering technology programs at Georgian College of Applied Arts and Technology, Barrie, Ontario.

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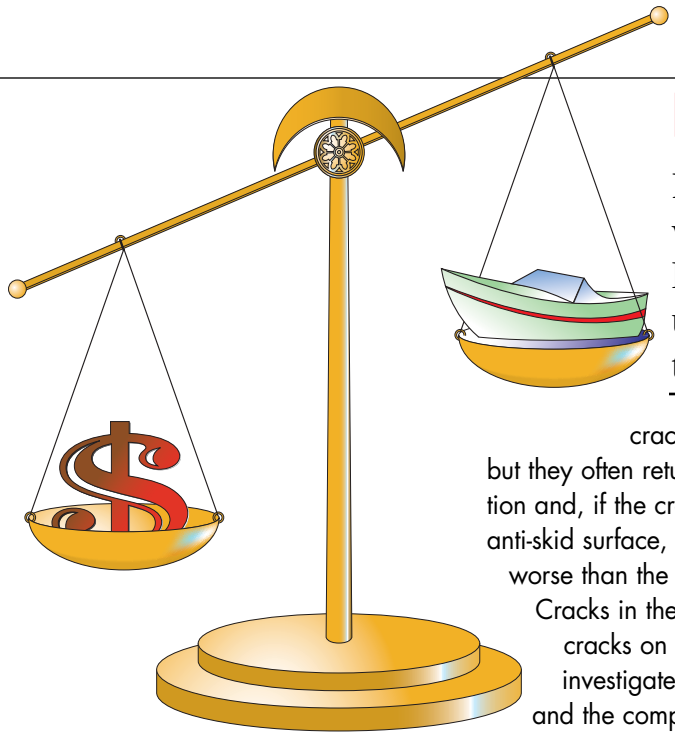


BALANCING BOAT WARRANTIES

Read your boat warranty and you'll find out what's covered and what is not. You'll also learn that "manufacturer" refers to many unrelated companies, not just the company that built your boat.

[BY NICK BAILEY]

Unlike cars and recreational vehicles, boats are built of components and systems made by a wide range of individual and separate manufacturers. An owner of a new or previously owned boat may presume that the boat is covered by a seamless and comprehensive warranty. This is rarely the case. When a salesperson refers to a "warranty," generally it's a collection of warranties provided by each of the manufacturers of all the installed equipment, engines, gen-set, steering and control systems, refrigerator, pumps, MSD, stove, instruments and gauges, windshield, deck fittings, cabin hardware, canvas, trailer, et al. The only warranty normally offered by the boatbuilder is for the boat hull, deck and structure. Understanding the terms and conditions of all the manufacturers' warranties is the key to pursuing successful warranty repairs.

Boat Structure

Most boat manufacturers have limited warranties with respect to cosmetics. Details such as hairline cracks, gelcoat voids or air bubbles, fading of gloss or color are often specifically excluded. These problems are considered strictly cosmetic and are common to most fiberglass boats. Hairline cracks can be repaired but they often return at the same location and, if the crack extends into an anti-skid surface, a repair may look worse than the original damage.

Cracks in the hull, or any large cracks on deck should be investigated by the boat dealer and the complaint recorded as early as possible during the warranty period in case the condition worsens. The boat owner should consider having a qualified marine surveyor inspect the damage and provide a report on behalf of the owner.

Osmosis ("blisters") is a problem that may or may not be covered. Some builders warrant against blistering for a specific number of years; some for the life of the hull. Some boatbuilders have covered blister repairs as a gesture of goodwill, exclusive of warranty, to avoid bad publicity or a lawsuit. Again, seek the advice of a marine surveyor and keep good records. Often, the written record becomes the basis for a resolution.

Be careful when working on hulls that are guaranteed against osmosis. The warranty fine print may specifically exclude coverage if you sand the hull prior to applying antifouling paint. There are "no sand" prep systems, but you may not achieve satisfactory adhesion of the bottom paint.

Engines

Engines are treated as a completely separate entity with an independent warranty registration. Though the boatbuilder is responsible for installing the engine properly, the dealer is usually responsible for carrying out the required pre-delivery inspection (PDI) and completing the paperwork for the engine warranty registration.

The engine manufacturer's authorized dealers must complete the requisite PDI procedures, which usually require that a completed checklist be returned to the engine manufacturer together with the warranty registration. Without the proper PDI and warregistration, you don't have an engine warranty. Where a dealer is not an authorized service depot for the engine, it's the dealer's responsibility to employ an authorized technician.

Read your engine warranty carefully. Sometimes, a warranty specifies that an authorized dealer perform a 20-hour or 100-hour service, or the warranty is void. This first service is designed to complement the PDI and detect symptoms before they lead to major problems. This service usually corresponds to the first scheduled oil change. It's in your best interest to have this service done by an authorized dealer, regardless of whether it's required under the warranty.

Occasionally, problems with the boatbuilder's engine installation, such as alignment faults or a poorly engineered engine exhaust system, can lead to mechanical problems. In these cases, the dealer is in the best position to handle the problem. Stay calm, express your concerns, document them and demand the best service. Good communication is key.

Engine warranties typically do not cover the cost of boat handling during the repair. Your original dealer may step in to cover hauling, cradling, trucking or launching in the interest of customer satisfaction.

Warranty Remedies

• PUT IT IN WRITING!

When dealing with any warranty issues, put your complaints in writing. It's easier to keep track of problems and also protects you in case something deemed minor at first discovery turns into a major problem just outside the warranty period. It's the date of the complaint, not the date of the repair, that must fall within the warranty period.

If you are unhappy with the dealer's response, request the option of making your own repair arrangements through an independent shop. You will need to submit a written estimate to the dealer for approval. In some cases, the dealer may decide to work directly with an independent shop on a contract basis.

• DON'T BE AFRAID TO GO TO THE TOP

At an overworked service department the squeaky wheel does indeed get the grease. If the service manager is having trouble getting to your problem, go to the general manager or owner. If the dealership won't look after things in a satisfactory manner, contact the manufacturer. Start with customer service. Failing that, customer relations is the next stop. The company president is your last resort. Unfortunately, unless you are a big campaign contributor, a government official is not likely to be of much help, but the United States Coast Guard does have a defect notification program for specific safety problems, and there is a USCG Infoline at 800/368-0816. BoatUS (Boat Owner's Association of the United States) also offers its consumer advocate to its members (www.boatus.com).

• BE REASONABLE, STAY CALM

Try to remember your boat is supposed to be fun. Don't get your knickers in a twist over minor gelcoat flaws, burned out light bulbs or loose screws. But, if your new stern drive grenades, and you spend a cold night at sea awaiting rescue, and your dealership doesn't immediately drop what it's doing to look after you, no one should be surprised to get a call from your lawyer. Screaming and yelling won't help — the person on the phone is not the person responsible for the problem. A sternly worded letter will always get attention.

• DON'T DO IT YOURSELF!

Other than tightening loose screws and other normal minor maintenance items, don't fix it yourself unless you need to do something to minimize damage or the threat to your safety, such as stopping a leak. Don't service your own engine during the warranty period. Messing with a problem yourself may void your warranty. Nonetheless, you can help the repair process along by investigating and accurately assessing the problems. A vague complaint is, to most service departments, particularly annoying. Remember, once the boat is out of warranty, you can go back to fixing things yourself.

Other Equipment

New boats are built with components and equipment supplied by OEMs (original equipment manufacturers) and installed in the boat by the boatbuilder. When these items fail, the dealer looks to the OEM to support the warranty claim. Most OEM warranties provide for "no charge" replacement of the part, but offer no compensation for the labor to troubleshoot or remove and replace the component, or for other related costs. Here's where the dealer often absorbs extra costs to preserve the customer relationship.

Other Options, Other Dealers

When a dealer cannot or will not help, or the boat is in a location too distant for the selling dealer to service, you have the option of contacting the boat manufacturer for assistance. It can recommend another servicing dealership, or mediate a dispute. It's important that you establish good communications with a service facility you can trust.

Sometimes the nature of a repair requires skills beyond the dealer's service department's capability. The boatbuilder may request that you identify a qualified, independent boatyard that will submit a quote for the warranty repair. Here again, there may be costs that are not covered by the warranty. Many builders have preset compensation rates for repairs. Other costs could come out of your pocket.

The same is true for engine warranty problems. The independent boatyard didn't make any money selling you the boat, so you cannot expect it to absorb any costs. Don't be surprised if a yard is less than thrilled to undertake your engine warranty problems. Most repairs are billed "time and materials." But engine manufacturer's flat rate labor allowances for warranty work rarely cover the actual labor costs involved. With most engine warranty jobs, independent yards must either charge the boatowner for the added labor or lose money while they wait to get paid by the manufacturer. At least one major engine manufacturer makes a point of pouncing on any minor mistake in the claim process as a reason to deny the warranty claim. It's not uncommon for an independent yard or service shop to request prepayment from the boatowner with reimbursement to follow when, and if, the manufacturer approves the charges under its warranty policy.

Extended Warranties

You can purchase extended warranties on your boat and/or engine. These contracts are actually insurance policies and are usually offered by a third party. They can be relatively expensive, but if needed can save a fortune. Extended warranties are commonly purchased at any time within the original warranty period. Extended warranties offered by the major engine manufacturers are purchased and registered at any authorized dealer. Like any insurance policy, it's a matter of cost versus security, and no one can predict whether you will need it.

About the author: Nick Bailey is a 25-year veteran of the boat repair business and is service manager of Bristol Marine in Port Credit, Ontario.

ELECTRONICS

TROUBLESHOOTING TANK SENDERS

A fuel tank sender is one of those devices that either works or doesn't. When it doesn't, you long for a dipstick. Follow these steps to test and install a new one.

[BY JAN MUNDY]

Is the fuel tank half full, or half empty? Many boaters have been stranded by an empty fuel tank because they didn't know how much fuel was in their boat's tank. Often the fault is with the fuel tank sender, not the gauge.

Conventional float-arm style fuel tank senders consist of a small wiper arm that moves up and down with changing fuel levels and a processor that sends electronic impulses to the gauge for analog or digital output. The arm rides on a rheostat. Older units have a wire-wound rheostat. Vibration and shock eventually erodes and breaks the wire, creating incorrect readings on the gauge. Corrosion of the unit also contributes to erratic readings. Another type of sender has a ceramic rheostat screened with conductive ink. While it doesn't have wires to break, the wiper gradually wears where it crosses the rheostat from debris contained in the fuel. This occurs with a wire-wound unit as well.

Continuity Check

Disconnect the DC power supply first.

Common float-arm type fuel sender.

Before removing the sender, check all wires and connections at the tank and gauge. Corroded or loose terminals, or a poor ground, may be at fault. If not properly grounded, the gauge pegs out at full and stays there. If the system proves fault-free, your next step is to check the continuity of the sender with a multimeter (VOM).

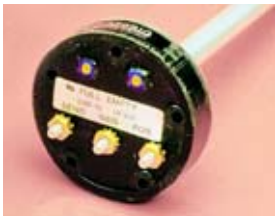
Disconnect the sender from the gauge. Attach a VOM, the positive (red) lead to the sender's output post and the ground (black) lead to the sender's flange on the tank. Most marine fuel senders have a resistance of 33ohms to 240ohms. Using the gauge as your guide, the VOM reading on the resistance scale should indicate 33ohms with a full tank, 240ohms at empty and somewhere between 80ohms to 120ohms when half full. A more accurate test is to unscrew the sender from the tank, attach it to a VOM (as above), and manipulate the float arm, moving it to the full (up) and empty (down) position while noting the resistance on the VOM. If the sender checks out, the gauge may be at fault. But before removing, obtain another sender that you know works and connect it to the gauge. Troubleshooting fuel gauges normally requires a decade box and the services of a marine electronics' specialist.

Match Don't Mix

Before purchasing a replacement, you'll need to measure the fuel tank depth. Senders are available for varying tank depths. Manufacturers don't recommend mixing the resistance of a gauge and sender. For best performance, a 240ohm gauge, for example, must be matched with a 240ohm sender. Your dealer can help determine the correct sender if you know the brand and model number.

Conventional float-arm style fuel senders are less reliable, especially on large horizontal tanks, than more expensive probe-type units with no moving parts. A tank with a depth of 41cm (16"), for example, has a 23cm (9") bracket and 30cm (12") float arm. Vibration and signal amplification from float arms longer than 51cm (20"), the recommended maximum, can break or cause erratic readings. For powerboat use, select a sender with a heavy metal bracket to absorb some of the shock from pounding.

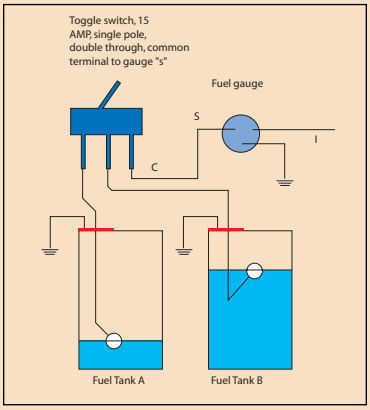
New senders install in the same standard SAE five-hole flange opening making the installation easy. Use the same wires to connect the sensor to the fuel gauge, provided they are in good shape and are marine grade (many older boats have automotive-style wiring.) Float-arm style fuel senders are more difficult to install due to accessibility. Be sure to mount the float arm correctly so it doesn't touch the tank sides and it swings in the right direction. Fuel sender kits are available and help to eliminate some of the guesswork.



Probe type sender has no moving parts. Constructed of one small tube inside a larger tube, the inner tube acts as a capacitor, measuring air volume as fuel level changes in the tank and activates the sending unit.

One Sensor, Two Tanks

Q: My 1975 11m (36') Uniflite has two new fuel tanks and one fuel gauge connected to a toggle switch to select which tank to display. The gauge reads "full" only if I remove the ground wire from the gauge, leaving the "S" and "I" posts connected to the tank sensor and the ignition respectively. Can you provide the proper wiring for this setup? *H. Michael Owen, "No Big Deal," Oakley, California*



Wiring schematic shows one fuel gauge used to register fuel levels in two tanks.

PROJECTS

DRILLING HOLES IN BOATS

I became reacquainted with dinghy sailing last summer when I acquired an old Sunfish. A fun boat in a blow, it lacked dry storage for my keys, wallet and other stuff. Utilitubes from Rabud (Tel: 954/925-4199, Web: www.rabud.com) were the perfect storage solution. They're made of polycarbonate, and they feature a watertight, twist-lock, gasketed deck plate. I installed the smallest model, the Utilitube 8 (US$20.50). They are available in four sizes from 20cm (8") to 67cm (26-1/2") in length.

Modifications often require drilling a hole in your boat, a somewhat unnerving experience for the uninitiated. But like any precise work, after you've drilled a few holes and gained experience, it becomes just a means to complete another project. Regardless of what hardware you're installing, if it requires drilling through fiberglass, use these simple steps as a guideline.

— By Jan Mundy

STEP 1: Trace the OD of the tube. This is the cutting line.

STEP 2: As there was no under deck access, I was drilling blind so I first drilled a 6mm (1/4") pilot hole in the center to check for height and width clearances. If the positioning was incorrect, a sealant patch, perhaps even mounting a cleat, would hide the error.

STEP 3: Insert a stiff rod (I used copper rod) to measure height and width clearances.

STEP 4: Drill a 12mm (1/2") pilot hole along the cutting line. This becomes the starting position for the jigsaw.

STEP 5: Insert the blade of the jigsaw into the drilled hole and begin to cut. Be sure to use a sharp blade. I used a 7 TPI to cut through the foam-backed deck.

STEP 6: Dry fit the Utilitube. Use a wood file to remove any high spots.

STEP 7: Mark the outside perimeter of the deck plate. Drill the holes for machine screws. To do this, drill one hole at a time, and insert the fastener. When all are drilled, remove the tube.

STEP 8: Clean the mating surfaces with solvent.

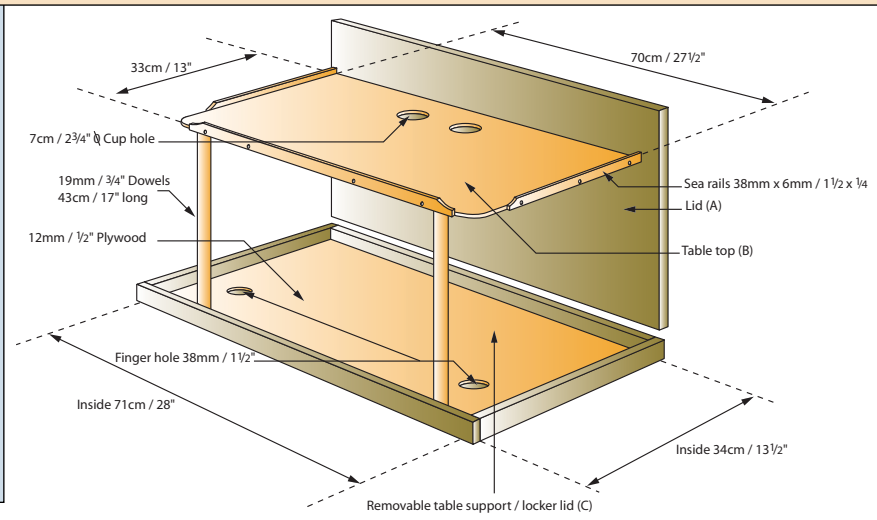
STEP 9: Dab some 3M 4200 (or equivalent) polyurethane sealant into the fastener holes and apply a bead of silicone onto the underside of the deck plate, and insert the Utilitube.

STEP 10: Success. Dry storage for my stuff.

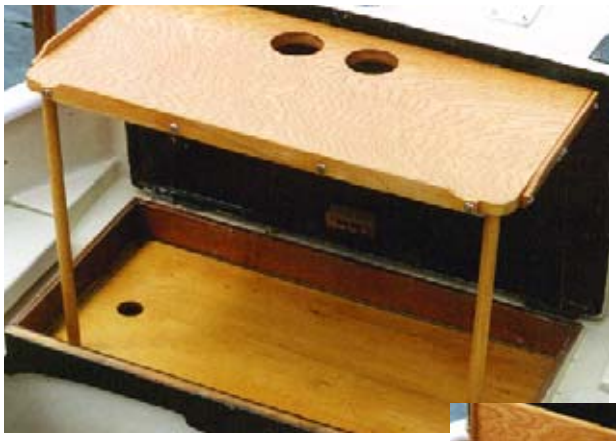
CONVERTIBLE TABLE

Materials

- **(B)** Table top, 1 piece 33cm x 70cm (13" x 27-1/2"), 16mm (5/8") plywood
- **(C)** Support lid, 1 piece 34cm x 71cm (13-1/2" x 28"), 12mm (1/2") plywood
- Legs, 2 pieces 19mm x 43cm (3/4" x 17") dowel
- Fiddles 6mm x 38mm x 1.5m (1/4" x 1-1/2" x 5') mahogany
- 4 Spring clips for dowel holders
- 1 Friction catch
- 2 Folding shelf brackets
- 2 Butt hinges
- Varnish



Projects



"Sea Eagle," a 6.7m (22') converted lifeboat, was in need of a cockpit table, so I designed one that utilized an existing cockpit locker, and fits snugly in a 5cm (2") space under the locker lid.

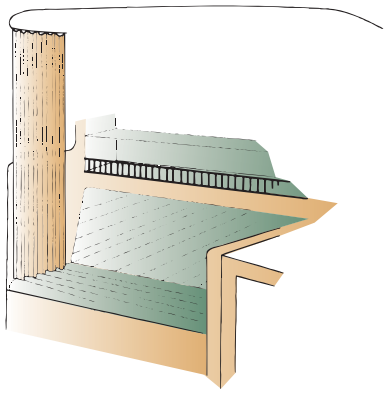
Made of plywood, the folding table top **(B)** attaches to the underside of the locker lid **(A)** by two sliding shelf brackets. Holes cut into the top hold plastic cups. Legs made of wooden dowel support the table front. When not needed, these stow between the table front and locker lid, secured by spring clamps. Mahogany or teak fiddle rails complete the table. To support the legs, cleat stock was glued to the inside locker edge and a plywood lid made to fit the inside dimensions. All components were finished with multiple coats of varnish. I later added a 30cm (12") piece of PVC pipe to hold an umbrella.

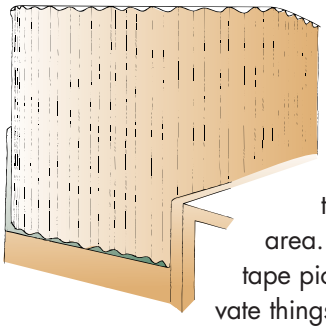
— Bert Small, Salt Spring Island, British Columbia

A CHILD'S STATEROOM

So you've found a boat your family can afford, but it's not so large that each child can have their own stateroom. The layout allows each child their own area at night, or during the day if needed, yet there are no bulkheads to separate their area from the rest of the cabin.

There is a simple method you can use to provide some measure of privacy anytime, day or night, to each child. A simple curtain that is pulled around their area is easy to make. It doesn't keep out sound, but it does keep out prying eyes.





In the past while sailing with children aboard, I found settees, both port and starboard work well for boys, and a quarterberth is preferable for girls. I say this because girls need a little more privacy than most boys, and a quarterberth serves this function well. The standard quarterberth has walls on three sides, with only an opening toward the main cabin area. This allows the girl to tape pictures up, or to store private things away as desired. Whereas the settee seats, which turn into a bunk berth at night, have shelves behind them for boy's things, or sometimes storage behind them for clothing or other things of a personal nature. Most quarterberths are wider than one girl needs, so add some small plastic storage bins for her stuff as well.

Select a fabric for the curtains that is bright, reasonably flexible and preferably water-resistant. Hanging the curtains is a simple task at reasonable cost. I used a Recmar Shower Curtain Track kit for each area. Available from BoatUS (US$15.99, catalog item number 176122), these 1.8m (72") long kits contain the aluminum track and all needed hardware. The curtains are your choice. The track is easily bent in surprisingly small arcs that eliminate sharp corners. The curtain carriers travel freely, and the track fits right against the overhead. When not in use, the curtains are simply pulled back to one end and tied in place.— *Donald Boone, Sequim, Washington*

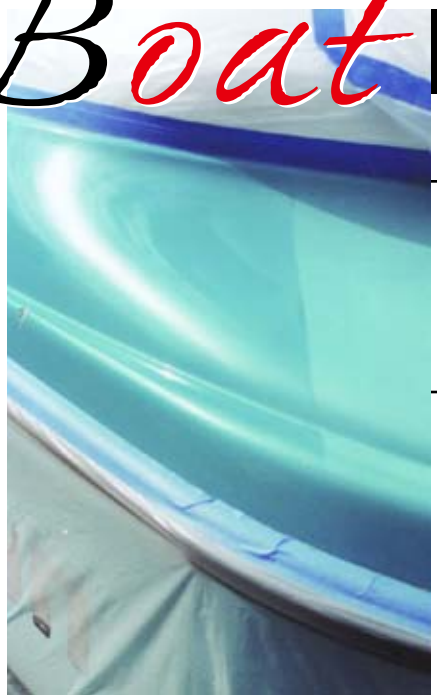
Projects Wanted

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

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

EMAIL: info@diy-boat.com

Boat Detailing



Reviving your boat's glossy finish and creating a factory-new appearance is surprisingly easy if you use the proper techniques. Follow these steps for a long-lived durable shine.

[STORY AND PHOTOS BY JAN MUNDY]

Gelcoat, the exterior finish on fiberglass boats, is a porous mix of polyester resins and pigments that must be sealed from the damaging effects of ultra-violet (UV) rays, salt, dirt and weather. Neglect it, and it becomes more porous, resins oxidize and what remains is a faded, dull finish.

There is no magic wipe-on, wipe-off remedy that removes oxidation and has a gloss that lasts a lifetime. Achieving a like-new shine isn't very difficult, and doesn't require a lot of extra work, especially if you invest in quality materials and tools. We discovered this after spending a day with Ray Lemieux of 3M Marine, an expert in boat and automotive detailing, and DIY columnist and former marine technician professor Wayne Redditt.

Do these four steps to achieve a factory-new shine: wash to remove all contaminants; mechanically repair the gelcoat by sanding or compounding; chemically bond a protectant to the gelcoat to protect from further oxidation; and maintain the surface to extend longevity of protective coating.

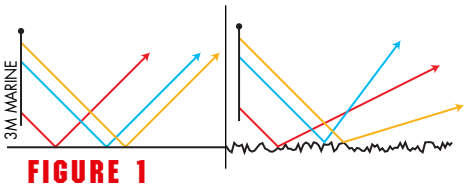


FIGURE 1

Effect of sun's rays on gelcoat: (left) Smooth, flat surface of new gelcoat reflects light just like a mirror; (right) UV breaks down the molecules, rain washes out the minute pieces that break away, creating a rough surface that reflects light at an angle and looks dull.

STEP 1

Scrub the surface thoroughly with a quality boat soap and water using a wash mitt or abrasive Scotch-Brite sponge. Flush with freshwater. Don't use automotive soaps or household soaps, which may strip the wax or damage the gelcoat. If the application instructions recommend using a certain cleaner with a specific protectant (i.e. wax) to obtain the desired finish, follow the recommendations.

Use the "Oxidation Test" to determine condition of gelcoat. For surfaces in good condition that only require rewaxing, go to Step 3. For oxidized gelcoat, wipe with a solvent to remove silicone, wax or glaze buildup. Spray the surface with water, which should wet out rather than bead if all finishes are successfully removed.

Two options for repairing oxidized gelcoat are: fill the cavities with a quality wax or polish (hereafter referred to as "wax"); or knock down the high spots, either by compounding or sanding until the surface is flat, then follow with a filler. Just applying a wax on heavily oxidized

OXIDATION TEST

(top): No Oxidation: Mirror image of ruler reflected in the gelcoat. (middle) Light Oxidation: Bottle reflected in the gelcoat appears cloudy, showing the label, but you cannot read the type. (bottom) Heavy oxidation: Little or no reflection of bottle in the gelcoat.

gelcoat is a short-term repair. The surface has sheen when viewed from the side, but no deep luster, and rain in time washes away the wax. Oxidized gelcoat, whether light or medium, is best repaired by compounding or sanding to obtain a flat surface, filled with a glaze (or wax if a one-step product), then followed with a wax.

STEP 2

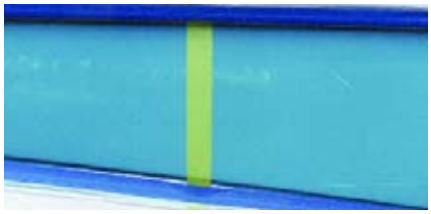
If your boat's gelcoat is looking cloudy or lightly oxidized, you need to apply a color restorer. Heavier oxidation requires more aggressive repairs, either by wet sanding followed by a finishing material (glaze), or use of a rubbing compound, then glazing. Take care when using compound. It is an abrasive process that can damage the

thin gelcoat, which is about 20/1,000" thick or the thickness of five sheets of paper. Frequent compounding can remove too much gelcoat, exposing the laminate underneath.

Color restorers and rubbing compounds don't like heat. Besides being abrasive, they contain water and petroleum distillate or other lubricant that keeps the liquids wet and prevents excessive scratching. If applied in the sun, it will haze. If it hazes, it's too late to work it. A wax you want to haze; a compound or glaze you don't.

Products that restore gelcoat color and gloss don't provide a durable UV-protective coating. Whether it's a one-step or two-step process, all products must be overcoated with a protectant wax after washing with boat soap, within a few days and certainly no longer than a week. You could wash then wax without waiting, but the wax wouldn't form as strong a chemical bond to the gelcoat.

One-step restorer and wax removes light surface oxidation and stains from leaves, bugs, birds and other fallout. Apply by hand with a terry towel or buff with a slow-speed 1,500 to 2,500 rpm sander-polisher or a drill and a wool compounding pad. Finished result (bottom) has a deep luster. As one-step restorers only offer UV protection for one to three hand washes, follow within a week with a premium wax after a thorough washing.



If you cannot feel a scratch, it's likely to disappear with a rubbing compound or a light wet sanding. Scratches that are still visible after buffing (or sanding) require more extensive repairs. [Ed: Refer to DIY 1998-#1 or DIY "Fiberglass Clinic" CD for step-by-step instructions to repair scratches and dings.]

Start wet sanding with 800-grit wet/dry paper, then 1,000 grit, sanding in opposite directions. Follow with a one-step restorer or rubbing compound to remove scratches from sanding then a glaze to remove compounding swirls. Wait a few days before waxing.

Buffing compounds are best applied with a wool compounding pad on a slow-speed sander-polisher or drill. (See "Buff Stuff" on page 24 for buffing techniques.) Squeeze some rubbing compound on the gelcoat, spread it around with the compound pad, then buff. Use lots of compound to keep the surface cool.

Heavily oxidized areas require more compound. Buff an area about 15 seconds per square foot to prevent overheating (burning) the gelcoat. Don't be too aggressive. Plan on less than 30 minutes to buff one side of a 9m (30') boat, for example. Compounding repairs the gelcoat, flattening the surface to reveal some shine but without any depth of image. With a rubbing compound, you will always have some color transfer to the pad. When compounding by hand, an old wool sock or sweater removes oxidation quicker. Or use a thick pile terrycloth towel as it doesn't scratch gelcoat. Protect untreated areas from splatter during the buffing process with 3M Ready-Mask Painting Tape.

Product Review

JUST ADD WATER

There's an easier way to wash and rinse with 3M Marine Heavy Duty Hull and Deck Cleaner. It's a concentrated mix of powerful cleaning agents containing sodium hydroxide and methyl alcohol, some other acids, salts, soda and a surfactant. Designed to connect to a garden hose, a 947ml (32fl.oz) bottle mixes the equivalent of 15L (4 gallons). Its ready-mix nozzle has two settings, mix and water. To use, turn on the water, then point and shoot. First rinse, then wash, then rinse off. A molded eyebrow just above the nozzle outlet fine-tunes the spray, directing it wherever you aim the nozzle.

Buff Stuff

Different buffing pads are used when compounding and polishing. Wool pads are the most aggressive and the best for "cutting" gelcoat. Some detailers prefer foam pads, black for compounding, yellow for polishing. Use terrycloth pads (not shown) for applying and removing wax.

When buffing a compound or glaze with a hand drill, operating it at 2,000 rpm to 3,000 rpm generates more heat and gives better cutting action.

Polisher/sander with 15cm (6") disk is run at 1,500 rpm. Keep the pad as flat as possible with pressure tilted on the trailing edge. A pad weighted on its leading edge tends to climb and take off and get caught in hardware. When working on sharp corners, feather the edges and always have the pad edge coming off the corner not into the corner so it doesn't dig in. Continually move the pad so it doesn't rotate in one place and "burn" the gelcoat. Put a hand on the surface. If it's hot, it's overworked.

Dressing Pads: Use a spur to clean pads before first time use to remove loose fibers. Cleaning used pads regularly to remove leftover sling doubles their life. Wear a mask when spurring a pad.

Store used pads in Ziplock bags so they don't become contaminated with other grits or dirt, dust and other contaminants. And don't mix your grits. Use one pad for the compounding, one for glazing (if applying) and one for waxing.

Apply the finishing material in the same manner as compound, except use a polishing pad. This glaze removes swirls from compounding and mechanically repairs the gelcoat to give a leveling and reflectivity that enhances the overall color and finish. The result is a high gloss finish that closely duplicates a factory-new appearance. There is no wax in this product — what you see is what you get! Within a week's time, wash the surface and apply a quality wax to protect the gelcoat from UV damage.

Q: How do you know when you've buffed enough?
A: "When the finish you receive is pleasant to you," states Ray Lemieux. While you could continue buffing with finer and finer grit compounds, at some point, it becomes impossible to achieve a higher gloss.

One-step Imperial Compound and Finishing Material takes half the work time of the two-step compound-glaze application to achieve a deep luster that reflects shine. The key to using either product is the type of finish you want and how it compares to the rest of the boat. It has no UV protection, so must be waxed within a week or so.

TIP Gel Conditioner

Sometimes gelcoat is so badly oxidized nothing brings back the shine. Before going the painting route, apply Penetrol, let it work the surface for 5 minutes, then apply a rubbing compound. Apparently it conditions the gelcoat and helps to break up the oxidation.
— James Turner, Pensacola, Florida

Rubbing compounds range from 1,000 to 1,500 grit. It's not propriety knowledge what actual grit companies use in their products, but the darker the color, the more aggressive the compound.

STEP 3

Now that the gelcoat is repaired, you need to take the necessary steps to avoid oxidation from reoccurring. Protecting the surface with a quality wax that contains good UV protection is the solution.

Few modern waxes are pure and natural waxes, but contain man-made ingredients instead. When properly applied, these protective "adhesives" chemically bond to the gelcoat. A wax needs heat over a prolonged period of time to bond to gelcoat. Ambient and surface temperatures, and the temperature of the wax are critical to achieving a strong bond. A boat baking in the hot summer sun could have a hull surface temperature slightly higher than the air, but on deck, surface temperatures could rise to 54°C (130°F) or higher. Under these conditions, the wax dries before it bonds to the gelcoat. When applied at cooler temperatures, however, around 10°C (50°F), the wax bonds, hardens and hazes, but it just takes longer.

Apply wax with a terry towel or one with looped fibers, or an orbital polisher/waxer. A paste wax is more durable than a liquid, typically lasting almost three times longer before needing reapplication. New paste formulations don't require aggressive rubbing, just wipe on, and wipe off. Always apply wax in the shade or under cover, and allow time for it to chemically bond. To wax a 6m (20') boat, for example, you would wax the entire boat, take a break, return and wipe off.

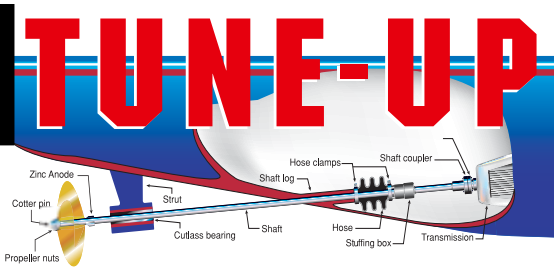
Wet it down! To lubricate the wax and extend the working time so it doesn't flash too quickly, spray on some water.

STEP 4

Wax now protects gelcoat from UV damage, but with every washing the degree of protection diminishes. And if surfaces aren't wiped dry, water droplets act as sunlight magnifiers that penetrate and break down the protective wax layer, once again exposing the gelcoat. A spray-on protectant helps maintain the wax coating by adding glossifiers to the wax, enhancing the shine and removing water spots.

After washing the boat and while the surface is still wet, spritz on Clean & Shine (or similar protectant) and wipe off with a terry towel. It boosts the gloss, removes water spots and extends the life of the wax.

Drive Train TUNE-UP



A step-by-step survey and repair of the drive train from the propeller to the engine coupling will keep your inboard engine running smoothly and vibration free.

[BY HARRY SWIECA]

Inboard propulsion systems are designed with three main components: the engine, transmission, and what is commonly referred to as the drive train. The propeller, shaft, support strut and/or stern tube and bearing, engine mounts and engine alignment are the key components that are vital to trouble-free operation of your boat and engine. Impact damage and wear to these parts can result in excessive hull vibration, engine damage, poor performance and other mechanical problems. Inspecting drive train components should be part of your annual preseason maintenance plan, or whenever the boat is hauled, or after a major engine overall.

Prop Probe

Start by inspecting the propeller. Minor nicks and dents on blade edges can be tapped back into shape using a small hammer and a steel backup block. Carefully smooth the repaired edges using a fine grade hand file, as filing too steep an angle on the blade edges causes them to resonate or sing during operation, and may weaken the blades. Bent blades require prop removal for repairs by a prop shop. Check that the propeller nuts are secure, and that a stainless-steel cotter pin has been inserted into the shaft end. On a sailboat equipped with a folding or feathering prop, check that moving components are not loose or wobbly. Excessive movement creates heavy vibration at any speed. [Ed: Details on prop inspection, repairing and balancing appear in DIY 2002-#2 issue.]

Surveying Bearings, Struts and Shafts

Grasp the shaft and propeller with your hands and apply upward pressure while observing the shaft support cutlass bearing mounted in the strut or stern tube. Replace the bearing if more than 1.5mm (1/16") of movement is detected. (See "Bearing Replacement" on page 28 for proper procedures.) Examine the strut (if equipped) for corrosion, cracks and dents. It should fasten securely against the hull.

Check the shaft for straightness by manually rotating it and observing the length for wobble or an out of round condition. Any visible out of round condition causes vibration. Be sure to check the shaft end at the propeller hub for wobble as well. If shaft wobble is easily visible, replacement is recommended. A prop shop can determine if the shaft is repairable.

Checking for play in the cutlass bearing.

(top) A loose strut can cause bearing damage, excessive vibration, shaft bending, and other alignment problems, or could break off completely. (middle) Hairline cracks caused by hull flexing. The hull must be reinforced in this area. (bottom) Worn cutlass bearing.

Key Play

Working from inside the engine compartment, grasp the shaft with one hand where it enters the hull at the shaft log and stuffing box. Grasp the shaft coupler with the other. Twist both in opposite directions while observing the shaft's driving key at the base of the drive coupler for movement. Any movement indicates wear and will require complete disassembly for repair. Failure to make repairs can result in loss of the propeller shaft during reverse operation.

Checking for movement in the keyway.

Worn shaft key must be replaced.

Mounting Fixes

Your engine fastens to the hull with shock-absorbing mounts constructed of cast metal. These mounts have a long threaded stud bolt protruding from the center that fits through heavy metal side plates attached to the cylinder block, usually at the four corners, though some installations use two mounts aft and only one forward. The stud is insulated from the cast metal housing by a solid rubber compound material. The hardness of this rubber increases or decreases the mount's ability to dampen vibration. Two large nuts on the threaded stud adjust the engine position and lock it into place. Lag bolts secure mounts to the engine beds (or support stringers). Slotted holes allow moving the engine side to side as needed during the alignment process. Check tightness of all bolts and nuts. Loose mount adjusting nuts are a cause of vibration. If lag bolts turn in the holes repair or replace the engine beds. On older boats the wooded beds or fiberglass laminate often become waterlogged and delaminate.

Inspect rubber inserts on each mount for fuel and oil damage. Look for distortion on mounts or separation of rubber where vulcanized to metal. If the rubber around the center stud is bulging or distorts with the engine at lowest idle, or if the stud moves easily when the engine is moved, replace the mount.

(left) A typical engine mount with slotted base and adjusting nut that raises or lowers the engine to reposition the transmission coupling. (right) Deteriorated engine bed.

If two mounts are damaged, replace all mounts. If only one mount is damaged, replace the mounts in pairs, either front or rear. Some manufacturers use different hardness of rubber for the front or rear mounts. Another model may have a heavier mount on the port rear side, lighter mount on the port rear, or may have heavier mounts on the port and starboard front, lighter on both rear mounts. Consult your engine service manual, the engine manufacturer or dealer before purchasing new mounts.

When refitting, orient all mount slots in the same direction to allow maximum adjustment. Mount repairs require a full engine alignment once the boat is back in the water.

Drive Train Tune-Up

TIP Matched Couplings

When it's necessary to separate the shaft and transmission couplings either for engine realignment or other service, place a mark on the joining flanges with nail polish or liquid paper. This ensures that they align exactly the same way they came apart. — *JM*

Bearing Replacement

If your lift test detected a worn cutlass bearing, the next step is to decide whether you are skilled enough to attempt replacement. Often this job is best left to the experts as it involves removing the propeller and shaft. On many boats these components haven't been disassembled for some time. If this is the case, removal without the proper tools may be more than you bargained for.

Some boatowners may argue that the best procedure is to remove the propeller, bang out the old bearing, and pound in a new one. To complete this job properly, a better solution is a complete system overhaul. This involves the removal, inspection and repair or replacement of all components: propeller, shaft, coupler, keyway, and cutlass bearing. If when replacing the bearing the shaft assembly is badly worn, then most likely the rest of the system is worn as well.

Before starting a project of this magnitude it's best to stand back a minute and consider what steps are involved and what tools are needed. To remove the propeller, for example, a prop puller is a must. Removing the locking nuts and whacking the hub with a hammer is definitely not the desirable method. Your boat yard or marine store can supply you with this tool or recommend someone to remove the prop. Once you have the prop off, send it to a propeller shop for balancing or repair. (Some boats require rudder removal before proceeding.)

Now remove the shaft coupler from the drive coupler. Remove the four or five securing bolts from the back face of the coupler, and slide the shaft slightly aft. Rotate the shaft manually, and cut the seizing wire from the shaft set screws and remove them, and/or remove the key from the keyway.

A slide hammer (commonly used in body shops) is needed for the next step. It consists of a shaft with a weight on it that comes up against a stop. You screw the thread of the rod onto the thread on the end of propeller shaft, and then use the slide puller. It consists of a large double-ended metal nut, with one side threaded to match the thread size of the tapered end of the shaft, and the other threaded to accept a threaded rod. Thread the nut onto the end of the prop shaft, then slip the slide weight on the rod, and secure with a keeper nut. To operate, the slide weight is brought forward then slammed backwards towards the aft stop, jerking the shaft out of the coupling. In the wrong hands, this tool can cause serious damage to the transmission. One or two hits should produce results. If not, use a electric heat gun (the type used to strip paint) to apply heat to the outside surface of the shaft coupler. Never use an open flame heat source in a boat or you risk explosion or fire damage.

The DIY method of pulling the coupling off the shaft may be the easiest. Spray a release solution into the coupling. Using a socket slightly smaller than the shaft diameter as a spacer, join the two coupling flanges so the socket is centered over the shaft. Insert long, fully threaded bolts or threaded rod and nuts into the flange boltholes. Gradually tighten the bolts (or nuts), slowly pushing the shaft out of the drive coupling. You should notice immediate movement of the shaft. If the bolts become difficult to tighten, use the electric heat gun and apply heat to the outside surface of the coupler in the shaft area. When the face of the shaft coupler meets the transmission output flange, remove the bolts and add additional spacers. Repeat the process until the shaft is completely removed from the coupler. Inspect the shaft key end and coupler, and replace if worn.

The next step is to remove the shaft from the boat. Slide it aft, out of the strut. If it doesn't slide easily, apply a spray lubricant. Inspect the shaft diameter in the shaft packing area for wear. Replace the shaft if grooved. If the shaft and its connected parts are in good condition, clean and lightly lubricate so they slip together using minimal pressure.

TIP Is Your Shaft Straight

If you've hit bottom lately or wound the prop in a line or fish net so tight the engine stalled, it's quite possible the shaft is bent. To determine if a shaft is true, hold a pointer (screwdriver, knife, etc.) steady at a set distance away from the shaft and slowly spin the shaft while checking the gap with a feeler gauge. A variation in the gap may mean the shaft is bent, a repair that requires removal and servicing by a machine shop. — *JM*

TIP That Sinking Feeling

Routinely check bolts and nuts holding the shaft coupling to the transmission output shaft, shaft set screws and key. Vibration causes the nuts to loosen bolts to back out, and couplings to part. Consider locking the nuts with Loctite, and drilling a hole in the end of each bolt and seizing with stainless-steel seizing wire. A hose clamp fastened to the shaft just aft of the key will prevent it from shaking loose. — *JM*

Now for the fun part. There are tools available for removing the cutlass bearing, but they are expensive and very cumbersome to use. An easy way to remove the bearing is with a standard hacksaw and narrow chisel. Disassemble the hacksaw and remove the blade. Reassemble the hacksaw with the blade passed through the cutlass bearing allowing the body of the hacksaw to hang down with the teeth of the blade contacting the rubber insert. (On boats with a stern tube, use a keyhole saw or sawzall.) Now here's the trick. Instead of inserting a single blade, attach two new blades but insert them in reverse directions. Select fine tooth blades of the type used to cut metal with at least 32 teeth per inch.

With the saw assembled, pick a spot in the cutlass bearing and applying even pressure slowly cut a slot into the rubber material. When the blades make contact with the shell, lift the saw, relocate it approximately 12mm (1/2") over, and repeat the process. Use a long flat tip metal screwdriver or thin chisel to peel the rubber insert from the bearing.

Next, slide the hacksaw into position and slowly cut through the shell taking care to keep equal pressure on both ends of the saw during the in and out stroke. Made of bronze, brass (freshwater use) or non-metallic for aluminum boats, the shell material is thin and cuts quickly. It's important that the cut is not rounded or humped; otherwise the blades will cut into the support strut housing. Cut until the saw blade is just short of cutting into the strut housing. Lift the saw and make a second cut, 180° opposite, in the same manner. Disassemble the saw and remove it. Using a narrow chisel, peel away the material between the two slots starting at the edge the same way the rubber was removed. Once the section is peeled away, tap the remaining bearing out of the strut, or grasp and pull out using needle nose pliers. Scrape the sides of the strut housing and locate the heads of the two locking setscrews. They should turn out freely. If not, drill out and replace. Remove nicks and corrosion from the strut bore using fine sandpaper or a smooth file.

Bearing Choices

Choose the proper replacement bearing and most likely you won't need a repeat job. An alternative to a conventional cutlass bearing, where the shaft revolves inside a fixed bearing, is Palmer Products' Shaft Saver. This innovative bearing is fixed onto the shaft, which then revolves in

Drive Train Tune-Up

the strut. Albeit it's new technology for recreational boats, it's been used on various commercial craft since WWII. (Test reports and installation information are available on the company's web side at www.shaftsaver.com or call 800/692-2179.) Another option is to install a Duramax Marine (www.duramaxmarine.com) two-piece bearing. Split lengthwise, it allows insertion without removing the shaft. In cases where bearing removal was easy, and all components are in good shape this maybe a good choice.

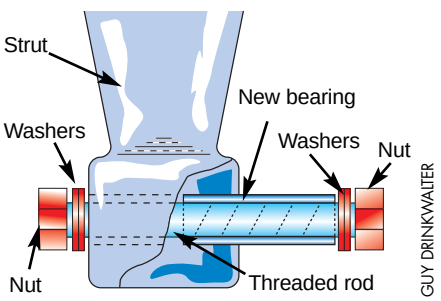
Shaft Saver bearing eliminates restoring or replacing worn prop shafts due to bearing wear.

New Bearing Installation

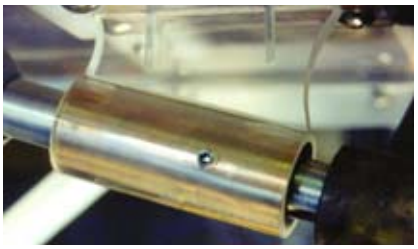
For unity's sake, the following steps detail installing a standard cutlass bearing of the type you just removed. After cleaning the strut housing, dry-fit the new bearing into the hole. Don't force it! Provided you purchased the identical bearing, it should be slightly tighter than a slip fit into the housing. When forced it will collapse, preventing the shaft from rotating.

Sometimes, however, the bearing was custom made to fit the strut, and requires machining to be usable. Use an inside-measuring caliper to determine the inside diameter of the strut. Be sure to check both ends. Have a machine shop machine the bearing with an outside diameter .0012mm (.005") larger than the inside diameter. This gives a reasonable press fit into the strut. Also have the shop cut a 12mm (1/2") wide lead onto the bearing at one end approximately .0015mm (.006") less than the strut bore size. This allows the bearing to partially slip into the strut for proper alignment.

Bearing replacement is not as hard to do as you might think. To install, apply a lubricant such as petroleum jelly on the bearing body. Now make a bearing "installer." Purchase a piece of 16mm (5/8") diameter threaded rod, approximately twice the length of the strut (or stern tube) plus about 7.6cm (3"). Thread a nut onto one end of the threaded rod a short distance from one end. Slide the bearing on the rod. Don't heat the strut with a torch to expand the metal or you'll likely burn the new rubber bearing beyond use.



To install a new bearing on a strut tighten nuts on threaded rod.



(top) Strut assembly. (middle) New cutlass bearing installed in stern tube. (bottom) Seizing wire prevents shaft locking screws from loosening.

Now slip a couple of washers larger than the diameter of the strut onto the threaded rod, slide the new bearing over the threaded rod, push the threaded rod through the strut, slide on more large washers, and thread the remaining nut onto the other end of the rod. Using two wrenches, slowly tighten both nuts. This compresses the washers toward each other while slowly compressing the bearing into the strut. Continue compressing until the outside edge of the bearing is flush with the strut. Caution: if the bearing does not press into the strut with light pressure, remove it and sand the outside diameter evenly. Remove only enough material from the bearing so it inserts without distortion.

With the bearing in place, the last step is to drill spot the setscrews into the bearing, and insert new screws. Use a drill bit smaller than the threaded hole and drill into the bearing enough to create an indentation. Don't drill through the bearing. Insert the setscrews and tighten securely.

Assemble the shaft assembly in reverse order taking care to repack the stuffing box if needed. [Ed: Consult DIY 1999-#2 issue for pack-

TIP EXTREME IDEA

Some boatowners uncouple the transmission coupling from the shaft coupling prior to haulout and realign the engine after the boat is back in the water to prevent hull flex and possible damage to the prop shaft, strut or bearings. — *JM*

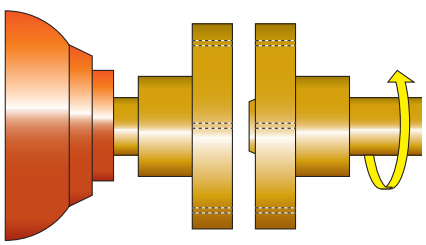
ing materials and instructions.] With the shaft installed and locked into place, install new stainless-steel seizing wire through the shaft locking setscrews (or insert the key into the keyway). If the shaft was replaced be sure to drill spot the shaft through the setscrew holes to help secure the shaft.

Alignment Made Easy

Engine to propeller shaft alignment is critical to eliminating hull vibration. A misaligned engine causes excessive stress on the engine, mounts and stringers as well as premature drive coupler failure. While on land and blocked, the hull is distorted, and engine misalignment between the transmission flange and propeller shaft can be off as much as 12mm (1/2"). It's best to roughly align the engine to the drive coupler while the boat is on land, then perform a final alignment a few days after relaunching. Sailboats should also be fully rigged and tuned before completing alignment. (For boats equipped with flexible coupling follow the manufacturer's alignment procedures.)

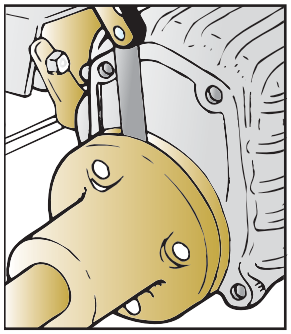
Remove the short piece of hose that attaches the stuffing box to the shaft log. Slide the shaft coupler (and shaft) against the mating flange of the transmission coupler. Use wood shims or make a wood block that is notched to fit the shaft, to support the shaft and position it in the center of the shaft log. Adjust the engine mounts using the large adjusting nuts on the studs until the pilot in the coupler easily slips onto the transmission. This is a critical step. Snug adjusting nuts then move the coupler aft and then forward back into position. Rotate the shaft 180° and recheck. Readjust each mount as needed to obtain a slip fit of the coupling pilot. When you're satisfied with the fit, spray a light coating of rust inhibitor on the coupling faces, then tighten mount and coupling nuts.

The final alignment process is where your time, effort and good workmanship will shine. After launching, allow the boat to settle for at least one full day. Attach and tune standing rigging, if applicable. Adjust stuffing box leaks using only hand pressure to secure the main packing nut until the leak has stopped. Secure the jam nut by turning it firmly up against the packing nut and tapping the edge of the nut smartly with a small hammer. The shock will lock



GUY DRINKWALTER

Rotate just the prop shaft 180° and recheck alignment.



DAVID AIKEN

In-the-water alignment: Butt the coupling flanges together and use the proper feeler gauge to check vertical and horizontal clearances between the coupling faces.

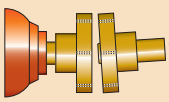
it into place better than a packing wrench.

Check the coupler alignment and adjust if needed. The recommended maximum gap when aligning couplings is .0002mm (.001") for every millimeter (inch) of coupling diameter. This equates to .0007mm (.003") for a 7.6cm (3") diameter coupling. To determine gap clearance, insert three metal shims of the proper thickness at equal distances between the flange faces. If the size shim is not available, you can use larger ones of identical thickness. [Ed: In a pinch, thin paper doubles nicely as feeler gauges.] Now readjust the engine mounts so each of the shims manually slips in and out of the coupler face with equal force. Be careful not to lean on the engine while making final adjustments. When you're comfortable with the alignment, rotate only the prop shaft 180°, and check it one last time. Recheck the securing nuts on engine nuts. Install new coupler bolts with lock type washers in the coupler.

About the author: Boating for Harry Swieca is both a hobby and a business. He once operated a mobile marine electronics company, and owned a boat storage and repair facility in Chicago, Illinois. He is a certified mechanic and is currently a marine surveyor for Davis & Company.

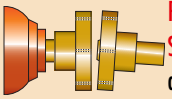
Problem / Solution

BOTTOM VIEW



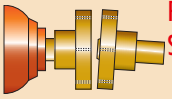
Problem: Gap is wider at the bottom.
Solution: Raise the stern mounts evenly a few turns. Recheck alignment.

TOP VIEW



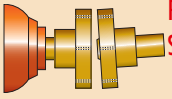
Problem: Gap is wider at the top.
Solution: Raise front mounts evenly a few turns. Recheck alignment.

SIDE VIEW



Problem: Gap is wider on the starboard (right) side.
Solution: Move front mounts to starboard. Recheck alignment.

SIDE VIEW



Problem: Gap is wider on the port (left) side.
Solution: Move front mounts to port. Recheck alignment.

GUY DRINKWALTER

SAILBOAT -RIGGING-

RUDDER FIXES

Procedures to repair or modify common rudder problems.

[EDITED BY JAN MUNDY]

Steps to Repair Soggy Rudders

Q: I recently noticed a crack along the bottom edge of the rudder on my 1981 CS 33 that extends about 7.6cm (3") up the leading edge of the rudder. The rudder is foam filled and drips water from the crack when the boat is hauled. The rest of the rudder appears sound. What steps would you recommend to repair this problem?
Bill Wilson, Kincardine, Ontario

A: Most rudders gradually absorb water and it's not a big deal until a crack develops, usually due to frost heave. A foam-filled rudder tends to suffer more damage as it holds more moisture. Freezing temps crush the foam inside the rudder, and heave and crack the outside skin. This often causes separation of the seam where the port and starboard halves of the outside skin are joined. The usual fix follows. Be sure to protect the eyes with goggles and wear a properly fitted dust mask when cutting or sanding.

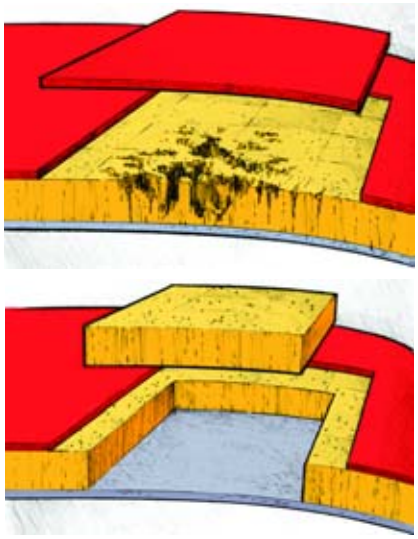
If you decide to have it fixed professionally, the job represents somewhere between 16 and 32 hours of labor at most yards. You can save some money if you remove and reinstall the rudder yourself.

STEP 1 Evaluate the rudder's overall condition. Use a moisture meter to determine how wet the rudder is. Verify how badly delaminated the outside skin is from the foam core by percussive sounds of the rudder with a hammer (a surveyor or the local yard can help with this). The goal is to determine how much of the foam core is wet and needs to be removed, and the extent (cost and labor) of the repair.

STEP 2 Remove the rudder from the boat.

STEP 3 Cut open a "window" in the side of the rudder using a router or circular saw, removing just the outer glass skin to gain access to the wet core. Dry the deteriorated or wet foam core. Use heat lamps to accelerate drying. Damp foam will eventually dry when exposed to air, but it can take a long time. Inspect the internal metal (usually mild steel) web that attaches the rudder blade to the rudder shaft. Look for excessive corrosion or cracked welds, and repair as needed. (Refer to DIY 2000-#3 issue for instructions on replacing interior rudder tangs.)

STEP 4 Replace the wet core. This can be done with more A+B polyurethane foam or with solid polyester resin and chopped glass filler (if you don't mind adding a bit of weight). Another option is to fill

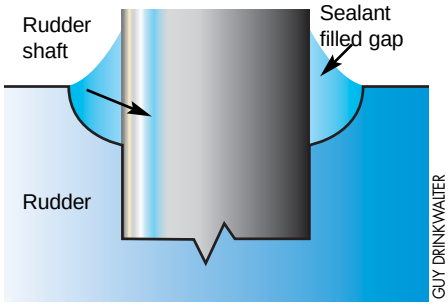


GOUGEON BROTHERS, INC.

with epoxy resin thickened with colloidal silica to a peanut butter consistency. Now that you have the rudder opened, check the rudderstock for corrosion. Water trapped in the laminate can cause crevice corrosion. You don't want to go to the trouble to make the repairs to the rudder laminate and have the stock fail later.

STEP 5 Re-skin the rudder. Sand or grind the entire outside, or at least the side with the opening plus any cracked areas of the outside skin, to bare glass and laminate at least a couple of layers of new glass and resin (1808 stitchmat works well). Also wrap fiberglass around the fore and aft seam between the two halves. Fill and fair as needed using a thick mixture of epoxy resin and microballons. Prime coat with an epoxy primer for re-application of antifouling paint.

STEP 6 Seal the rudder shaft to prevent water re-entering the rudder blade where the blade meets the shaft. I recommend digging out the fiberglass laminate adjacent to the shaft to a depth of about 6mm



GUY DRINKWALTER

(1/4") wide. Fill this small circular trench around the shaft with 3M 5200 or 3M 4200 sealant. This makes a much better seal because it's flexible and less prone to cracking during temperature extremes than the original metal-to-glass interface.

STEP 7 Reinstall the rudder.
— Nick Bailey

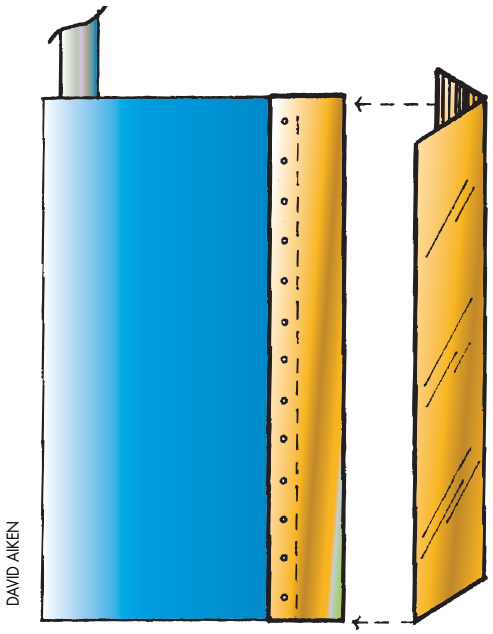
A Simple Method to Increase Rudder Area

Q: I have a 1937 8.5m (28') wooden boat with a really small rudder. The steering is unresponsive in reverse and at slow forward speeds. I was thinking of attaching a larger plate to the existing rudder to increase its surface area, with the hope that it will also increase steering control and responsiveness. Do you know of any sources on this, as to how to size and shape the add-on piece, how to attach it to the existing rudder, or the effectiveness of doing it?

Jerry Kerner, Hastings on Hudson, New York

A: Normally rudder size is based on a percentage of lateral plane, or lateral profile of the boat, and often factoring in the sail plan for sailboats. If you have the plans, a naval architect can provide the calculations. When drawings are not available, which I'll presume is your case based on the boat's age, it's trial and error.

Mark Ellis, notable designer of Cabo Rico, Liberty, Niagara and Nonsuch boats, suggests a technique that was once common on wooden racing boats. On meter boats, for example, attached to the rudder's trailing edge is a strip of copper or monel. This presented a fine edge, unobtainable with wood. Ellis suggests starting sea trials by attaching a temporary piece to the trailing edge. Use inexpensive aluminum flashing and start with a 7.6cm- (3"-) wide strip. This low-tech approach



DAVID AIKEN

may require numerous haulouts, so you'll need to negotiate a rate with the yard. Once you have determined the most effective profile, make a permanent one of copper (or stainless steel). The copper need not be of a gauge heavier than copper weather stripping. Cut it with shears, cutting pieces out to more easily bend the plate. The finished piece would fold in half and fasten

with screws or rivets to the rudder sides. Apparently, it's not necessary to fair the plate into the rudder, as the thickness of the plate won't make much difference. You may need to modify this approach, depending on the thickness of the rudder's trailing edge and its construction.

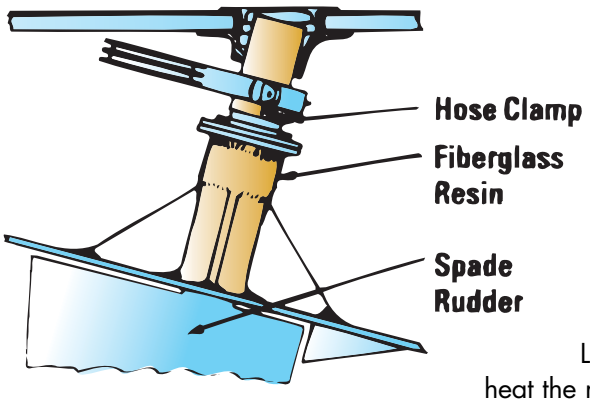
— Jan Mundy

Rudder Post Service

Q: I need to replace the stuffing box packing in the rudder post on my 1976 Tartan. The boat is currently on the hard. I removed the rudder and post but I'm unable to break the stuffing box adjusting nuts free. I've used penetrating oil and a torch but without success. Any suggestions?

John Kraft, "Hallelujah," Apopka, Florida

A: The stuffing box assembly is likely connected to a fiberglass rudder tube by means of a rubber hose, so you need to be careful when applying heat. This job is more easily done with the rudder off the boat. Drop the rudder, undo the hose clamp at the bottom, remove the whole assembly and place it in a vise. Use a cold chisel placed on the side of each nut, give it a couple of hard taps with a hammer. An impact wrench is a handy tool for this job. Hopefully, this will loosen the nuts. If it doesn't, take a wrench and slip a pipe over the handle. Increasing the leverage may free the nuts.



EDSON CORPORATION

Lastly, heat the nuts until they are hot and cherry red in color. You need high temps for heat to be effective. Apply heat evenly to prevent cracking the nut. Even now, removal may require leverage or more shock taps to remove the nut. Be sure when reinstalling to put some Tef-Gel on fasteners to facilitate removal later.

— Nick Bailey

UPGRADE

INTELLIGENT SANITATION

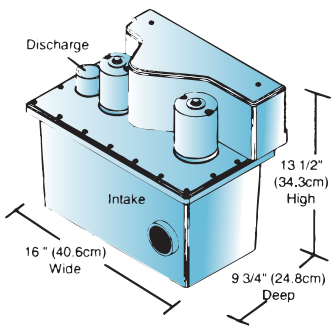
Simple-to-install, this ultra compact onboard treatment system eliminates a holding tank for boats operating in discharge zones.

[BY DAVID AND ZORA AIKEN]

No category of boat gear prompts as much discussion, distress and occasionally outright disgust than the marine head. Confusing and sometimes conflicting regulations make a difficult situation impossible to resolve.

Having recently become the proud (and foolish) owners of a second boat, we have managed to double our concern for all of the above. Since it was time for a new head system, we first spent some time conducting a study of other boaters' experiences or recommendations. We learned that many boaters have switched to a Raritan Lectra/San MC and those that have are very satisfied with its operation.

Given the subject, that's saying a lot, so we decided to join the converts. This device macerates the sewage then uses electrically charged saltwater to kill bacteria. After destroying bacteria and viruses, it reverts back to salt and water. When the treated discharge empties into the water, it does not add any illness-causing elements to the environment, so it meets EPA Type 1 standards for overboard discharge. Despite the system's proven ability to disinfect waste, No Discharge Zones exist were boats are prohibited from emptying any sewage, even that treated to the EPA standard.



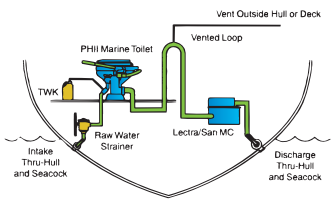
Lectra/San MC, a mini onboard treatment system, uses salt to treat sewage immediately and automatically with each flush and meets the USCG requirements for a Type I MSD.

Custom platform fabricated of marine ply with a rubber cushioning pad ready to install in the cockpit seat locker.

Lectra/San MC strapped securely on platform in cockpit locker.

The main installation considerations before purchasing a Lectra/ San MC are available space, power consumption (it draws about 1.7 amp hours per 2-minute use), and, of course, feasibility of the individual installation.

The space issue is probably the easiest to resolve. The treatment tank is truly compact, measuring 40.6cm wide by 34cm high by 25cm deep (16" by 13-5/16" by 9-3/4"). It must be positioned so its top is at the same level as, or lower than, the toilet's discharge fitting. We'd hoped to fit the tank in a locker conveniently situated directly behind the toilet, where sliding doors would provide easy access should the need arise. But as the hull shape usually tapers locker spaces in heads, instead, we found a good spot in a cockpit seat locker. This involved building a platform base to mount the unit securely. As the tank installs in line with the discharge hose, we routed new hose from the toilet through the under-sink cabinet, through an aft bulkhead and into the seat locker. It's still within the recommended distance of 91cm to 1.8m (3' to 6') from the toilet itself. Installation may require a vented loop (prevents back siphoning and backflow), depending on the relative level of tank to toilet.



Lectra/San MC with Vented Loop (Above Waterline)

Sample installation.

Completed head: Raritan Cricket is a compact choice for a mid-sized powerboat or sailboat toilet, and the telescoping handle makes it noticeably easier to use. Discharge hose passes through cabinet under the sink. Control Indicator Panel on the left side provides visual monitoring of the salt and voltage supply.

After determining the tank's location, we now measured for the hoses and made a list of required fittings and other materials. Our installation included marine plywood, some 25mm (1") square wood cleats, epoxy glue, and stainless-steel screws for the mounting base; 3.8cm (1-1/2") ID odor-resistant sanitation hose (has a smooth interior); and all-stainless hose clamps. Included with the Lectra/San is a Control Indicator Panel and saltwater feed tank (optional, but needed for our installation). Installation instructions specify the type of wire and other electrical fittings needed for 12-, 24- or 32-volt setup. Other miscellaneous supplies included PVC cement (for attaching hose fittings to the unit) and Teflon tape (for all threaded connections).

The mounting platform is made of 12mm (1/2") marine plywood, with wood cleats glued and screwed to the

TIP FLEXIBLE OR RIGID?

Many MSD manufacturers recommend using schedule 80 PVC pipe rather than hose. Pipe is virtually impervious to smell but requires joining to a piece of flexible hose to pass around bends and at connections to treatment devices and toilets to prevent the pipe from vibration damage. If you do opt for hose, buy the best quality sanitation hose you can find. There is no economy in cheap hose. Cheap hose permeation causes nasty odors. — *JM*

TIP Pure-Fume Aroma

Where practical, replace the standard vent hose, typically 16mm (5/8") diameter, with 3.8cm (1-1/2") diameter or as large as possible. Locate hull vents fittings on the transom or near the stern, not under the rubrail. Use two vents on sailboats, one per side, so when heeled, there is always an open vent. Make sure the hose is not blocked with impacted sewage. — *JM*

top, framing the unit to prevent any possible side-slipping. It sits on substantial supports screwed to cleat stock mounted to the hull in the locker, forming a solid base for the Lectra/San. Mounting straps hold it tightly to the base. A rubber pad under the tank helps to minimize noise and vibration.

Next we turned our attention to the installation of the new toilet, a manually operated Cricket from Raritan. This unit didn't fit the existing mounting base in our boat's head, but by adding a wooden support piece and angling the placement slightly, we were able to install it without any extra construction to the head sole. As with any such installation, if the toilet is below the waterline, add a vented loop to prevent siphoning.

After mounting the toilet and the treatment tank, the hoses were cut to length and connected. In small spaces, connecting hoses to fittings is difficult. To soften stiff hoses so they connect more easily to hose barbs, leave in the hot sun for a while or place in hot water for a few minutes. Our setup also includes a diverter (Y) valve and a small holding tank, to give us legal options in case of a power loss or when cruising offshore.

Wiring involves connecting the positive terminal on the treatment tank to a power distribution center (requires a 60 amp fuse or breaker), and negative terminal to a negative distribution post. We used 6 AWG wire, the recommended size, allowing for the distance from the panel (or post) to the tank and back to the panel, and a 3% voltage drop. A cable from the Control Indicator Panel plugs into the back of the treatment tank. Luckily, this panel mounted very close to the toilet and followed the same wiring path as the discharge hose. A supplied template simplified cutting the hole for the panel.

On a boat with an electric toilet, installation can also be setup for single-touch operation. The same button on the panel automatically activates the flushing mechanism and the treatment system. For manual toilets like ours, a sensor kit is available that activates the unit automatically after manually pumping three to five strokes, generally within a 10-second-time period. This sensor is not essential to operation. The push-button mechanism works fine. Provided the boat is used in saltwater, no other components are needed. The salinity of ocean water is sufficient to operate the system.

If the boat is usually operated in fresh or brackish water (or if the Lectra/San is used with pressurized freshwater), Raritan recommends installing a salt-feed tank. The smallest 7.5L (2gal) tank, requires adding premixed salt and water (mix in a bucket). Each time the MSD is used, some of the salt solution is mixed with the incoming water to provide the proper salinity. A 15L (4gal) tank automatically adds the required salt to the system when hooked up to a pressurized freshwater supply. It's also possible to add salt to the system by simply pouring table salt into the toilet bowl with each usage. The control panel indicates if sufficient salt is added or if more is needed.

DIY Refit Bill

Lectra/San MC	$1,036.00
Cricket manual MSD (with marine size bowl)	$282.50
7.5L (2gal) salt feed tank	$67.90
8' Sanitation hose	$56.00
8 Hose clamps	$36.00
Marine plywood, cleat stock, glue, stainless-steel fasteners, paint, wire and connectors, and other miscellany	$25.00
2 Diverter valves	$140.00
Total	**$1,643.40**

This is a weekend job, if you don't need to remove an old toilet, cut out a locker, or otherwise rework the interior.

With the boat's interior under construction, we decided to finish a remodeling project that we started some time ago. The head compartment now sports new lockers, new wood, new paint and a functioning foot pump.

About the authors: In search of alternative solutions, liveaboards David and Zora Aiken first rebuilt "Atelier's" head compartment to accommodate a composting MSD (this install appears in DIY 1999-#2 issue). They are hoping this treatment tank and head combo is their last head reconstruction.

Lightning

HIT OR MISS

There is no way you can prevent lightning striking your boat, but you can improve your odds and minimize damage by installing a lightning protection system.

[BY SUSAN CANFIELD]

Boaters underestimate the very real danger lightning poses," says Ewen Thompson, a University of Florida researcher. He notes, for example, that ground flashes can be expected to hit from 4% to 20% of moored sailboats in Florida each year.

Cruising sailboats, he says, are typically hit at least once in their lifetime. In "Lightning & Sailboats," a Florida Sea Grant college program publication, Thompson reports that the standing record for the greatest number of strikes to a single boat is five, while the highest strike repetition rate is twice within 10 seconds. So much for the old adage that lightning never strikes twice in the same place!

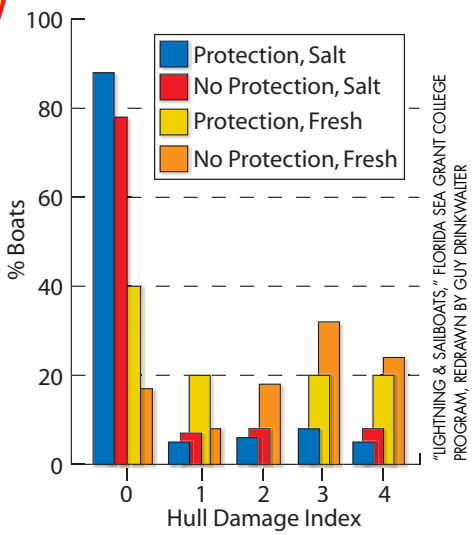
Lightning damage to boats is more severe in freshwater than saltwater, suggests Thompson. Of 71 boats struck by lightning, only one boat in 10 in saltwater suffered damage when the mast was grounded **(FIGURE 1)**. In freshwater, six boats in 10 were damaged despite having grounded masts. The disparity was likely due to inadequate grounding.

Most lightning strikes occur in the afternoon as hot moist air rises into the atmosphere where it condenses, forming fluffy cumulus clouds. As moisture accumulates, these clouds darken and become the large typically anvil-shaped storm clouds known as cumulonimbus. In the process, the lower portion of a cumulonimbus cloud develops a negative charge. As a thundercloud passes overhead, a concentration of positive charges accumulates on objects at the earth's surface beneath it. Since these positive charges are attracted to the negative charge of the cloud above, they tend to accumulate at the top of the highest objects around. On a boat, that highest object may be a mast, antenna, outrigger or, in the worst case, any person onboard.

Lightning occurs when the electrical potential — the difference between the positive and negative charges — becomes great enough to overcome the resistance of the insulating air between them and to force a conductive channel. This channel usually starts about five miles above the earth and extends downward as a series of increasingly long sparks, known as stepped leaders, which ionize a path through the air. When the tip of a negatively charged stepped leader is 27m to 91m (30 to 100 yards) from the earth's surface, a positive attachment spark is launched to meet it **(FIGURE 2)**. Where a stepped leader, such as a mast or tuna tower, and attachment spark meet, the bulk of the lightning current follows.

Since lightning tends to strike the highest object in its vicinity, All boats are vulnerable. Unfortunately, few boatbuilders sell boats with lightning protection systems installed. The reasons are obvious. If a protection system fails the builder can't be sued, and if there's no system and the boat is damaged, it's an act of God. It's left to the boatowner to recognize the need and install a suitable system on his or her boat.

Sailboats with aluminum masts and a sportfisherman rigged with a metal tuna tower or metal outriggers both have a straight path to a lightning ground conductor, a design advantage over a small open powerboat, motoryacht or express cruiser with no obvious route to ground. When designing a lightning protection system for your boat, or evaluat-

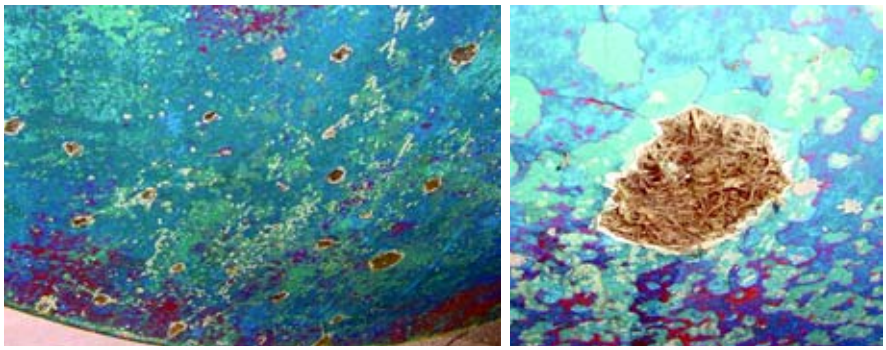


"LIGHTNING & SAILBOATS," FLORIDA SEA GRANT COLLEGE PROGRAM, REDRAWN BY GUY DRINKWALTER

FIGURE 1

Damage report of 71 boats struck by lighting in saltwater and freshwater, and with or without a lightning protection system installed.

- ***0 = No hull damage***
- ***1 = Small non-leaking cracks or burns***
- ***2 = Small holes, minor leaks***
- ***3 = Holes larger than 6mm (1/4") diameter above waterline***
- ***4 = Holes larger than 6mm (1/4") diameter below waterline***



(left) Exterior of a pockmarked fiberglass hull bottom damaged when lightning passed through on its way to ground. (right) Charred resin in one of the pockmarks. This type of damage is fairly typical in boats that lack a good lightning protection system.

When lightning struck the VHF antenna on this 8m (26') Grover cuddy cabin while cruising Chesapeake Bay near Annapolis, Maryland, it burned a hole through the cabintop, and the resulting shockwave shattered the windshield. Note the hole in the hardtop and the burn pattern on the left above the helm. Owner Morgan Wells and two other men in the cockpit were injured. The boat did not have a lightning protection system.

ing one already installed, determine what must be done to ensure the safety of personnel onboard, maintain the boat's structural integrity and minimize damage to installed electronics. Let's take a look at the five basic components of effective lightning protection: A lightning protective mast with an air terminal (lightning rod) at its top, and one or more conductors connected to an external ground plate or its equivalent, to provide lightning a direct path to ground while creating a "zone of protection" for personnel onboard; Bonding conductors used to equalize the electrical potential of large metal objects such as tanks, engines, towers and davits, to prevent side flashes (arc-over discharges) from the lightning protective mast or its conductors; Appropriate wiring techniques, lightning arrestors, and transient voltage suppressors for electronics protection; System inspection and maintenance; Appropriate personal conduct.

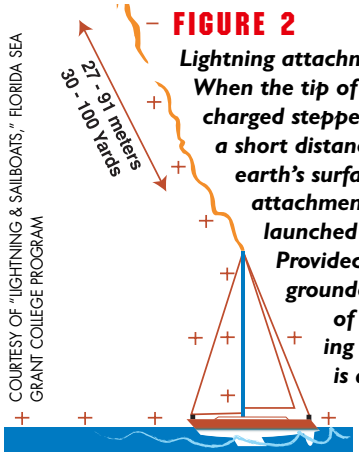


FIGURE 2

Lightning attachment to a mast: When the tip of a negatively charged stepped leader is within a short distance from the earth's surface, a positive attachment spark is launched to meet it. Provided the mast is grounded, the likelihood of lightning attaching to the masthead is a safety feature so far as the crew is concerned.

Lightning Protective Mast

A grounded mast significantly reduces the incidence of damage or injury from a lightning strike, and there is no evidence that it increases the likelihood of being struck. A grounded mast will divert to itself a direct strike that might otherwise fall within a cone-shaped space extending from the conductor at the top of the mast to a circle on the water's surface with a radius equal to the height of the conductor or lightning protective mast (**FIGURE 3**). For masts over 15m (50') in height, the zone of protection is defined by a circular arc with a radius of 30.5m (100') and its concave side facing upward (**FIGURE 4**). The radius of the arc is based on the striking distance of a lightning stroke which typically exceeds 30.5m (100').

The role of the air terminal (lightning rod) is to divert lightning to itself and away from people onboard. It does this by launching an attachment spark to intercept a downward-moving stepped leader. To do its job properly, an air terminal should extend at least 15cm (6") above the top of a lightning protective mast and any equipment located there that needs to

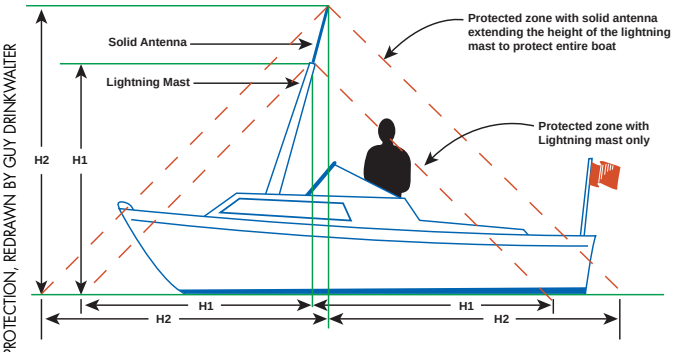


FIGURE 3

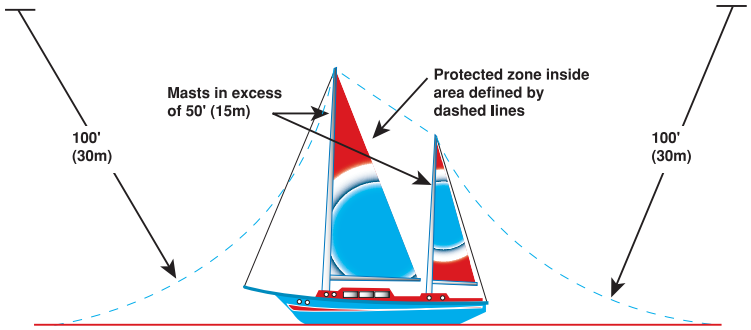
Stay in the zone! Lightning protection for a powerboat or sailboat with a grounded mast no higher than 15m (50') above the water. The cone-shaped zone of protection extends from the highest point to a circle on the water's surface with a radius equal to the height of the conductor or lightning protective mast.

Lightning

be protected (**FIGURE 5**). If there is no antenna, light or other equipment at the masthead to be protected, an air terminal is not required on an aluminum mast.

Air terminals have traditionally had sharp points since it was theorized that a sharp point creates the largest electrical field and is more likely to launch an attachment spark. Recent experiments, however, suggest that the optimal air terminal tip radius of curvature is 4mm (3/16") minimum to 12mm (1/2") maximum. Static dissipators, devices that generally have a bristly brush-like appearance with multiple conducting points, are claimed to prevent a lightning strike.

A metal mast used as the primary lightning conductor between the air terminal and ground plate should have a conductivity not less than that of a #4 copper conductor. If your boat has a non-conductive mast, connect the air terminal at the masthead to the external ground plate using 4 AWG wire or a copper conductor of equal or greater conductivity. Although partially conductive, carbon fiber materials should be considered non-conductive as a lightning protective mast.



ABYC E-4, LIGHTNING PROTECTION, REDRAWN BY GUY DRINKWALTER

FIGURE 4

On masts higher than 15m (50'), the zone of protection is defined by a circular arc with a radius of 30.5m (100') between the air terminal and water. Each mast requires a conductor with ground plate directly underneath.

Boats that lack a permanent mast can erect a temporary one as needed. Its height and location when deployed should be such that the entire boat falls within its zone of protection (**FIGURE 6**). An aluminum outrigger with conductivity equal to or better than a #4 copper conductor can be used, as can a stainless-steel whip antenna. Due to its higher melting temperature, the conductivity of a stainless-steel whip may be equal to that of 8 AWG copper wires. Since the antenna's loading coil presents a high impedance to the flow of lightning current, it should be shorted, equipped with a surge suppression device (lightning arrestor) or grounded above the coil.

Metal stays and shrouds provide lightning parallel paths to ground. Use 6 AWG wire or other copper conductor of equal or greater conductivity to connect chainplates to the ground plate. Lightning doesn't like to change direction. If a conductor is required to turn, the radius of the bend should be no less than 20cm (8") and the included angle no less than 90°. To minimize side flashes and the induction of high voltage to the boat's wiring, don't route lightning conductors parallel to the boat's AC or DC wiring.

All materials used in a lightning protection system should be corrosion resistant. Use stranded copper wire, ribbon or copper flashing (cut into

In the event of a lightning strike, dissipators such as the Forespar Lightning Master may help to discharge the ion charge and keep you out of harm's way.

FIGURE 5

An air terminal should extend at least 15cm (6") higher than the highest point on the masthead and fasten to a minimum 4 AWG copper conductor connected to the grounding plate or strip. If the mast is aluminum and there is no equipment at the masthead to be protected, an air terminal is not required.

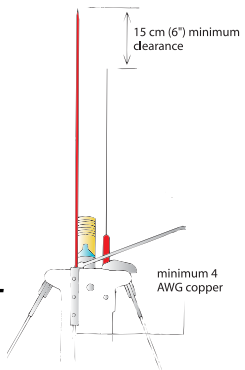
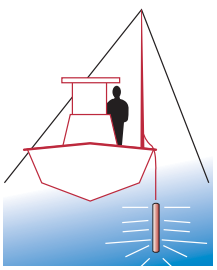


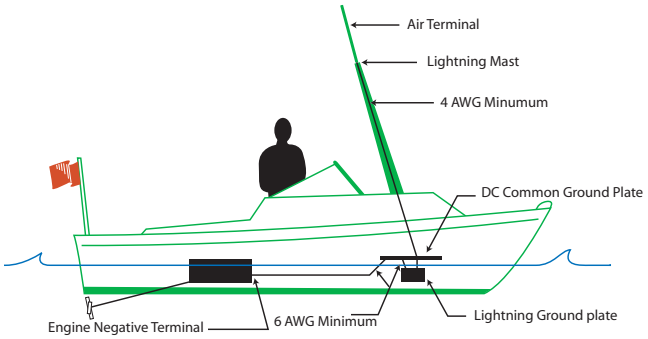
FIGURE 6

Boats that lack a permanent lightning protective mast should erect a temporary one. Its height and location when deployed should be such that the entire boat falls within its zone of protection. Several companies manufacturer a copper conductor cable(s) that lead from the mast into the water.



GUY DRINKWALTER

ABYC E-4, LIGHTNING PROTECTION, REDRAWN BY GUY DRINKWALTER



A basic lightning protection system for powerboats; measures taken to protect installed electronics not shown.

strips) with a thickness of at least .8mm (1/32"). Annealed 12mm (1/2") copper tubing, radiused if necessary and then flattened, makes an excellent conductor. Don't use copper braid. Where it's necessary to connect dissimilar metals, such as aluminum and copper, corrosion can be reduced by the use of suitable plating or by installing a metal fitting that is galvanically compatible with both metals. Many marine stores sell bi-metallic connectors for this purpose. If your boat has a lightning protection system, check the size of the conductors. Any 8 AWG conductors compliant with previous ABYC and NFPA standards should be upgraded. Subsequent research has proven them inadequate.

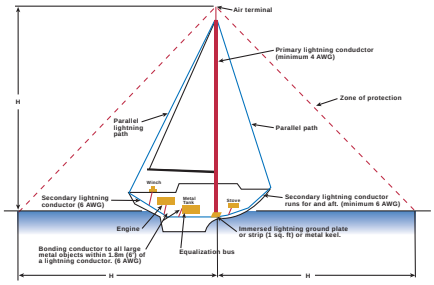
The lightning ground for your system can be any metal (copper, copper alloy, stainless steel or aluminum) surface at least 930cm^2 (1' square) that is submerged in the water. A metal hull, rudders, external ballast keel or centerboard (provided it's in the down position) makes an excellent ground. If your boat has none of these, bolt an exterior ground plate or strip to the hull, insofar as possible, directly below the lightning protective mast. Don't use propellers, shafts or metallic rudders in lieu of an exterior ground plate or strip unless the lightning protective mast is located toward the stern. All connections to the ground plate or strip should be as short and direct as possible. If you use a ground plate forward under the lightning mast, rather than a grounding strip, ground backstays or other objects aft to the engine negative terminal, metallic rudders or other external ground at the aft end of the boat. Due to their porosity, a sintered bronze plate (Guest Dynaplate is one example) designed for grounding radios is not as effective in dissipating the charge of a lightning strike as a solid copper plate of the same size and shape. In addition, heat from a strike can turn water trapped in these plates to steam, causing them to explode.

Stem-to-stern external grounding strips should be at least

TIP Freshwater Boaters Beware

Freshwater is, by far, a poor conductor of electricity than saltwater, and doesn't dissipate a lightning current as effectively. If you use your boat in freshwater, University of Florida researcher Ewen Thompson recommends installing a larger underwater grounding plate or strip than suggested by ABYC. — *SC*

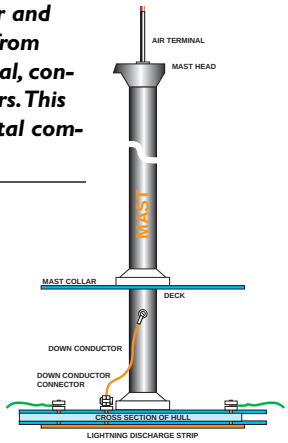
Lightning



Ideal protection system: Stem-to-stern aluminum underwater grounding strip mounted externally below the waterline serves as the boat's ground plate helps avoid destructive side flashes. Keel, toerail, shrouds, mast, all major metal components on the boat are all directly connected to the strip. Fasten the strip with two thru-bolts to prevent twisting.

19mm (3/4") wide and, except for stainless steel, have a minimum thickness of 4mm (3/16"). Stainless-steel strips should be at least 3.2mm (1/8") thick. Since lightning dissipates from the edges of the metal, a 2.5cm by 3.6m (1" by 12') strip has nearly six times the amount of exposed edge as a 930cm^2 (1' square) ground plate. If a grounding strip is used, it should run aft from a point directly below the lightning protective mast. On a sailboat, the strip should be located where it will be submerged when the boat is heeled to port or starboard. If this is not possible, two strips should be used. The edges of a ground plate or strip should be sharp, exposed and not caulked or faired into the adjoining area.

A lightning discharge system for power and sailboats, the LDS 2000 kit (US$250) from Chestnut Hill consists of an air terminal, conductor, grounding strip and all fasteners. This system still requires connecting all metal components to the grounding strip.



Bonding Conductors

While the lightning protective mast and its conductors are designed to direct a lightning strike to ground, the bonding system is intended to prevent sideflashes by keeping sizeable metal objects within 1.8m (6') of a lightning conductor at the same potential. Use 6 AWG wire or a copper conductor of equal or greater conductivity to connect objects such as bow and stern pulpits, horizontal guardrails, handrails on cabin tops, steering wheels, sail tracks, smokestacks from galley stoves or cabin heaters, metallic hatches, arches, towers, electric winches, davits, stoves and metal tanks. If an exterior grounding strip is used, an equalization bus can be run inside of the boat parallel to the strip. Lightning bonding wires connect to this bus, reducing the number of connectors run to a single bolt.

Don't encourage the high voltage associated with lightning to pass through the engine as it can damage the bearings. Connect engines directly to the grounding plate, strip or bus. Also, do not connect the primary grounding conductor to seacocks or thru-hull fittings. It's best to leave seacocks isolated whenever possible.

Electronics protection

Solid-state electronics are very intolerant of voltage surges, and even a well-protected boat can lose electronics due to lightning. Lightning-bypass gaps, transient voltage suppressors and metal-oxide varistors are available from electronics' distributors to protect antenna coils, coaxial cables and power supply lines, respectively. The best thing you can do to protect electronics is to disconnect antenna cables and all wiring leads. Don't forget to remove microphones. (Don't remove grounding cables that run to metal equipment cases or chassis.) Turning off a circuit breaker is not sufficient. Lightning will easily jump the gap. Thompson goes a step further and recommends enclosing all electronics in metal boxes that are then connected to the bonding system. All this being said, in the event of a direct strike, there is nothing that will protect all of the electronics all of the time.

Inspection and Maintenance

Inspect your lightning protection system annually and whenever alterations or repairs are made to any of its components. Check for corrosion and tighten any loose connections. Use a multimeter to test for system continuity.

Personal Conduct

When threatening weather approaches keep everyone out

TIP Fusing The Negative

FUSING THE NEGATIVE
Instead of disconnecting all leads on the GPS, VHF or other electronic devices as recommended by ABYC, some boaters advocate installing a fuse in the negative lead. This is in addition to the required fuse or circuit breaker in the positive lead. The theory is that a lightning strike will likely blow out the reverse polarity diodes (which are easily cut out of the circuit to allow temporary use), as well as the negative fuses, but save the electronics. Fuses are just another insurance policy. Go ahead and install them. What's to lose? *— JM*

of the water and inside the boat (within the zone of protection). The safest place is in the cabin. Stay well away from the mast and rigging. Avoid touching stays, shrouds, railings, lifelines, outriggers, antennas and other components of the lightning protection system. In particular, avoid touching two grounded objects simultaneously, such as a metal steering wheel or throttle control and a stanchion, in such a way that you become an electrical conductor between them. In an open boat, stay as low as possible.

When conditions that create an electrical charge between clouds and the earth exist, there is nothing that can be done to prevent the lightning discharge. No lightning protection system can prevent that. The operative word is "protection" not "prevention." A boat can be struck in open water or while tied to a dock. Refrain from using electronics, which should be disconnected anyway, especially the VHF radio except when needed for an emergency.

A Final Caution

Appropriate system design is unique to each boat. Whether you do the work yourself or have a marine electrician or rigger do it for you, review both the ABYC and NFPA lightning protection standards before installing a lightning protection system (see "Resources" for ordering information). Lightning doesn't know you exist and it doesn't care. The only thing you can do is provide lightning an unimpeded path to ground. Lightning protection systems are intended to protect people first and the boat second. You do what you can to protect electrical systems and electronics, but there you're largely at the whim of Mother Nature.

About the author: Susan Canfield is a marine surveyor with Marine Associates of Annapolis, Maryland. She is a member of the Society of Accredited Marine Surveyors and the American Boat and Yacht Council.

RESOURCES

- "Standards and Recommended Practices for Small Craft," Standard E-4, Lightning Protection (12/96); American Boat & Yacht Council; Tel: 410/956-1050, Website: www.abycinc.org $35 ($17.50 for ABYC members)
- "Standard for the Installation of Lightning Protection Systems," 2000 Edition, NFPA 780; National Fire Protection Association, Tel: 800/344-3555 or 617/770-3000 if calling from outside U.S., Website: www.nfpa.org $29.75 ($26.75 for NFPA members)
- For more information on lightning and boats, visit the following websites: National Lightning Safety Institute: www.lightningsafety.com
- National Weather Service Lightning Information Center: www.srh.noaa.gov/mlb/ltgcenter/ltgmain.html
- University of Florida: www.thomson.ece.edu/lightning/title.html

POWERBOAT - RIGGING -

EXTREME POWER BOOST

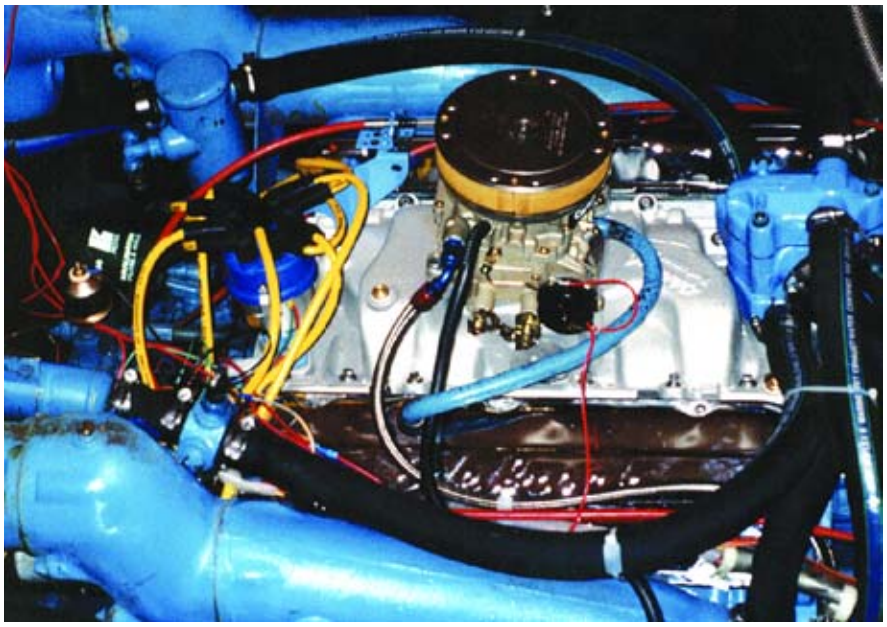
Better fuel economy, a cleaner burning engine and reduced maintenance are just a few good reasons to add high tech components to your boat's engines, even in a motoryacht with a cruising speed of just 8 knots.

[BY DWIGHT POWELL]

After purchasing a 1968 cruiser with original engines, it occurred to me that I could make some significant power improvements using high-tech components, yet keep the strength and dependability of the original blocks.

It's equipped with twin 427 CI Crusader engines that enjoy a reputation for ruggedness and dependability. Having GM blocks means parts are available almost anywhere for rebuilds or upgrades. These engines feature Quadrajet carbs, breakerpoint ignition and the original cast iron intake manifolds. This configuration may have worked well for 30-plus years, but the potential for fuel savings and new, more dependable technology would likely improve performance.

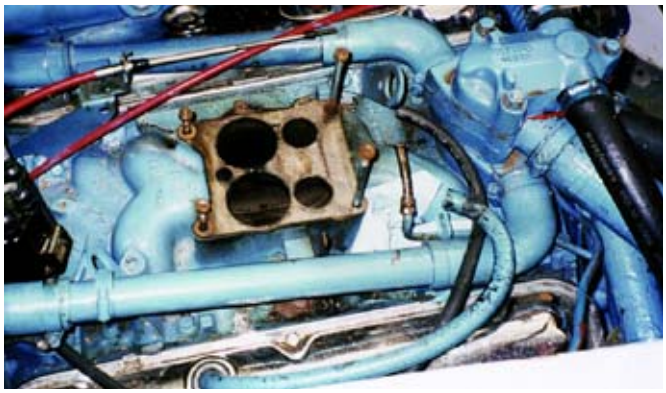
Original Quadrajet carburetor.



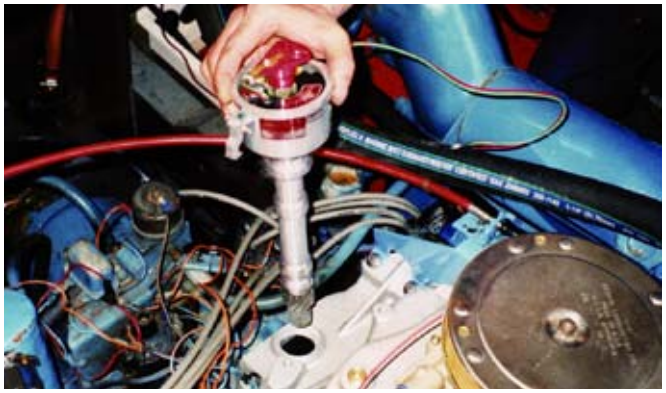
After consultation with my mechanic, Jeff Harrison of Jeff's Mobile Marine, we decided to change the distributors completely. The existing units used breaker points and required gap and dwell setting at each change. Skeptical traditionalists advise against installing electronic ignition in boats. Other than some anecdotal evidence: "If the distributors fail, you can't walk home," or "That's how the engines where built so stay with the original;" I could find no evidence to avoid this upgrade. Breakerless, electronic ignition, has been used for many years with incredible reliability, and is fitted in all modern marine engines. We chose Mallory distributors because these are small with inexpensive caps and rotors, and with sockets that most resemble the original.

Next came the carburetors. While I have nothing against Quadrajets, my previous boat had Carters, which I found easy to adjust and were extremely reliable. Besides, Carter carbs were a better fit for the new intake manifolds not yet installed. Also, in keeping with the idea of "balance" in the engines, I felt it was important to match the carbs and intake manifolds. The new Carter carbs are designed for marine applications with return lines for Positive Crankcase Ventilation (PCV) and the fuel pump vent. Oddly enough, while there was a vent port on each fuel pump, it was not connected to the Quadrajets, nor was there a port on these carbs to do so. (Make sure you use fuel system components designed for a marine application. Automotive parts do not have the safety features required to prevent

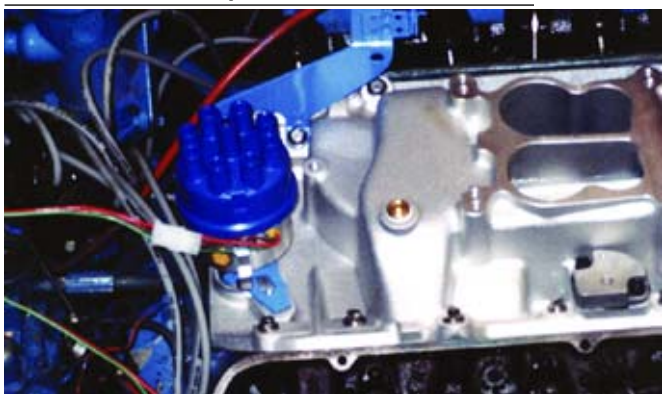
Out with the old distributor.



Original cast-iron intake manifold.



Installation of Mallory electronic distributor.



New aluminum Edelbrock Performer 2.0 manifold. Note larger plenum chamber opening. Footprint of new distributor is smaller than original with traditional cap.

fuel or vapors from getting into the boat.) Venting gasoline and/or fumes into the bilge is a potentially fatal practice!

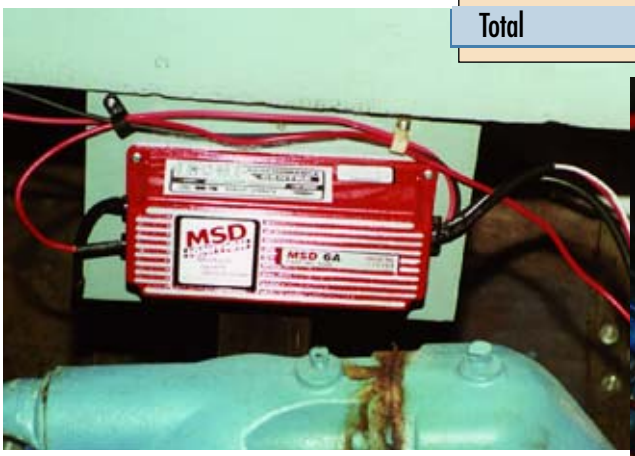
I chose new intake manifolds from Edelbrock. They are made of aluminum and have a slightly higher tower or plenum chamber for the carb to sit on. This extra height allows the manifold to deal more effectively with something called a "sonic." Without getting too complicated, this sonic can either be helpful or harmful depending on engine timing. Edelbrock manifolds are also designed to improve the air-fuel vaporization and flow efficiency to the cylinder heads, making for more low rpm torque and better fuel economy.

Lastly, we installed a Multiple Spark Discharge (MSD) on each engine. Such units are most often used in racing boats because they put out greater spark per sec-

Hoses were replaced with certified ones, including a certified Vetus exhaust hose.

DIY Upgrade Bill

2 Mallory electronic distributors	$900
2 Carter Marine carburetors	$800
2 Edelbrock Performer 2.0 intake manifolds	$500
2 MSD units	$600
Miscellaneous bits and pieces	$200
Total	$3,000 for both engines



Multiple Spark Discharge units installed on each engine deliver a spark 10 times more intense than a regular coil and distributor.

With new electronic distributor, Edelbrock manifold and Carter Marine Carb, this ol' gal is ready to go racing, err boating!

ond and provide a more complete burn of the fuel mixture. They get their power directly from the battery — just imagine the umpf! According to the manufacturer, the spark is 10 times more intense than a regular coil and distributor arrangement. Today's fuels have lower octane and with long periods of idling, a common occurrence in boats, engines don't burn the fuel completely. This condition increases fuel usage and pollution. Harrison suggested that while MSD units are most often used on high performance boats, we should try them on a lower rpm, displacement cruiser.

The net result of the above upgrades produced higher torque in the lower rpm range, more spark advance from the electronic distributors and MSD units. Subsequently, this provides more efficiency at idle, better fuel economy and less carbon buildup in the engines. While it's too soon to claim success, I notice the engines start faster and idle smoother with less spark plug fouling.

One added benefit to all of this, I hope, is reduced maintenance. No points to change and set, spark plugs that last longer, and cleaner burning engines.

About the author: After a seven-year bow-to-transom refit, Dwight Powell traded his vintage Chris-Craft cruiser for a wooden 11.2m (37') Egg Harbor. His next upgrade is to install a Floscan Fuel Management System, which will verify the engine modifications, followed by a complete wiring overhaul. Both will appear in upcoming issues of DIY.

MAINTENANCE

OF HULLS, DECKS & INTERIORS

A collection of tips for refinishing brightwork, stripping coatings, bottom painting, purging water tanks, installing a fire system and how to build a do-it-yourself sandblaster.

[BY JAN MUNDY]

STILL LOOKING GOOD

A well-maintained coating of Cetol on author's Island Packet after six years of service in California, Florida and Maryland.

Natural wood finish requires very little effort if maintained regularly. When I purchased my Island Packet in 1994, it had two factory-applied coats of Cetol on the exterior brightwork. A few months after commissioning, I applied two more coats using a technique I've successfully used for many years. First, prepare the wood by rubbing the surface with a white 3M Scotch-Brite pad, rinse with a vinegar-water mixture, and let dry for a day, then apply Cetol liberally and neatly with a foam brush (I never mask). Every year thereafter I repeat these steps, applying two coats with no sanding.

Some owners find that Cetol only lasts a year or so before needing sanding or scraping the coating down to the bare wood. The problems begin when water migrates under the coating. The key to a long-lived clear finish is to clean the surface once a week by spraying with water and wiping off with a soft rag to get rid of dirt and mold that eats into the Cetol. In San Diego, California, the air pollution was so bad that it literally ate away the Cetol anywhere water pooled or the pollutants concentrated, such as on the cabintop grab rails. Also, after waxing the deck, sometimes I use the same rag to lightly wax the rail. This provides some added waterproofing, but don't rub too hard or you'll remove some Cetol.

— Butler Smythe

TIP Taping Trick

When masking the hull before applying an antifouling, barrier coat or topside paint, use a high quality tape designed to withstand the elements, such as 3M Long Mask or 233+. Then apply an inexpensive masking tape overtop. Pull the tape away when you've finished the job. Both tapes tear off easily without breaking into small pieces, as can happen when tape is left in place for more that a few days or when it gets wet.

PASSIVE BLASTING

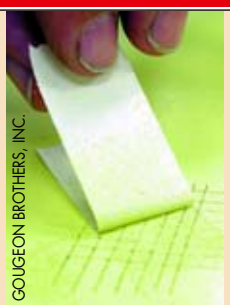
Condition of hull after a power wash.

Rather than hand sanding his boat's fiberglass hull below the waterline, DIY reader Doug Alexander built a sandblaster from components readily available at most hardware and department stores. His blaster consists of a 110-volt, 5-hp compressor (US$276) with an upright storage tank, and a sandblast gun (about US$30). This is not a powerful setup compared to a commercial unit one could rent, but it's a lot easier than hand sanding.

TIP One-Step Paint Adhesion Test

When you're not sure if an overcoating of paint, varnish or oil is compatible with the existing substrate, do a patch test before painting. The following routine is adapted from an article previously published in "Epoxyworks," Spring 2001 edition, published by Gougeon Brothers. Based on the American Standard for Testing Materials (ASTM) test number D3359, this test provides a method to check the adhesion of the primer to the surface, and the paint to the primer and to the surface, all at one time.

Prep the test area, then apply the primer (if using) and paint following the manufacturer's instructions. Once cured, use a single-edged razor blade to score a pattern of parallel lines, about 3mm (1/8") apart, in a crosshatch pattern through the coating to the substrate. Apply a strip of high quality masking tape diagonally across the pattern, leaving a tail on the tape. Rub the tape hard onto the pattern, and then pull it slowly back over itself. If the paint lifts from the primer, then the coatings are not compatible or the surface prep is inadequate. In either case, alter your surface prep or apply a different primer and test again. Repeat these steps until you are satisfied with the results.



GOUGEON BROTHERS, INC.

TIP Don't Pour, Ladle

Instead of pouring paint from the can into a paint tray or other container, use a ladle to transfer the paint. That way you'll avoid paint dripping over the can label, and you'll still be able to read the application instructions.

Basic blasting system.

With a spray pattern of about 25mm (1") in diameter, blasting is a slow process but doesn't damage the hull. Owner is wearing gloves, a mask, eye protection and heavy coveralls (not shown) as protection from the airborne sand, which gets into everything!

Using a fine grade of silica sand (#505) left a nice smooth finish on the hull. A coarser grade of sand would clean faster, but the finish is much rougher. Sand was loaded into a pail with the siphon hose in the pail. A small rubber hose inserted into the sand inlet with the other end out of the sand allowed air to enter the hose with the sand, which helped to prevent clogging. On the down side, the spray area is only about 25mm (1") in diameter, so it takes a long time to clean an area. Also, moisture in the compressed air mixed with the sand often clogged the nozzle and this required constant cleaning. Water filters (US$25) on the airline helped to eliminate some of the moisture. Cheaper filters were very fragile and broke easily. After blasting, the bottom required only a light sanding and solvent wash before applying an epoxy primer and antifouling paint.

Before and after: the cleaned area (right) is very smooth to the touch. It took 10 45kg (100lb) bags of sand to clean the 7m (23') hull.

BOTTOM PAINTING FAQ

Of all the questions boatowners ask the experts at Interlux, these 8 are the most common.

DIYer Wanda Gray, preps the bottom on "Dream Weaver III," an Alberg 37.

Q: How should I choose an antifouling for my boat?

A: Besides selecting bottom paint for the type of water where you boat, whether freshwater, saltwater or brackish, the most important consideration is how often you use your boat. You don't need any coating on the boat's bottom if it's moved constantly. If used once a week, then apply an ablative paint, such as Micron CSC or Micron Extra. Every outing generates a fresh coat of copper, renewing the antifouling properties. Boats that are used more frequently require a hard paint that leeches out, such as Ultra-Kote, rather than wears off. Two or three coats of a hard paint can last up to 18 months no matter how far or how fast you travel.

Q: Does my new fiberglass boat require application of a barrier coat below the waterline?

A: A new boat has a very dry hull After launching, the boat's bottom immediately starts to soak up water. Though most boatbuilders offer a limited hull warranty, it's usually prorated over a few years. If you're planning to keep your boat, it's worth spending US$60 per gallon for a barrier coat. Besides the maintenance factor, you'll get better return on your investment when selling the boat.

Q: Is it necessary to sand after priming?

A: Some manufacturers offer a no-sand primer, but to minimize any chance of flaking, it's best to sand the primer before application of antifouling.

Q: How do I prep a hull that has never been painted?

A: You must remove the thin film of mold release wax on the surface, then sand it before applying bottom paint. Wash the hull thoroughly using a Fiberglass Solvent Wash 202 and agitate the surface with a Scotch-Brite pad. Rinse the hull with water, which should sheet off. Where the water beads, you'll need to repeat the solvent wash and scrub. Continue flushing the hull with

water until all wax is removed. Now sand with 80 to 120 grit paper. Hull cleaning is important. Sanding heats any remaining wax on the surface, and then pushes it into the open pores in the gelcoat. That will keep any bottom coating you apply for the first few years from sticking.

Q: I've purchased a boat used in freshwater that has Interlux VC 17m on the bottom and plan to launch it in saltwater. How do I prep the bottom?
A: VC 17m is a very thin film. Either strip with B172, an alcohol-based stripper, or denatured alcohol, or overpaint with a compatible paint, such as ACT. To strip, lightly wet sand with 80-grit paper to open up the pores, soak a Scotch-Brite pad with stripper, and scrub.

Q: Are VC 17M or VC Offshore available with Biolux?
A: Apparently these products are in the works but they are stalled in the registration process.

Q: Should I use VC Tar or Interprotect as a barrier coat under VC 17m?
A: Four or five coats of VC TAR comprise the conventional undercoat for VC 17m, as it remains more flexible then an epoxy system. Nowadays, more and more boat owners are using Interprotect 2000E/2001E. Applying five or six coats, sanding the final coat with 320-grit paper, gives a harder and slicker bottom.

Q: How do I get paint to adhere to my propeller, shaft and strut?
A: Painting underwater metals is a four-step process: degrease, etch, prime, then paint. Clean the surface with Fiberglass Solvent Wash 202 or its equivalent. Now etch the metal using an etching solution, such as Viny-Lux Primewash 353/354. Etching provides the chemical and physical bond for the primer. Without etching, the primer and paint will flake off in sheets. Cover with an underwater metal primer, such as Interlux 360R, or epoxy barrier coat. Priming also isolates the different metals. These two steps should last five to 10 years when properly prepped and primed.

Apply a copper-based hard paint, such as Fiberglass Bottomkote, rather than an ablative paint. Outdrives require a bottom paint specially formulated for aluminum, such as Trilux.

WATER TANK WOES

Q: I inadvertently put several gallons of diesel fuel in my 58.5L (70gallon) freshwater tank. Immediately, the tank was drained and flushed repeatedly while adding baking soda and water purifier. Despite my efforts, there is still a taste and smell of diesel. The tank cannot be removed. Is there any additive or process you could suggest to totally clean the tank?
Jim Pickard, "Sea Saw," Rock Hall, Maryland

A: DIY contacted three companies, of which two are manufacturers of chemicals and cleaners, and one produces fuel-cleansing devices. All offered different solutions. As you've flushed the tank, it's likely that you've removed the fuel. The small amount of residue remaining is enough to give a pronounced taste and smell. Apparently, sodium carbonate hydroxy hydrate reacts with hydrocarbons and neutralizes them. Capt. Phab Purge Tank Cleanser is a product designed for tank cleaning with this chemical as the main ingredient. Mixing 56g (2oz) of this powder per 8.3L (10gallons) of water is the recommended solution. Add 397g (14oz) to your tank, fill with water, and let it soak. Then pump it through the system to clean the lines and taps. For ordering information, log onto www.capt-phab.com.

Another possible method to remove the diesel residue and associated odor is to use an enzymatic bilge cleaner according to Jeff Tieger of StarBrite. This bio-cleaner literally eats hydrocarbon fluids, turning them into carbon dioxide and water. With these cleaners there's the possibility of sulfur dioxide gas forming, which, besides being a health hazard, also corrodes electrical connections. Because of this effect, Tieger doesn't recommend this type of bilge cleaner when used on a regular basis. As long as you vent the fumes coming off the tank (use fans in the area), there should be no problem on a one-time basis.

Algae-X recommends rinsing the tank with Bio-Solve, a product used by fuel refineries to clean storage tanks and oil spills, and to suppress gasoline and oil fires. The concern with this product is contamination of the tank after usage and the resultant health risk.

If all else fails after the various flushing efforts, replace all the hoses serving the potable water system. A taste and/or purifying filter for drinking water may also improve the water quality.

If I paint a transducer will it affect depth readings?

Transducer manufacturer, Airmar Technology, recommends applying one thin coating of bottom paint. It won't harm the transducer or cause erratic readings, and it's a better alternative to amassing sea growth.

What You Should Know About Fire Extinguishers

If you have a house fire, you call the fire department. If you have a fire onboard your boat miles offshore, you must rely on your own resources. Here are some points to remember when purchasing, installing or servicing your fire fighting equipment.

This is not the time to try to save a buck by buying an undersized portable fire extinguisher. Select a size that meets or exceeds the requirements for the volume of the cabin (or engine compartment) as calculated in cubic meters or cubic feet (length x width x depth). When in doubt, always choose the larger size. Refillable cylinders are more expensive than nonrefillable ones and available in the 125 cu.ft. size range and larger.

An automatic self-extinguishing system, permanently mounted in the engine compartment, makes good sense on boats with inboard engines. Using a portable extinguisher to quell an engine room fire means opening the space, which lets in oxygen that fuels the fire. As these units are difficult to aim, they often miss the fire source, or are misdirected due to dense smoke or difficult access. Fire-suppressing agents in automatic systems, unlike dry chemical agents, leave no residue and won't harm the engine or components. Halon was the agent of choice for automatic systems until its manufacture was banned in 1993. If you have a Halon system, you can still recharge it, but the recharge will be recycled Halon. Today there are lots of Halon alternates. One economical agent is FE 241, which stands for Floraltetrafloralethane. These systems are heat activated to discharge when ambient engine room temperature reaches, as with Fireboy-Xintex systems, 73.8°C (165°F). A desirable feature is manual override. A smoldering electrical fire produces a lot of smoke but very little heat, hence delaying the automatic discharge. Installation with a diesel engine(s) also requires an automatic shutdown override system installed at the helm station(s). Since the discharged agent will not stall the engine, continued running may remove the agent via the engine air intakes, possibly allowing the fire to reignite.

Are your portable fire extinguishers easily accessible and quick to grab? Too many boats have extinguishers mounted under a sink or hidden in a locker, rather than in a clearly visible location and readily accessible to the space being protected. Never install a unit under a hatch cover or companionway. An explosion will blow the cover overboard along with your fire protection. Fireboy-Xintex recommends you check the extinguisher's pressure gauge daily and weigh the extinguisher every six months, or at least annually. Refillable cylinders should be hydrostatic tested every 12 years.

Fire fighting effectiveness of all extinguishers and extinguishing systems is compromised unless you interrupt engine blowers and all sources of ventilation (oxygen). Some larger yachts have automatic systems to close air intake vents. We don't know of any aftermarket kits available, but I'm sure designing one isn't too challenging for the skilled DIYer.

Product Review

SURE GRIP POLYMER SHEET

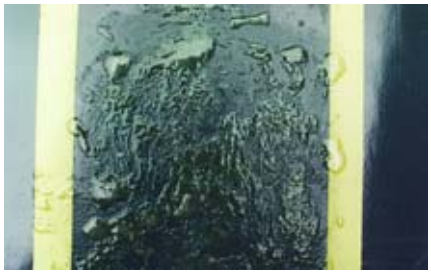
King StarBoard is an excellent maintenance-free product to replace wooden components onboard. But it's very slippery, an important shortcoming when used for cockpit seats, tables, grab rails, swim platforms and other items. The manufacturer, King Plastic, has resolved this issue with the release of King StarBoard AS. It's the same product as the original except the surface layer has a textured dot pattern designed to be slip resistant and promote water drainage. Offered in 12mm (1/2"), 19mm (3/4") and 25mm (1") thick, 1.3m by 2.4m (54" by 8') sheets, prices are US$285, US$430 and US$575 respectively.

TAKING IT OFF

A quality paint stripper should remove most, if not all, of the coating in the least amount of time, allow easy cleanup with water, and achieve a paint-ready finish.

For our paint remover test we used a board finished with three coats of Interlux Brightside applied four years ago over Epiglass epoxy resin. Products tested were Soy Strip from Franmar Chemical, Interlux Interstrip 299E, and 3M Marine Safest Stripper. A fourth stripper, Take Off, is no longer available and omitted from this discussion. When used properly, these strippers don't pose a serious health risk. Nevertheless, heed the instructions on the labels carefully when handling and wear heavy solvent-resistant neoprene or butyl rubber gloves, a face shield, goggles and protective clothing. Good ventilation is a must, especially when working with a solvent or acid-based stripper. When using chemical strippers, be sure to collect shavings in plastic bags for proper disposal.

After thoroughly washing our test surface to remove dirt and other contaminates, we masked three sections horizontally, then divided each section vertically. This grid allowed test results based on exact timed intervals. One by one, each stripper was applied over the full width and the results timed carefully. Remarkably, none of the strippers harmed the epoxy. Ambient temperature was 18°C (65°F). The surface temperature of our test board was just slightly warmer. Most strippers work best in warmer temperatures. All three paint removers tested are "wet" strippers. It's advisable to cover the surface with plastic wrap to prolong the stripper's wet time and prevent it from drying.

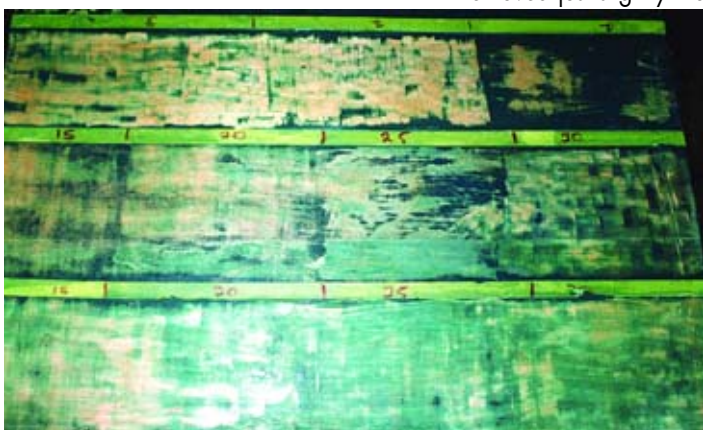


Semi-paste paint removers, like Interstrip 299E and Safest Stripper, are thickly applied with a brush, using a light touch, much like buttering bread rather than aggressive painting.

Soy Strip is a non-petroleum-based liquid solution made of soybeans and other proprietary ingredients. A pourable-type cap simplified application. Within 14 minutes the paint began to lift. For the next 15 minutes, the stripper was checked every 5 minutes, the finish scraped, and the results noted. Though this product quickly softened the paint initially, there was little difference in surface finish during our timed intervals. For better effectiveness, it was necessary to reapply and wait longer, though the manufacturer doesn't recommend prolonged exposure times. Where this product had removed the paint, the surface was very smooth, similar to a 150-grit sanded finish.

Interstrip 299E is a brushable, semi-paste solution designed to adhere to vertical surfaces. This type works best when applied in thick layers with a brush. As our test board had three coats, about 2ml per coat, we dabbed on the stripper about 3mm (1/8") thick. For best performance, apply a minimum thickness of five times the density of the coating to be stripped. Removal happened fast. Within 11 minutes the paint began to lift. At the 15-minute mark it scraped easily. This remover required aggressive scraping to remove the finish, but the paint came off in sheets rather than small bits. Interstrip continued to soften the paint over the next 10 minutes. Again, we allowed only 30 minutes before final scraping of the surface. In this case, reapplication was needed for complete paint removal with a longer wait time. Directions on the label recommend a standing time of up to two hours for several layers, but the surface must remain wet. The treated surface was very rough, more like 50-grit sandpaper. Interstrip contains no methylene chloride, caustics or acids, but it's powerpacked with solvents, namely acetone, toluene, methyl alcohol and ketones.

Though 3M Marine offers more powerful paint strippers, we opted to test one that is the most environmentally friendly. Safest Stripper is a thick paste containing dibastic acid esters. Following the instructions on the label, we first sanded with 100-grit paper then brushed on a thick coat of stripper and waited. The longer it has to "cook" the paint, the better the removal results. Scraping tests were done at three time intervals. After 1 hour, it had softened little of the paint. At the 2-hour check, the remover easily enabled the paint to be scraped off in sheets, and an hour later, removed just slightly more paint. Again, reapplication was necessary for a complete stripping. Once completed, the surface was in paint-ready condition.



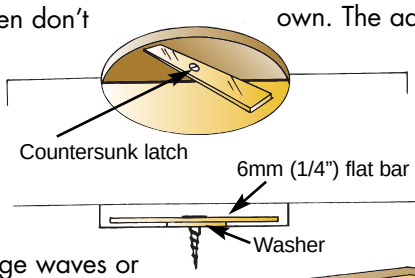
Initial test results in timed intervals. While not scientific, these results typically do show that semi-paste formulations perform better than liquid paint strippers to remove our green polyurethane topside paint. They probably also effectively remove bottom paint and varnish. Longer wait times would have certainly improved the strippers' effectiveness and minimized reapplication.

Good Boatkeeping

[BY DAVID & ZORA AIKEN]

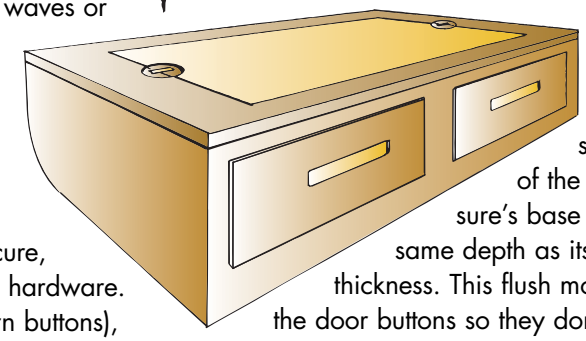
KEEPING THE LID ON

Under seat or berth stowage locker lids (hatches) often don't have any type of closure hardware. These lids just sit atop their framework. When a boat rocks in large waves or wakes, or gets knocked down in heavy weather, these locker lids could lift off and become missiles.



To hold lids secure, install some closure hardware. Door buttons (or turn buttons), those flat pieces of metal that rotate, work well. You can buy them ready-made or assemble your own. The advantage of the DIY variety is you can make a longer retaining bar for a better hold.

To install, use a router or chisel to cut out the shape of the closure's base to the same depth as its thickness. This flush mounts the door buttons so they don't damage seat cushions that sit on top of the lockers.



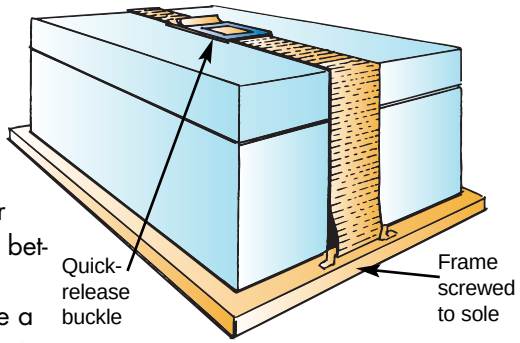
Many standard turn buttons are already mounted on a round base. Be sure to fasten these into the top of the seat locker frame, not into the hatch, as the button must turn over the end of the hatch.

If you decide to make the closures, buy a 7.6cm or 10cm (3" or 4") length of 6mm (1/4") flat metal bar for the turning part. The diameter of the base to be routed will of course depend on the length of this metal section. To attach the button, place a stainless-steel washer over the top of the locker frame, then use a #10 screw to attach the metal bar. The washer under the bar will allow the metal piece to turn. Turn buttons are equally useful for vertical applications such as locker doors. They are much more reliable than bayonet closings or other small cabinet hooks.

TOOL SAFE

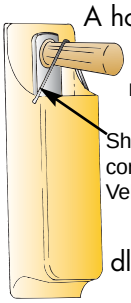
If boat traffic in marinas and waterways is causing things to roll around or drop overboard, it makes good sense to secure all items that might become uncontrolled flying objects.

A standard handyman's toolbox, a common item on most boats, could launch an entire arsenal of airborne projectiles. At the very least, an overturned toolbox makes a frustrating mess. So, find a permanent location to stow the box. To build a toolbox frame, screw 25mm (1") square strips of wood to the cabin sole or inside a locker. Put a "footman's loop" (a rectangular bracket for holding straps) on each end of the frame. Attach a piece of webbing with quick-release buckles to each bracket. Place your box in the frame, and then fasten the straps.



HANDLE HOLDER

A holder for the winch handle is truly a great idea, as many racers learn after donating a few to Neptune. But even a holder doesn't guarantee the handle stays onboard.



Attach a short length of shock cord or Velcro to the holder. Drop in the handle, and then loop the strap over the top. This anchors the handle in rolling seas, so you avoid an accidental bruising of ankle or knee, and keeps it onboard.

About the authors: David and Zora Aiken are the authors and illustrators of numerous boating, camping and children's books, including "Good Boatkeeping" and "Good Cruising" published by International Marine. They live aboard "Atelier," in Grasonville, Maryland.