DIY boat owner
the MARINE MAINTENANCE MAGAZINE

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DIY Editorial Index

You can review or print a copy of the complete 1995 to 2002 Editorial Index online. Just go to www.diy-boat.com and click on "Archives," or call us toll-free at 1-888/658-BOAT to have one sent via snail mail.

WHY ABYC?

In every issue of DIY boat owner Magazine, readers will note various references to the American Boat and Yacht Council (ABYC) and its standards. These standards are the bare minimum requirements for safe design, construction and repair. When buying a new boat, or when dealing with an installer or repair shop, boat owners should insist that ABYC standards be followed. If you are doing the install or repair, it's imperative that you adhere to ABYC standards as well.

Teak Tips for Indoor Application

DIY readers may be interested to learn about my experience with Armada. I've been very pleased with Armada satin on the exterior teak on my 1976 Penn Yan 30 Sportfish. Over the winter, I often refinish teak in the basement of my house. Despite fans, lights, fresh air etc., Armada can stay tacky for days. According to Stacey Crown of Armada Coatings (Tel: 800/336-9320) there are three things that can help when coating teak indoors. First, air circulation is critical and fans do accelerate the drying process. Since the first coat usually takes the longest to dry because the natural oils in the wood slow the drying process, Armada recommends that you wipe the bare wood with acetone to remove as much excess oil as possible. Also, Armada adjusted the formula about 1-1/2 years ago to make the product less dependent on outdoor air circulation. So if you're buying a new can, be sure to check the date stamp on the top. The first number is the year so anything that starts with a 1 is 2001. The next 2 numbers are the month. So anything that starts with 107, 109, 112, 201, and 203 for example and later will dry a lot faster indoors.

Mike Holden, Ajax, Ontario

Name that Sender

In DIY 2002-#1 issue, page 18, there is a reference to a gas tank probe-type fuel level sensor that has no moving parts. I cannot locate the manufacturer of this sensor. Please advise.

Thomas Stennett, Frisco, Texas

Livorsi Marine (Tel: 847/548-5900, Web: www.livorsi.com) makes this fuel level sender, part GSFLC, avail-

For Trailer Boaters Only

Any one who has ever owned a trailerable boat knows the prime difficulty when loading is attaching the winch strap hook to the bow ring. This involves walking down a slippery ramp or doing a balancing act on the trailer strut and stretching like a gymnast, either feat sure to result in getting wet.

StarBrite's EZ Hooker boat hook combines a standard boat hook with a special plastic holder that attaches to an extension handle to quickly and easily attach the winch strap hook to the bow eye without getting into the water. EZ Hooker costs US$14.50.

Are You Ready For

COMPUTERIZED CONTROL?

In keeping with the trend toward sophisticated electronic-controlled engines and transmissions, Glendinning Marine Products (Tel: 843/399-6146, Web: glendinningprods.com) offers a control package that, along with the normal shift-throttle operations, gives the operator better control of the engine.

EEC-2001 benefits are numerous. A single lever combines gear and throttle operations making operation effortless. Indicator lights clearly show gear position and an audible beep signals when the control handle is moved to the neutral position. A "Warm" button locks the engine in neutral, which allows the operator to safely throttle up while running the engine out of gear. Instead of full speed when throttling down, selecting "Slow Mode" reduces control handle operating range to 50%, a great advantage when maneuvering in close quarters. Pressing the "Sync" button engages automatic synchronization to link the speed of two engines. A programmable idle speed selection allows up to 20 idle speeds for better control when docking, trolling, etc. A bump mode allows the operator to make minute adjustments, about 10 to 12 rpm faster or slower per bump, to set the ideal cruising speed. The control head detent and/or drag settings are easily adjusted while underway without disassembling the head. Other features include a control head light dimmer, low battery voltage warning indicator light and transmission override, a "Take Slow" button to transfer control to one of six stations, mechanical back-up and plug-and-play cables for easy installation. A dual lever control is optional.

The ECC-2001 operates with most electronically governed engines and transmissions. If repowering is in your future plans, this unit will increase the cost by about 10% but the payback in improving overall operation and boat handling may just be worth the expense.

New Breakthrough in Antifouling

It's been many years since consumers could purchase antifouling paints containing tributyltin (TBT), though it's not until January 1, 2003 that this substance is banned worldwide. Boat owners who purchased TBT–containing paints in the mid-80s likely recall just how effective they were against fouling, especially the self-polishing copolymer (SPC) antifoulings. Copper-based traditional antifoulings and the better performing ablative-type paints, which release biocide at a gradual rate, replaced such paints. Neither of these coatings can match the lifetime of SPC paint because the amount of biocide released falls during their life until there is not enough biocide released to deter fouling.

Interlux has just launched the next generation of antifouling paints. Micron 66 (sold in Europe as Micron 55) is the first self-polishing coating that doesn't contain TBT, yet it apparently offers the exact outstanding performance as it's banned cousin. This paint reacts with saltwater in a controlled way, sustaining the release of biocides throughout the lifetime of the antifouling without decline. The result is protection from slime, algae, weed and shell fouling build-up, even when the boat is stationary for prolonged periods. There is no build-up of paint, as the surface constantly polishes away (like a bar of soap) and hauling and relaunching doesn't require recoating. Micron 66 contains Biolux SPC, a revolutionary and patented biocide that combines with the copper acrylate copolymer resin to protect for two seasons or longer. Micron 66 is compatible with most TBT SPC, TBT-free and hard antifoulings offer by Interlux (except VC17) and competitors. Now, wouldn't it be great if Interlux develops a Micron 66 in colors other than copper black, blue or red.

able in 30.4cm, 61cm, 91cm, 122cm, 152cm and 183cm (12", 24", 36", 48", 60" and 72") lengths.

Parts Source for A4 EI

The article titled, "Junkyard Payoff," in DIY 2002-#3 issue documented the restoration of an 8.2m (27') O'Day including the rebuild of an Atomic 4. This engine was modified with an electronic ignition with parts purchased from a NAPA store, which are also available from Sierra. Component parts are NAPA 1146A or Sierra 18-5297. If you are purchasing parts from an automotive supplier and you are installing them in spaces that require ignition-protected equipment (e.g., gasoline engine spaces), be positively sure that those parts are marked "Ignition Protected." Automotive and marine parts are not the same. "Ignition Protected" is a proven lifesaver in marine applications. Accept nothing less.

A No-Fog Burner

You published my inquiry in the "Talk Back Q&A" column in DIY 2002-#3 issue, titled "Binding Cranky Outboards." The problem was due to my winterizing procedures, which includes fogging the engine. Upon relaunch in the spring, I only ran the engine slowly for 10 to 15 minutes, then shut it down, and didn't run the engine for another three weeks. Even though the engine stopped smoking after the initial run, apparently not all the fogging solution burned off. An old timer told me I didn't bring the outboard up to operating temperature in that initial short run and the remaining fogging solution got "stiff." He advised me to put Marvel Mystery Oil in a spray bottle, shoot it in the cylinders and let it sit a while. Then, with plugs out, I cranked the engine. The engine struggled but broke free of whatever was binding it. I put the plugs in and it fired instantly. Lessons learned? After sitting all winter, run the engine hard, bringing it up to full temperature, burning off all the oils and fogging solution. An initial shot of Marvel Mystery Oil wouldn't hurt either.

Rick Paliuca, Westerly, Rhode Island

Steve Auger comments: Marvel Mystery Oil is a wonder product like Rislone used to try to bring old motors back to life. Not too many modern day techs put much faith in its rehabilitating qualities. In racing, it's used as the oil for checking combustion chamber volumes, as it will mix with most other lubes without causing any lubrication failures.

Currents

What Mast Cleaner?

In DIY 2002-#3 issue, a letter from a reader raves about the advice he received concerning mast maintenance and waxing at one of your MRT workshops. What product/technique did you recommend?
Tim Paul,

We recommended he clean his anodized mast with 3M Marine Aluminum Cleaner and Restorer. It's a soft paste, one-step wipe on, wipe off or buff. We used this product to clean a galvanized aluminum car-topper nearly seven years ago, and it still shines.

Bruce Keeper

No information was included on where to obtain the Bruce anchor chock mentioned in DIY 2002-#1 issue, page 4. This product would satisfy a customer's request.
Myrl Stone, Tidewater Marina, Maryland

The BA100 anchor chock is distributed in the U.S. by Imtra, New Bedford, Massachusetts (Tel: 508/995-7000, Email: currey@imtra.com).

Power, Sail or Both

In a recent survey posted on DIY ONLINE asking web readers what type of boat they own, 56.5% responded having a powerboat, 37.4% own a sailboat and 5.9% own both.

To cast your vote in our next poll, log onto DIY ONLINE at www.diy-boat.com. Results are posted in DIY ONLINE and in the next DIY print issue.

WANTED

DIY reader Ian Phillips needs to moor his tender to a jetty and use it anytime of the day regardless of tide conditions. He once saw what was described an endless rope mooring using a mushroom anchor that was placed a distance from the jetty and when the tender was required the boat was just drawn in and when finished pulled out by the same rope attached to the jetty. This setup didn't include pulleys with a continuous line. If you know how to rig this mooring, contact Ian at ianphill@singnet.com.sg.

If you have plans on building a fiberglass or wood sea hood, Dudley Hattaway would like to hear from your. Email him at sqsailors@aol.com.

Dave Grassley recently purchased a 1984 5.6m (18.5') SeaRay Seville as a restoration project and wants to obtain an original sales brochure that may indicate color schemes, engine options, etc. He's also is need of a replacement dash, either a reproduction or an original one rescued from a boat that may be headed for the grave. If you can help, email Dave at dave@grassley.com.

What's @ diy-boat.com

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Masthead

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Talk Back Q&A

HELP LINE 1-888-658-2628

When to Use Gasket Sealer

Q: I dismantled my outboard and blew out the salt encrusted cooling passages with compressed air. I'm ready to reassemble the engine block but do not know if I should apply gasket maker/sealant as well as the gasket.

Ken Anderson, Ft. Myers, Florida

A: On 1990 models and newer engines, cylinder head gaskets are installed on a clean, dry surface and without a sealer unless the manual indicates so. To ensure a good seal on older engines, also apply Quicksilver Perfect Seal on water jacket and powerhead base gaskets. Don't use RTV silicone on gaskets unless the service manual indicates RTV (it makes the gasket squeeze out when torqueing).

— Steve Auger

Ignition Protected Circuits

Q: An upgrade to my DC system includes adding a Blue Sea 8080 parallel battery switch to replace a four-way switch. The online manual (www.bluesea.com) for this battery switch cautions that the house 100-amp breaker is not "ignition protected" and should not be installed in a battery box. The current switch is mounted on the external wall of the settee housing the battery box. Batteries are maintenance free, though cutouts in access panels provide air passage between the switch and the batteries. What is the risk of installing the 8080? I doubt the current four-way switch is ignition protected either.

Chip Lohman, "Whispering Swan," Quantico, Virginia

A: According to Scott Renne, president of Blue Sea Systems, it's best to err on the side of extreme caution when recommending not installing C-Series magnetic circuit breakers, such as the one in the 8080 Parallel Panel, in battery compartments. The American Boat and Yacht Council Standards prohibit non-ignition-protected circuit breakers in gasoline and propane compartments. Blue Sea Systems also includes battery compartments, especially those with traditional flooded lead-acid batteries, into this prohibition as an added precaution because many battery compartments are poorly vented and accumulate concentrations of hydrogen gas. While not abandoning the firm's conservative position on battery compartments, Scott has less concern about non-ignition protected circuit breakers in a well-ventilated compartment that contained maintenance-free batteries. *— Jan Mundy*

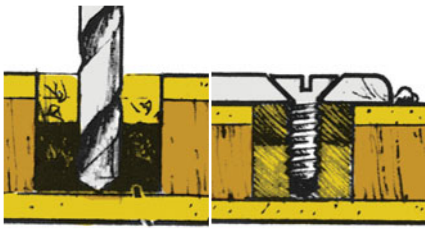
Epoxy Bonded Hardware

Q: I would like to mount brackets for an aluminum boarding ladder to my boat. Thru-deck bolts would be the best way to secure the brackets, but I have to use screws instead because of the location. I plan to use 7.6cm (3") stainless-steel screws, anchored as solidly as possible. What bonding material should I use in the screw holes that adds durability and strength?

Andy Leimanis, "Oh Donna," Vancouver, British Columbia

A: The best method to attach fasteners where there is no back access and you cannot thru-bolt with a backing plate is to use the hardware bonding method. Bonding fasteners with epoxy resin (e.g. Epiglass, West System) increases the load transfer area to provide the needed holding power. Bonding techniques vary for cored and non-cored decks and for aluminum and stainless hardware. The following instructions are outlined in more detail in the booklet "Fiberglass Boat Repair & Maintenance" (catalog number 002-550), published and sold by Gougeon Brothers (Tel: 517/684-7286). Considering the point loading on a boarding ladder, you must prepare the hull and hardware exactly as outlined to ensure a good bond and prevent damage to the deck. To do this, mask the working area, then solvent wipe. Masking prevents contaminating the work area with wax residue, etc. Drill an oversize hole, twice the diameter of the fastener and to a depth of its length. To increase the holding power, fill the hole one-third full with epoxy thickened with colloidal silica. Let cure. Place the mounting brackets in position and outline the perimeter and fastener holes with a pencil. Drill pilot holes in the cured epoxy for the screws. Tape plastic around the work area to protect from spills. Using 80-grit paper, sand the area within the pencil line. Also sand the contact surface of the mounting brackets to expose fresh metal. Mask the finish surfaces of the brackets for protection from epoxy spills. Solvent wipe all mating surfaces. Mix up a small batch of unthickened epoxy and wet-out the matting surface of the deck, inside the drilled deck holes and screw threads. Wet out the mounting surface of the brackets, then aggressively sand with 80-grit paper. This exposes fresh metal in epoxy, thus eliminating air and the possibility of oxidation. West System also recommends etching the aluminum prior to wetting out (purchase the 860 Aluminum Etch Kit). Thicken epoxy resin with colloidal silica to a peanut-butter consistency. Apply liberally to the deck mounting surface. Fill the fastener holes and, using a toothpick or small stick, stir to remove any air

Talk Back Q&A

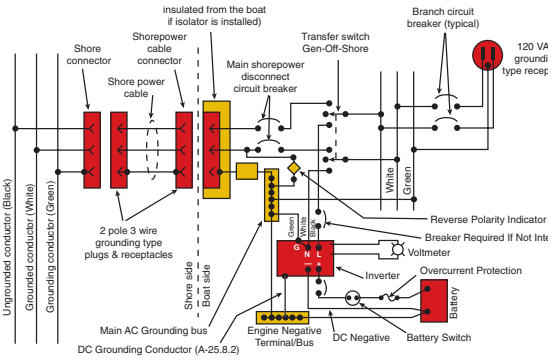

GOUGEON BROTHERS

bubbles. Liberally coat the screw threads with thickened epoxy. Place the brackets in position and tighten the fasteners just until epoxy begins to squeeze out the joint. Clean up any epoxy residue. Remove the masking tape. Allow the epoxy to fully cure at least 24 hours before attaching the ladder, and wait three days to a week before applying a load.
— Jan Mundy

Inverter Wiring

Q: I have a 1,000-watt inverter that I plan to install on my boat. I would like to incorporate the 110-volt AC output into the boat's existing shorepower outlets; however, I believe that there can be serious problems if both the inverter and shorepower were inadvertently connected simultaneously. Is it feasible to connect into the existing outlets using an isolation switch or a relay, or should I install extra 110-volt outlets that are powered only from the inverter? Do I need a fuse between the battery and the inverter on the 12-volt side? There is nothing shown on the installation wiring diagram, and I believe that there may be internal fuse protection. Inverter instructions say to install in a well-ventilated area. I was planning to install it in the engine compartment. Any problems with overheating or high ambient temperature?
Gary Way, "Cardinal, " Point Roberts, Washington

A: DIY contacted Jack Csenge, president of Jack Rabbit Marine (Tel: 203/9618133, Web: www.jackrabbitmarine.com), for his expert opinion. "The inverter must be connected to the ship's AC main through a free-standing AC selector switch. Output from the inverter connects to one leg of this switch. The shorepower cord connects to the other leg of the switch and output of the switch connects to the AC main breaker. The AC selector switch locks out shorepower if "inverter" is selected and locks out the inverter if "shore" is selected. This makes it impossible to accidentally connect two AC sources to the same electrical panel and allows inverter power to feed the existing AC circuits in the boat. An on/off switch in the DC positive connection of the inverter is a good idea. ABYC also requires a fuse in the DC inverter positive wire located near the battery. This fuse should be 200 amps for a 1,000-watt inverter. Inverters heat up when they are working hard and need ventilation for cooling. Most have fans inside. We have located inverters in a roomy engine compartment without experiencing problems. Just don't put it above the exhaust manifold. It's best to locate the inverter near the battery bank to keep the DC wires as short as possible."



ABYC A-25 POWER INVERTERS STANDARD

Schematic of inverter with external AC transfer switch.

Sourcing Oily Slick on Water

Q: My boat has twin 454

Mercruisers. The starboard engine exhaust leaves a light gas or oil sheen in the water. What's causing this?
John L. Formica, Kent Island, Maryland

A: Check the fluid levels on a regular basis to determine if it's a lubricant that is getting into the water. Start by ensuring that all lubricants are at the full mark on the dipstick. Run the engine under normal operating conditions for 5 to 10 hours, then check levels for any changes. If any lubricant level increases, then something is getting in, either fuel or water. If a level drops then it may be the cooler. If there are no level changes, the slick could be unburned fuel caused by a bad carburetor, fuel pump or weak spark. Don't forget to check trim tabs and other accessories that use lubricants.
— Steve Auger

Too Short Pick-up Tube

Q: During a pump out, only about one-third of the holding tank's contents is extracted then the pump stops. The tank likely only contains liquids. I'm the second owner and honestly don't know if the tank has ever been emptied since I've owned it. I'm not sure how a holding tank is manufactured so it's difficult to analyze the problem.
—Jay Haire, "Skol," San Francisco, California

A: Check the top of your holding tank. If the pumpout hose goes into the top of the tank it must have a draw-tube or pick up connected to the hose that extends to near the tank bottom. This allows the entire contents to be pumped out. As soon as this pick-up tube sucks air, the pumpout stops. Most likely your tank has a cracked or broken pick-up tube. As soon as the crack or break is exposed the pump sucks air. Check it out. This is a common problem.
— Nick Bailey

Pipe Plumbing Preferred

Q: I'm installing a holding tank in my Grampian 26 with discharge diverted directly overboard or to the tank then to overboard or pumpout. The expensive sanitation hose won't bend in tight spaces, which suggests that I use a couple of 90° elbows. Will these elbows be a problem? I can't

find 45° connections, which would work better.
Cameron Carey, "Caper," Boston, Massachusetts

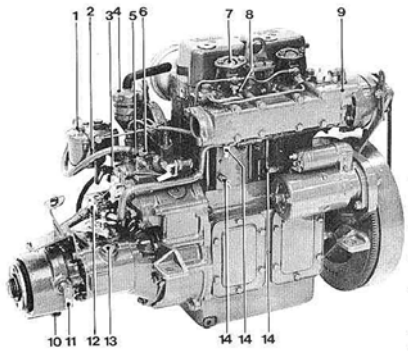
A: As this is a new install and not a retrofit, both Raritan and Sealand, manufacturers of MSDs, recommend using Schedule 40 pipe with the necessary elbows, rather than hose. Even the very best sanitation hose can cause odors to permeate, unlike pipe that is impermeable. Elbows can trap waste and cause odors, but in many installations there are no other options. Many of the better-constructed new boats use pipe for sanitation plumbing.
— Jan Mundy

Starting a Volvo MD 11-C

Q: I recently bought a sailboat with a Volvo MD11-C engine. When starting the engine, you pull a switch on the console. This switch connects to a lever at the engine, which pushes down on a button on the engine. Pulling the switch has no affect when starting the engine or on engine speed when cranking. The engine is a little hard to start when cold but fine thereafter. What is this switch and what may be wrong with it?
Richard Foy, "Conbrio," Moose Jaw, Saskatchewan

A: The MD 11C is equipped with a compression release for each cylinder located on each valve cover. They are the levers with the round knobs. The linkage you describe sounds like the cold start button located on the injection pump. This button helps cold starting only slightly by advancing and enriching the diesel injection. To start easily, the engine needs good compression, adequate cranking speed and proper injection of the diesel fuel. A problem of low compression often arises when an engine has endured long periods of dormancy and the piston rings have not had the opportunity to wear and thus maintain a good seal with the cylinder liner as it changes shape over time. In some cases, just running the engine at full load for several hours may reseat the rings. Otherwise, the engine may need to be rebuilt. The problem of poor injection is often the result of soot buildup in the combustion chamber during warm-up and low load operation. Again, running the engine at full load for several hours may clear out this soot. Fuel additives may also prove helpful. Otherwise, the injectors may have to be removed and cleaned. Avoid using starting fluid as it may damage the engine internally. If the engine is operated in cold climates, a block heater may be advised.
— Larry Blais

MD11C, Reverse gear MSB



1. Venting screw, fine filter
2. Fine filter
3. Fuel pump
4. Oil filler, engine
5. Cold start button (MD11C)
6. Venting screw, injection pump
7. Injector
8. Injector pipe nut
9. Thermostat housing
10. Cooling water drain plug, reverse gear
11. Cooling water inlet
12. Cooling water pump cover
13. Oil dipstick and oil filler reverse gear
14. Cooling water drain cocks for engine (3 on MD11C, 4 on MD17C)
15. Fuse box
16. Decompression lever

Beware Unsafe Engine Mods

My 1987 Renken 2354 has a 305 Mercruiser with some modifications by its previous owner, including installing an automotive intake manifold and four-barrel carburetor. This setup works quite well, except that there isn't a choke making cold starts a bit of a nuisance. My local repair shop says that it cannot hook up a choke with this setup and instead, suggested installing a carburetor with an electric choke and maybe even a new manifold. Any suggestions? *Ron Jordan, "Stress Leave," Sydney, Nova Scotia*

A: Most modern four-barrel carbs used on marine engines are Weber AFB, a square bore carb (all four barrels are the same size) that uses battery voltage to control the choke unloading process for cold starts. The 4.3lx uses a 3310-807826A1 ($1,048) Weber that should work well. If the intake is a spread bore style (secondary barrels are bigger than the primary barrels) use an 806758A1 adapter plate ($104.55). Caution: It's a major fire and explosion hazard to use automotive carburetors without flame arrestors on inboard marine engines.
— Steve Auger

Resealing Gasketed Hardware

Q: Because water was leaking at several thru-bolt locations on deck, we removed the stanchions on our O'Day 272. Rubber-like gaskets attach to the base plates and the exposed edges of the gaskets have cracked. Where do I obtain gasket material or should I just remove and reinstall with a sealant?
Ken Roddenberry, "Papillon II," Pennington Gap, Virginia

A: Rubber gaskets are commonly supplied with various hardware in lieu of using sealant. It makes for a quick and clean installation for builders but is not always watertight, especially once the gasket deteriorates. You'll get a better seal without the gasket using a polyurethane or polysulfide sealant. My favorite is 3M 4200 Fast Cure as it dries in less than 10 minutes. It has the same adhesive bonding properties as 3M 5200 but it allows removal if needed, unlike the 5200.
— Jan Mundy

TECH TIPS

STAIR TREAD ADD-ONS: Many newer sailboats have beautifully varnished companionway steps that are slippery when dry and deadly slick when wet. For a better grip, install a strip of self-adhesive, skid-resistant material.

A REAL DOODLE: A Doodlebug is a heavy-duty plastic holder for 3M ScotchBrite pads with a swivel head that fits a standard threaded broom handle. Most marine retailers sell the pads but not the holder, selling cheaper knockoffs in lieu. The real thing is available from industrial cleaning suppliers and worth the price. *Susan Canfield, "Aeolus," Annapolis, Maryland*

HANDY HAIR LIFTER: Next time you want to remove pet hair from clothing or upholstery, don a rubber glove and lightly rub the surface.

SCREEN SAVER: If you like to operate a laptop in the cockpit but glare from the sun makes viewing impossible and purchasing a sunlight viewable one isn't in the budget, make a mini bimini or have a canvas maker fabricate one.

SUPER STAIN REMOVAL: To remove heavy-duty stains, add Super Iron Out, a household cleaner, to a 3.75L (1 gal) garden sprayer, mix with water according to the directions for fiberglass tubs, spray on and rinse well. Do not allow solution to dry on the gelcoat. *Gary Akin, "Tara," Florence, Alabama*

PLASTIC PROTECTORS: To protect deck areas that receive a lot of wear, such as the bow platform, mount some clear Plexiglas or acrylic, about 6mm (1/4") thick, shaped to fit the area.

WIPERS IN A BOTTLE: A frequent coating of RainX applied to your boat's windshield does as good a job of shedding water as wipers and with an unobstructed view.
Dan McDougal, "Dry Dock," Joppatowne, Maryland

BETTER-THAN-TEAK REPLACEMENT: When you tire of refinishing teak steps on boarding ladders, consider purchasing replacement steps made of recycled plastic lumber from Tops In Quality (Tel: 810/364-7150, Web: topsinquality.com). Available in lengths 20cm to 35.5cm (8" to 14"), they cost US$15 or less. And these near-teak steps will fool even the most astute perfectionist. Bet you can't pick which is the teak step in the photo below?

SINK ORGANIZERS: To stow soap bottles, scrubbers, etc, in the galley or head, purchase a couple lightweight plastic containers that mount to sinks with oversize suction cups.

TERMINAL CLEANER: If you need to remove oxidation from wiring connectors or protect them from corrosion, try Fluid Film, an automotive product.

120 DAYS AND COUNTING: When you're doing a job outdoors that requires masking, such as painting or repairing fiberglass, and the job spans a couple of weekends, be sure to use 3M Marine Safe-Release Painters' Masking Tape (#2080). It can withstand the elements up to 90 days after application. DIY's test samples applied more than four months ago are still holding strong and remove easily without any adhesive transfer but some tape tearing.

DIESEL

A-Z of PLUMBING FUEL SYSTEMS

A properly designed fuel system and a few simple precautions go a long way in preventing engine failure and major problems.

[BY LARRY BLAIS]

Diesel engines require an uninterrupted supply of clean fuel. Without it, they will not run well, or for very long.

For starters, the fuel that you pump into your tank should be as fresh and pure as possible. Always buy fuel from a source that sells a lot of it. If the fuel is not used right away, add a fuel stabilizer to unused fuel that will stored in your tank for a long time. When taking on fuel from a questionable source, use a multi-stage filter funnel to help detect contamination. Stop filling and go to another supplier if you suspect poor quality fuel.

Contaminated diesel fuel can quickly clog fuel filters and damage expensive engine injection system components. Dirt, corrosion by-products and other debris can come from the air or from the fuel dealer's piping and storage tanks. Your own boat's tank may be corroding internally, adding to the mix. Water in fuel usually comes from condensation but a leaky fuel tank deck fill cap or a poorly positioned tank vent (especially in sailboats) can also be the source. Microorganisms like bacteria and fungus are often airborne and, once they get into the tank, they thrive at the boundary between the fuel and any water in the tank, creating a slimy sludge. Add biocides to kill these organisms. If you want to avoid using these toxic chemicals, magnetic flux technology, such as Algae X, may be the answer but fuel must be flowing through these units to be effective. When sludge has built up in the tank, fuel polishing by a professional with special filtration equipment may be required to remove it and return the diesel to a usable condition.

System Maintenance

Low sulfur diesel fuels and some winter blends may lack the lubricity needed to keep internal injection parts properly lubricated. Check with your engine's manufacturer to see if a lubricant additive should be used. Never use anything containing alcohol (e.g. methanol), as it damages fuel system components. Gasoline in a diesel fuel system can be disastrous on many levels, including the high risk of explosion in a non-ignition protected engine space. The fuel fill should be clearly labeled "Diesel," not just "Fuel" and certainly not

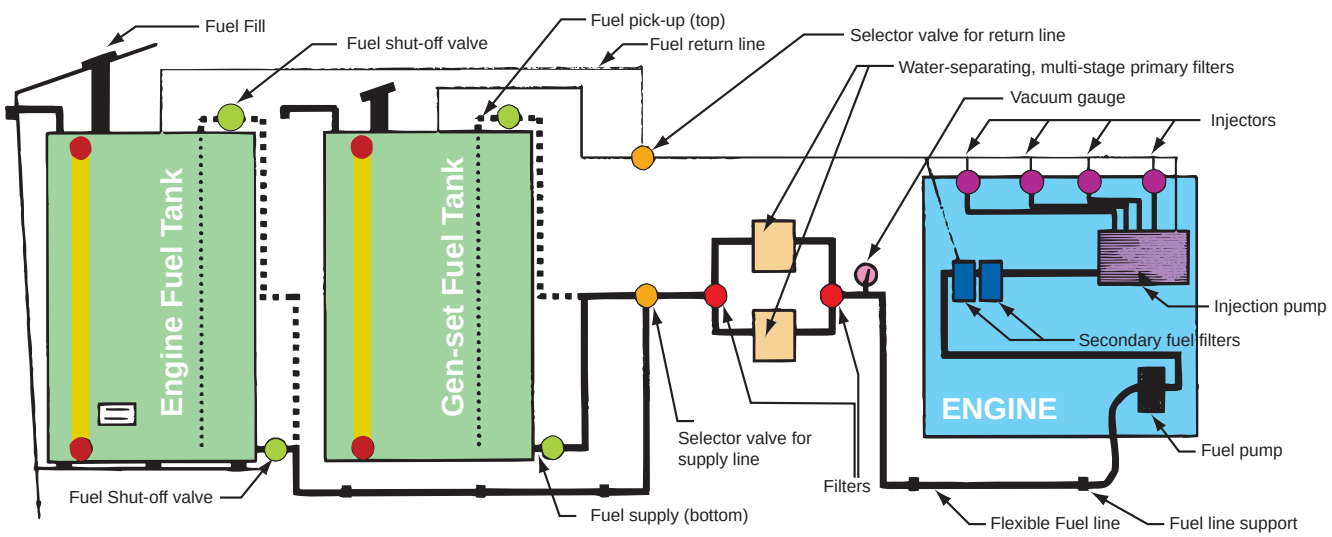
TIP Calculating Fuel Flow

The general rule of thumb for a 4-cycle diesel engine is:

*Horsepower x 0.18 = Gallons per hour fuel flow

*This could be much more, depending on the engine. Check your service manual for specifications. — *LB*

Dual head (duplex) filter arrays allow one filter to be serviced while continuing to operate through the other. Note the sender/switch teed into the vacuum gauge. It's wired to an indicator on the bridge.



"Gas," sometimes a leftover after repowering from gas to diesel.

Every fuel system component from the fuel filler and tank, through the valves, lines, filters, pumps and injectors, to the fuel return should be accessible for maintenance and troubleshooting.

Tanks, Fuel Lines

Mount metallic tanks so moisture cannot get trapped against the tank's exterior and promote deterioration. Restrain the tank so it can't move around. Restraining straps should have anti-chafe material between the strap and the tank. Tanks equipped with a sight gauge should have shut-off valves at the top and bottom of the gauge and a warning label to keep the valves closed, except when checking fuel level. Be sure the tank is equipped with a fuel shut-off valve in case a leak develops somewhere downstream in the system.

Properly fit and secure metallic fuel lines to reduce vibration, metal

Separate fuel outlets and valves for the gen-set and the main engine. Note the shutoff valve at the bottom of the sight gauge.

Separate fuel pickups for each of the two main engines, gen-set and cabin heater. Bushings made of 500 series stainless steel provide a galvanic barrier between the copper-based alloy fittings and the aluminum tank.

fatigue and prevent leaks. Route lines well above any bilge water where they can be subjected to corrosion. Connect rigid lines to the engine by a flexible hose and support these within 10cm (4") of this connection. Where flexible hose is used, it should be of the appropriate type. The ABYC standard for diesel fuel systems (ABYC H-33) requirement in H-33.6, Flexible Fuel Hose, section H-33.6.1, states that: "Flexible hose shall comply with the requirements of UL (Underwriters Laboratories) 1114, Marine (USCG Type A) Flexible Fuel-Line Hose, or SAE (Society Of Automotive Engineering) J1527, Marine Fuel Hoses.") Hose ends should be fitted with permanently installed end fittings or secured with corrosion-resistant hose clamps. Properly protect and secure all lines to prevent chafing and other physical damage. Use clips and straps made of corrosion-resistant materials to secure all lines. The ABYC standard should be consulted whenever you are working with any marine fuel system.

When more than one tank supplies fuel, provide selector valves for each supply line and also for each fuel return line. Be sure these valves are easily accessed and clearly labeled to indicate which tank is feeding which fuel device. Be careful not to set the return line valves to return fuel to a full tank. Return fuel to the tank from which it is being drawn.

Proper Filter Installation

Locate primary filters with ample clearance to change elements without making a mess. Arrows, usually cast into the filter housing, indicate the direction that fuel flows through the filter. Some primary filters are fitted with two-micron elements; however, a larger pore size may be more appropriate for your situation. When selecting a filter, remember that diesel engines typically return two to six times as much fuel as they consume. The fuel flow capacity of a fuel filter is usually measured in gallons per hour. All filters and fuel lines must be sized large enough to allow adequate flow.

Primary filters of the turbine-type, water-separating, multi-stage configuration are very effective. A water

Plumbing Multiple Consumers

"Our floodlights pierced the stormy darkness. There were whitecaps everywhere. The wind had come up quickly, but we weren't concerned. We'd been through worse. Then the generator quit and with it went the floodlights. While we struggled to find the problem, the port engine quit, then the starboard. We were dead in the water."

This unfortunate incident occurred when a leak in the gen-set fuel line allowed air to enter the generator's fuel system, starving it of fuel. As the air was drawn to the main fuel manifold, it was sucked into both propulsion engines, disabling them.

To prevent this from happening to you, plumb each "consumer" with it's own fuel source from each tank. —LB

sensor in the filter bowl can be wired to a light at the helm to indicate when water needs to be drained from the filter. A vacuum gauge in the line to the engine indicates the vacuum required for the engine fuel pump to pull fuel through the filter element. Most engines can tolerate 12.7cm (5") of vacuum (Hg) without starving for fuel. Refer to your service manual to determine the reading that indicates it's time to replace your filter element. To monitor this gauge while underway, plumb it to the bridge or wire an electric sending unit to a gauge, light or alarm on the bridge.

Plumbing multiple filters in parallel with selector valves makes it possible to service clogged filter elements while underway without shutting down the engine. If the filter is mounted above the fuel level in the tank, some type of pump is needed to purge the air out of the serviced filter. Plumb the pump with valves to isolate it from the rest of the system when not in use.

The engine fuel lift pump may have a built-in debris filter that should be checked whenever the engine's secondary fuel filters are serviced. Excess fuel from the engine's injection pump and injectors join together to return to the fuel tank. If this line also joins to a return line from the top of the engine's secondary filter, you may have an air-purging orifice in the filter and may return significantly more fuel. Whatever the case, never connect the fuel return line to the supply side of the fuel system as it's hot and may contain air or debris. Instead, it should go unimpeded all the way to the top of the source fuel tank, unless it's being used to transfer fuel to another tank, which should only be done under close supervision so as not to overfill that tank.

Separate Fuel Supply

How should the fuel system be plumbed when there is more than one diesel fuel "consumer" aboard, such as a propulsion engine and a generator, cabin heater, water heater, galley stove or other diesel-fueled device? Should the supply lines branch off downstream of the primary filter? How about just downstream of the selector valves or just ahead of the selector valves in a nice shiny manifold?

Unfortunately, many boats are plumbed this way. Boatbuilders and installers now realize the grave potential for disaster that exists with such schemes and have started plumbing each diesel fuel consumer with its own dedicated fuel supply. If the fuel supply is plumbed from the bottom of the tanks or through the top with fuel pickups, each consumer has its own exclusive source from each tank. This prevents a failure in one fuel system from affecting any other fuel consumer.

About the author: Larry Blais joins the DIY team of marine professionals as writer of our new "Diesel Talk" column. A master mechanic, master shipwright and marine surveyor, Larry has operated boatyards for more than 30 years. He teaches classes for the United States Coast Guard, Havorn Marine Survey and Shipwrights's School, University of Washington's Sea Grant program, and hosts workshops in diesel care for the Northwest School of Wooden Boatbuilding.

ELECTRICAL

WIRING BASICS

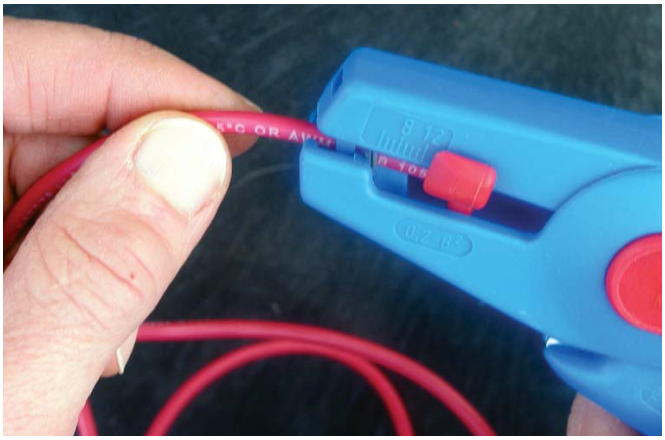
There comes a time during your tenure as a boat owner when you will have to install or reinstall electronic or electrical equipment. With the proper tools and instructions, wiring can be an easy job for the do-it-yourselfer.

[BY JAN MUNDY]

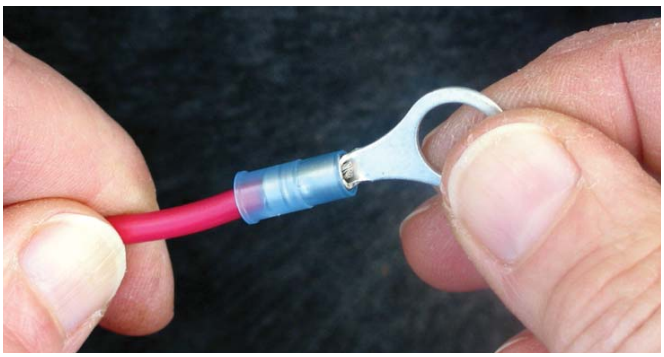
Electrical wiring in boats has advanced from the sole realm of professionals to mainstream practice. Nowadays, you can purchase all the required tools and ABYC recommended wire, connections and other components from any well-stocked marine retailer. An investment of less than US$100 can buy you the basic tools you need to get started, including a quality wire stripper, crimper and butane torch. You'll need various sizes of wire, different styles and sizes of terminals both standard and heat-shrink type, several diameters of heat-shrink tubing and a few adhesive-lined heat-shrink terminals for use on wires that pass through the bilge.

Wiring is easy when you follow the strip-crimp-shrink technique.

1. Set the indicator on the wire stripper to the size of the wire you are stripping. This tool automatically removes the correct amount of insulation from the wire. To ensure a positive connection, make certain all terminals and wire strands are free from corrosion.



2. Select a terminal that is correctly sized to the wire. Make sure the wire range of the terminal is compatible with the actual wire size. Terminals come in three colors



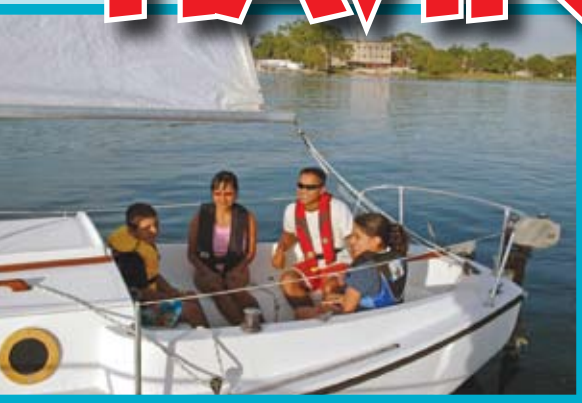
to match wire sizes: red for 22 to 18 gauge; blue for 16 to 14 gauge; and yellow for 12 to 10 gauge.

3. Place the terminal in the proper color-coded jaw of the crimp tool. Slide a length of heat-shrink tubing over the wire end and insert it into the terminal. The wire insulation should be flush against the barrel of the connector. Make sure the strands do not extend into the contact area.

4. Center the crimp in the jaw and squeeze the handles with enough pressure to make the crimp. An adequate amount of pressure is required. Two crimps are required. If using a ratchet-style double crimper, firmly squeeze the handles until the jaws release — a single squeeze is all that's needed to make both crimps. Lightly pull the finished crimp to see that the wire is held firmly in place.

5. Waterproof the connection with heat-shrink tubing. To do this, slide the tubing over the end so it butts against the terminal base. Use a butane mini-torch to heat the tubing until the insulation shrinks and seals the wire. Identify each wire with stick-on labels when installing.

HAVING A BLAST



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PRO SERIES

GETTING A GOOD GRIP

A boat deck can be a safety hazard without a good slip-resistant finish. You can restore some deck non-skids with a near factory finish. Here's how.

[BY NICK BAILEY]

Production fiberglass boats have a variety of slip-resistant patterns molded directly into the deck gelcoat. Despite the apparent variety, there are only two general types: printed, repeating patterns or random, non-repeating patterns.

The most popular printed patterns are variations on a raised diamond or box shape (FIGURE 1), but fabric style weave patterns are also common. Random style non-skid either resembles stucco (FIGURE 2) or a stipple similar in appearance to a painted non-skid additive or aggregate. (FIGURE 3). Different non-skid styles present the repairer with different matching problems. The difficulty level of seamlessly recreating a repeating pattern ranges from difficult to completely impractical whereas a random pattern is merely tricky to duplicate.

Repeating the Hard Way

A repeating pattern non-skid can only be recreated in a mold. So if you need to duplicate a large area, you must come up with an identical surface to use as a mold. This style of deck has the "non-skid" arranged in discrete panels with smooth strips or "spillways" (FIGURE 4) in between so the objective is to mold a complete individual panel. If you're lucky, a sistership is available and, with the owner's permission, a "splash" can be taken from it to lay up a replacement panel. Although it may only consist of gelcoat with a couple layers of glass backing, the panel must have enough strength to be pulled from the mold and handled without cracking. Meanwhile, the surface of the repair must be precisely finished and recessed lower than the surrounding deck to accommodate the thickness of the new non-skid panel without creating a hump. The panel is bonded in place with epoxy or a layer of glass mat wetted with polyester resin and clamped with weights or a vacuum bag. This procedure can be likened to adding a veneer or inlay to a wood tabletop. In order to prevent cracking in the spillway around the repair perimeter, the surface of the new panel and adjacent deck is usu-

FIGURE 1
Close up of diamond repeating pattern non-skid.

FIGURE 2
Stucco-style random non-skid on coaming.

FIGURE 3
Example of stipple-style random non-skid on cabin top.

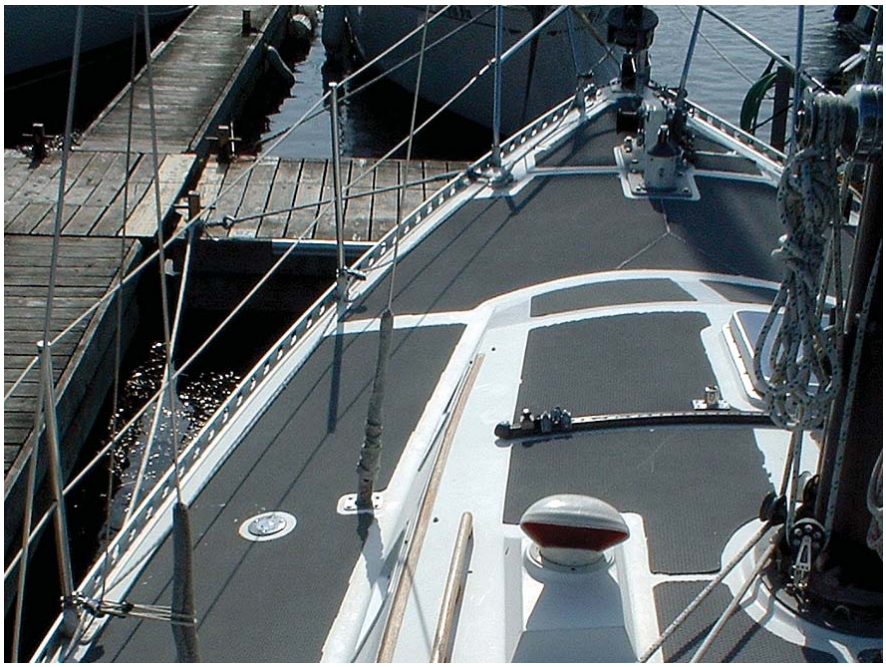


FIGURE 4
Non-skid panels in contrasting color.

ally beveled with a grinder so that a glass tape joint can be applied, like drywall, to join the new and old deck surface. The tape joint is filled and faired, then finished in smooth gelcoat.

This procedure is difficult, time consuming and expensive, and assumes you can find something to use as a mold. It's also risky as there are lots of things that can go wrong during the molding and bonding processes. [Ed: Detailed instructions for replacing small patches of this non-skid style appears in DIY 1998-# issue or the MRT CD "Fiberglass Cosmetic Repairs."]

There are alternative repair strategies available that may provide some short cuts. Repairers often literally bend over backwards to preserve the existing non-skid by doing core repairs from the underside of the deck if it's accessible. Small repairs, such as stress cracks or local core replacement around a fitting, lend themselves to neatly deleting the non-skid in the repair area and doing a symmetrical deletion on the other side of the deck. This changes the original pattern in a subtle way and the boat remains looking close to factory original **(FIGURE 5)**.

To do this, the damaged non-skid is carefully masked off in a pattern using straight lines or corners and curves of consistent radius. Then the non-skid texture is removed by sanding, starting with 80 grit and finishing with 220 grit or higher. If the underlying laminate is exposed, it's necessary to spray color-matched gelcoat. Once cured, wet sand using 600 then 800 grit, then buff with a medium grit rubbing compound to create a polished finish. In many cases, the original gelcoat is thick enough to allow removal of the non-skid pattern without exposing the underlying laminate and it's brought up to a polished look without applying new gelcoat.

For large repairs, it's often not practical to simply "lose" the existing non-skid. Something is needed to replace it. The simplest non-skid replacement involves sanding off the existing pattern and applying a random pattern on one or two panels, or if consistent cosmetics are the priority, the whole deck. (See "Application" below).

FIGURE 5
Pattern changes are easy to make to this factory original non-skid pattern.

Stucco Style Repairs

The most common style of random pattern non-skid resembles stucco and is applied in much the same way, using a paint roller loaded with gelcoat thickened with colloidal silica. This style of non-skid also provides an excellent surface underfoot and is by far the easiest to apply.

Roll-on slip-resistant coatings, however, are still subject to matching problems. It's relatively easy to produce a reasonable match to the original deck texture but an exact match is much more difficult and not guaranteed by most repairers.

Pro Series

Minor differences in gelcoat viscosity and rolling technique cause large differences in the non-skid texture. With practice it should be possible to get close to the original texture but for the repair to be considered acceptable by the customer, close may not be good enough. Once again, to minimize side-by-side comparisons of texture (and color) it makes sense to isolate the new non-skid from the original surface by creating a distinct boundary or cut-off for the repair area. If the original non-skid is arranged in panels, then refinish the whole panel. If the non-skid is continuous from stem to stern it makes sense to create a smooth border or spillway, as outlined above to separate the new area from the old. Again, a matching break on the other side of the deck is considered mandatory to preserve symmetry.

Application

STEP 1 PREP

Presuming the repaired surface has been filled and faired with gelcoat and sanded smooth with 80- to 150-grit paper, remove all dust with compressed air and wipe it with a lint-free rag damped with acetone (or lacquer thinner). To simplify masking, complete adjoining repairs to smooth gelcoat. Carefully delineate the non-skid area with 3M Fine Line, Long Mask or 233+ masking tape and seal the inside edge of the tape by rubbing it with a plastic spatula or the back of a fingernail.

STEP 2 MIXING

Pour some of the color-matched polyester gelcoat pre-mixed with air-dry wax into a litre (quart) size paper bucket or smaller. Add clean colloidal silica (strained through a sieve if in doubt), a bit at a time to the gelcoat, and mix vigorously by hand with a paint stir stick. The mixing proceeds until the silica is absorbed and the gelcoat achieves the approximate consistency of mayonnaise.

STEP 3 TESTING

At this stage, before adding catalyst to the gelcoat, it's time to test the mix for its appearance as non-skid. Scoop out a sample blob onto a scrap sheet of plywood and roll out using an 18cm (7") short nap paint roller. The thicker the gelcoat the taller the "peaks" left by the roller and the more aggressive the non-skid will be. (Aggressive non-skid is good for footing but can tear a lot of skin in the event of a fall.) Compare the sample roll to the original gelcoat and adjust the mix accordingly. Add silica if too flat; if too aggressive, add gelcoat. Keep track of the mix ratios so the same gelcoat consistency can be achieved batch to batch.

Completed painted deck shows smooth spillway breaking up the non-skid surface.

STEP 4 CATALYZING

Here is where a pro's experience shows. Unlike epoxies, which have a fixed mixing ratio, polyesters are flexible and the catalyst ratio can be tailored to give more or less pot life and to compensate for ambient temperature. Mix ratio can vary from 2% to 5% catalyst depending on temperature, the type of catalyst used, and the working time needed. Regardless, working times are seldom more than half an hour. Once the catalyst is added and mixed, it's time to hustle.

STEP 5 APPLYING

Give the work area a final quick acetone wipe before the "hot" mix is thinly applied by trowel to the repair surface. Work the mix with a roller to finish spreading it evenly over the surface. Initially, roller strokes are

Skid-Free Terms

Textured deck finishes that are designed to help prevent slipping or sliding are commonly referred to as anti-skid or non-skid. To determine which is the more accurate description, I consulted Webster's.

"Anti" is defined as "that which counteracts, operates against, prevents, cures or neutralizes." The defination of non-skid is "having a surface so constructed as to reduce slipping or skidding." Though there are deck surfaces that counteract slipping, there are none that we're aware of that truly prevent or cure a slide. As most deck finishes are designed to "reduce" slipping, the best word for the product is non-skid.

— Jan Mundy

TIP Ready-to-Use Deck Paint

No more mixing additives with a coating to create a non-skid deck paint when you purchase Interlux InterDeck. This ultra-durablepolyurethane paint is pre-mixed with non-skid compounds. Available colors are white, cream, gray and squall blue. —*JM*

applied in a unidirectional pattern using firm pressure to distribute the gelcoat. Once the gelcoat is evenly spread, ease pressure on the roller to avoid causing streaks. In small areas, a random back-forth–sideways action with the roller tends to give the most consistent results (**FIGURE 6**). On large open areas, like a foredeck, rolling in one

FIGURE 6
Stucco-style non-skid applied with paint roller.

direction with overlapping strokes is best. If, however directional streaks appear, correct these by rolling across them at right angles. Stop rolling the minute the gelcoat looks consistent, as it never pays to overwork the surface. Thickened gelcoat non-skid is usually applied with one heavy coat. It's important to avoid leaving overly thick areas, especially overlapping onto the masking tape. As soon as rolling is completed and while the gelcoat is still wet, carefully peel off the masking tape, pulling at a 45° angle away from the wet surface. If the tape is left until the gel has cured, it will be difficult to remove and leaves behind a ragged edge. Clean up with acetone.

STEP 6 DETUNING

If the peaks are uncomfortably sharp after the new gelcoat has dried, lightly scuff it with 80-grit sandpaper. It should not scratch bare skin!

About the author: Nick Bailey has spent 25 years in the boat repair business and is service manager of Bristol Marine in Mississauga, Ontario.

UPGRADE

TEAK DECK CARE

A guide to maintaining, sanding, refastening and recaulking teak decking.

[STORY AND PHOTOS BY SUSAN CANFIELD]

If you're considering refastening and recaulking your boat's teak deck overlay, first assess the condition of the underlying fiberglass or composite deck molding. Percussion soundings and moisture meter readings taken by an experienced marine surveyor will help you decide how best to proceed. If there's evidence of extensive deck core delamination, it may be better to remove the teak overlay completely and recore the deck. The author used a moisture meter and marked the readings on strips of masking tape. Analysis of the readings and soundings indicated only localized water intrusion at deck fittings, with no significant delamination.

Teak decking provides exceptional traction and aesthetics, yet it's more expensive and requires more maintenance than any other slip-resistant material. Many boatbuilders still hand-lay teak decks, fitting, bedding and screwing planks down one at a time. While the craftmanship is to be admired, so is the sheer quantity of fasteners, most of which typically extend through the upper skin of the fiberglass deck laminate and into the core, as needed to attach the wood.

As I discovered, after a total deck refit, 1,300 screws secure the teak overlay on my 1982 Tayana 37 cutter. These are also 1,300 potential paths for water to leak into the boat's interior. In the process, the typical end grain balsa or plywood cored deck construction eventually rots and delaminates. I often find evidence of deck molding delamination in my surveys, and boats with teak overlays are the most common victims. Is it any wonder teak decked boats have earned the nickname "leaky teakies"?

Before you ask why any sane person would buy a teak decked boat, remember that teak, wet or dry, is truly a great slip-resistant material. Properly maintained, it looks terrific.

Teak Upkeep

There are three keys to successful teak maintenance: weekly washdowns, infrequent bleaching and occasional sanding to keep the surface flat and smooth so water rolls off. Routine washing goes a long way to keeping teak decks in optimum condition. Clean saltwater works best; it bleaches the teak and helps prevent mildew. If clean saltwater isn't available, freshwater will do, but mix some TSP (tri-sodium phosphate) with your chosen detergent. Wet the decks down, and then allow the detergent solution to soak into the wood for several minutes before scrubbing lightly with a white (fine) 3M Scotch-Brite pad. (Tip: fit the pad on the end of a long-handled Doodlebug and you can stand while cleaning.) Scrub in a circular pattern or across the grain. Don't use a bristle brush and don't scrub with the grain as both tend to tear out the softer wood fibers, creating ridges and valleys that will trap dirt and mildew, making the wood more difficult to keep clean.

With weekly washdowns, a teak deck will gradually weather to an attractive silvery gray. Bleaching the wood restores its natural color, but it also erodes the wood more quickly, so do it infrequently. If you need to spot clean stains left by suntan lotion or food, make an oxalic acid paste and then neutralize with vinegar or Borax. For general cleaning, try a one-step cleaner first. I prefer Tip Top Teak Cleaner, a granular product that comes packaged in two sizes. If a one-step cleaner just doesn't cut it, use a two-part teak cleaner from StarBrite or Te-Ka. The acid in two-part cleaners will dull fiberglass and painted surfaces, and wreak havoc on anodized aluminum. So mask the hull sides beneath deck scuppers and drains, and any anodized aluminum that would otherwise be exposed to the cleaner. I keep a roll of 3M Marine's Ready-Mask, a pre-taped plastic film, onboard for the purpose. I prefer to dilute Te-Ka 1:1 with water and then apply it using two plastic spray bottles I've labeled A and B. Before applying part A,

TIP From Dust to Filler

If you remove the old caulking before you sand, be sure to save the sawdust. It makes an excellent thickener for use with epoxy resin when filling gaps or gouges in the teak trim.
—SC

One-Step Cleaning

Any time you apply a chemical to a porous surface and scrub, you're taking something away. The stronger the chemical, the more aggressive the cleaning power.

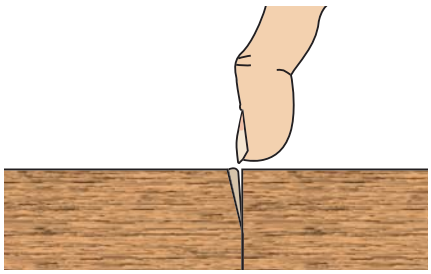
Cleaning teak is no exception. This wood is made up of hard (dense) and soft (less dense) wood. Two-part teak cleaners perform much like liquid "sandpaper," removing a portion of soft grain, exposing the wood underneath. Over time, frequent applications can damage the wood fibers and leave grooves in the wood, which then requires sanding.

Tests conducted by DIY's test team on teak cleaners and reported in DIY 1999-#2 issue, proved that one-part products clean weathered or blackened teak as well as two-part cleaners. And one-part cleaners, such as Amazon One-Step Teak Cleaner, BoatLife Teak Brite Teak Cleaner and Cape Ann One-Step Teak Cleaner & Brightener (my three favorites), clean without any harsh chemicals. With a neutral pH (7 to 8.5), they won't harm other surfaces and are safe to use on decks. The stronger two-part alkaline cleaners with a pH as high as 14 may soften caulking — I highly suggest doing a spot test first. These cleaners also damage gelcoat and painted surfaces. After using a two-part cleaner, rinse thoroughly, flushing the decks, scuppers, drains and lockers. Any residue will continue to "eat" the wood and surrounding surfaces. Personally, I don't recommend their use.

For complete test results, refer to DIY 1999-#2 issue. This article also contains information on teak finishes and offers solutions to cleaning and upkeep. — *Jan Mundy*

wet the teak deck thoroughly with water. Keep a hose with spray nozzle handy and don't let the surface of the wood dry until you're finished with both part A and part B. A fine water mist will allow the cleaner-brightener to work, even under a hot summer sun, and prevent premature drying. After cleaning, it's best to avoid using teak oils and sealers. Both tend to attract dirt and break down the seam caulking.

With all this loving care, you'll still have to sand your teak deck every year or two to keep the wood grain flat, so water will continue to readily run off. If your deck is badly eroded, and you need to remove a lot of wood to make it smooth again, consider first removing hardware bolted to or through the overlay. Yes, this is a major hassle, but if you leave the stuff on, you'll have to hand sand around most of it. Besides, now's the perfect time to rebed all those fittings so they won't leak.



GUY DRINKWALTER

After washing the deck, look for areas along seams that stay wet far longer than the surrounding deck, a sure sign of failed caulking. In these areas, you can likely insert a fingernail or thin blade between the caulk and teak.

Removing all deck hardware involved removing fixed interior headliners to access thru-bolted deck fittings.

In the hands of a skilled operator, a belt sander or 20cm (8") disc sander with 80-grit paper can quickly smooth heavily eroded teak decking. Less experienced operators should stick with a random orbital sander and 120-grit paper. It'll take longer, but you're far less likely to scar your deck in the process.

Plug Replacement

After years of weathering, cleaning and sanding, the teak plugs (a.k.a. bungs) covering the decking screws will wear so thin they'll lose their grip and pop out. Wherever a screw head is exposed, water is likely to find its way into the deck core, so it pays to replace popped plugs promptly. First, remove the exposed screw and redrill the countersink and counterbore to an appropriate depth. Vacuum up all debris. Now inject penetrating epoxy into the hole to seal the core, and install a new screw that's a 6mm (1/4") shorter. Finally, dip the bottom of each plug in varnish, which serves as glue and sealer, align the grain with that of the surrounding teak plank then tap it home. Let the varnish dry, then use a sharp chisel, beveled side down, to cut the new plugs off just above deck level. Sand the plugs flush with the deck using a sanding block or orbital sander. If your decking is badly eroded and you have a number of popped plugs, remove all plugs and screws before sanding.

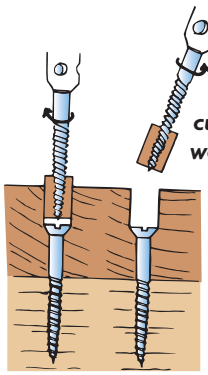
Refastening Tips

At some point, sooner or later, you'll need to refasten and recaulk. After surveying three leaky teakies, I decided it was time to overhaul my own boat's teak deck. I spent the better part of two weeks on my knees and, while I didn't emerge from this refit looking like new, my decks did. In the process, I learned a few tricks to make the work go more quickly.

It's best to do this job with the boat indoors or under an adequate

TIP Lasting Teak

Maximize the life of your teak decking by taking a disciplined but conservative approach to maintenance during the boating season, including routine washing and light sanding, and by using a full-size boat cover in the off-season.
—*SC*



Teak plugs are quickly removed with a drill and a custom bit made by cutting the head off a wood screw of the appropriate size. Once removed, the author used an awl (or ice pick) to clean the screw head for screw removal.

weatherproof cover. You'll also need a good set of kneepads. With my boat's 1,300 plugs and fasteners, refastening became a very tedious two-day job. Most plugs are easily removed by running a screw into them. Plugs not readily removed were probably dipped in epoxy before being fitted and must be drilled out. Once all plugs and screws are removed, sand the decks as needed. Then countersink, vacuum, inject penetrating epoxy, and install screws and plugs as indicated above. When the job is done, head for a hot tub.

A major refastening or recaulking project is best accomplished indoors or under a weatherproof cover. The author's boat cover is well vented all around and survived for longer than a year. When original blue poly tarps deteriorated, they were covered with white shrinkwrap.

Laying New Caulk

Weather, teak oils and sealers all take a toll on seam caulking, which eventually pulls away from the adjacent teak, letting water find its way under the overlay and into the boat. You can spot where caulking has failed when you wash your deck. Just look for areas along seams that stay wet far longer than the surrounding deck. You'll find you can insert a fingernail or thin blade between the caulk and teak.

The first step to fix failed seams is to remove the deteriorated caulking. Tackle small projects using a utility knife and hooked scraper made by heating the shank of a standard screwdriver or a file handle and bending it about 90°. As needed, shape the scraper's tip on a grinder to fit your

Redecking Options

If you plan to remove your boat's teak overlay, consider the many redecking options available. Unless you're restoring an historic vessel, there's little reason to hand-lay individually fastened teak planks. The least expensive option is to refinish your decks with gelcoat [Ed: As detailed in "Getting a Good Grip" beginning on page 16 of this issue] or paint, using non-skid particles in the areas you choose. [Ed: See DIY 2000-#4 issue for instructions on deck painting.]

Synthetic deck coverings, such as Treadmaster (Web: tiflex.co.uk/marine) and Vetus (Tel: 800-GO-Vetus, Web: www.vetus.com/products/deck_coverings.htm), offer better traction than paint, but the sharp edges of their non-skid patterns can be uncomfortable to walk on without shoes or sit on in a bathing suit. [Ed: Step-by-step procedures for installing deck coverings appear in DIY 1998-#3 issue.]

If you like the look of teak but lack the time or discipline to clean it regularly, check out Flexiteek or Tek-Dek, a flexible PVC compound containing a UV stabilizer and outdoor-grade pigments, both popular in Europe. Two companies in the U.S., Maritime Wood Products (Web: www.maritimewoodproducts.com) and Teak Decking Systems (Web: www.teakdecking.com) manufacture pre-assembled custom teak decking panels. Both use patented adhesives and vacuum bagging to bond teak planks to a thin fiberglass or plywood base. These panels are then installed on the boat using an adhesive, minimizing the need for fasteners.

Modern pre-assembled teak decking is installed using high-strength adhesives. Few, if any, screws are used around decking edges, and then only until the adhesive cures. These fasteners are then removed and holes filled and plugged. The result is a teak overlay with no greater propensity for deck leaks than a fiberglass molded non-skid deck.

TIP Inspect Hardware, NOW!

While repairing your teak deck now is a good time to inspect deck hardware fasteners and chainplates under a magnifying glass for evidence of corrosion. Stainless steel is highly susceptible to crevice and pitting corrosion in the oxygen-deprived environment inside wet deck core. I had to replace all of my boat's chainplates and several bolts.
—*SC*

seams. For larger projects, use a router or other mechanical means to clean out the old caulk and simultaneously deepen the seams. I found that a Porter Cable laminate trimmer (trim router) with a straight carbide bit worked well. If your seams are perfectly straight, a 15cm (6") circular saw with stacked (crosscut or dado) blades can be used in lieu of a router. You'll need some type of guide to keep the router or saw properly aligned with the seam. In tight areas a router or saw can't reach, I used a Fein MultiMaster variable-speed oscillating tool with a hooked knife blade. Fein "teak knives" are available in 3mm, 4mm and 5mm (approximately 1/8", 5/32" and 3/16") widths; use whichever corresponds best to your seam width.

Once the old caulk is out, be sure the seams are dry and vacuum to remove sawdust and any residual caulk. Since teak is naturally oily, wipe the seams with acetone (or denatured alcohol) to remove surface oil that could impair adhesion. Next, protect the deck with masking tape; 3M Marine's 233+ painter's tape works well. It's time consuming, but it'll mean less sanding once the new caulk has cured. Run masking tape alongside each seam, but don't let it lap over into the seam or you'll have trouble pulling the tape later. Tape over all other exposed teak as well.

Deck caulking is formulated to absorb side-to-side movement of the teak decking as it expands and contracts with changes in temperature. Virtually all caulk manufacturers say performance will be impaired if the sealant adheres to the bottom of the seam. A bond breaker or release tape, such as 3M Fine Line masking tape, can be placed in the seams to prevent adhesion. Many professional boat repairers omit this step, probably to reduce total man-hours when bidding for the job. The manufacturers of modern pre-assembled teak overlays (see "Redecking Options" on opposite page) use release tape, probably because they warranty their product. If you expect to own your boat for another 10 to 20 years, it pays to use a bond breaker or release tape.

I used BoatLife's two-part pourable Life Caulk without a release tape and was very satisfied with the results. (One-part products require that a primer be painted on the seam walls prior to caulking.) To avoid trapping air bubbles, hold the caulking gun vertically and fill the seams from the bottom. Use a putty knife (or plastic spreader) to smooth the surface of the caulk against the masking tape. Let the caulk set up before removing the masking tape, pulling at a 90° angle to the seam, or you'll spatter black caulk everywhere. Once the caulk has cured, you can run a sharp chisel along

Use a laminate trimmer (a small special purpose router) with straight bit to remove the old caulk in curved deck seams. Tack a flexible wood batten in an adjacent seam to use as a guide for the laminate trimmer. (inset) Save tricky freehand work along the king plank until last.

TIP Seal It!

Be sure to seal all exposed edges with epoxy resin filler. This includes fastener holes as well as other areas such as vent and hatch openings where the builder cut into the deck molding.
—*SC*

Caulking in areas not readily reached with a laminate trimmer is removed manually using a hooked scraper, made by heating and bending a screwdriver. Alternately, the variable-speed Fein MultiMaster I used with a hooked knife blade will do the same job much faster with far less physical effort.

Before caulking, protect your teak deck with masking tape. While this is a time consuming task, it will mean little or no sanding later.

Catalyst is added to BoatLife's two-part pourable Life-Caulk, mixed well then tightly sealed. Invert the can, and then use a disc sander (or grinder) to cut the rolled bead at the bottom. This allows bending of the can to form a pour spout. One gallon (3.785L) of Life-Caulk fills nine caulking cartridges. Cut a length of wire hanger to pierce any air bubbles that may form when filling the tubes.

each seam to trim away any excess. Finally, sand as needed with 120-grit paper to ensure the seam caulking and teak plugs are flush with the planking.

About the author: Susan Canfield is a NAMS-certified, SAMS-accredited marine surveyor in Annapolis, Maryland, where she sails her Tayana 37.

DIY Bill

MATERIALS

1 box each 3M Hook-it 12.7cm (5") and 20cm (8") sanding discs, 80 and 120 grit	$110
2 473ml (2 pints) Smith's clear penetrating epoxy sealer (CPES)	$32
1,300 screws, 19mm (3/4") marine-grade stainless steel	$123
1,300 teak plugs, 9mm (3/8") diameter	$143
10 rolls 3M #233 +, 19mm (3/4") paint masking tape	$50
6, 45.5m (50 yard) rolls BoatLife bond breaker	$162
15L (4 gal) BoatLife Life Caulk, 2-part pourable caulk	$470
36 empty caulking cartridges	$31
1 BoatLife Life Caulk solvent	$8
Miscellaneous consumables: latex gloves, paper suits, particle masks, paint rags, 946ml and 4.7L (1- and 5-qt) plastic mixing buckets, acetone, etc.	$80
Total	**$1,209**

Note: Quantities indicated are those used for the author's 11.2m (37') boat. Prices are in U.S. dollars and reflect special promotional pricing and/or outfitting discounts available through major marine suppliers. Additional costs not reflected here may include: fees for protected storage, mast removal, tool purchase or rental and skilled labor.

Labor	**Hours**
Remove deck hardware penetrating teak overlay	16
Remove teak plugs and screws	16
Remove deteriorated caulking	32
Sand overlay	6
Countersink/counterbore for new screws and plugs	6
Inject penetrating epoxy, install new screws and plugs	16
Recaulk seams	48
Finish sanding	2
Reinstall deck hardware	16
Total	**158 hours**

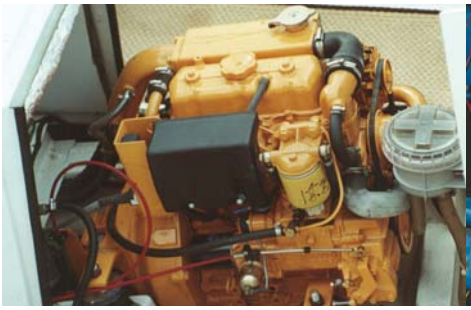
Note: Estimated hours to sand, refasten and recaulk the teak overlay on an 11.2m (37') boat, using power tools whenever possible. Labor includes preparation and clean up. Actual hours will vary depending on worker skill level, extent of deck overlay deterioration, tools used, working conditions, etc.

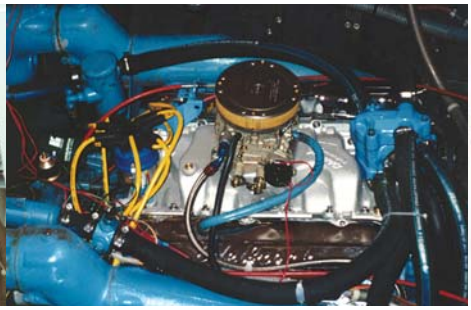
ENGINES

A SYSTEMATIC APPROACH TO ENGINE DIAGNOSTICS

Engines comprise a large percentage of a boat's value. Whether you are buying a used boat or you just want to know more about your engine, following these service procedures can help you determine the health of the powerplant without disassembly.

[BY HARRY SWIECA]





Your dreamboat is well equipped and the hull looks great. What about the condition of the engine and its related systems? You could hire a qualified marine mechanic to survey the engine but, unless you have a thick wallet, it's a good idea to pre-survey the engine and its systems before involving a mechanic.

Keep in mind that the cost of rebuilding or replacing a gas or diesel engine can well exceed the value of an older boat. A thorough inspection and evaluation can go a long way in determining how well the engine has been maintained and operated.

Quick Scan

Begin your survey with a complete review of the maintenance records. Check the frequency of oil and filter changes, fuel filter changes and any other work and log the total number of engine hours from the hourmeter, if equipped. Make sure the meter is working before you trust the reading. Note the engine manufacturer, serial number, model and horsepower.

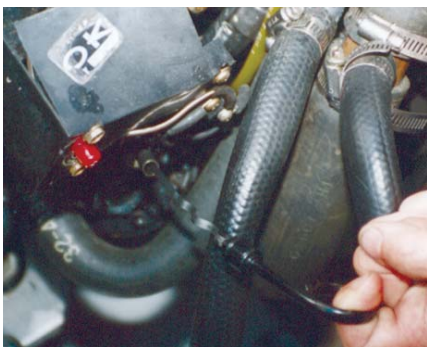
A visual inspection of the engine, wiring, thru-hulls and other components provides insight to possible abuse and neglect. Use a flashlight and mirror to inspect both sides of the cylinder block for rust and water stains that may indicate engine freeze damage or a cracked block. Sniff the engine compartment for evidence of fuel leaks and look under the engine for telltale oil, fuel and water.

Corrosion can cause many components to fail. Check the wiring, wiring harnesses, exhaust system, hose clamps and seacocks for corrosion. Make sure that the engine thru-hull valves open and close easily and are ball type or seacocks, not gate valves, which are not suited to marine applications. Rust, a white, "fuzzy" powder-like coating, or heavy green discoloration on metal parts are all symptoms of corrosion.

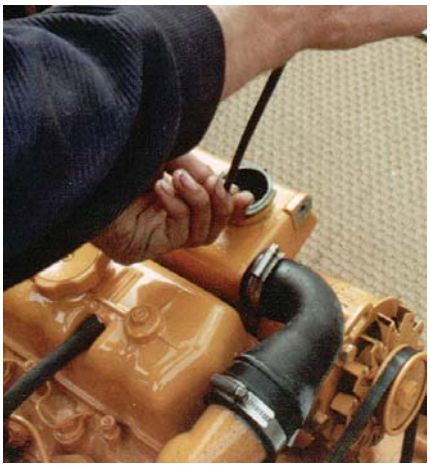
Inspect fuse blocks for corrosion.

Inspect Lube and Cooling Systems

As lubrication oil is the lifeblood of an engine, a simple inspection of the oil on the dipstick can reveal



Examine engine and crankcase oil.



Coolant check.

several problems. Remove the dipstick and examine its shaft above the oil level mark for rust or water bubbles. These indicate an internal leak of the cooling system water into the oil sump. Smell the oil. A rancid smell means the engine has suffered an overheat and there may be hidden damage. Now, wipe the oil from the dipstick on a white rag. If the thin film of oil shows a pasty abrasive soot-like deposit, the oil sump contains a carbon residue caused by a condition known as "blow-by." This is an alert to worn cylinders on both gas and diesel engines.

Inspect the transmission oil in the same manner. Oil that has a burnt smell and shows shiny glitter like flakes under a strong light indicates internal slippage of clutch plates or drive cone, conditions that can lead to a costly repair.

Open the oil fill cap on top of the engine and wipe under the valve cover with your finger. An emulsified, white colored oil film indicates moisture is entering the engine from either a bad head gasket or an internal crack in the cylinder block.

If the engine has a closed-cooling system, inspect the underside of the fill cap and wipe the underside of the tank with your finger. A slimy white paste or very dark colored coolant indicates a possible cylinder head gasket leak that has allowed exhaust gases to enter the cooling system. If exhaust gases escape out

Standard water separating fuel filter with drain on bottom of bowl.

of a cylinder then coolant has entered the same opening. This can mean major and expensive repairs. Pressure test closed-cooling systems for leaks using a manual automotive radiator pressure tester.

Fuel System Plumbing Check-up

Examine all fuel lines, connections and fittings for deterioration or leaks. If the primary water separating fuel filter has a drain valve or plug at the bottom, place a small container underneath, open the drain slightly and draw a small sample of fuel. Any water in the system settles to the bottom of the filter and drains first. In a diesel application, water or black flakes in the fuel indicate the engine may need an injector pump and/or injector service in the near future. Labor is the big cost here. This is your opportunity to capture fuel for laboratory analysis. It's not expensive and the report can be an excellent diagnostic tool. Second guessing fuel condition is not for amateurs. If gasoline smells like varnish or contains water or the filter is

Evidence of water in engine.

Standard stuffing box installation.

otherwise contaminated, it may be time to drain and flush the fuel tank to ensure a reliable fuel supply. There are professional service companies who can come to your boat, remove the fuel (gasoline or diesel), dispose of it responsibly or filter it for return to the tank after flushing. While the tank is empty, you can also pressure test it.

Drive Train Check up

Grasp the drive coupler and shaft, and manually rotate in both directions. Check the shaft and cutless bearing for wear. None of these replacement parts are expensive but labor costs can hurt if access is limited or the parts have fused.

Inspect the shaft log and stuffing box. These should be clean and dry. The hose should be intact and clamps should be doubled and free

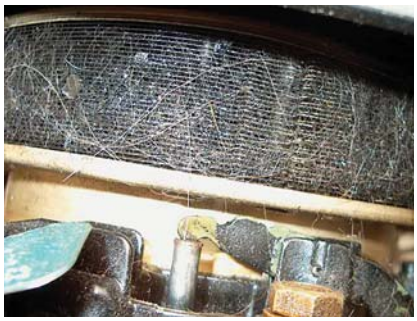
Testing the shaft coupler.

Soft or cracked hoses require replacement.

of corrosion. Look for signs of excessive dripping water. If possible, check the shaft and engine alignment. Doing this right means that the boat has to be in the water.

Don't Forget the Arrestor

A gasoline fueled engine has a flame (spark) arrestor located at the carburetor. This device is the engine's air intake and a major (and required) part of the engine's fuel ignition protection safety system. An arrestor that is gritty and clogged indicates there's been little maintenance performed on the engine. If it's dripping with oil, it's a safe bet that the engine runs poorly. If the oil was pasty during the oil dipstick check, wipe your finger under the arrestor and look for dripping oil. This will confirm suspicions of blow-by and worn cylinders.



Dirty flame arrestor.

Fix on Mounts

Inboard engines (including those with sterndrives) are secured to the boat by means of vibration dampening mounts that are secured to the boat's wood or fiberglass stringer support system. Mounts should appear in good condition, clean, dry and free of rust or corrosion, with no bulging rubber around the mount's center stud. When probed with a knifepoint, wood stringers should be dry and solid, not wet or soft. Examine the bolts to fiberglass encapsulated wood stringers. Corrosion at these bolts can mean that the wood inside the fiberglass is wet or rotting. You can explore this condition with a moisture meter. Wet or rotted wood here significantly reduces the stringer strength and its ability to hold the bolts for the engine mounts. Don't forget to inspect the transom wall for damage in the same manner. Many fiberglass transoms are

(Continued on page 29)

Inspect the condition of the engine stringers and engine mounts for movement.

IN-WATER ENGINE SURVEY

In addition to static testing covered in this article, a professional marine mechanic offers these tips to check the health of a gasoline engine at the dock under full-load conditions.

[BY GEORGE VAN NOSTRAND]

Tools Required

- Compression tester
- Fuel pressure/vacuum gauge
- Voltmeter
- Oil pressure gauge with flex tube
- Remote starter switch
- Mechanic's stethoscope
- Spark plug wrench
- Miscellaneous hand tools
- Note paper and pen

The following procedures generally apply to gasoline-powered inboards, although some tasks apply to all engines. Testing is performed with the boat in the water and presumes you have some experience with engine troubleshooting. Most of the testing equipment is available from rental outlets. Depending on the particular installation, the survey takes about two hours per engine to complete, including engine warm-up.

Have the manufacturer's specifications for cylinder compression, allowable tolerance and tune-up specs handy. As you work through each procedure, refer to the engine service manual for any safety concerns and keep a record of the test results, then compare with the manufacturer's specs to decide if any repairs are necessary.

With the boat in the slip and engine(s) not running, open all deck hatches and run the blower. To test the oil pressure, remove the electrical pressure sender and screw in a mechanical oil pressure gauge with a flexible tube. Start and run the engine at idle and various cruising speeds, noting the oil pressure. (For example, 20 pounds at idle, 30 to 55 pounds at 2,000 rpm.) Listen for knocks, abnormal sounds and vibration. Inspect the coupling, shaft and keyway and check the stern gland for leakage. Sound water pumps with a stethoscope to check bearing noise. Similar to a medical stethoscope but with a long probe, it's available from automotive suppliers for about US$8. You should hear an even "hum." A loud growl signals a defective pump. Be sure to keep loose clothing, etc., away from engine belts and pulleys. Watch for oil leaks, especially at the flywheel housing or the front seals.

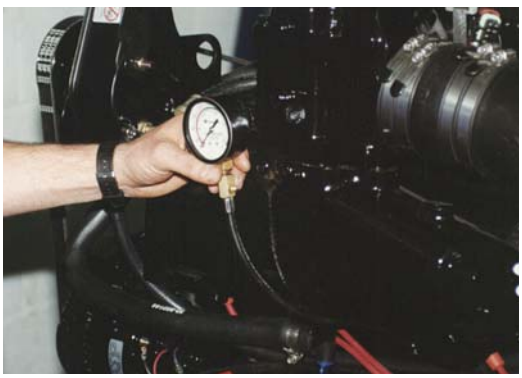
By now, the engine oil is warmed up to proper operating temperature so you can check oil levels in the engine and transmission. When you remove the dipstick smell the oil. Does it smell burnt? Is it milky in color? A hot oil sample taken from the lowest point and delivered to a lab for spectrographic analysis helps to determine bearing and cylinder wear.

To check battery voltage, disable the ignition by removing the power supply wire at the coil, usually a purple wire, and temporarily tape the terminal to prevent any spark should the wire touch a ground during this test. This is a safer method than grounding the high-tension wire from the coil to the block, as recommended in some engine manuals. If the high-tension wire is not grounded properly, it may spark and ignite in the presence of gas fumes or spilled gasoline. Connect the remote starter switch to the terminals on the starter solenoid and a VOM across the battery terminals. Crank the engine for 5 seconds noting battery voltage while turning. A reading of 10 volts is good with the acceptable minimum being 9.6 volts.

Remove the spark plugs and place them in order to identify any fouled cylinders. Test the cylinder compression by threading the compression gauge unit into each spark plug hole in turn. Crank the engine over the same number of turns (four) and record the readings by cylinder number. Do this with the throttle wide open, tying it in place, if necessary. This gets the proper amount of air into the intake and your readings will compare more accurately with the manufacturer's specifications.

If one (or more) of the cylinders is lower than the manual specifies, pump two or three squirts of oil into that cylinder and test it again. This is known as a "wet" test. Improved compression during a wet test demonstrates that the oil has sealed bad rings or piston problems temporarily. If no change occurs, it indicates burned or sticking valves. If available, use a cylinder balance tester while the engine is running. This is a more accurate indicator of weak cylinders. It momentarily shorts out one cylinder at a time so that any reduction in rpm is noted and compared. All cylinders should be near equal.

Optional tests include checking the charging system, fuel pump pressure and engine vacuum. To test the antifreeze alkalinity use a voltmeter. Ground the negative wire and drop the positive lead into the coolant. If the meter registers one volt or more, the antifreeze must be changed. Be sure to change antifreeze every other season as regular maintenance.



Check cylinders using a compression gauge threaded into each spark plug hole.

About the author: George Van Nostrand is a retired marine mechanic who is now a part-time delivery skipper of large motor yachts. He cruises with his wife Sheilah on "Dream Catcher," a 10m (34') tri-cabin Tollycraft.

TIP Small Things= Large Bills

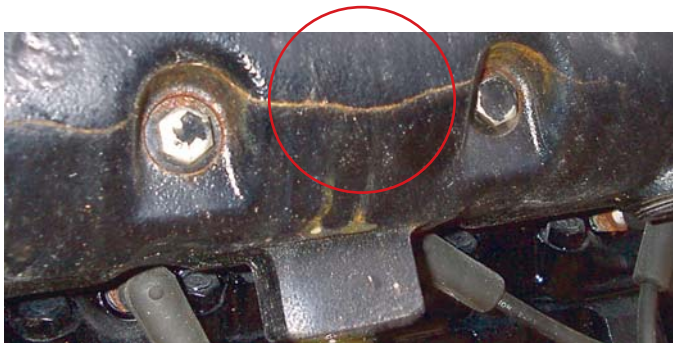
Inspect the accessibility of service points, such as fuel filters, cooling system and fluid service. Note possible service problems, such as poor access or outdated parts.

(Continued from page 27)

cored with wood that gets wet and rots from water that enters around the sterndrive unit. Labor costs for engine removal and fiberglass reconstruction can drive these repairs to great expense.

Exhaust Examination

Inspect the exhaust system at every connection point. This is an especially critical exercise in both engine health and human safety since gasoline engine exhaust contains potentially deadly carbon monoxide (CO). Every point of connection in the system must be vapor and liquid tight. Water stains or corrosion of a fitting under a connection



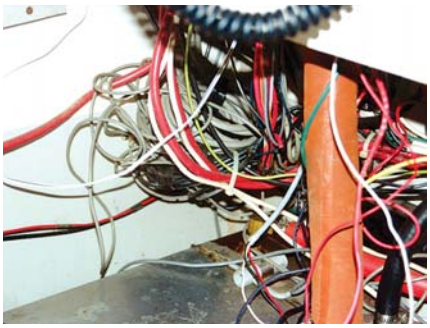
A cracked manifold.

are symptoms of leaks. Check all hoses for cracks and leaks. These connections must all have double clamps. If the system is equipped with a canister-type muffler, water trails and cracks or rust stains around the base indicate leaks. Stainless-steel mufflers and waterlifts are especially prone to corrosion failures. Inspect the transom exhaust ports for high deposits of carbon soot, which builds up after long hours of low rpm operation or can be caused by contaminated fuel or cylinder blow-by.

More Service Points

Inspect all engine-related plumbing and hoses. Soft and cracked hoses will require replacement. Again the parts are cheap. It's the labor that is expensive. Inspect the engine and engine room wiring. Disorganized or unsupported wiring is a fire hazard and is evidence of incompetent and dangerous wiring practices. Insurance company claim files are full of wiring-related boat fires that were totally preventable.

Inspect all engine linkage and controls. They should be in good condition visually and operate smoothly. The static position of the transmission may have a bearing on gearshift movement if the boat is on land. If the gear shift



Wiring that looks like a bird's nest requires many labor hours to update.

True-testing propeller blades.

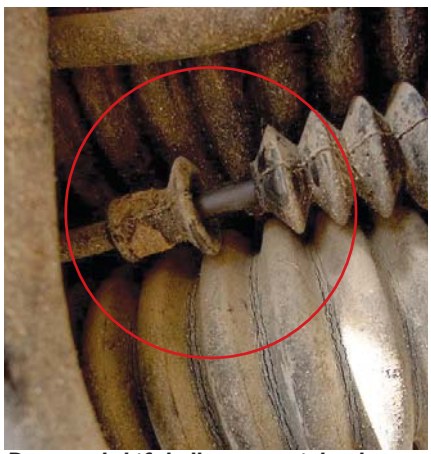
lever is difficult to move, be sure to give it a second look during launch and prior to on-water testing. If it's still stiff it may indicate a transmission or a control system problem.

Lastly, check all zincs (including the internal engine anodes) for wastage and thru-hulls for signs of corrosion activity. Inspect the propeller for damage. To do this, place the shift controller in neutral. Position a pencil with a good point 90° to the propeller blade edge or parallel with the prop shaft. Hold the pencil lightly against the thickest part of the blade. Now rotate the propeller slowly by hand. Allow each blade to contact the pencil point. If a blade appears bent, do the same test on the prop shaft. The prop is easily repaired. A bent shaft can involve an expensive repair or require replacement.

Sterndrive Notes

In addition to the above checks, sterndrives have other service concerns. Lower the drive unit to the full down position, if possible. Inspect the drive for damaged areas, such as cracks in the casings and oil leaks. Look for spreading damp oil stains at the ends of each oil line and on the casings. Stains indicate probable water contamination of the oil system. Locate the unit's anti-cavitation plate. Hold the unit at this point and slowly rock it sideways. There should be little or no movement. Now, lift the unit upward. Be careful of your back, as the unit is heavy. As you lift, observe the upper support pivot pin for movement. There should be none. Do this test several times to be sure of the results. If the pin shows movement, the upper bushing is worn. Depending on the age of the boat, it could be an expensive repair.

Aged or damaged U-joint bellows and/or shaft cable boots are well documented as causes of sinkings of boats with sterndrives. Move the drive side to side manually or with the steering wheel. Using a powerful flashlight, visually inspect the rubber bellows and hoses for cracks and tears. The rubber should be soft and free of large surface cracks. Pull the shift cable bellows fore and aft and look for splits in the valleys of the bellows. If the rubber is aged, plan on the expense of complete replacement of all bellows before launch.



Damaged shift bellows can sink a boat.

Sideways movement of the sterndrive more than 3mm (1/8") indicates wear to the steering arm linkage.

TIP Further Reading

If you're planning to purchase a used boat, the article titled, "Buying a Used Boat" in DIY 2002-#2 issue provides details on how to evaluate a boat's systems and performance, including a pre-purchase checklist, before making a purchase offer.

— *Jan Mundy*

Out-of-Water Testing

Contrary to what you may have been told, marine engines can be operated safely on land when properly connected to a cooling water source, a battery and clean fuel. Diesel engines require air, fuel and compression to fire. If a diesel engine starts quickly from a cold start, you can feel confident that the engine's cylinder compression is in good shape. Gas engines may take a while longer to start because they rely on an ignition system as well as air and fuel to run. On gas engines, compression and cylinder leak-down tests are recommended. The compression test should be done before starting a cold engine and again after it's warm. A significant increase in compression indicates worn cylinders, gummed up rings or valves. Better yet, consider an on-the-water test, if possible, as detailed in "In-Water Engine Survey" on page 28.

About the author: Harry Swieca is a certified marine mechanic and surveyor based in Northbrook, Illinois.

PROP APPEAL

Matching the perfect prop to your boat can greatly affect engine rpm and improve performance. Here's what you need to know when selecting a replacement propeller for your planing, semi-planing or displacement hull.

[BY STEVE AUGER]

As a technical advisor for a major marine engine manufacturer, I receive hundreds of calls each year from boaters that are looking for advice on propping their boat. Some want more speed, others want better fuel economy or more power and some have no idea what they want but know they aren't happy with the performance of their boat with the present propeller.

Most boat owners replace a propeller due to some sort of damage to their existing propeller. The selling dealer likely selected the original propeller for the owner. This prop may not be correct anymore due to changes in boat weight, available power and usage. Purchasing the correct propeller is usually the least expensive and user-friendly way to improve the performance of your boat. But with many diverse styles and price ranges, prop selection can be a confusing decision. Should you buy an aluminum, composite or stainless-steel propeller? What is blowout or the X" dimension? Ever heard of exhaust diffusers or an exhaust ventilation system?

There are many factors to consider when selecting a prop. Boat length and width, gross weight (boat, motor, fuel, passengers and gear) and the type of boating you do affect overall speed and performance. By becoming familiar with propeller design and terminology, you can eliminate the mystery associated with purchasing a new propeller.

How do I know if I have the correct propeller pitch?

Pitch is the distance that a prop moves ahead in one full revolution if it was run through a solid material (like a screw through wood). If a prop, for example, is a 53cm (21") pitch it moves ahead 53cm (21") in one revolution.

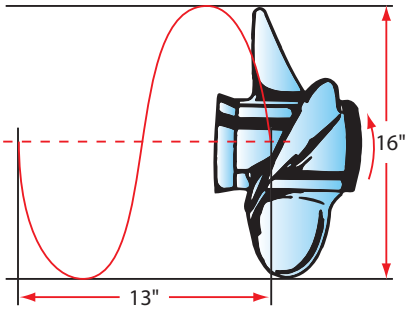
Every engine has a recommended maximum rpm at wide-open throttle (WOT). In order for your engine to operate within this range you must select a prop with the correct pitch for your boat and motor application. Too much pitch and the boat is lazy getting on plane and your engine won't reach its maximum rpm. This can cause engine damage to the pistons and/or valve train. Too little pitch and the boat can't reach top speed and the engine over revs its maximum rpm. This also causes engine damage. An adjustable pitch prop lets you change the propeller's performance to suit the application.

The correct pitch produces a package that gets on plane quickly and produces good hull speed at cruising rpm and WOT. This process requires a digital shop tach that accurately displays engine speed. Once the maximum rpm with your existing prop has been recorded, you can change the pitch. Expect the rpm to change by approximately 200 rpm for each 2.5cm (1") of pitch that is added or subtracted.

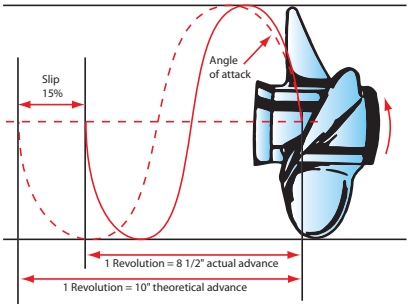
What is prop diameter and how do I know if it's correct for my boat?

Propeller diameter is the distance

Props are made of aluminum, bronze, plastic and stainless, are offered in single or multi-blade configurations with constant, variable or adjustable pitch, varied rakes and with or without cup.



Similar to "threading" a wood screw, pitch is the distance a propeller moves in one revolution, or 33cm (13") in this illustration, if moving through soft wood.



The difference between theoretical and actual distance traveled in one revolution of the prop determines the amount of slip.

across the propeller from blade tip to blade tip. Boats with a high horsepower-to-weight ratio often use a prop with a small diameter and large pitch, resulting in high speeds. There is not much variation in the case of outboard or sterndrive propellers as diameter is usually determined by the prop manufacturer and is not changed unless you're tweaking the prop to obtain maximum speed. Inboards do use diameter to change the maximum rpm and performance characteristics of a non-planing or semi-planing hull. Boats with a low power-to-weight ratio usually use less pitch and more diameter.

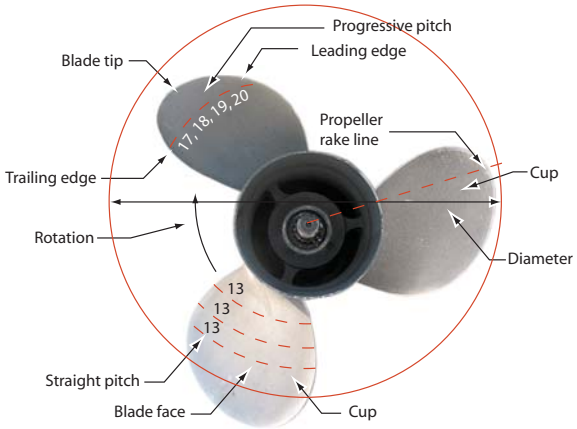
My dealer keeps referring to "prop slip" as a cause of my boat's poor performance. Should I be worried about damaging the engine?

All props have propeller slip and though it sounds like a bad thing, it isn't. Slip is the difference between theoretical and actual distance traveled in one revolution of the prop. If there were no slip each time you shifted into gear the engine would stall. Normal slip values are 8% to 12% for family boats and light cruisers; 10% to 15% for big cruisers; 5% to 10% for sport boats and offshore performance boats. Installing a propeller with more blade area or diameter can reduce slip.

What other features affect a boat's performance?

"Rake" is the angle of the prop blades from the front of the outer hub to rear of the outer hub to which the blades are attached. Rake is used to reduce ventilation and cavitation. Basic aluminum props are usually a low rake at around 0° to 10°. High-performance props, such as Mercury Laser II, are made of stronger stainless steel that can use a high flat rake or progressive rake similar to that of the Mercury outboard cleaver with, for example, 20° at the hub, 10° at the tip.

"Cupping" is when the trailing edge of the blade is formed or curled away from the blades. Before the technology that produced the newer special metal alloys used in modern propellers was available, cupping was used to reduce cavitation and ventilation. On today's modern props, it's usually used to tweak the maximum engine speed to the correct number. Adding cupping reduces rpm and can alter the rake or pitch, depending on where the cupping is placed on the trailing edge. Removing cupping increases rpm.



Basic parts of a propeller.

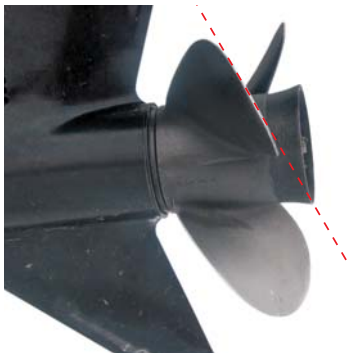
"Ventilation" occurs when air from above the propeller is pulled into the high-pressure area of the propeller blade (the back side). This causes the prop to lose its bite and the engine starts to rev as speed drops. Causes include mounting the engine too high on the transom, over trimming the motor or damage to the anti-ventilation plate area of the gearcase. When prop ventilation occurs, the best advice is to bring the boat back to idle and accelerate again slowly.

"Cavitation" is the water around the propeller actually "boiling" due to low atmospheric pressure in that area of the propeller blade. As these bubbles move across the blade of the propeller, they encounter the high pressure area of the blade that produces the forward thrust, eventually bursting the bubbles and leaving what is known as "cavitation burn" on an aluminum propeller blade. Bent nicked or broken blades or too high an engine mounting height that

TIP Prop Upkeep

Regularly inspect your propeller for nicks and bent blades. Besides the negative affect in performance, a damaged prop can result in costly engine damage. When installing a propeller always apply waterproof grease on the splines and torque the prop nut to manufacturer's specifications. — *SA*

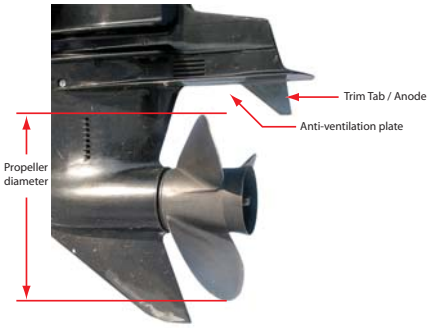
If you use your prop as a "depth sounder," you may also have bent the blades. Such damage requires removal, and rebuilding and balancing by a propeller repair shop.



An example of a prop with constant pitch, where the pitch is the same from the leading to the trailing edge.

This prop has 0° flat rake as the face of the blade is perpendicular to the propeller hub and forms a straight line.

Nearly all high-performance props contain some degree of cup.



Anti-ventilation plate on an outdrive eliminates or reduces the possibility of air being drawn from above the propeller into the back side of the prop blades. Propeller has a flared trailing edge to push exhaust gases out and away from the blades.

introduces ventilation, which in turn causes cavitation, usually causes massive cavitation.

Just like a wheel out of balance that causes vibrations in a car, so will your boat vibrate at speed if the prop is out of balance. A bent blade directly results in vibration, whereas chips and scratches can cause cavitation. If blades are missing big chunks, the life of bearings and seals in the gearcase can be affected, leading to an expensive fix. Have a qualified propeller shop check prop balance if you suspect you have a problem.

How do I determine prop rotation?

Propellers come in both right and left-hand rotation. Most twin-engine applications use a right-hand rotation (clockwise) prop on the starboard engine and left-hand rotation on the port engine. If you set the props on a table the right-hand prop is the one where you can place your right wrist on the table and your palm will lie on the back side of the blade. Some engine manufacturers code the drives. Mercury Marine, for example, identifies its left-hand Alpha drives and outboards with an "L" on the end of the prop shaft.

How many blades do I need?

Adding a blade or two can increase hole shot time and deliver better fuel economy. Due to improved propeller technology, it's possible to get a variety of blade configurations in aluminum props that were not available even five years ago. This is particularly beneficial on mid-size cruisers powered with a small V-6 engine where converting from the basic (and older) technology three-blade prop to a new four blade produces better performance out of the hole and the boat now cruises on plane at a lower rpm thus saving fuel. Stainless props also come in a variety of blade shapes, blade numbers and configurations.

How much can I expect to pay?

Aluminum and composite props start around $130 and perform well for all-purpose use. These props are a good choice where grounding is a possibility, as repair costs are lower than for a stainless steel one, assuming there is no gearcase damage. Composite props allow you to change a single blade, though, whenever I've hit something, I've always wrecked every blade.

Stainless steel props are more durable but expensive, costing $600 plus. They do improve performance throughout the rpm range. Let's say you want to improve your hole shot to pull up a skier. A stainless-steel five-blade prop does a much better job of getting the skier up quickly and allowing the boat to run at lower rpm on plane than a standard three-bladed aluminum prop. If you have a sport boat and want to improve your overall top speed, a three-blade, high rake stainless prop, such as a Mercury Laser or Mirage Plus, allows the use of a raised motor height to produce higher hull speeds. Before installing a stainless-steel propeller check with your dealer to ensure the engine is approved for its use. There are some models of mid-sized outboards that don't have the shifting components to accept the additional weight of a stainless prop.

Bronze propellers are still widely used on bigger boats that use inboard engines driving shafts through hull bearings and external struts. These props are usually selected by the boat builder and may require tweaking as the boat gets older and gains weight. Owners of older boats can achieve better fuel economy by ensuring that the props are checked regularly for bent blades, nicks and checking the rpm operating range.

How do I test run a prop?

The main requirement is to select a

Boat: 7m (23') 1977 FORMULA / Loaded weight: 2903kg (6,400lb) / Engine: 454 Mercruiser, 1995, Gen 5, Bravo I drive / Accessories: Trim tabs										
	Mirage 3-Blade 14.5x21 aluminum	MiragePlus 3-Blade 15.5x19 aluminum	MiragePlus 3-Blade 15.5x17 aluminum	Revolution 4-Blade 14.6x19 aluminum	HighFive 5-Blade 13.5x17 aluminum	Velocity 3-Blade 14.0x17 aluminum	Mirage 3-Blade 14.5x21 SS	Laser II 3-Blade 14.0x19 SS	Michigan 3-Blade 14.0x19 aluminum	Unknown 3-Blade 14.5x17 aluminum
rpm	**mph**	**mph**	**mph**	**mph**	**mph**	**mph**	**mph**	**mph**	**mph**	**mph**
5000			45@4650		40@4750	41@4700		44@4600	39@4900	41@4850
4500	43@4200	42@4100	43		38		44@4400	38		38
4000	40	40	37	42@4000	33		42	35		34
3500	36	34	32	36	28		35	30		30
3000	30	26	30	29	21		29	24		23
2500	18	22	19	21	13		20	10		14
2000		12	15	12	9		10	9		9
Accel.	20 sec	15 sec	15 sec	17 sec	12.5 sec					
Calculated Speed	55.7	49.2	49.9	48.0	51.0	50.5	58.4	55.2	58.8	52.1
% Slip (CSp/Asp)	30%	17%	11%	14%	28%	23%	33%	25%	51%	27%
% Slip (ASp/CSp)	23%	15%	10%	13%	22%	19%	25%	20%	34%	21%

Notes: rpm x Pitch x 0.667 x 0.00094697 = Calculated Speed
Weight, wet = ~2,903kg (~6,400lb)
Calculated Speed (CSp)/Actual Speed (ASp) -1 = %Slip

CHASING PROPS

A detailed look at some common propeller questions and the solutions after running the specs through Mercury Marine's prop calculator.

BY STEVE AUGER

Q: I have a 1989 9.3m (30.6') sedan bridge Tollycraft powered by twin 5.7L Mercruisers with vee drives. Loaded weight is 5,624kg (12,400lb). The boat has trim tabs and is used for pleasure. Top speed is only 23 mph at 3,600 rpm. Recently, I changed to a smaller 40.6cm by 38cm (16" by 15") Michigan Wheel, three-blade bronze prop and, while this didn't improve my top speed, it sent my fuel economy off the charts. I believe the motors are just too small for the boat. My goal is better fuel economy. WOT is not an issue.
Mike Morelli, Kailua, Hawaii

***Q:** Detailed work sheet compiled by DIY reader David Avedesian of Rockville, Maryland during sea trials of different props. His prime objective was to operate the engine at the correct rpm at wide-open throttle (WOT).*

***A:** This boat's best performance is achieved with the Mirage Plus at 4,650 rpm. The critical factor is that the engine operates at WOT at it's designed maximum rpm, regardless of the top-end speed. A 7.3m (24') Formula with this engine should be running in the 60-mph category. Values given show a high slip value, rather than the typical 10% to 12%, and are all 15 mph low. This massive slip value would produce a sensation akin to driving a car with the clutch in; you would definitely notice this when underway. There are three likely causes: the hull is heavier than its designed weight; the engine is whipped; or the hull has a big hook.*

A: With the existing props and gear ratio (1.5:1), this engine should turn up to 4,400 rpm and the boat should run at about 35 mph. It's possible that the engines may be "soft" due to the low rpm at WOT. To achieve the best fuel economy and rated rpm at WOT, you'll have to decrease prop pitch, approximately 2.5cm (1") of pitch per each 200 rpm required. Apply this formula to your specs and it appears you need to reduce the pitch by 10cm (4"). This is presuming there are no other problems with the drive-line that may be consuming horsepower, such as a seized cutlass bearing, bad stuffing box, bent shafts or rudders, etc.

Q: I'm trying to find information on the original prop specs for a 1977 Glastron Bal Harbor 225 cruiser with a Ford 302 V8 188hp gas engine. When purchased, the boat had a 34cm by 48cm (13.5" by 19") pitch. It now has a prop of the same pitch but 12mm (1/2") larger diameter. Running at 4,000 rpm with the smaller prop, speed is 27 mph; with the larger prop, it's 36 mph. I'd like to know what prop I should run with this boat.
Rick Hearn, Winnipeg, Manitoba

A: It's unusual to see speed gains of 10 mph from two props of equal pitch regardless of diameter differences. It's likely that the larger diameter prop is cupped, which provides more bow lift. This also reduces the wetted surface of the hull, resulting in higher speeds due to less drag. An 888 (Ford 302) has a WOT rating of 3,800 to 4,200 rpm. Try both props at WOT and select the one that allows the engine to run in the specified rpm range. A prop that allows the engine to under or over rev at WOT can cause expensive engine damage.

TIP Need More Horsepower?

Installing a multi-blade prop (e.g., High five or Alpha Four) can increase the performance of a planing hull that is underpowered.

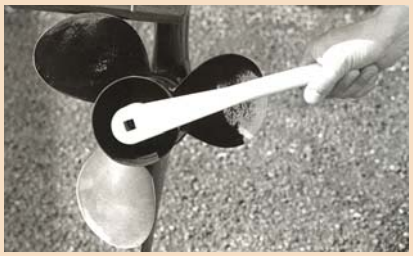
prop that allows the engine to rev to its maximum rated rpm as specified in the engine service manual. Experimenting with different props can get expensive. Unfortunately, few boatyards are willing to let a customer take a prop for a weekend test. If the selection is wrong, the dealer will be reluctant to take the incorrectly selected prop back. Check with other boat owners that own similar boat-motor packages and compare results. Also, contact the boat builder, who can likely recommend a propeller upgrade, based on test sessions performed by the builder and engine manufacturer. There is no exact science that tells you which prop will be the best for your boat-motor combination and application requirements. Visit with the dealer who does your regular maintenance and discuss its policy on propping.

If you are committed to buying a new prop, many propeller manufacturers, prop service shops and Mercury Marine dealers (likely other engine dealers as well), offer a propeller recommendation service. You complete a form (sample form appears below) that is then run through a propeller recommendation data base. This helps you begin your propping process by providing a starting point as far as pitch and diameter are concerned. At this point you can try different blade configurations, blade numbers and, in the case of outboards, raise the motor height to increase top speed, or lower it for more hole shot.

With a little patience and knowledge, propping your boat can improve your boat's overall performance and result in reduced fuel costs and a better day on the water.

TIP Be Ready for a Rock Attack

According to "Murphy's Law of Probability," if you have a spare prop you rarely need one, if you don't have a spare, you will likely need one. After purchasing your new prop, keep the existing one as a spare and carry the tools to change it.



Use a floating prop wrench to change props after being attacked by a large rock. Note cavitation "burn" on the aluminum blade (right).

About the author: An advisor to DIY's Technical Helpline, Steve Auger is a service training instructor and Mercruiser product support specialist for Mercury Marine.

Sample Propeller Recommendation Form

Boat Information

Manufacturer _____ Model & Year _____ Length overall (LOA) _____
Beam _____ Weight (Loaded) _____ Hull type _____
Accessories (jackplate, trim tabs) _____ How do you use your boat? _____

Type of Hull

SAIL: Racing _____ Fin keel _____ Round bottom _____
Double ender _____ Full keel cruising yacht _____ Motorsailer _____
POWER: Trawler _____ Displacement hull _____ Hard chine _____
Planing hull _____ Other _____

Motor & Drive Information

Manufacturer _____ Model & Year _____ Gas or Diesel _____
Cubic-inch displacement _____ Horsepower _____ Operating range (rpm) _____
Hull type _____ Number of engines _____ "X" Dimension or motor height _____
Drive gear ratio _____ Shaft diameter _____

Propeller Information

Manufacturer _____ Number of blades _____ Diameter & Pitch _____
Prop material _____ WOT rpm with this propeller _____ Top speed _____
Current performance is: ❑ Good ❑ Average ❑ Poor
What are your performance goals? _____

PATCHING DECK HATCH LEAKS

The drippy evidence of a leak can be a long way from its source at a leaking hatch. Follow these procedures to find and fix the leak.

[BY NICK BAILEY]

Repairing a leaking hatch is not always as easy as it sounds. You can't stop a leak until you find the source and therein is the challenge. Waiting for a day of steady rainfall to help you pursue leak sources may not fit your detection and repair schedule. Leaks can be prodded into action with the "rain" from a garden hose.

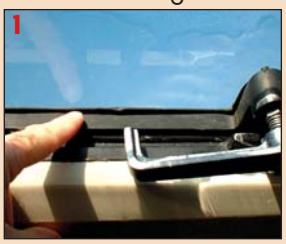
Standard leak hunting technique using a hose requires teamwork. Up on deck, you begin with the hose irrigating the lowest fittings first. Below, your spotter keeps watch. Water is gradually pointed to higher fittings until the spotter calls out that water is getting inside. Careful inspection usually determines the origin of a hatch leak. Armed with a paper towel and a flashlight, follow the wet trail back from where the drip forms, dabbing it dry as you

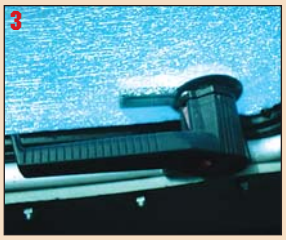
Leak testing with hose.

FIND THE LEAK

LEAKS COMMONLY APPEAR FROM FOUR DIFFERENT ROUTES:

ROUTE 1 Through the hatch lid.





1: Leaks between the lens and frame first show up here.

2: At hatch dogs or fittings that pass through the hatch lid. Look for drips off the bottom of the handle shaft (acorn nut in this case).

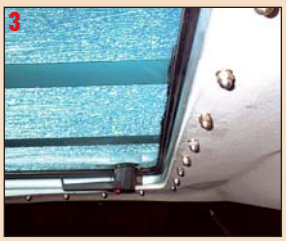
3: Leaking Lewmar handles have replaceable O-ring seals.

ROUTE 2 Via a deteriorated rubber gasket.

1: Rubber gasket between the hatch lid and base.

2: This locker hatch gasket looks dubious.

ROUTE 3 Under the hatch base and/or through the base mounting fasteners.



1: A leak between the hatch base and the deck may show here.

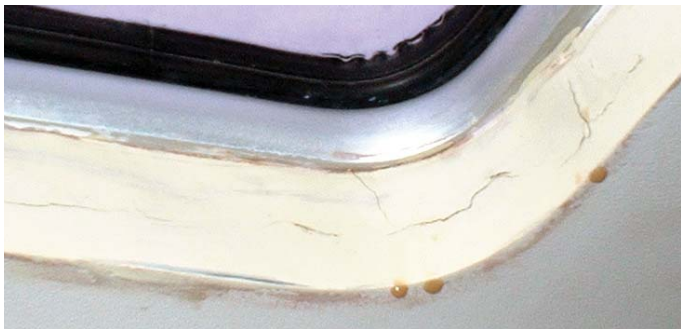
2: Smearing sealant externally on the joint like this won't usually work.

3: A leak can also emerge at one of the hatch frame fasteners.

ROUTE 4 Out of the deck core or inner liner exiting at the hatch cutout.

1: Look for water seeping from cracked filler between deck and liner.

2: Gap between deck and liner mold can act as a conduit to carry a leak to a different location.

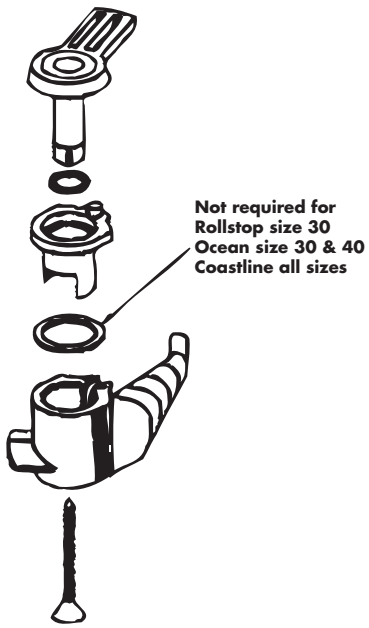


Seepage of brown ooze indicates a wet core.

go, until you see the first sign of seepage out from under or between parts of a hatch.

Leaks arriving by Route 4 (as described on the opposite page in "Find the Leak") are the most difficult to trace. They originate at some other fitting and can travel a long way between the liner and deck or through the deck core before exiting at a vulnerable point in the hatch cutout on deck. Brown water seeping from around the edges of the hatch hardware or the headliner edge trim is a symptom of wet balsa (or plywood) core and is bad news requiring prompt action. Time to bring in a moisture meter or call a surveyor or repair yard you trust.

Washer stack for shimming hatch dog.



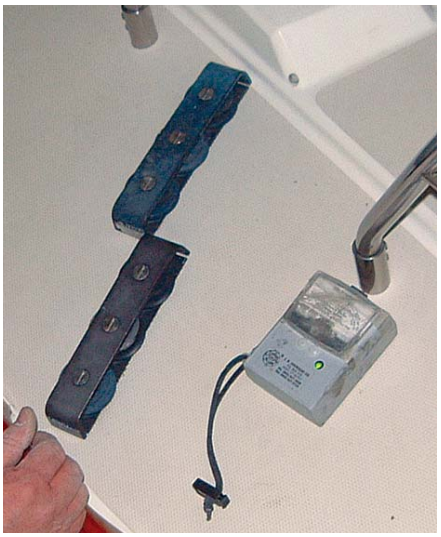
Parts of a Lewmar hatch dog assembly. O-rings are replaceable.

Tame the Leak

Repair techniques vary depending on the source of the leak. Leaks through the lid, as found in Route 1, are caused by either the lens or lid fittings. Framed lenses commonly leak at the flexible bedding around the plastic (acrylic) lens. A proper repair requires complete removal and rebedding of the lens using a high flex glazer's silicone. A Band-Aid approach won't work. [Ed: See DIY 2001-#4 issue for complete hatch lens repair details.]

Any type of hatch lid can leak where holes have been drilled for fittings. Hinges and latches on frameless hatches take a beating and should be periodically tightened and rebedded with a polyurethane sealant. Many anchor locker and cockpit locker lids are Balsa cored so it's important to keep the fittings well sealed. Hatch dogs fitted through plastic lenses differ as they usually rely on O-rings and rubber washers that keep them sealed while allowing them to rotate. Dismantle the hatch dog assembly and replace all O-rings whether they look worn or not. If possible get the hatch manufacturer's repair kit. Cut sealing washers from scrap rubber or neoprene. Thoroughly clean (Don't use solvents on plastic/acrylic lenses.) the surface where the O-ring rides. Apply a light coating of Teflon grease or sail track lube to the O-rings during reassembly to help them seal and to prevent sticking.

Close-up of gasket on edge of hatch lid with frame.



Use a moisture meter to identify water saturated areas.

Steps to replace a gasket: 1 Loosen gasket on frameless hatch lid. 2 Press gasket back in place 3 Apply Sudbury Elastomeric sealant.

Rainwater leaks by Route 2, between the hatch lid and base, are usually not a problem with a typical framed hatch because they are designed to shed water. These are left open a crack for ventilation and still things can stay dry, but don't try this when underway in rough seas. The pressure of green water on deck will blast water violently through the slightest gap. To ensure a hatch stays sealed under these conditions, the neoprene gasket between the lid and the base must be in good condition and the hatch dogs properly adjusted to maintain firm clamping pressure. Over time the neoprene gasket deteriorates and gets crushed flat and the dogs no longer clamp tight. Most hatch dogs are adjustable but eventually you run out of adjustment and then it's time to replace the gasket. This entails peeling and scraping off the old gasket and glue from the hatch and gluing a new one in place using contact cement or a combination sealant glue, such as Rule's Sudbury Elastomeric Marine Sealant. If gasket material is not available from the hatch manufacturer, use generic neoprene weather stripping of approximately the same size and shape. You'll also need to readjust the hatch dogs to suit the new gasket.

Where leaks occur via Route 3,

(continued on page 40)

Steps to resealing a hatch frame: 1 Break the seal by gently driving a putty knife between the hatch base and deck. 2 After hatch base is removed, scrape off the old sealant. 3 Apply new sealant, being careful to plaster each fastener hole well.

exiting along the hatch base, the culprits are usually loose hatch base fasteners. Any that turn easily with a screwdriver must be resealed. Remove suspicious fasteners and any sealant residue, clean both surfaces, tape the repair area to reduce clean-up, then rebed using a polyurethane sealant, such as 3M 5200. Don't skimp on the goo. If in doubt as to exactly where the flange is leaking remove and reseal the entire hatch base flange. This may not be easy. Try tapping a putty knife under the edge to cut the sealant and then gently wedge it up a bit at a time with a broad chisel. Indiscriminant prying will result in a bent hatch flange or worse. Carefully clean off all old sealant from the deck and base flange. Apply sealant to the individual fastener holes and run a continuous bead all around the flange. A well-bedded flange should squeeze sealant around its perimeter as it's bolted (or screwed) down. (Masking beforehand helps to eliminate clean-up.) If you think you might someday have to remove the hatch or its fasteners use a polysulfide sealant, such as 3M 4200. This class of rubbery sealant doesn't have the ferocious adhesive strength of polyurethane but on a large bedded surface will seal almost as well.

Leaks manifesting from Route 4 are difficult to identify, tricky to trace and are a sign of trouble brewing. If a slow leak continues to appear under the hatch at the lower edge of the deck or headliner opening, even after the hatch base is rebedded, you should suspect other hardware as the culprit. Look for wet spots on deck with a moisture meter or if in doubt rebed all the fittings on deck. This is preventive maintenance that should be done at least every 10 years and could save your deck.

About the author: A regular contributor to DIY and author of DIY's "Pro Series" column, Nick Bailey crews onboard "Looney Tunes," a competitively raced wooden Thunderbird skippered by his wife Wendy.

POWER BOAT RIGGING

How to troubleshoot power tilt and trim systems.

[BY STEVE AUGER]

Tilt and trim systems ("power trim") require regular maintenance just like your inboard or outboard engine. Failure to keep up the maintenance schedule results in little or no trim capability and that means poor fuel economy and poor boat performance. Here are a few basic steps to ensure your power trim system is working correctly.

Electrical

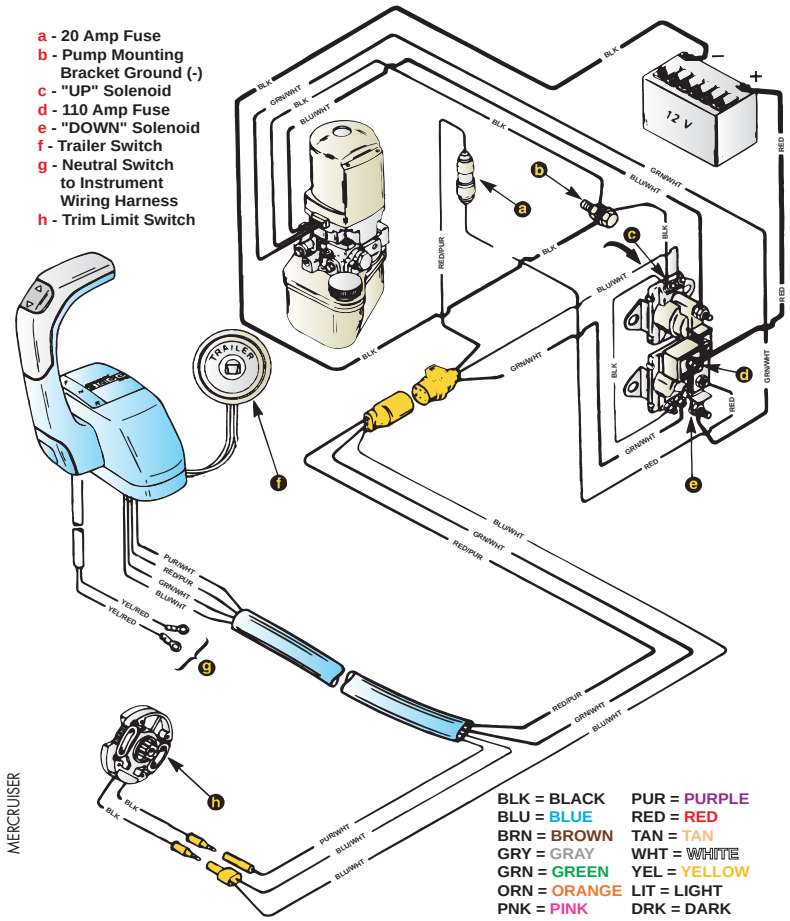
The electric motor that drives your power trim pump uses as much as 75 amps of DC power. When troubleshooting a power trim system, first check the condition of the battery cables that supply the current to the power trim pump. The cables should be a minimum 10 AWG marine-grade insulated wire. There should be no corrosion on the terminals. Check the insulation for cracks or chafing and replace if required. Cracked insulation causes the dreaded stray current corrosion if cables end up in bilge water. If cables are in good condition lay an inductive ammeter on the positive battery cable and trim the motor "up." The ammeter should spike up to a maximum of 75 amps and then stabilize at 25 to 50 amps. If your values are higher than this the electric motor needs attention. This is a job for a marine dealer or an auto electric rebuilder.

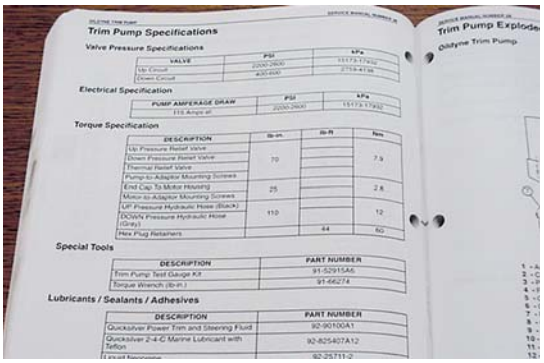
Checking the amperage draw with an inductive ammeter.

Your dealer can quickly check the condition of the pump using a test gauge.

Hydraulics

The most common complaint about a power trim system's not working correctly is that, after trimming the motor all the way "up," you move the power trim switch to the "down" position and nothing happens. A low oil level in the reservoir usually causes this. Refer to your engine service manual for specific instructions to check and/or top up the oil level. Most modern sterndrives are checked with the drive tucked in (rams fully retracted). Most new outboards are checked with the motor





When you are stuck on the ramp and your trim won't work your service manual's troubleshooting section becomes invaluable.

Check for oil leakage at seals and hose connections.

The oil reservoir on a late-model stern-drive trim pump. Oil level should be between the min and max marks with the trim rams fully retracted.

Outboard power trim out of the clamp brackets showing oil fill. Note the ram is fully extended.

in the full "up" position with the trailer lock in place. Be sure to use the correct fluid for your engine's power trim system as outlined in your owner's manual.

Another common complaint is that the motor is trimmed "up," but a few days later it falls to the "down" position. Leaking hoses often cause this "leak down" condition. Look for evidence of oil on the water or on the ground if it's a trailered boat or in the bilge. If there is no oil leaking outside the system then the fault is the power trim "up" system. If it's a Mercruiser engine, you'll need a power trim pump adapter repair kit and two trim ram seal kits (about US$100 cost). These kits replace all valves in the pump and trim ram(s) that fail due to corrosion. Most power trim systems that leak down have had water get into the oil at one time or another in the boat's life, usually about three weeks after the owner has a leaking hose or seal repaired.

Repair kits are available for the experienced DIYer.

Newer model outboards use a modular trim system that may not be repairable and require a complete replacement. Before doing this, however, first disassemble and clean all the valves using the procedures outlined in your service manual. Check with your dealer to see if a repair kit is available for your engine.

About the author: Steve Auger is a service training instructor and Mercruiser product support specialist for Mercury Marine. He has more than 33 years experience servicing outboard and sterndrive engines.

FAMILY BOATBUILDING: BUILDING THE 100-HOUR DINGHY

Here's a simple method to build a boat that requires few tools and little experience. It's ideal for first-time builders and one that can involve the entire family.

[STORY AND PHOTOS BY JAN MUNDY]

To raise money for The Hospital for Sick Children, DIY decided it to build a boat at a boat show. Since I was the only one with any boat building experience, I got the job but finding a boat that we could start and complete in nine days was difficult. We contacted Noahs (Tel: 416/232-0522 Web: www.noahsmarine.com) a supplier of boat building materials, and ended up purchasing plans for a Glen-L Eight Ball–SG dinghy. Measuring 2.6m (8'6") in length, a beam of 1.3m (4'4") and weighing about 38.5kg (83lb), this vee-bottom pram can be rowed, sailed or powered with a 3 hp maximum outboard. To simplify building, we opted to build the rowing model, excluding the daggerboard and case, mast step, rudder, mast etc.

Stitch and glue is the ideal construction method for amateurs to build a boat. It combines plywood, fiberglass and epoxy resin to create a lightweight but exceptionally strong boat. It requires no mold or building frame. Instead, a boat is "stitched" together with wire or plastic wire ties. The completed boat has all the virtues of a fiberglass boat. Except for routine painting and brightwork varnishing, it's completely maintenance free.

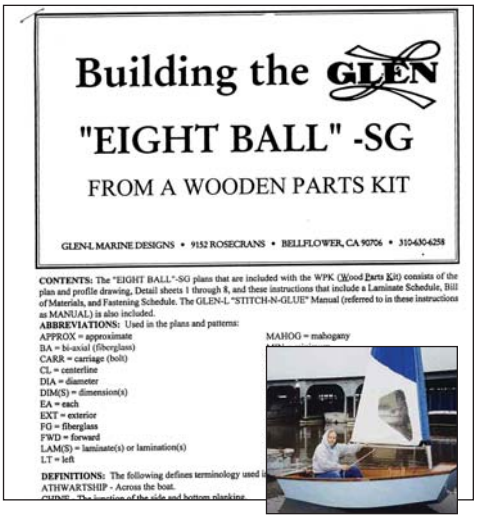
Glen-L (Tel: 562/630-6258, Web: www.glen-l.com) offers all types of sail and powerboats available as plans, patterns or kits. I elected to purchase the plans only, as I had an inventory of resin, glass and the like from other projects. Plans for the Eight Ball-SC (US$41) included full-size patterns for all components, a step-by-step building booklet, materials list, source list and even a list of the tools necessary for construction. Glen-L offers a wooden parts kit (US$453) plus an epoxy kit, which includes the wire, resin, fiberglass tape, fillers and all other assembly materials.

Few tools are needed. Besides the basic woodworking tools and supplies, you'll need epoxy resin and fillers, 16-gauge copper wire (or purchase plastic wire ties or mallable iron wire), disposable containers and stir sticks for mixing the resin, flexible squeegees, putty knives, foam rollers, cheap glue brushes in several widths and a box of "rubber" gloves (purchase the ones sold for medical use at a pharmacy).

Here starts my day-by-day account of our dinghy's construction. After reading this, we hope it inspires you to build one of your own.

Day 1

Prior to the show opening, I transferred the full-size paper patterns onto the wood, outlining the cut lines using a fabric wheel and carbon paper. Three sheets of 6mm (1/4") Luann plywood (waterproof spruce or mahogany ply is a good option) made up the bottom panels, side panels, transom, bow, seat bases and seat tops. Knees, gunwale, outboard support and bow cap were fashioned from 2.5cm (1") solid mahogany. A circular saw worked best to cut straight lines, a jigsaw for curved lines. Alignment marks on the patterns were transferred on the side and bottom panels. Plywood edges were then sanded smooth to removed splinters. Sides and bottom edges were also drilled with 2mm (3/32") holes for wire "clamps,"


Building the GLEN
"EIGHT BALL" -SG
FROM A WOODEN PARTS KIT
GLEN-L MARINE DESIGNS • 9152 ROSECRANS • BELLFLOWER, CA 90706 • 310-630-6258
CONTENTS: The "EIGHT BALL"-SG plans that are included with the WPK (Wood Parts Kit) consists of the plan and profile drawing, Detail sheets 1 through 8, and these instructions that include a Laminate Schedule, Bill of Materials, and Fastening Schedule. The GLEN-L "STITCH-N-GLUE" Manual (referred to in these instructions as MANUAL) is also included.
ABBREVIATIONS: Used in the plans and patterns:
APPROX = approximate
BA = bi-axial (fiberglass)
CARR = carriage (bolt)
CL = centerline
DIA = diameter
DIM(S) = dimension(s)
EA = each
EXT = exterior
FG = fiberglass
FWD = forward
LAM(S) = laminate(s) or lamination(s)
LT = left
MAHOG = mahogany
DEFINITIONS: The following defines terminology used i
ATHWARTSHIP - Across the boat.

spaced about 10cm (4") apart and 9mm (3/8") from the panel edges. Gunwale reinforcing strips and seat cleats were glued on to save assembly time at the show.

Day 2

We setup a building site in our DIY exhibit. The panels that form the hull lay on a long table (no need for a mold or building frame), though sawhorses would be a better choice as they allow access underneath. While I assembled the panels, a helper cut the copper "stitch" wire into 20cm- (8"-) long pieces. Starting with the two bottom planking halves laid flat, I began threading wires from the inside. This involved inserting a wire, pulling the seams together, and then twisting the wire to loosely tighten. This job is best done with two people. Stitching the bow was next, then sides and transom. Where panels bent in to meet the bow and transom, it was necessary to drill more holes, closely spaced together, to secure the panels.

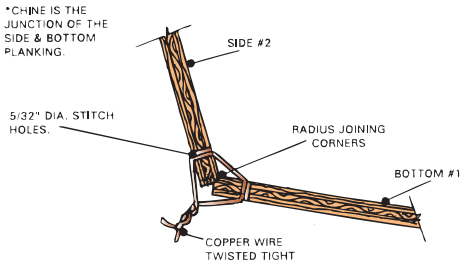
Stitching proved to be a major challenge and fortunately, an experienced stitch-and-glue kayak builder dropped by to help me wrestle with the panels. When all ties were in, we stood back and closely surveyed our

dinghy, looking for skewed or twisted panels. Once all was aligned and hull lines were fair, we twisted each tie tight, being careful that the panels didn't shift as we tightened. It's impossible to match all joints, though gaps of up to 6mm (1/4") are acceptable. All seams were now covered with wide strips of masking tape to stop resin fillets from dripping through the seam gaps. With help from some onlookers, we turned our hull over to begin the interior finishing.

Day 3

Fillets made of thickened epoxy seal the gap between the panels and create a smooth form over which is laid fiberglass tape. Both operations had to be done in one day.

Working a small section at a time, seams were first coated with unthickened epoxy, rolled and brushed on, then filled. To mixed epoxy resin, I added enough lightweight fairing powder and colloidal silica at a 1:1 ratio to form a putty slightly thicker than peanut butter so it wouldn't run or sag. This mixture was then poured into a small plastic freezer bag with one end cut and, using it like a pastry bag, applied the compound to the seam in a thick, continuous bead. Fillets butt up to the wire ties. Otherwise, you get a bump in the fillet where it contacts the tie that requires filling or sanding once cured. Bonded wire ties are also nearly impossible to remove. Passing a stir stick over the fillet gave a nice smooth and round seam. Before moving on to the next stage, which is coating the seams with epoxy and applying fillets, I cleaned up any spills. It's much simpler to do this when resin is in a liquid state, rather than sanding cured, hard epoxy.



GLEN-L

TIP Fillet Filling Tubes

To quickly and easily dispense thickened epoxy, such as in filleting applications, consider using 810 West System fillable caulking tubes. These tubes fit into a standard caulking gun and can be refilled until the epoxy cures. With a set of two costing only US$2.20, it's a much better method than messing with plastic bags.

Before fillets had fully cured, I began taping. This was done by wetting out the 7.6cm- (3"-) wide fiberglass tape and laying it over the seams. This saved a day of waiting for the fillets to cure and then I prepped and sanded prior to taping. Some builders prefer to apply unthickened epoxy resin directly to the seams and then lay down the tape dry. Instead, I saturated pieces of tape in a tray of resin and laid them over the seam, using a squeegee to remove wrinkles and air bubbles. To obtain a straight edge, it's recommended to strike a pencil line along each seam and set the tape to the line. Another good practice is to mask the areas outside of the pencil lines to eliminate some of the mess caused by excess resin and drips. Since tape ends fray, in order

to produce a clean edge, I cut the pieces slightly longer and trimmed them to size with a sharp utility knife when the epoxy was tacky but not fully cured.

Day 4

The fiberglass tapes had fully cured overnight, so I scrubbed the seams with water and a ScotchBrite pad to remove the amine blush, a waxy by-product of epoxy resin that, if not removed, can prevent adhesion to additional resin applications. Panels and fillets were sanded with 80-grit paper to remove any high spots and drips. This took a full half-day, but even then I wasn't pleased with the results but time was pressing, so it was on to the next step. The bow and transom knees and backing

blocks for the bow eye and outboard motor were epoxy glued on.

After wiping the entire interior with solvent to remove any contaminants, I rolled and brushed on three coats of unthickened epoxy resin. Rather than waiting for each coat to cure, subsequent coats were applied while the epoxy was in the "green"

TIP Let it Cure

Polyurethane paints, such as Interlux Brightside, won't cure properly when applied over "young" epoxy. Better to let the resin cure for about seven days before painting.

stage, which means slightly tacky but not so it can be disturbed when touched with a brush. This usually occurs in one to three hours, depending on the ambient temperature.

DAY 5

At this stage, the hull was very rigid. With help from a few spectators, we turned our dinghy over. After removing the masking tape, I pulled out the stitch wires using pliers. For wires that were epoxied, the ends were cut off with side cutters and punched below the surface. Sometimes, applying heat with a soldering iron will soften the epoxy and release the "stitches." But I was without an iron and having used copper wire, I wasn't too concerned. To fill all wire holes, any gouges or low spots in the plywood and the gaps between the sides and bottom, I mixed batches of epoxy resin and filler powder (microballons). This non-structural putty was applied with a flexible putty knife and/or squeegee and spread on thickly so it lay proud of the plywood. Joining edges were molded with putty to form a round bead.

DAY 6

Using a wood rasp and Sure Form, the filled seam joints were radiused and then sanded with 80-grit sandpaper in preparation for sheathing. The entire hull was sanded with 120-grit paper until it was almost perfectly fair. Any high or low spots or

dings were refilled, as needed. These tend to show like dots on a mirror after fiberglassing and painting. Flattening the transom and keel slightly with a block plane prepared the hull for the skeg.

Next step was to vacuum the hull to remove all dirt and sanding dust, followed by a solvent wipe to remove any contaminants. I then rolled on a coat of unthickened resin to seal the plywood hull.

DAY 7

After curing overnight, the hull was ready for a scrub with water and ScotchBrite pad to remove the amine blush. Once dry, it was given a solvent wipe in readiness for sheathing with fiberglass and application of sealer coats. Building instructions call for taping the outside joints, but I opted to sheath the entire hull exterior in 6oz fiberglass cloth for added abrasion resistance.

Rather than pre-wet the hull with resin and then apply the cloth, I applied cloth on a dry hull. Sheets of plastic covered the floor to catch drips — this is a messy job. Cloth was draped over the hull with the weave parallel to the keel and wrinkles smoothed out by gloved hands (worn to prevent contamination from skin oils). Luckily, the cloth was wider than the boat so joining pieces wasn't required. I like to dab a brush load of unthickened resin on the cloth, which sticks the cloth to the hull so it doesn't move, then spread epoxy with a resin-soaked roller and use a squeegee to smooth out the cloth to remove wrinkles, air bubbles and excess resin. Where the sides

TIP Mixing Epoxy

- Epoxy must be mixed at the precise ratio or it may not cure. Purchase metered pumps that dispense epoxy to the exact ratio.
- After mixing the resin with the hardener, stir for at least one minute before adding filler, and then stir for another minute.
- Scrub cured epoxy with water and a ScotchBrite pad to remove the amine blush before another coating or gluing application.
- Clean surfaces with solvent (I prefer lacquer thinner) before applying epoxy resin or glue. Aggressively wipe the surface and change rags frequently to prevent spreading the dirt around. After cleaning, don't wipe the surface with bare hands or you risk recontamination and jeopardizing the epoxy bond.
- Time is of the essence when sheathing, so I prepare containers of resin only in advance. Add the hardener and stir when needed. Continually check the surface, looking for dull spots that signal a "dry" laminate. Recoat such areas with epoxy resin. Look for drips and remove before the laminate begins to cure.
- Cured epoxy is hard stuff and very difficult to sand. When you do a procedure, such as filleting, laminating or taping, be sure you tip off any drips, runs or sags with a brush or roller before exiting the work area. Time spent in reducing the amount of sanding is time well spent.

meet the curve of the bow, it was necessary to slit the glass to form darts. When just slightly tacky, about three hours or so, excess cloth was cut off flush with the gunwale with a sharp knife. While the laminate was still green, I rolled on a coat of unthickened epoxy to fill the weave, followed by another coat four hours later. Applying subsequent coats "green on green" — when epoxy becomes tacky but is not yet set — eliminates having to wait for a full cure and then prep washing the surface prior to recoating. If the cloth starts to pull away from the surface or it shifts, the laminate is still too green.

DAY 8

After an overnight cure, the hull was thoroughly washed and scrubbed to remove the amine blush. I epoxy glued the skeg in place and let it harden. The entire hull was then sanded with 120-grit paper, primed and painted. I used Interlux Brightside, a single-part polyurethane, to ensure a quality, durable finish. (See Tip "Let it Cure" on page 45).

DAY 9

The next stage was to finish the interior. Again, the hull was turned right side up. Seat tops were glued to the seat sides and cleats on the side panels. Undersides of these tops had previously received three sealer coats of unthickened resin. I used a block plane to radius edges, and applied fillets to edges where seats joined the hull sides. Seats are fully watertight and act as buoyancy compartments.

DAY 10

After a final sanding of the interior with 120-grit paper, it was primed and painted. We used Interlux Brightside in white, mixed with a flattening agent to reduce glare.

DAY 11

The last day of the show and the Eight Ball was almost complete. Oarlocks and a stainless-steel bow eye were installed. Mahogany rubrails and the bow cap were epoxy glued and screw fastened. There wasn't time to varnish these pieces so we gave the winner a can of varnish and some brushes.

PROJECTS

BLISTER FACTOR:
Indicates the level of difficulty with 10 being the hardest, 1 the easiest.
1 — 10

NO SWEAT CABIN INTERIORS

Insulating a boat hull helps keep the heat in or the cold out and prevents moisture from forming on the hull interior, which can lead to mildew, wet bunks and general discomfort. There are lots of options available to address the problem. Here is one boat owner's approach to cabin insulation.

Blister Factor 7

Few wood or fiberglass production boat hulls are insulated during construction. On the other hand, insulating a steel or aluminum hull is a must to keep the hull from sweating and to dampen vibration.

"Mystic Bond," our custom trawler "yacht" started as a standard 12m (40') lobster hull built by North Shore Boats of Arisaig, Nova Scotia. The hull, engine, fuel and other tankage were then shipped to Big Pond Boat Shop in Big Pond, Cape Breton, where the main saloon, cuddy cabin top and aft deck were added, followed by the side decks. The hull exterior was finished with AwlGrip. My wife and I had to decide whether or not to insulate the fiberglass hull before we could proceed with finishing the interior.

Why Insulate

There are three reasons to insulate a boat's interior. First and foremost, good insulation keeps the interior of the hull nearly free of condensation. Typically, production boat builders (except steel and aluminum) attach a liner directly to the hull. Alternatively, panels are constructed and fitted with a liner. Eventually, condensation finds its way through the liner or behind the panels and collects on horizontal surfaces, such as bunks, the cabin sole or in the bilge.

Insulation also keeps the boat's interior cooler on sunny days. This is particularly true of dark colored hulls. The boat also retains heat on cold days if the boat has a heater and similarly, keeps it cooler, if air-conditioned.

Lastly, insulation helps to dampen sound within the boat, even though that is not its primary purpose. Engine rooms are usually insulated with a heavy material, such as Soundown (Tel: 800/359-1036; Web: www.soundown.com) made of a thick sandwich of either lead and fiberglass or vinyl and foam. The sheets are finished on one side with vinyl or aluminum foil. Its primary purpose is noise reduction but, when glued against the hull, it also reduces condensation.

Options

Cored fiberglass hulls or wooden hulls do not particularly need insulation because the hull core materials such as balsa, foam or thick, doubled wood planking already serve as good insulating materials. This doesn't completely eliminate condensation but it's greatly reduced, particularly when thick foam cores such as Core-Cell are used.

On steel or aluminum hulls, it's practical to spray the hull interior with insulating foam. This is normally done during construction and can fill all gaps between structural supports. It's an excellent insulator but a very messy process to undertake on a finished boat.

Pink fiberglass insulation used in homes is not a good choice in a

(continued on page 50)

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
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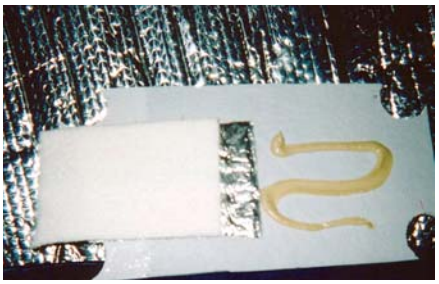
EMAIL: info@diy-boat.com



Test fiberglass board with Bull Dog Premium adhesive, Thermo-Foil and Fossfiber polyester marine liner.

Vertical surface lined with Thermo-Foil cut around a porthole.

Interior of main cabin finished in cherry and mahogany

(continued from page 48)

marine environment as it traps moisture. It also tends to break down with vibration and is difficult to keep in place. Semi-rigid foam boards, another item used in homes, would be a good material but its effectiveness depends on it being glued to a flat surface (of which there are very few on boats).

An alternative to sprayed insulating foam is radiant barriers, such as Space Age Heat Shield (Web: www.heatshieldmarine.com) or materials normally used to line refrigerators or freezers. The primary advantage of Heat Shield is that it's flexible and can be cut to fit in a cramped space. It's more sophisticated than what is used in the construction industry but it's also pricier. A 12mm by 1.2m by 2.4m (1/2 " by 4' by 8') sheet of Heat Shield costs $US236. Another option is a combination one-step liner glued or stitched to an insulation material. Soundown offers a variety of different finishes that match many existing liners.

Ceiling in main cabin is foam-backed vinyl on 3mm (1/8") marine plywood with mahogany battens.

Final Selection

The cabin tops and the aft deck on "Mystic Bond" are made of Core-Cell and fiberglass. Inside, the ceiling is finished with foam-padded panels on battens so we did not feel a need for any insulation. The main saloon walls are layered with 12mm (1/2") mahogany and 19mm (3/4") marine plywood epoxied and fiberglassed on the outside. Again, here there is no real need to reduce condensation. Our main areas of concern were the aft cabin, the heads and forward cabin as they have vast expanses of solid fiberglass.

Given the cost of materials sold for marine use, we decided to look at other options. One product is Thermo-Foil, a densely packed bubble wrap between two layers of reflective aluminum. Thermo-Foil is used primarily in the construction industry to provide insulation under poured concrete slabs and to line metal pipes or steel buildings. At a 12mm (1/2") thickness, it's very flexible, can be cut with scissors or a utility knife to the desired shape and easily glued directly to the hull. Thermo-Foil is not a real insulator but a reflective barrier. With its bubble wrap (they call it polyethylene bubbles) it has an R-value of 6.7 on a horizontal surface. Although this would not be sufficient for a home, the reflective value and vapor barrier effect seemed ideal for a boat hull. The real kicker is that, at US$166/CDN$250 for a 1.2m by 38m (4' by 125') roll, I have enough for my next boat.

Installation

After cutting the insulation to shape, we secured it with a waterproof construction adhesive (Bull Dog Premium), which was beaded on the hull, spread in some places with a putty knife and then applied the Thermo-Foil to it. On vertical surfaces, we had no problem keeping the Thermo Foil in place as the construction adhesive dries quickly and is quite thick. We experimented with several different glues before settling on the Bull Dog Premium. Once

dried, this glue was easier to scrape off the hull or sand than other glues we tested which remain somewhat rubbery (and messy!). Spray adhesive contains some nasty toxic stuff when working in an enclosed space, so we stayed away from that as well.

Cooler and Dryer

After a full summer of cruising our solution seems quite adequate. Even with our dark blue hull, the interior is comfortable and condensation free. The temperature inside the boat is quite comfortable even on 30°C (86°F) days. Gluing the insulation directly to the hull has eliminated condensation. There is no need for other finishes or paneling behind cabinets. We were concerned about the heat buildup on the outside of the hull and its effect on the fiberglass. My concerns were satisfied with some reading, consulting with the DIY Technical Helpline and a summer with record heat. The fact that the hull is hand-laid fiberglass varying from 19mm (3/4") to 3.8cm (1-1/2") thick is also reassuring. There should be no distortion in hot climates.

Adding hardware to the boat hull is easy. Just cut the Thermo-Foil and rip it off, sand away the Bull Dog and drill the holes. Where I miscalculated on the size of the space required, I simply cut a patch of Thermo-Foil and glued it on. On seams, we used an adhesive-backed aluminum tape commonly found in the heating section of building suppliers. It resulted in a virtually invisible seam once firmly applied.

Our next step will be to install a liner to the upper parts of the aft cabin and cuddy cabin walls. We will likely glue this with a spray adhesive applied directly to the Thermo-Foil. The only disadvantage I perceive is the possibility of ripping the liner off the Thermo-Foil if the material is snagged somehow, also a hazard with the expensive foam-backed vinyl ceiling liner.

About the author: André Massicotte installed the plumbing, electrical, mechanical, heating and other systems, while the builder finished the boat's decks and exterior. He built all furniture and cabinetry at his home then trucked it to the builders for installation. Though the interior is comfortable and liveable, Andre's project this winter is to complete the interior joinery work.

Resources

The Reflective Insulation Manufacturer's Association (RIMA) consists of manufacturers or private label marketers of reflective insulation and/or radiant barrier products. As each manufacturer offers its own products, you are likely to find different recommendations on the application, costs and the results you are likely to achieve by using its products. RIMA recommends to you research carefully the options available for your particular application. For a list of members in your country, log onto www.rima.net/active_members.htm.

COMFORT ZONE

Blister Factor **7**

Aside from an aft deck sunpad, many powerboats have limited deck space for sun bathing, napping or sleeping under the stars. This nifty two-person lounge on the foredeck

of an express cruiser is a real attention getter. Albeit this one is built into a channel molded into the deck, it's possible to retrofit a similar single or double deck lounging pad.

Made of 19mm (3/4") StarBoard, this lounger consists of

six pieces: a full-width stopper for the deck cushion, hinged back, a two-piece hinged cushion support, a base bolted to the deck and a retainer for the hinged back. Details include a multi-positional back, heavy-duty stainless–steel hinges, a stainless-steel grabrail and a split cushion with evenly spaced dome fasteners mounted to the deck to enable fastening a protective acrylic cover. As StarBoard is easily cut, routered and drilled, it's not difficult to fabricate. The most difficult task is to engineer a design that fits your boat's foredeck. Boats with generous deck camber complicate the design.

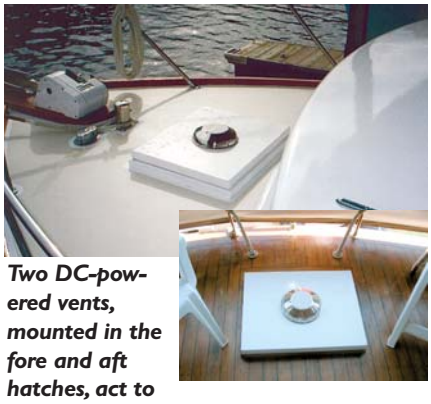
Make thin plywood patterns of all components and double-check all measurements before cutting the StarBoard. Use all stainless–steel fasteners and thru-bolt the base to the deck. Where access to the cabin ceiling is impossible, fasten with screws bedded in epoxy or an adhesive sealant.

— Jan Mundy, Editor

VENTILATE 24/7

Blister Factor ***7***

Powered vents are a godsend for boats that are left unattended even for a few days. Such passive maintenance ventilation greatly reduces mold, mildew and musty odors in enclosed spaces belowdecks.



Two DC-powered vents, mounted in the fore and aft hatches, act to take in and exhaust air, producing the healthy cross-flow ventilation that removes stale odors and provides the fresh air to inhibit mold and mildew.

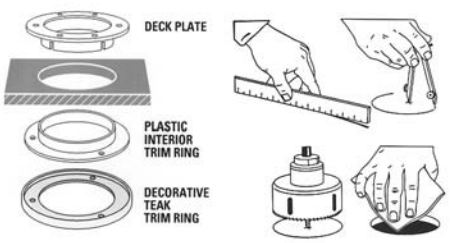
Underside of aft hatch shows mounting of two-speed switch.

Owning a boat involves two kinds of maintenance: proactive and reactive. Ventilation is a good example of proactive maintenance for several reasons.

When not in use, and for the sake of security, boats are often closed tightly for days, weeks, even months at a time in the damp and generally harsh marine environment. Boats that have been closed up during their owner's absences, especially cruisers with living spaces and all the conveniences of home, can become a welcoming environment for mold, mildew and bacteria growth that flourishes in general dampness and produces foul odors. Over time, these conditions can damage upholstery and other interior fabrics, electronics and other gear stowed onboard.

There are two kinds of ventilation: passive and active. Deck vents are examples of passive ventilation that rely on wind movement to circulate air in the same way as opening hatches and windows, which are usually closed when the boat is unattended. A better choice is to circulate a constant supply of fresh air throughout your boat. Such active ventilation is easily achieved by adding a number of mechanical vents.

On "Wiking," an 11.2m (37') Egg Harbor, we installed two DC-powered vents, one at the bow in the forward hatch and the other in the hatch above the aft cabin. These vents come with two fans to allow either exhaust or intake operation.



Artwork above represents the steps to installation. Top left, checking for deck camber; top right, measuring hole; bottom left cutting hole with hole saw; bottom right, smoothing edges of hole with sandpaper.

Two-speed operation moves air at 56.6 cu. m (2,000 cu. ft) per hour on the high-speed setting, and 42.4 cu. m (1,500 cu. ft) per hour on the low speed setting. Our boat, with its 3.9m (13') beam and headroom of 1.9m (6'4"), totals about 84.95 cu. m (3,000 cu. ft). This means the vents exchange the interior air every hour, even at the low speed. Powered by the 12-volt house system, both vents, running on the "high" setting, use less than .5 amps. For boats with minimal power available, consider installing Nicro solar-powered vents that run on sunlight and charge a NiCad battery to supply power at night or on overcast days. These vents move less than half the amount of air per hour, depending on the model.

Vents are very easy to install and come with complete instructions. Just a hole, some sealant, an electric drill, screwdriver and about an hour of your time and you're done. Select a location that is clear of hoses, wires or other obstructions and is preferably a flat surface. Deck surfaces with a lot of camber require shims to level the mounting area. Cut the hole with a holesaw or jigsaw, apply sealant, press-fit the vent and fasten trim ring. Solar vents require no wiring; 12-volt powered vents require a power source, so you'll either have to run wires from your panel or tap into a nearby DC circuit. We ran off a cabin light in the aft cabin and the forward head exhaust fan in the bow.

An investment in active ventilation for your boat is an example of proactive maintenance that returns big dividends in minimizing dampness and mildew, fewer odors and less rot.

About the author: Since purchasing "Wiking" in 2000, Dwight Powell has rebuilt the engines, upgraded the wiring, reworked the interior, had the hull and deck professionally painted, added new canvas and much more. Articles documenting his work have appeared in previous issues.

CURE FOR ODOR FATIGUE

Blister Factor 1

Last year we purchased a Salon Mate air purification system from Quantum Pure Aire (Tel: 800/966-5575, Web: www.quantumpureaire.com). Originally, we had intended to use it on our boat, but another circumstance warranted its use.

A long-time tenant vacated one of our rental properties earlier this year. While inspecting the house after his departure, we discovered that there was a leak around the window in the

shower. The tenant had never mentioned this, but we suspect that the leak was there for some time, as the wall behind the tile was definitely bulging. My husband took a crowbar and popped off one of the tiles and that was all it took for the entire wall to come down. Almost immediately, the most awful stench enveloped the room. All the insulation on that wall was soaked (for who knows how long) and much of the wood was rotten.

There was no way that we could do any more work in that bathroom until the smell was gone. At first, we set up an exhaust fan and closed the room off. But the next day the smell was just as bad and perhaps even worse. Then my husband remembered the Salon Mate and retrieved it from our son, who had been using it at his place. We put it in the bathroom of the duplex, though we were skeptical of its promise. It took a couple of days, but that terrible smell was completely and permanently eliminated.

Now this unit's back onboard and our boat is forever odor-free.

About the author: Maria Russell is the founder of Women Aboard, the network for women in boating. She and husband, Dave, lived aboard for eight years, raising their three children. For the third time in 24 years, they have moved onboard, "Discovery," a 1978 Californian trawler, this time without children.

MOLDING A FAIRING BLOCK

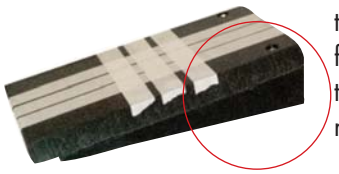
When upgrading your boat's electronic equipment involves mounting a new thru-hull transducer, you might also need a fairing block. Here's how to make one.

Blister Factor 8

STEP 1 Select a mounting location on the hull that maximizes the transducer's performance, offers protection for the transducer stem inside the hull and allows easy routing of the cable. Closely follow the manufacturer's installation guidelines. My preference is a mounting position directly below the helm, though this isn't always possible.

STEP 2 Determine the deadrise angle of the hull using a combination square with bubble level, adjustable set square and spirit torpedo level.

STEP 3 Fabricate a temporary angle block made of StarBoard. Tape provides traction for subsequent operations. Since the angle matches the fairing block on the outside, wedges will later be cut from this block and used as a backing plate inside the hull.



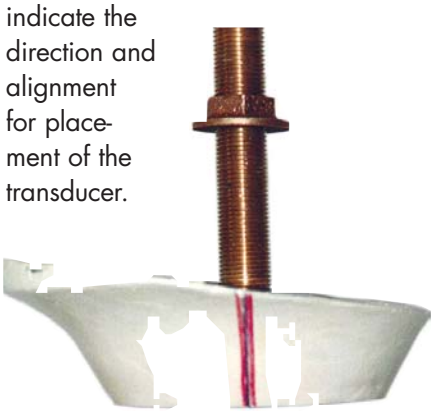
STEP 4 Place the 12.7cm- (5"-) diameter transducer in a glass bowl about 35.5cm (14") in diameter. Apply a thick coating of mold-release wax to both the bowl and transducer and wrap the transducer head in waxed paper.

STEP 5 Place the bowl on the angle block. Be sure the transducer is facing in the correct direction (if it's directional) and that the stem is at 90° to the rim of the bowl. Place waxed paper or plastic (not shown) between the bowl and the angle block. This prevents spills from bonding the two components.

STEP 6 Mix a batch of unthickened epoxy resin. Allow the resin to overflow to produce a level mounting edge.

STEP 7 Once cured, remove the one-piece fairing block and transducer from the mold.

STEP 8 Fill minor imperfections, then sand, prime and apply several coats of anti-fouling paint to match the hull. Mark a reference point on the block; in this case the author uses a stripe, to indicate the direction and alignment for placement of the transducer.



STEP 9 Cut a wedge from the angle block to serve as a backing plate on the inside of the hull. Drill a hole for the stem through the hull and backing plate and mount the transducer, sealing the joint with 3M 4200 or 5200 adhesive sealant, and tighten the fastening nut.

— Bill Macklin, Stratford, Ontario

THE MISSING LINK

Is it the tool that makes the man (or woman), or the man that makes the tool? In the case of Link Tools, it's both.

[BY JAN MUNDY]

If you have ever dropped a socket in the bilge while tightening or loosening a fastener, you'll appreciate Link tools. If you haven't experienced "Murphy's Law of Unintended Disconnects," and you do a lot of your own routine engine maintenance or equipment installations, you likely soon will and you'll wish for Link tools. With Link tools you won't be fishing sockets out of the bilge, often a hopeless effort, or dodge the socket that falls to the deck and rolls into the water during mast adjustments.

Link tools are unique in their patented locking system developed by Paul Roberts, inventor of the quick-release ratchet wrench in the '60s. Each "link" locks together and regardless of the number of extensions or drive combinations you connect, they stay together. This means no more sockets stuck on a fastener while the handle rests in your hand. No more accidental disconnects and bruised knuckles while doing engine repairs.

Link Tools International offers tool sets that range from five to 41 pieces, 1/4" or 3/8" drives and the corresponding 6mm and 9mm metric sizes. The small set (US$149.99) includes a ratchet, 5cm and 15cm (2" and 6") extenders, universal joint and UniDriver (resembles a screwdriver handle). The larger set (US$249.99) includes both SAE and metric socket sizes, spark plug sockets, socket-mounted slot, Phillips and Torx screwdriver bits, Hex bits, UniDriver, universal joint, 2 extenders and locking ratchet handle. A custom molded carrying case makes it easy to select tools. Turn it upside down and all tools stay in place. When securely latched, this kit apparently floats for at least 10 minutes, likely long enough to fish it out of the drink!

Link's patented locking technology begins with the ratchet handle. Just slide the thumb-operated gold button forward to quickly connect, securely lock and release. Extensions, the UniDriver and other "links" in the set feature a spring-loaded collar that engages or disengages a case hardened steel pin that fits into detents in the socket housing. Simply push on a socket or bit and it "clicks" to permanently lock.

Components let the user customize the tool for any job, providing maximum driver and reach capabilities. With connections at both ends, the UniDriver converts to a screwdriver when used with a socket-mount bit. Attach it to the ratchet and it converts to a high-torque ratcheting driver for driving or extracting nuts or screws. Attach an extension handle and universal joint and you can work around corners. An optional palm wrench lets you hand tighten, then attach the ratchet for the final torque. If it's a breaker bar you need, Link also offers sliding T-bars with its patented locking mechanism. For those really demanding jobs, there's an optional 43cm (17") brace.

Tools are nickel-chrome plated for rust resistance, made to 130% ANSI strength standards and are guaranteed for life. Unless the finish is scratched it likely won't rust, but for added protection toss some silica gel packs in the case.

Link tools are not available in stores and only sold direct by from manufacturer. Say you're a boater and for a limited time receive discount off the 3/8"/9mm drive 41-piece case set (as shown in the photo). Contact Link Tools International (Tel: 888/433-4234, Web: www. link-tools.com)

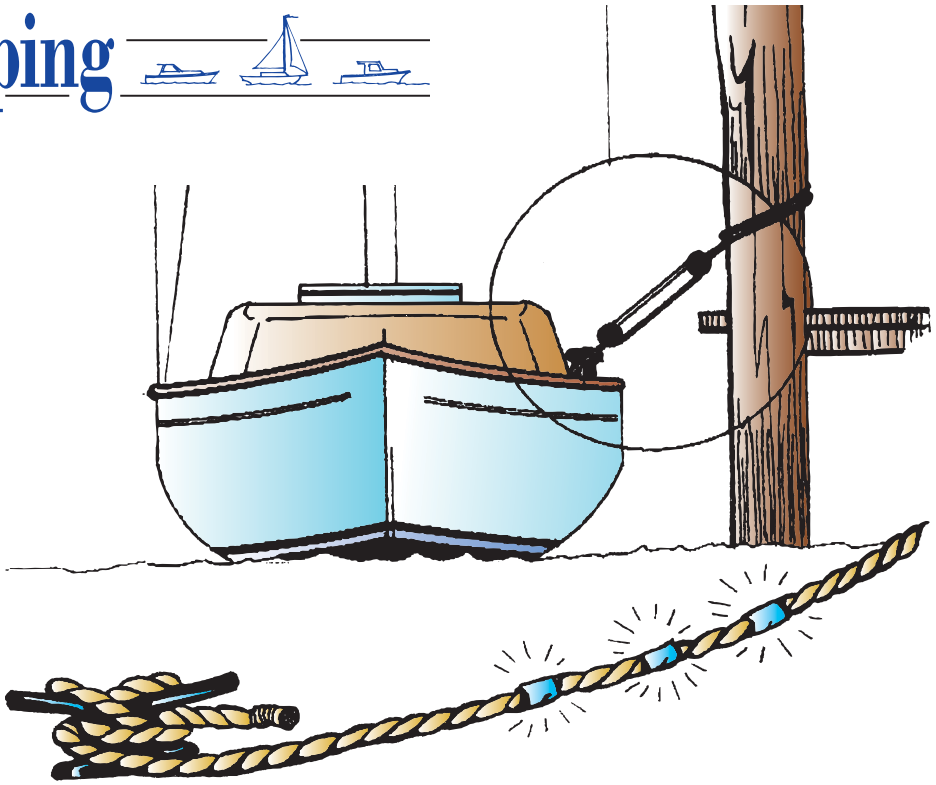
Some advice from a tool collector: Don't lend your Link set to a friend. After using it, they may decide to claim amnesia.

"I am a marine surveyor and I was bragging about my little Link set to a client. I had the tool in my kit bag and he asked to see it. Within minutes, he had borrowed it to remove a panel in the boat for access to the fuel tank fill pipe bonding wire during the survey." – Pat Kearns

Good Boatkeeping

DOCKING TACKLE, READY-MADE FISTS

[BY DAVID AND ZORA AIKEN]



DOCKLINE ADD-ONS

The tie-up arrangement at our current slip is very convenient for boarding and loading. We can use the usual four mooring lines plus springlines, but we have a long , wide dock on one side, not just a finger pier. The tidal range in our area is moderate, so when tying up the boat we have to allow enough slack in the lines for the inevitable shifting that occurs with variations caused by tide or wind direction.

We need to tie the lines in such a way that they keep the boat a good distance off the dock in all situations. This almost guarantees there will be some times when the boat is too far off for convenient boarding.

To avoid retying lines every time this happened, we initially used a single line looped around a winch and tied loosely to a dock bollard. To board when the boat was too far from the dock, we simply pulled on the line to bring the boat close enough for leaping. But when the wind was strong and blowing the boat away, pulling the boat back proved too difficult, particularly when one hand was loaded with packages.

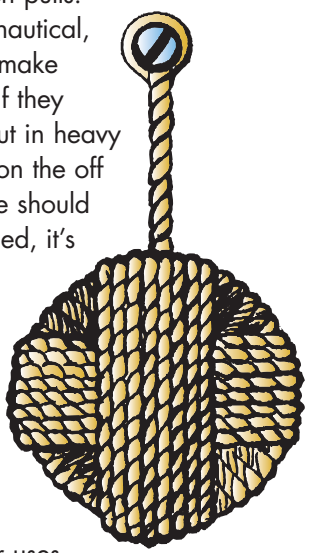
A simple block-and-tackle arrangement solved this problem. One end of the tackle attaches to the boat winch, the other end to a dock cleat or bollard. There must be enough slack on the line that runs through the block-and-tackle to tie off either end. This allows us to pull the boat to the dock whether we are on the dock or on the boat.

When boat slips face a long dock and are separated by finger piers, mooring lines often create a problem. Such an arrangement requires that you tie docklines across the finger piers in order to give the lines a sensible lead to the cleats or bollards on the main dock. This tie-up naturally creates a tripping hazard on the finger pier.

It helps that all boats in the row are probably tied up the same way, so presumably all boaters are cautious when walking on the finger piers. As a reminder to yourself and others, call attention to the lines by wrapping sections of them with brightly colored or reflective tape or ribbon ties. The wraps or ties should be at about 20cm (8") intervals along the section of line that crosses the pier. Or use both colored and reflective tape for both day and night attention-getting.

MONKEY FIST

Fortunately, you don't have to tie your own monkey fist anymore. These practical, decorative knots may be found in most marine-related gift shops, where they are seen most often on key chains. Boat uses for them include door, drawer or overhead screen pulls. They look nautical, they don't make any noise if they swing about in heavy seas, and on the off chance one should get damaged, it's easily replaced. A focused look around the boat will probably reveal many other uses for this handy item.



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"