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DIY BOAT OWNER

THE MARINE MAINTENANCE MAGAZINE

Off-Season Handbook

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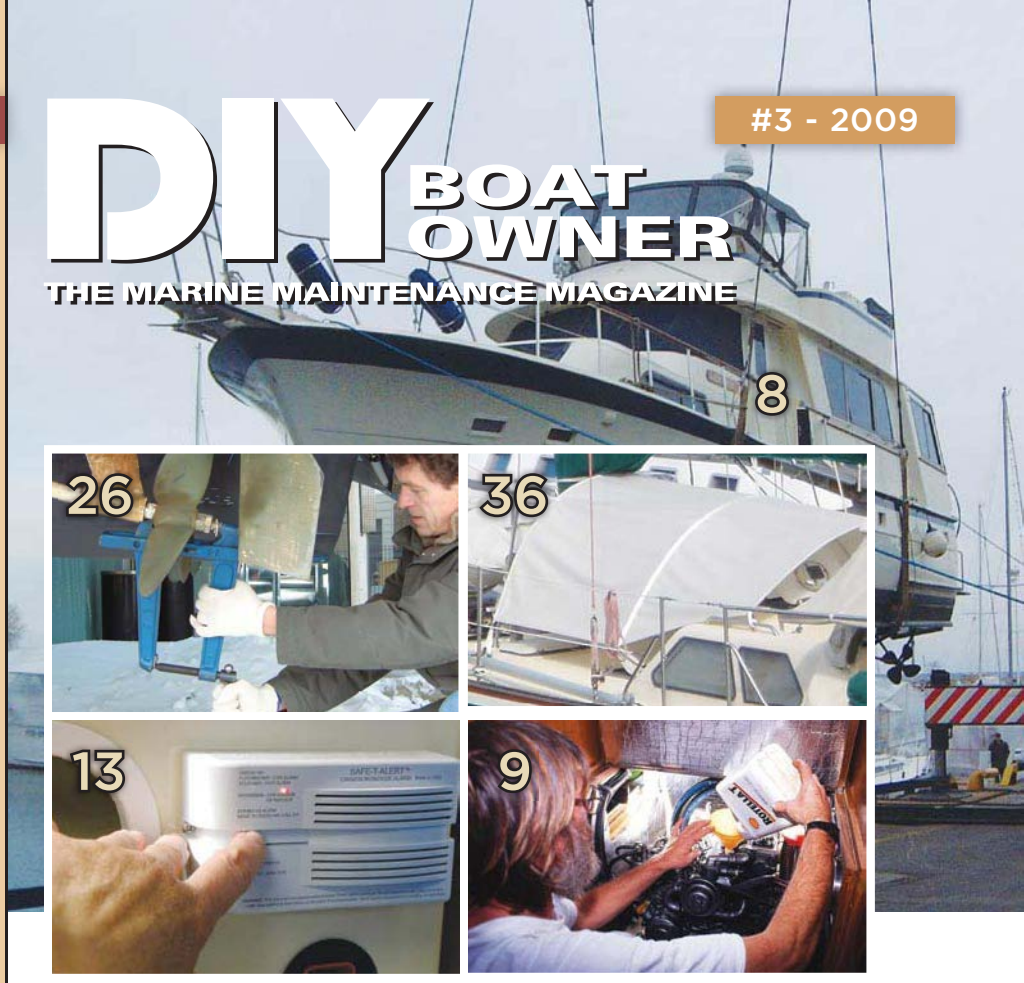
#3 - 2009



COLUMNS

DEPARTMENTS

Haulout Special

On the Cover: If you're one of the many boaters who stow their boats on land during the winter season, turn to page 16 for the complete guide to haulout and lay-up tasks. Photo by Billy Black.

Edited by Jan Mundy

DSC Radio Check

With some help from TowBoatU.S. companies on the Gulf and Atlantic coasts from Mobile, Alabama to Sandy Hook, New Jersey, recreational boaters now get peace of mind in knowing they have correctly installed their Digital Selective Calling (DSC) VHF marine radio and can confirm that it's functional.

A free, DSC-VHF radio check service is now available under a single TowBoatU.S. digital hailing number, which allows boaters to easily call their local TowBoatU.S. tower for a complimentary DSC-VHF radio check.

To use this service, first register your radio's Maritime Mobile Service Identity (MMSI) number, then call your local TowBoatU.S. company's landline telephone number to schedule the free DSC-VHF radio check. Phone numbers are listed online at www.BoatUS.com/msl. When you call, ask what local VHF channel your towing company uses, as this will be the channel to set up on your radio prior to making the radio check. Enter the TowBoatU.S. MMSI number, 0-338-04000, in your radio address book.

TowBoatU.S. operators will confirm if the GPS latitude and longitude position is displayed during the radio check. The free radio check does not confirm the operation of the one-button, mayday distress button feature.

If you'd like to learn more about DSC-VHF radios, go to the free, online DSC-VHF tutorial at www.BoatUS.com/mmsi, where you can also register to receive an MMSI number for your DSC radio.

Jan Mundy

The Lowrance LVR-880 incorporates NMEA 2000 with DSC for distress and, when connected to a GPS chartplotter, which in this installation is a Garmin 5212, a one-button mayday distress feature provides rescuers and nearby vessels with exact latitude and longitude location information, greatly reducing search and rescue response times.

If a Boat Could Talk, What Would it Tell You?

More than 20 years ago, Boat Owners Association of the United States (BoatU.S.) started asking its members about their boats, marinas, boat dealers and any other marine service provider that they had worked with. The organization wanted to know how boats were holding up, if any problems arose and whether or not boaters were being treated fairly if a dispute arose. Most importantly, it wanted to share that information to help other boaters steer clear of problems.

As of this past summer, BoatU.S. Consumer Protection Database (http://my.boatus.com/consumer/database.aspx) has reached its 10,000th entry and it remains the only nationwide database of consumer complaints and safety information reported by boat owners, the U.S. Coast Guard, manufacturers, marine surveyors and marine technicians.

The database contains thousands of specific reports about boats, marine engines, boating products, dealers, marinas and related boating services, as well as information about how or whether the companies involved responded to each complaint. Manufacturer's defect recall notices and safety alerts published by the U.S. Coast Guard and a selection of service bulletins issued by boat builders are also included.

The database is searchable by boat and engine make, model, year, hull number or serial number or by the type of problem and also it provides for registering a new problem.

To increase accuracy, BoatU.S. makes every effort to collect boat make and model information and hull and engine identification numbers. Having this data is vital because analysis often shows that problems are confined to specific models or a series of hull numbers.

The database does not rate or evaluate boats, engines, marine products or services, so users should not expect to find an overall company report card. Also, boaters searching the database will most likely find reports about larger companies simply because large companies have more products on the water. "Keep in mind that the presence or absence of reports is as much a reflection on market share, rather than the quality of a boat or lack of it," said BoatU.S. Consumer Protection Bureau Director, Caroline Ajootian.

The database is located at www.BoatUS.com/consumer and available to BoatU.S. members.

Garmin Recalls 2009 BlueChart Cards

Due to reported water depth discrepancies in some of its 2009 electronic nautical charts, Garmin is conducting a voluntary

Sacha

product safety recall of the 2009 version of its marine cartography data cards known as BlueChart g2 and g2 Vision.

The affected data cards were sold between April 8 and June 3. In certain waters, the data card provides inaccurate indications of the depth, creating a risk of running aground, according to the company. Garmin says it has only received reports of data cards giving inaccurate depth indications in the waters along the coast of Sweden and Denmark. Nevertheless, the company says it decided to issue a global recall of the BlueChart g2 and g2 Vision cards.

Affected products are the 2009 version of the BlueChart g2 in Garmin proprietary card format, BlueChart g2 in micro SD/SD card format and BlueChart g2 Vision in microSD/SD card format.

Affected customers will be provided with a free replacement BlueChart or BlueChart g2 Vision v2008.5. When the 2009 version has been corrected, Garmin intends to make it available free of charge to those customers. For information, visit www8.garmin.com/bluechartrecall.

New Hand at the Helm of Chapman

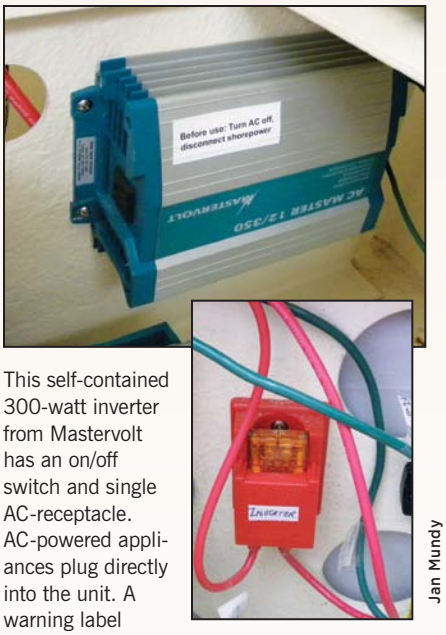
Since 1966, Elbert "Mack" Maloney has been the driving force behind the reference book known to generations of boaters as the bible of boating, *Chapman Piloting: Seamanship And Small Boat Handling*. He's also been the guiding editor of *Dutton's Navigation And Piloting*, as well as *Chapman Boater's Handbook*. This month, with the publication of *Chapman Piloting's* 66th edition, this esteemed editor, writer and consummate mariner hands the wheel over to a new editor, the first time the book has changed bylines in more than 40 years.

The new editor, Charles Husick, is a *DIY* contributor and *BoatU.S. Magazine's* technical editor. A longtime sailor, member of the BoatU.S. National Advisory Council and former president of Chris-Craft boats, Chuck is a respected expert on safety, electronics and innovation in the boating community. His expertise and deep knowledge will continue to enhance the 928 pages of *Chapman*, a crucial reference book that deserves to be aboard every boat.

"They told me not to get the trailer too deep in the water."

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 to inadvertently supply energy to the AC system 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



This self-contained 300-watt inverter from Mastervolt has an on/off switch and single AC-receptacle. AC-powered appliances plug directly into the unit. A warning label reminds users to disconnect the AC main and shorepower before using. Even small inverters require mounting in a well-ventilated compartment and circuit protection, in this case a 40-amp fuse, in the positive wire.

Jan Mundy

A: The inverter must be connected to the ship's AC main through a freestanding 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. It may be located 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.

Make sure you consult ABYC standard A-31, Battery Chargers and Inverters. There are other important requirements for inverters and installations, including one that requires a label be posted at the main electrical panel to alert to the presence of an inverter in the system. Since inverters operate on demand, AC power could be provided unintentionally if an AC appliance is turned on, which would "awaken" the inverter and energize the AC electrical system without knowledge or intent. A fault could lead to injury or death on an ungrounded boat that is not in the water, for example. There is, at least, one fatality known to have been caused by such a fault. Since many inverter installations are done by DIYers, reference to the standard can be lifesaving. These cautions are usually found in the installation manual of inverters that are built with the intent for marine applications.

Plumbing Multiple Tanks

Q: I'm restoring a 1973 Bell Boy 22' (6.7m) hardtop cruiser and have replaced the two original 18-gallon (68L) fuel tanks with Tempo plastic tanks and added two more 22-gallon tanks (83.2L) amidships, one under the helm seat, the other under the lounge seat. What is the best way to plumb all four tanks so they can be used individually, all at once or two at one time? The boat has a Volvo 270 sterndrive powered by a 302 Ford V-8 engine and a Yamaha 8-hp four-cycle kicker engine. Ideally, I want to operate either engine off any one of the four fuel tanks.
Dave Hodges, Mount Hermon, California

A: I have never been too keen on having fuel tanks with multiple manifolds and valves as this promotes the possibility of undetected fuel leaks. I advise you to install a shut-off valve at each tank outlet then route a fuel line from each of the four tanks to a fuel manifold then route a fuel line with a shut-off valve from the manifold to each engine. Otherwise, you'll need to run a fuel line from each tank to a manifold with a shut-off valve installed on each line just prior to the manifold. When running the main engine, always close the shut-off valve to the kicker and vice versa. Be sure each tank is equipped with a functional anti-siphon valve.

Preventing fuel from siphoning from a tank if a fuel line is broken can be done in several ways to achieve this critical safety protection. For guidance to doing a safe installation of this modified fuel system, consult ABYC (www.abycinc.org) standard H-24, Gasoline Fuel Systems, for guidance to compliance for the installation and plumbing. The U.S. Coast Guard (USCG) also publishes an online edition of the Fuel System Compliance Guideline, which is more of a practical "how to" than the standard itself. ABYC's standard for safety exceeds the minimum USCG requirements but they are a place to start. The online version of the compliance guideline is found at www.uscgboating.org/safety/boatbuilder/fuel/fuel.htm.
— Steve Auger

One-way Steering

Q: My boat's engine is a '97 Bravo Three drive that no longer turns to the left with the steering wheel. While troubleshooting the problem, I found that the upper swivel shaft is loose (not fitting tight) inside the gimbal ring assembly. If this is causing my steering problem, what is the solution?
John Mckenzie, Lebret, Saskatchewan

A: A loose gimbal ring to steering shaft connection will not prevent the drive from turning left but it does cause sloppy steering. The gimbal ring to steering shaft play

may be reduced by loosening and retorquing the U-bolt located at the top of the gimbal ring. This job requires 40 foot-pounds on a torque wrench. This loosening and retorquing process should be performed yearly as outlined in your engine maintenance guide. If the drive does not turn with the steering wheel, pull the pin that connects the steering cylinder to the drive unit tiller arm. If the drive then can be moved by hand you have a steering system problem, such as cable or rack or steering cylinder. If the drive does not move freely, you likely have something jammed in the transom assembly area preventing full movement of the drive unit.
— Steve Auger

Plywood Repair

Q: My small trawler has a lower helm station with a plywood helm seat. Over time, a leaking cabin door has damaged the seat causing the top ply to peel in places. I can't replace the seat but I can replace the plywood. (I've already fixed the leaky door.) How do I best glue the new plywood over the rough surface of the existing seat? With some of the top ply missing, I'm afraid I won't get a solid bond unless I either use some kind of filler first or use a thick, paste-like adhesive.
Dan Tipton, Stuart, Florida

A: Your repair product of choice is epoxy resin. To do this job, first degrease the remaining plywood with solvent to remove contaminants and then sand as best you can with 80-grit paper to abrade the smooth areas. Apply one coat of unthickened epoxy resin to the wrong side (mating surface) of the new plywood panel and let cure. This seals the wood so the thickened epoxy glue doesn't soak in. Wash the epoxy plywood surface to remove any amine blush and sand with 120-grit paper. Tape the seat perimeter edges to facilitate clean up of the squeezed out epoxy. Mix a batch of epoxy thickened with colidial silica to a mayonnaise consistency. Apply a heavy coating of this thickened epoxy to both the seat bottom and new plywood mating surface and then lay down the plywood. Use a rubber or metal laminate roller and lightly roll out the ply surface to the edges, applying light pressure to remove air bubbles and excess glue while still keeping the surface level. You'll need to devise a method to hold the plywood tight against the seat bottom using staples, tape, battens, braces, exercise weights, etc. When the bond has cured, seal the plywood top and all edges with three coats of clear epoxy and then varnish or paint.
— Jan Mundy

Practice Proper Charging

Q: When using a battery charger to charge my boat's batteries, they appear to boil in the cell. Any thoughts on this problem?
Stuart Henderson, Toronto, Ontario

A: If your tool collection does not include an accurate digital voltmeter, stop reading now and remedy that omis-

sion first. For maximum service life, battery charge/float/state-of-charge voltage indications are measured within 1/10th of a volt accuracy. Assuming that you are using a basic voltage limited charger, what is the maximum voltage, measured at the battery terminals, of the charging rate? The nominal initial target is 14.2 volts. At this voltage, some off gassing of hydrogen is normal. As voltages rise above nominal, increased water use, overheating and plate damage can occur.

Does the gassing appear the same in all cells? A partially shorted cell will gas excessively and tend to limit the maximum terminal voltage. If cells are gassing equally and the "on" charge voltage reading is 14.1 to 14.3 volts, then all sounds okay. Except, leaving the battery connected at that voltage for long periods will severely shorten its life. Put the charger on a timer with "on" time set to replace necessary amp hours or better, invest in a quality multi-step charger that monitors the battery and maintains a float voltage of approximately 13.2 volts after a programmed charge.
— Dick Rogers

A Hooking Solution

Q: I want to install a simple reefing hook on my 26' (7.92m) sailboat for mainsail reefing purposes. Can you tell me the specific type of hook I need and how and where to install it? There are a bewildering variety of hooks available including U-hooks, reefing hooks, Cunningham hooks, tack hooks and downhaul hooks. Several of them seem to perform a similar function.
Bob Griffiths, Parry Sound, Ontario

A: The downhaul, tack and Cunningham hooks are all similar; the mainsail one is very different. You have two rig choices. Use a jiffy hook (a.k.a. Cunningham hook) on a 2:1 tackle so the hook is always through the sail luff grommet and the line runs back to the cockpit. This means that you lower the sail while, at the same time, pulling it down with the reef line, all from the safety of the cockpit. Mark the mainsail halyard so you know how far to lower it so there's sufficient luff tension. For each reef, rig a separate tackle and run all lines aft to a common cleat. Alternatively, permanently mount a reef hook on the boom. This requires physically placing the sail grommet on the hook after lowering the sail. The first option gives the best control and is the one that I prefer.
— Jan Mundy

Evidence of Core Wetting

Q: After a rainstorm, a brownish liquid seeps from the flying bridge aft drain holes on my 1986 Ocean Alexander 40 DC trawler and stains the areas it contacts. These drain holes are located in the side cavity that surrounds the bridge. Inside an inspection plate, the area is wet. I assumed the drain holes were plugged so I drilled them, this liquid poured out and it's been raining brown ever since. Any suggestions?
Al Shuhart, "Sundial," Punta Gorda, Florida

A: I suspect this is a case of a saturated core. Water is probably migrating into the laminate from hardware mounting(s) not properly sealed where they penetrate the molding and the balsa or plywood core has become water soaked. After a rain, the leak source lets in more water, which runs through the wood, oozing the brown fluid (water likely stained rotted wood) at the lowest point, the flying bridge drain holes. You must locate the source of the leak and seal it or water will continue to break down the laminate's core and eventually affect the structural integrity of the flying bridge, its sole (floor) and other adjoining moldings. These leaks can migrate to the cabin side where they will damage the molding panels for those structures. You should engage a competent marine surveyor now to assess the cause, nature and extent of the problem before you take any action to seal off the leak source. If the problem is limited to the flying bridge, consider yourself lucky. If not, at least you'll know what you face in the repair. For complete details on replacing core, refer to the DIY CD-ROM *Fiberglass Boat Repair*, available at www.diy-boat.com
— Jan Mundy

Filings in Gear Lube

Q: When I drained the gear lube from my 1988 Mercruiser Alpha One drive, I get a small "fuzz ball" of iron filings on the magnet of the drain plug. The lower unit was rebuilt in 1998 (gears and bear-

DIY BOAT OWNER
THE MARINE MAINTENANCE MAGAZINE

DIY Boat Owner™
The Marine Maintenance Magazine™
P.O. Box 22473
Alexandria, VA 22304

Publisher: Nancy Michelman

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Circulation: Susan Clark

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Front Cover Photo: ©Billy Black

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Subscription Rates:

1 year (4 issues)	$25
Canadian residents	add $5
Foreign residents	add $25
EZINE (web version) 1 year	$15

Payable in U.S. Funds only

DIY Boat Owner #3 Fall Issue 2009; DIY Boat Owner, ISSN #1201-5598 is published quarterly by Boat Owners Association of the United States, 880 S. Pickett Street, Alexandria, VA 22304-4695. Periodical postage paid at Alexandria, VA and additional mailing offices.

POSTMASTER: Send change of address to DIY Boat Owner, PO Box 22473, Alexandria, VA 22304-2473

Printed in USA

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Metal filings on gearcase fill screw magnet.

ings replaced) and the drive appears to be working well. There is no water or brown oil in the drained lube. I run the engine about 30 to 50 hours a year and change the gear lube each year at end of season. How much, if any, metal filings are acceptable? Do I need an adjustment or overhaul of the lower unit?

David Beach, "Knot Home," Waupoos, Ontario

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

— Steve Auger

Why Use Marine Oil?

Q: I have been using Castrol 10W30 synthetic automotive oil in my rebuilt 1985 350 Volvo Penta engine. I'm now informed that this may not be a good idea. What do you think?

Andy Mead, St. Catharines, Ontario

A: You have described your oil correctly as automotive engine oil and although this is excellent oil for automobiles, it's far too light for a marine inboard engine unless you do all your boating above the Arctic Circle. Most consumer-operated marine inboard engines are operated in a narrow band of ambient temperature of around 50F to 90F (10C to 32C) and therefore don't require a light oil for cold engine start up. (An automobile has an ambient operating temp of -35F to 100F (-37C to 37.7C) so it requires lighter oil for cold engine start-up.) The actual design of the marine engine oil ensures that the oil is better suited to the high load that a marine engine has, compared to an automotive engine application. The shear point of automotive engine oil is too low for a marine inboard application.

The oil Volvo recommends for your engine is Volvo straight 30 Weight synthetic marine engine oil. You could also use Mercury 25W40 synthetic marine engine oil if you're unable to find the Volvo oil. I would advise you to switch to a quality marine-grade engine oil and stay away from any automotive engine oil.

— Steve Auger

Seal All: Available in 1lb (0.45kg) blocks from Home Depot and electrical supply houses, Duct Seal (Gardner Bender part number DS-110) is the industrial equivalent of modeling clay. It's cheap, non-toxic, waterproof, odorless, reusable, non-staining, non-flammable, adheres to almost everything and is formulated to seal electrical conduits with no worry of it damaging insulation. Use it to seal the hawse pipe, electronics cables where they exit the mast or stern arch, or seal nuisance leaks.
Harry Hungate, "Cormorant," currently based in Turkey

Close Watch: Normally sold as a wildlife surveillance camera, the Wildview Infrared Xtreme ($100 at www.wildview-cam.com) makes a practical boat security monitor. Battery driven, weatherproof and using infrared flash, it silently takes photos of anyone or anything that comes near your boat.
Dan Martin III, Seabrook, Texas

Shroud Ribbons: Before you take down the mast, tie red ribbons on the port shrouds, green ribbons on the starboard ones, and other colors for running backs, baby or jackstays. Ribbons simplify sorting of rigging when raising the mast and are especially helpful when the mast has multiple shrouds or backstays.

Optic Eye: A hand-held dental mirror or mechanics mirror with an extendable handle makes a great tool to inspect out-of-sight hoses and wiring. The latter is available in any auto parts department of a discount retailer. They come is several sizes and extension lengths. They are very inexpensive so have an assortment and keep them handy.

Jan Mundy

Circlip Removal: When you need to remove circlips (the retaining clips that always spring off into the drink), chuck the screwdriver and pliers and buy inexpensive circlip pliers. They come with a variety of interchangeable tips and can open either inside or outside clips. Always replace a circlip, never reuse.

Jan Mundy

Shrinkwrap Guard: A cost-effective solution to preventing punctures and tears where shrinkwrap stretches across stanchion tops, windshields and other peaked angles is to cover the angles, corners and other protrusions with pieces of inexpensive, brightly colored foam pool noodles, secured with wraps of shrinkwrap or pvc tape.

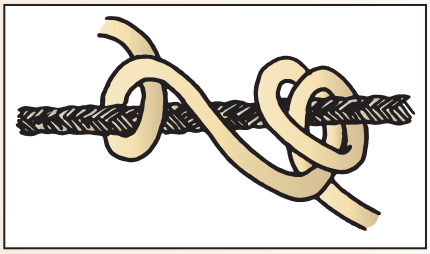
Seacock Exercise: It's a good idea to frequently open and close all seacocks to ensure valves are working freely. So you don't miss any and you know their location in an emergency, add the placement of all seacocks to your boat plan... you know, that sketch you keep in your logbook that shows routing of wiring, plumbing, etc. While you're at it, use a labeling machine to make the adhesive baked, vinyl labels that you can wrap around the hose at the seacock or attach to the flat shaped handles of ball type valves.

Mildew-Free Cushions: Once a year remove the foam (open cell only) from your interior cushions and spray with a mold and mildew preventative, i.e. 3M Marine Mildew Block, and let dry. While you're at it, spray carpeting (do a spot test first), shower, etc. to create an invisible barrier where mold and mildew won't grow.

Electric Shorts: For a positive electrical connection, install new vibration proof (star) washers between the terminal and the component, not between the terminal and the nut.

Pinhole Nozzle: When you winterize your washdown pump, be sure to also de-ice the plastic nozzle to prevent it from cracking when temps drop below freezing.

Cheater Knot: To secure one line to another, such as when you're attached one anchor rode to another in a Bahamian moor or attaching a cheater line to a genoa sheet when it's necessary to relieve tension while adjusting track cars. Use a rolling hitch to make the attachment.



A Helping Handhold: To hold parts in place when gluing or attaching nuts and washers, especially when working overhead (against gravity) or in other awkward areas, lightly dab some silicone sealant on the part before assembling.

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Although reader tips are accepted as submitted in good faith, DIY has not tested or proven those tips. DIY offers no guarantee or warranty as related to their fitness or suitability for service or application as reported.

End of Season SERVICE

Follow these steps to prepare your engine for off-season storage.

(top) Always change oil in fall as part of your engine off-season prep. (middle) Remember to service the water separating fuel filter. (bottom) When replacing a spin-on canister-type oil filter wipe a light film of engine oil on the filter seal; never use grease.

Story and photos by Nigel Calder

As another boating season draws to a close, it's once again time to think about decommissioning the engine. Tasks involve servicing the lubrication, fuel and cooling systems, electrical components, control cables and drive train.

Oil and Grease

An operating engine, especially a diesel engine, produces harmful contaminants that are flushed into the pan and held in suspension by the oil. If left over the winter months, these attack sensitive engine surfaces. Always change the engine oil and filter at the end of the boating season rather than at the beginning of the next one. The transmission (and any saildrive or sterndrive unit) also need an annual oil change.

Before changing oil, run the engine until warm to ensure that all the old oil drains out. It is not as easy to run the engine once a boat is ashore as there are likely to be problems supplying the necessary cooling water so the oil is best changed before a haul out. Following the oil change, run the motor for a few minutes, engaging both forward and reverse gears, to circulate the clean oil throughout the engine and transmission.

Any grease points need greasing (most modern engines don't have grease points). Some diesel manufacturers recommend pulling the injectors to squirt proprietary oils into the cylinders but, unless the injectors need servicing, this is more work than most boatowners will want to get into.

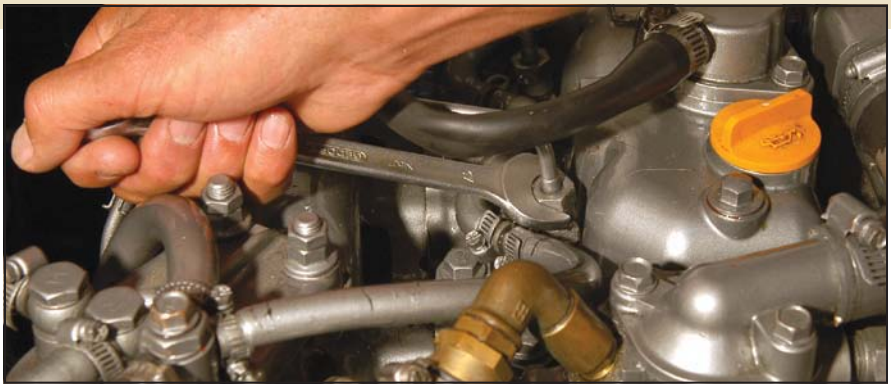
If present, clean or replace the air filter (many small diesel engines don't have air filters), after which you should seal the air inlet along with the exhaust to keep moisture out of the engine. Be sure to leave a conspicuous note (the ignition switch is an option) to remind yourself to remove the covers when recommissioning.

(top) Two necessary oil change tools are a strap wrench to loosen the oil filter and a diaper or other absorbent material to catch any spills. (bottom) Place used fuel filters in a closable plastic bag for disposal at a hazardous waste collection facility.

Clean Fuel

According to one estimate, 90% of all marine diesel engine problems are caused by dirty fuel. Replace the fuel filter element(s) at least annually. If a filter is covered in slime, the fuel tank is contaminated with bacteria. Other forms of contamination are water and sediment that gather in the water/fuel separator filter bowl.

If there's evidence of a contaminated tank, the tank needs to be drained or pumped out. Sometimes, a tank requires a thorough flushing, which, in turn, may require cutting access holes into inaccessible compartments.



Follow the procedures specified in your owner's manual to bleed the engine after changing fuel filters.

As troublesome as this may seem, it's a fraction of the work and expense incurred as a result of even relatively minor fuel system repairs.

After changing engine fuel filters, "bleed" the fuel system to remove all air. With most modern engines this is done by opening the throttle wide and cranking but, with some older engines, it is quite an involved procedure (see your owner's manual). After bleeding the engine, run it for a few minutes to make sure all the air is out of the system. Once again filter changes are best done before a haul out.

Many people like to add a bacteriocide (a.k.a. biocide) to diesel tanks to prevent bacterial growth but the bacteria can only survive in the interface between water and diesel. If there is no water in the fuel, there will be no bacteria.

It doesn't seem to matter how much, or how little, diesel is in the tank over the winter. (Gasoline is different, especially gasoline with ethanol.)

Cooling System

Remove the valve elements from any anti-siphon valve (vented loop) and wash in freshwater.

Drain the freshwater side of a closed cooling system and refill with a 50/50 water/antifreeze solution at least every two years. This needs to be done even if the existing coolant already contains antifreeze and even if the boat is in an area where it will not experience freezing temperatures. Antifreeze contains various corrosion inhibitors that get used up over time and need replacing.

The raw-water side can be either drained and/or filled with an antifreeze solution.

Draining requires particular attention to low spots where water can collect.

Recommissioning

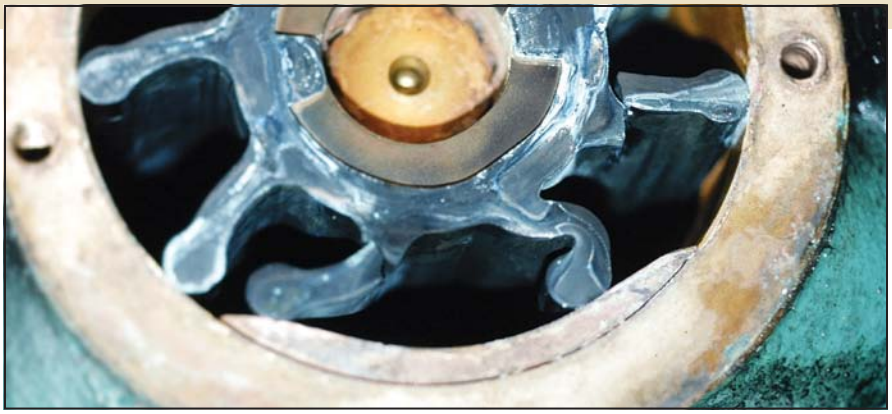
Some mechanical shaft seals require a "burp" after launching.

Uncover any engine openings that were sealed at lay-up time and reinstall the raw-water pump impeller (if removed). If drained, the raw-water system needs priming. A stuffing box nut may need loosening. If the shaft seal is the type with a rubber boot, any time the boat is hauled and then put back in the water, the boot may burn out if it is not primed by pulling it back until water squirts out. (Some seals have a vent hose that eliminates this problem.) Alternator and other belts should be checked for proper tension. Any that are hard and shiny or cracked need replacing.

It's a good idea to crank the engine for 10 to 15 seconds with the throttle closed so that it does not start. This will get some oil moving around the bearings. If it's cranked for any reason for longer than this, you may need to remove the drain plug from the water-lift muffler so that the extended cranking does not flood the exhaust system.

Now crank the engine for real. Immediately as it fires, check the oil pressure and confirm that water is discharging from the raw-water cooled exhaust thru-hull. Idle the motor for several minutes to establish thorough lubrication of all internal surfaces and, while this is going on, make a check for any oil or water leaks. If all looks fine, you should be well set for the new season.

—NC



(top) Worn impeller with vanes that have taken a "set." (left) Remove the waterpump impeller to access the impeller.

Check for debris in the raw-water filter and clean if needed, a step that should be repeated before every engine start up.

The flexible impeller is best removed from most raw-water pumps in order to stop one impeller blade from being compressed against the pump cam all winter long, which may bend the blade permanently. Check the impeller for cracking of its vanes or excessive wear (the tips will be flat instead of rounded). If any vanes are broken, you need to track down the missing pieces (they will probably be in the heat exchanger). Impellers should be replaced every two years regardless of use time. Make another reminder note to put the impeller back when recommissioning. The engine should be run for a few seconds to drive residual water out of the exhaust system, after which you remove the drain plug from any waterlift type muffler. Inspect sacrificial anodes (many modern engines don't have any) and replace if they're more than half eaten away. Clean the raw-water strainer and any suction screen on the outside of the hull.

Instead of draining a raw-water system, after closing the raw-water seacock and making a routine inspection (as above) of the flexible pump impeller, any sacrificial anodes and the raw-water strainer, disconnect the raw-water suction line from the seacock, dip it into a bucket of plumbing antifreeze, and run the engine until the solution is pumped out of the exhaust. [Ed: To simplify this procedure consider installing a Forespar two-way seacock

Easy Engine Flush

Forespar

Forespar's Engine Flush out Valve offers a quick and easy way to winterize inboard engine systems. Made of Marelon, a glass-reinforced nylon that meets the material requirements for thru-hull fittings and seacocks in ABYC standard H-27 for marine use, it comes with a specially designed thru-hull fitting that replaces the existing one.

The seacock/valve threads into the existing raw-water thru-hull and the hose barb end connects to the engine intake cooling hose. To winterize the system, simply thread one end of a garden hose to the brass female coupler on top of the valve, place the other end in a bucket of plumbing antifreeze and turn the valve handle 90 degrees. It also works well to flush engines operating in salt or brackish water with freshwater after use to avert corrosion. Valves are available in a variety of styles and sizes or with standard NPT parallel threads for use on existing bronze thru-hulls.
— JM

as described in "Easy Engine Flush" above.] Use propylene glycol, rather than ethylene glycol, since the latter is toxic and should not be discharged overboard. The raw-water system is now fully protected against freezing.

Control Cables

Engine and transmission control cables are a common source of operating difficulties. Things to look for are: corrosion at the end fittings; bending of actuating rods; seizure of the swivels at the transmission or engine; cracks, cuts, burns or melted spots in the conduit sheath; corrosion under the sheath (it will appear swollen) and excessively tight curves or kinks (the minimum radius of any bend should be 8"/203mm).

If you disconnect cables at the engine and transmission, you can check the free movement over the full operating range of the remote controls. When the cable is reattached, it is important that the neutral position on the remote control corresponds with the neutral on the transmission. Check that the transmission lever is moving fully into forward and reverse. Note that many mechanical transmissions are susceptible to damage if the operating lever at the transmission does not move through an arc of 30 degrees or more in both directions.

Shaft Seal

It is remarkable how often you see the bilge pump on a boat laid-up afloat throwing out a steady stream of water every few hours. In almost all cases, the source of the leak is a traditional stuffing box (many modern boats have a different kind of shaft seal that is more-or-less immune to leaking). If the battery should die or the pump fail, the boat will sink and it won't be because the pump stopped working. It's the leak that sinks the boat. [Ed: A surveyor we know finds rudder stuffing boxes to be a regular source of this kind of leak. These packing glands are often obscured from view in remote, small, dark places. Find them and check them. A bright flashlight, a mechanic's mirror and knee pads are essentials for this inspection.]

The packing can be pinched up to stop water ingress. However, if this is done, it is important to engage the transmission at the dock for a couple of minutes when the engine is put back in service and then shut down the engine and immediately feel the stuffing box. If the box is more than slightly warm the packing is too tight and the propeller shaft is in danger of being "burned" (scored). The packing must be loosened again.

When a leak through the stern-tube cannot be sealed without tightening the packing to the point at which it heats the shaft, the packing needs replacing. This should, in any case, be done every few years since old packing gets hard. It might as well be done at winterizing time on boats that are hauled.

Electrical

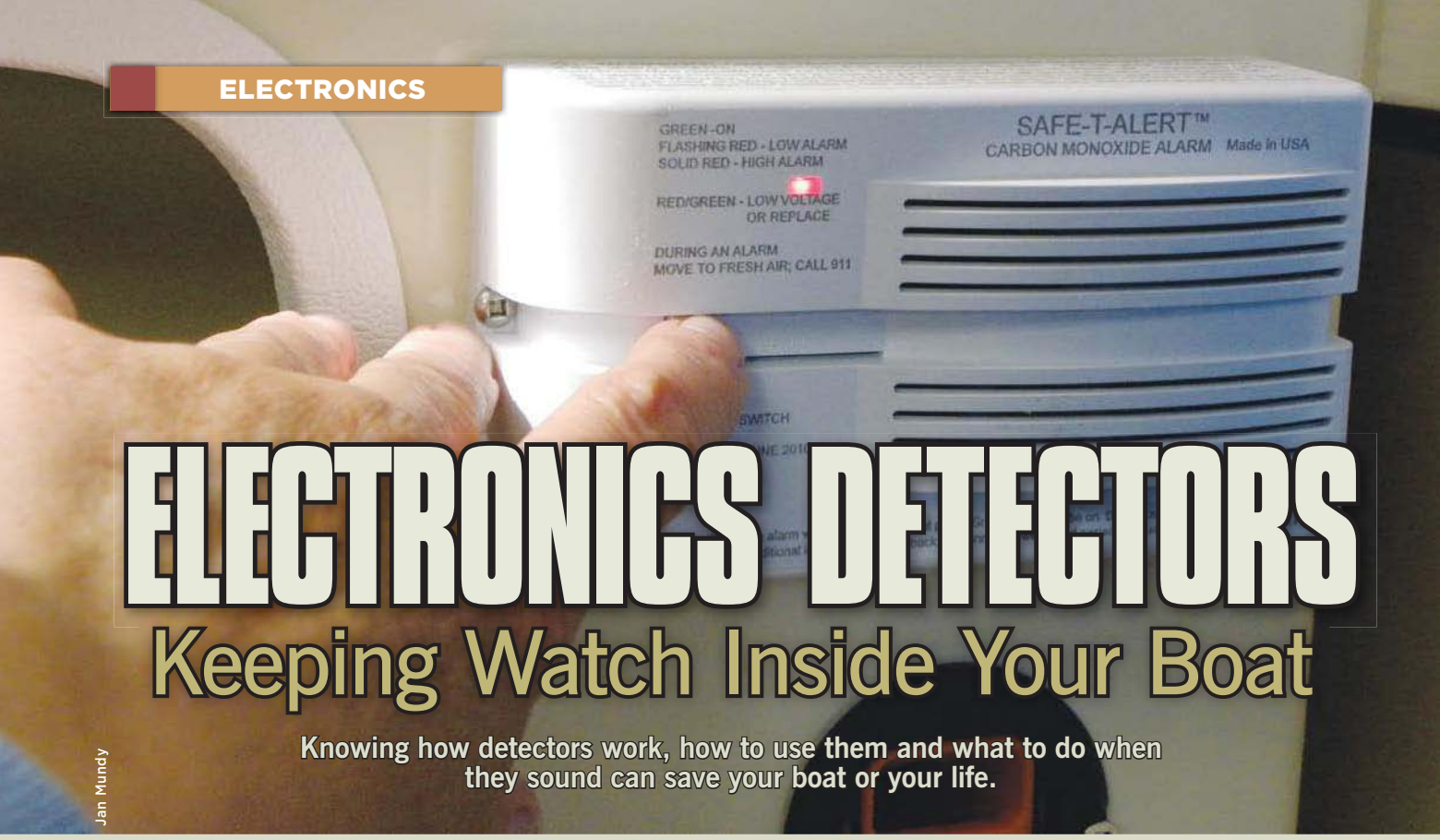
Batteries are the number one replacement issue. A battery left in a partially discharged state for a period of months will suffer a permanent loss of capacity. There are two aspects to battery lay-up: achieving a full charge before lay-up and maintaining this charge during lay-up.

If an engine-driven alternator is used to recharge the battery, regardless of alternator size, the engine will have to run for several hours before the battery is fully charged because the charge acceptance rate (the ability of a battery to take a charge) tapers off quite sharply the nearer it approaches a full charge. A battery charger may have to be used to top up the charge. [Ed: Never use a portable charger that is intended for automotive use. In a gasoline engine space, sparks from this kind of charger can be the source of igniting residual gasoline vapors. These chargers are not usually ignition protected. If you must use such a charger, leave it outside the boat as an extra caution against a potentially disastrous meeting of spark and volatile vapors.]

After charging, a wet-cell battery should have its water level topped up. It's a good idea to clean its top using a rag dipped in a solution of baking soda and then squeezed out, followed by a wipe with a dry paper towel. This will minimize electrical "leaks" across the case. Once charged, store all batteries in a cool, dry place. The cooler the better, since this slows the rate of internal self-discharge. A fully-charged battery will not freeze, even in temperatures well below zero. Depending on battery type, there will be some internal self-discharge. Wet-cell batteries should be put back on a charge once a month; gel-cells and AGMs can be safely left for several months.

Inspect the electrical harness, especially the starting circuit and, in particular, the engine ground strap or cable (which runs to the battery negative post). Corroded terminals and connections need to be undone, cleaned, retightened and preferably sprayed with a sealant or smeared with petroleum jelly.

About the author: Nigel Calder is best known for his best-selling books, *Boatowner's Mechanical and Electrical Manual* and *Marine Diesel Engines*, both now in their third editions and available from International Marine Publishing.



Jan Mundy

ELECTRONICS DETECTORS

Keeping Watch Inside Your Boat

Knowing how detectors work, how to use them and what to do when they sound can save your boat or your life.

By Charles Fort

Sophisticated onboard electronics have almost become an extension of their human user. A GPS knows exactly where you are, radar can see targets miles ahead and behind and a depth sounder can listen for echoes to the bottom to determine water depth and spot fish. But there are other less glamorous electronics onboard that tirelessly look for flame from a fire and/or sniff for smoke, monitor and alarm presence of invisible and odorless carbon monoxide, smell volatile vapors that could lead to an explosion and even feel for water in the bilge, letting you know of a sinking hazard.

Carbon Monoxide Alarms

The American Boat and Yacht Council (ABYC) has required carbon monoxide (CO) alarms since 2001 and it's not difficult to see why. Boats are exposed to more sources of CO than houses. Engines, generators and propane (LPG) galley stoves all use carbon-based fuels that are sources of deadly CO. All this in a much smaller area than a typical house. Unlike smoke, CO is odorless and colorless and can't be detected by a human.

How they work: CO alarms are much smarter and more complicated than smoke alarms. A small sensor detects CO and then a microprocessor runs the level through a time-weighted chart to determine when a person's carboxyl hemoglobin (COHb) level begins to be dangerous. COHb is the level of CO saturation that can be measured in human blood. For example, 70 parts per million (ppm) of CO, weighted over four hours equals a 10% level, which is near when an alarm would first sound. At 400 ppm, COHb reaches 10% and the alarm would sound in only 15 minutes. Other factors affect how soon a given person would be in a toxic state where illness or death is the outcome.

According to Jeff Wiseniewski, vice president of MTI, makers of Safe-T-Alert alarms, CO alarms have become much more sophisticated in the past few years and are much more accurate than those of the past that produced nuisance alarms that, eventually, were ignored when heard. Ultimately, false alarming led to the monitoring unit's disconnection by the very people they were designed to protect. Two boaters were killed in Florida after rafting up for a night with two other boats, all of which were using gasoline-fueled generators. The couple was overcome because the CO alarm in their boat had been disconnected, probably because it was an older model that was prone to nuisance false alarms.

How to use them: CO is "missive," which means that it weighs the same as air and mixes well with air. Where the air goes so goes the CO so positioning the detector/alarm is not overly critical and placement is easy since many of them are powered by a nine-volt battery. However, they should (obviously) be mounted where you can see them and (not so obviously) should not be mounted in a corner or near a low shelf or berth since a blanket or jacket could inadvertently cover them up. Wiseniewski also recommends that they be kept at least a foot away from an opening port or hatch and not too close to a propane stove where their vicinity could affect the alarm's performance.

How many do you need? According to ABYC, CO alarms "shall be located to monitor the atmosphere in the main cabin and each sleeping area." Any CO alarms that use the boat's 12-volt system should be wired directly to a battery (with a proper fuse). Look for CO alarms with the UL 2034 Marine listing.

CO alarms usually require no maintenance and have a useful lifespan of 5 years from the date first put into service. That lifespan will be a lot more obvious now that an addition to the UL standard requires manufacturers to design an "end of life" signal into their alarms

Is it an Alarm or a Detector?

Carbon monoxide (CO) and smoke alarms have improved drastically in the past few years, so much so that the names have been changed. Before 1998, these devices were called detectors. After that date, they are marked as alarms.

What this means is that if your device says it's a smoke or CO detector, it is at least 10 years old and it's time to buy a new style alarm. (This goes for your home as well as your boat.)

— CF

as of August 2009. The signal has a one-time 30-day override, giving owners time to get a new alarm.

Safe-T-Alert (www.safetalert.com) also recently began manufacturing a test kit for CO alarms that allows alarms to be tested up to seven times. A recent fatal accident in Baltimore illustrates why this could be a lifesaver. The subject boat was equipped with a CO detector, complete with a green "ready" light, but it was more than 10 years old and never alerted the unfortunate occupants. The Marine Carbon Monoxide Alarm/Detector Test Kit sells for about $30.

CO cannot be seen, smelled or tasted. If an alarm sounds, don't discount it for doing so can be deadly. Reset the alarm (it will begin sensing again in a few minutes) and get outside into fresh air and make sure that everyone on the boat is accounted for. Call emergency services if any crewmember complains of headaches or nausea and, if someone is disoriented or unconscious, immediate medical attention is necessary and a mayday call is justified. Don't go back in until you're certain the boat has been ventilated sufficiently and your CO alarm doesn't sound any more. A simple change in boat direction can really make a difference here.

It's important to find the source of the CO before using the boat again. Common problems are leaking exhausts from engines or generators, boats nearby or rafted with generators or engines running and carbon fueled cooking or heating appliances onboard. The source may not be on your boat at all.

Sensor Safety

Carbon-based fuel combustion requires oxygen and so do we. You don't want to be competing for this crucial element in a small, poorly ventilated space found on most boats. A loss of as little of 5% of required oxygen is toxic for humans.

ABYC A-26 and A-7 Standards both require an oxygen depletion sensor that shuts off the fuel supply, which extinguishes the flame, to non-sealed combustion appliances (such as propane stoves and heaters) when oxygen in the cabin falls below 95% of normal level. Another good reason to slightly open a hatch or port to let in fresh air.

— Pat Kearns

Vapor Detectors

William Toohey of Oceanside, New York, was having problems with ethanol in his gas. His boat, a 1979 Bertram 28, is equipped with fuel filters that have a plastic drain screw in the bottom. The boat also has a vapor detector for which he is extremely thankful. When the drain screw began turning into "jelly" and leaking, the vapor alarm activated. After shutting down the engine and inspecting the fuel system, he was shocked to see that fuel had been leaking on a spinning seawater pump and was being thrown all around the hot engine. "It is amazing," he says, "that no fire or explosion occurred." He's quite certain that a few more seconds would have been enough to ignite the vapor.

How they work: Vapor detectors monitor gasoline or propane vapors (or both) in a similar way that CO alarms monitor CO with an important exception. There is no time-weighted average. When a level of 25% of the lower explosive limit of a vapor is detected, the alarm sounds instantly. This makes them slightly more prone to false alarms but as critical as a rising level of explosive vapor is, no vapor alarm sounding should go unheeded.

How to use them: Vapor alarms should be mounted in the engine space and/or the lower part of the bilge because vapors (except CO) are heavier than air. Avoid mounting the detector too low since even a quick splash of bilge water can put it out of service. Mounting it closer to the forward part of the bilge helps avoid sloshing water when a boat comes onto plane. Jeff Wiseniewski recommends forming a "J" in the wires leading to the alarm to prevent water from running down the wire to the sensitive electronics.

Vapor alarms take more current to run than other alarms and are always run off the ship's 12-volt system. Look for an alarm that is UL 2034 listed. Some manufacturers recommend that vapor detectors that are in the engine space be replaced annually because of their placement in an atmospherically hostile bilge area.

What to do when it sounds: A properly operating vapor alarm sounds before an explosive mixture is present but it's critical that the situation be handled as an emergency. Shut down the engine and battery supply, open the engine compartment and find the source of the vapor leak. For a small leak that can be safely repaired, a bilge blower (one that is known to be ignition protected) can help rid the engine space of vapors. If you're out on the water, there is likely nothing you can do about a ruptured fuel tank that's spewing gas into the bilge except call for help and a cell phone is a better choice in this case than a VHF radio, which is not required to be ignition protected (a handheld VHF radio used away from the spill would be safe too). Flares are obviously a bad idea. Have all crewmembers don life jackets and move everyone to the forward part of the boat. As a last resort the crew can take to the water, but don't go far. You need to be able to warn a passing boat operator that your boat is a floating bomb.

At the dock, larger quantities of spilled gas should be dealt with by professionals. Get off the boat and call 911. Don't operate anything electrical, including the blower. It's no help with eliminating spilled liquid fuel.

Smoke Alarms

Though smoke alarms have been required for years in homes, it's only recently that boats have come under scrutiny. The National Fire Protection Association (NFPA) currently has a voluntary standard calling for smoke alarms on new boats 26' (7.9m) or more in length that have sleeping compartments. The problem is that there are not yet any UL Marine listed alarms available. That will be changing soon but, in the meantime, a smoke alarm that is UL-217-RV listed (RV listed alarms have to meet similar specifications to the proposed marine specs) will do fine. They are available for as little as $15.

Jan Mundy

How they work: Smoke alarms use one of two types of sensors: ionization or photoelectric. Ionization sensors are better at alerting to fast fires, while photoelectric sensors are best for smoky fires. For boat use, an ionization or combination alarm is best.

How to use them: Smoke alarms should be placed in the living space of the boat but not so close to the galley that making toast will set them off. Some alarms have a mute button that silences them for a few minutes during minor cooking accidents but keeps them operational. Alarms can be hard-wired into the boat's system or have a self-contained battery that has to be replaced every year (the latter have the advantage that they can operate even with a dead ship's battery). Servicing is simply a matter of vacuuming on and around the alarm to keep dust and dirt out of the sensitive electronics and using the test button monthly. The lifespan of a smoke alarm is 8 to 10 years in ideal conditions.

What to do when it sounds: Smoke alarms ashore most often save lives when people are asleep but, on a boat, an alarm serves to alert the crew of a problem if everyone is above decks as well. In the case of a fire that is readily apparent and extinguishable, grab an extinguisher but, if it's already out of control of a handheld or fixed, automatic extinguisher, get everyone off the boat.

High Bilge Water Alarms

In a claim filed with BoatU.S. Marine Insurance, the owner stated that his 31' (9.4m) powerboat began to lose speed and feel sluggish. Shortly afterward, the engine quit and the owner's wife saw water coming from the bilge pump discharge. The owner dove below and was shocked to see a foot of water over the sole. After donning life jackets and calling the Coast Guard, the owner tried to find the source of the water, but by then the water was too deep. They were taken off the boat, which sank, and later the boat was refloated. The investigator found that a hose had come off a head discharge. In his opinion, if the operator had found the leak sooner, merely closing the seacock would have saved the boat.

Starting in July 2009, ABYC standards require a high-water alarm on all new boats that have an enclosed accommodation space.

How they work: Bilge water alarms are simple devices that use a switch (usually a float switch) to activate an alarm when water reaches a pre-determined level. They can give you a warning that allows you enough time to find a leak before it's too late. High-water alarms can also be used to alert marina personnel to rising water in your boat. Some owners link the switch to the boat's horn, assuring it will be heard.

How to use them: The detector switch should be located far enough above the normal level of bilge water to prevent the alarm from sounding when the bilge has a small amount of water that the bilge pump can easily handle, but low enough to alert you if there's a problem. The same problems that plague bilge pumps can affect high-water alarms; namely, corroded wire connections and jammed switches. While the alarm itself may last indefinitely, float switches are notoriously troublesome and should be checked at least annually.

What to do when it sounds: It goes without saying that when a bilge water alarm sounds, someone needs to immediately check the level of the bilge water but where do you look for a leak that might be under the water line? According to a Seaworthy (www.boatus.com/seaworthy) study, 34% of boats that sank while underway did so because of leaks at thru-hulls, sterndrive boots, or the raw-water cooling system. Leaks are not always obvious but, since many thru-hulls are in the engine room, the same place that the sterndrive bellows and raw-water cooling system are, that's the first place to look.

About the author: Charles Fort is the associate editor of *Seaworthy*, the loss prevention news-journal published by BoatU.S. Marine Insurance, as well as a veteran cruiser and Coast Guard licensed operator. For a subscription to Seaworthy, go to www.BoatUS.com/Seaworthy.

THE COMPLETE DIY GUIDE TO WINTER LAY-UP

For boaters who are landlubbers in the winter, we've compiled the complete guide to preparing your boat, engine and equipment for hibernation, routine checks to perform at regular intervals during seasonal lay-up plus tips for organizing off-season projects.

Story and photos by Jan Mundy (exceptions noted)

Whether winter puts you in a deep freeze or brings more moderate temperatures, you need to protect your boat from the elements if it's not going to be used for an extended period.

In past issues, *DIY* has published numerous articles discussing haulout and layup procedures for boats, engines, boat systems and equipment that will be tucked in for a winter's nap. The following was compiled from these articles and its handy checklist format will help you organize your end-of-season maintenance chores for storing your boat ashore. (For details on prepping your boat for winter lay-up afloat refer to DIY 1998-#3 issue.) Not all these tasks will apply to every boat. You'll need to "cherry pick" which ones are applicable.

Different mechanical systems have their own quirks, so read your owner's manuals for specific instructions. It's important to follow the manufacturer's recommendations when servicing and winterizing components and engines, pumps, tanks, toilets and other systems and equipment.

Remember, most insurance policies do not cover damage caused by freezing. If you're unsure of any procedure, better have the job done by a qualified technician. Be prepared to provide a list of equipment needing attention.

Prepping for Haulout

• Before you haul out, check the condition of the winter cover and frames, mast supports, cradle or trailer and service or repair as necessary.

• Fill the fuel tanks. (If you need a reason for doing this, refer to "E-10 in Winter" on page 25.) Add stabilizer to gasoline fuel tanks at the recommended ratio (stabilizer to fuel) for engine storage. Diesel tanks require the addition of a biocide to prevent algae growth. Pour additives into the tank before haulout and run the engine for at least 10 minutes so the treated fuel has a chance to run through the lines and filters.

• Shut off engine and change engine oil and filter.

Tools and Materials

- Rubber boots, gloves and an old foul-weather suit (if doing your own pressure washing)
- Lubricants; anti-corrosion spray protectant
- Paper towels, rags and drop cloths
- Waxes, polishes, etc.
- Coveralls (or old clothes), rubber gloves, and dust masks, safety glasses or goggles
- Painting supplies: paint, sandpaper, brushes, etc.
- Ladder and theft-proof lock
- Electric buffer and buffing pads (if applying a paste wax)
- Extension cords and portable GFCI protection
- Duster brush, shop vacuum

• Pump out the waste holding tank. While pumping, pour several buckets of water in the toilet and flush several times and then pour non-toxic (plumbing) antifreeze into the toilet and pump through hoses, holding tank, diverter valve and macerator, if equipped. Check owner's manual to

Pat Kearns

ensure component compatibility. Pump tank dry.

• Contact your yard to book lift time for the haulout in preparation for storage ashore.

• Check insurance policy terms to ensure boat and all equipment are covered during storage. If you need to extend time afloat, contact your insurance agent and put your inquiry in writing.

• Make a list of all required parts and tools and collect them before haulout day (see sample list).

• Plan to attend the haulout. You might even invite your favorite marine surveyor to have a look at the hull and record any problems and provide a report of suggested resolutions.

• Line up helpers and treat them well or they won't be back next year.

After Haulout

• If the rudder has to come out for bearing or seal renewal, ensure boat is blocked high enough to allow rudder to be lowered for removal. If you forget, the yard might reposition the boat at nominal cost. The same should be considered if you are planning centerboard maintenance. Some yards prefer to open a hole under the rudder to accommodate the needed vertical clearance as blocking the boat higher than needed for keel clearance could result in hazardous conditions.

• Ensure support pads and blocks don't interfere with any planned work such as removal of lower rudder fitting, installation of a new transducer or thru-hull, repair or replacement of strake runners, or repairs to underside of keel or skeg. These are all good things to put in your written work order when you make arrangements for the haulout. Directing a yard blocking crew is not your prerogative.

• Be sure that boat is stored in a position that allows scuppers and bilges to drain. Test drainage with a hosedown. Make sure that your boat's drain hoses are intact so that drainage does not go into the hull, instead of overboard as intended.

Exterior Work

• Wash hull bottom but first close seacocks. Omit this step and you may find your galley and head spattered with dead sea beasties and salt scale that is powered up, up and away with the pressure washer.

• If pressure washing, be very careful, particularly if your boat has a copolymer or ablative antifouling paint or you may remove more than just fouling. Remove or mask anything, e.g. speed transducers, that might be damaged by the forces of pressurized water.

• If doing your own hull washing, wear boots, old foul-weather gear and safety glasses. Copper-based bottom paints are highly toxic.

• Wash growth off propellers, shafts, struts, sterndrives, trim tabs and transducers and inspect for damage or wear.

• Immediately after hauling out, thoroughly check the hull for damage or gelcoat blistering. Circle any suspect areas with a waterproof marker as, once the hull dries, the blisters are much harder to see and they may depressurize and flatten themselves beyond recognition.

• Check for zebra mussels. If you find some, check water intakes on engine, head and sink.

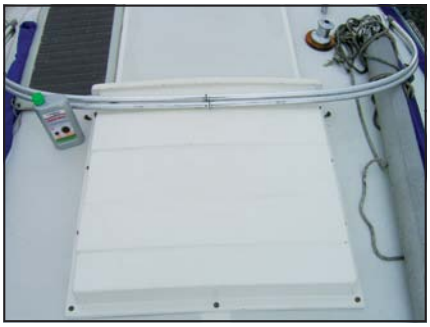
• Closely examine any plastic thru-hulls

TIP

Plan Ahead

Have your cockpit, mooring or trailering covers, biminis and convertible tops, dodgers or awnings repaired or order new ones this fall before you put the boat away. Otherwise, you'll be waiting in line next spring with the rest of us who leave those details until the thaw.

— JM



(left) Before: Deck stained by seagull droppings when a *DIY* reader's boat was unattended for more than one month. (right) After: Applied Interlux Heavy Duty Stain Remover, spread around with a brush, let it sit for 10 minutes and then lightly rubbed with a Scotch-Brite pad and rinsed off remaining residues. The non-skid areas were more of a challenge and required using a dental tool to pick off the residue softened by the cleaner, followed by reapplication, which left the deck looking like new again. The 15 by 15 square foot (1.39 square meter) area used less than one-quarter of the bottle.

for the telltale signs of UV deterioration caused by exposure to sunlight. Rub a finger over the plastic. If a chalk-like substance appears on your finger, the plastic is degrading. Replace the fitting.

• For hulls without bottom paint, apply an acid-based cleaner to remove heavy algae and scum buildup below the hull waterline. Wear protective clothing, goggles and respirator and work upwind to avoid noxious fumes.

• Inspect for cracks at the hull-keel joint on sailboats.

• Examine fiberglass rudders for cracks. Look for evidence of trapped water weeping out the lower edges. Check rudderpost for corrosion and manipulate the rudder for evidence of excess play. Make sure rudder is clearing the hull through its full rotation from stop to stop. Make sure that the rudder arc is the same on both sides. This is another good time to check with your surveyor. Ten minutes with a rudder now could save you big headaches after the boat is launched next season.

• Inspect all external fittings, including tank vents, rubrails, swim ladder fittings, etc.

• Thoroughly rinse the boat with plenty of water to remove any loose grime and grit that may be clinging to the surface. Begin rinsing at the highest point on the flying bridge or cabin top and work down, moving from the bow to the stern so the water drains naturally.

• Wash surfaces, working again from the top down. Don't let any soap dry on the surface.

• Apply a marine wax or polish (except non-skid areas) to protect gelcoat from winter's harmful UV rays. Buff the wax now as some waxes harden if left on and require much labor to remove. Never use a heavy-duty cleaner that strips previously applied wax without following with a wax or polish. For boats painted with a two-part finish (e.g. Awl-Grip), apply the recommended protective coating.

• Remove any remaining stubborn stains with Interlux Heavy Duty Stain Remover, a mild oxalic acid solution that is brushed on, left for a few minutes, agitated with a soft bristle brush and then hosed off with freshwater. Use full strength or dilute up to 50% with water. (See photos above.)

• Inspect hulls and topsides for damage and make plans for repairs during the yard's off-season time.

TIP

Never Miss Plug

Placing the drain plug at the helm or on the boat is a good idea but for larger, non-trailerable boats, it won't help the lift operator if he doesn't know it's there. Better to put the plug in a bag that hangs from the drain opening. Attach a small fishing line sinker weight to the end of the drawstring of a small bag containing the plug. Push that weight into and through the drain opening so that the sinker drops inside the hole and acts as a counterweight to the bagged plug. When the lift operator sees the drain and the plug, he can easily insert the drain before launch. With this arrangement, the drain is open to drainage and the plug is ready to use and not forgotten when needed.

— Pat Kearns

Touch all anodes to insure they are intact and replace any that show wastage.

• Wash Plexiglas and acrylic hatches and ports with boat soap and water and then apply a protective "plastics" polish.

• Clean all metalwork and apply polish or wax and then follow with Interlux Premium Teflon Wax Sealer to provide a protective barrier against the elements.

• Inspect sacrificial anodes and replace them now even if they are not extensively worn. Anodes are cheap insurance.

• Remove fenders (PVC lasts longer if stored indoors) and clean them. (See tip in "Under Wraps" on page 24.)

• Check all deck hardware, stanchions and lifelines for wear or looseness. Check condition of bedding compound and recaulk now so water doesn't leak through cracks and freeze (expand) during the winter, which aggravates the leaks and leads to more water damage.

• Check dock and anchor lines for wear and inspect splices. To wash lines, place them in pillowcases or large mesh bags and put them in a washing machine with cold water and a little detergent on the gentle cycle. Using a front-loading machine is much better as you will avoid the effect of the agitator. You can also soak lines in a bucket of water mixed with a little laundry detergent, rinse well and lay out or hang to dry thoroughly before storing the lines.

• Flake out anchor chain and examine it, link for link, for damage along with all connecting shackles and swivels.

• Inspect bow roller and pins, hawse pipe, samson post, bit, cleats and windlass.

• Lubricate all hatch hinges and dogs and opening ports and their dogs, door sliders and hinges. Inspect all hatch holdup hardware, especially gas-assisted lift type.

• Check condition of windshield wiper blades and order spares. Clean and lubricate wiper arms.
• Remove flags, dry and stow.

Brightwork

• Inspect brightwork and repair any damage.

Nick Bailey

• Clean teak, if discolored, and apply at least one coat of varnish or oil (two is better) to protect wood from winter's dryness and damaging UV rays.

Canvas & Upholstery

• Remove cockpit and flying bridge covers and curtains, wash in a mild detergent solution. Dry thoroughly.
• Check stitching and fasteners.
• To restore the water resistance of acrylic covers, apply 303 High Tech Fabric Guard.
• Stow all canvas, preferably off the boat and in a dry location.
• Inspect supporting frames and repair as needed.
• Clean vinyl seat cushions and treat with a vinyl protectant to prevent drying and cracking.
• Remove cabin cushions and mattresses and stow ashore in a dry location or prop up so all sides are aired.

When storing biminis, cockpit enclosures, convertible tops and curtains with plastic windows, lay towels or old sheets between the layers to prevent scratching and roll loosely. Never fold plastic curtains.

Cabin Interiors

• Remove all perishables, personal items, all paper products, foodstuffs, any items that can rust, rot or freeze plus all personal gear and any other loose equipment from the boat's interior.
• Because of the risk of theft, strip the boat of everything that's "liftable."
• Remove all absorbent materials such as cushions, rugs, bedding, books, charts, clothing, life jackets, canvas, curtains, dock lines or books that can absorb moisture and mildew while in storage.
• Disinfect icebox or refrigerator using a 10% bleach and water solution or a 50% vinegar/water solution or one-part 3% hydrogen peroxide, one part water and one-quarter part boat soap to kill any mold spores. Rinse with freshwater and let dry thoroughly. Leave the door or lid slightly ajar to allow air circulation.
• Clean appliances. Empty kettle.
• To help prevent mildew, wash countertops, cabinets, bunk tops and lockers with a disinfectant solution. Dry thoroughly.
• After cleaning with a disinfectant, apply polish to all smooth surfaces, including molded fiberglass shower stalls, to retard mold growth.
• Slightly open oven door to allow air to circulate.
• Vacuum carpets and upholstered furniture.
• Open valve on propane tank, light a stove burner, and then turn off valve. When flame extinguishes, turn off burner and solenoid switch. Close tank valve. This will ensure that no gas is left in the line.
• Open all drawers and locker doors and prop open the navigation table to enable better air circulation.
• Lift up floorboards and berth tops to air the bilge.
• To keep boat dry and mildew-free, use moisture absorber products or dehumidifier. For product information, refer to "Managing Mildew" on page 23.

Electronics

• Remove all portable electronics. It's not necessary to remove fixed electronics but storing them indoors in a dry location will prolong their life and they cannot be stolen.

TIP

Overcome Seasonal Amnesia

Unless your memory is better than mine, I strongly recommend you assign a storage place for all your loose boat parts. Package small items in envelopes or food containers and label all containers with a marker. Stow the whole lot in a designated section of your basement or garage.
— JM

• Remove all antennae and couplers, if practical.
• Spray exposed cable ends with a moisture-displacing lubricant and wrap with electrical tape.
• Check seals for wiring installations at deck penetrations (a.k.a. deck glands) for water tightness.

Plumbing Tasks

• Clean freshwater tanks with baking soda and water or use Captain Phab Purge Tank Cleanser to remove slime, the source of recurring bad tastes, and to eliminate that rotten egg (sulfur gas) smell from water tanks, including hot water tank and hoses. Let dry and leave inspection ports open to reduce moisture buildup. Tape mesh screening over the openings

Forespar two-way valve with two "open" positions simplies winterizing of toilets. A hose, long enough to extend above the waterline, connects permanently to a hose barb on the front of the seacock. Open the valve one way for raw-water. To winterize, move the valve handle to the "winterize" position, pour plumbing antifreeze through a funnel inserted into the hose and pump it through the toilet.

When winterizing the potable water system, avoid putting antifreeze into the water tanks. Instead, drain the freshwater holding tank and hot water tank and then use a bypass hose connected directly to the pressure water pump. This uses less antifreeze and doesn't require flushing the system with freshwater next spring.

and disconnected hoses and tank connections to restrict the intrusion of unwanted insect or rodent inhabitation.

• Polyethylene piping is not freeze damage proof. Drain and winterize your boat's water system using compressed air or a potable (plumbing) anti-freeze solution. The following steps explain the procedure.

1 Close valve to the hot water tank and disconnect the power source. Drain tank.

Antifreeze Know-how

Freezing temperatures can result in major damage and expensive repairs to your boat's water systems and pumps. The type and strength of antifreeze solution you use is important when winterizing these components.

There are two types of antifreeze: propylene glycol, a non-toxic and biodegradable solution more commonly referred to as plumbing antifreeze and used to winterize freshwater plumbing systems and engines; and ethylene glycol or common automotive antifreeze. Ethylene glycol is no longer used to winterize marine engine raw-water cooling systems. It's highly toxic, affecting pets, birds and animal life (even one teaspoon can be fatal), the marine environment and our water supply.

The protection level provided by a propylene glycol antifreeze is indicated by temperature rating. Most commonly available is "down to -50F (-45C)," a rating based on a residential standard that relates to the temperature at which copper pipes burst. Considering that you are unlikely to successfully remove all water from your boat's water systems when winterizing, a better choice is to purchase the more expensive -100F (-73C) rated antifreeze.

— JM

2 Connect a hose to the pressure pump intake that bypasses the hot water tank and freshwater tank. Pump non-toxic plumbing antifreeze through the system. Open every faucet in the galley, head, shower and cockpit shower, one at a time, both hot and cold sides, until antifreeze-colored water flows out. Turn all the valves and faucets off. Repeat with each tap.

3 An alternative method for draining water lines is to blow out the water using an air compressor. Open all faucets and valves and then disconnect a hose, often needed in more than one location to blast all branch hoses, and insert the compressor's hose.

• Drain the freshwater storage tank.

• To drain the accumulator tank, remove the hoses.

• Drain all sumps and pumps and pour antifreeze down sink and shower drains. Sponge sumps dry.

• Wash sinks, head and shower areas with a mild bleach, hydrogen peroxide or vinegar solution and dry thoroughly. Follow with a mildewcide spray.

• Remove hull drain plug (if provided) or pump out bilge water. Clean bilge with a marine soap and/or a degreaser. Let dry thoroughly. Place drain plug in a bag that's fastened to the steering wheel or engine controls so you don't forget it in the spring. (See Tip on page 18.)

• Remove bilge pump strainers and clean.

• Remove bilge pump intake hose and place in a bucket of plumbing antifeeze and then operate pump to circulate the solution through the system. Where you cannot remove the hose or for common centrifigal pumps, pour a little non-toxic antifreeze into the bilge and pump through the bilge pump.

• Winterize head by flushing a small amount of non-toxic plumbing antifreeze through the system. Add a lubricant (Sea Lube, Head Lube or equivalent) to the head to lubricate O-rings, pump shaft, pistons and valves and prevent corrosion. Consult your owner's manual for product specific advice when winterizing.

• Check all anti-siphon valves for clogging and clean if necessary.

• Drain washdown hoses and plastic hose nozzles.

• Winterize air conditioner, refrigerator, ice machine, deck washdown and any other equipment that circulates water. To do this, disconnect the raw water intake connection from the closed seacock and place the hose in a bucket of non-toxic antifreeze.

• Flush saltwater pumps (washdown, baitwells, etc., including any seawater pumps at galley or head compartment sinks) with freshwater. Pour a little antifreeze into baitwells and run pumps.

• Remove all fresh and seawater pump impellers so they don't take a set (deforming rubber impeller blade(s).

• Inspect and lubricate seacocks.

• Open all seacocks.

• Check that cockpit, deck and flying bridge scuppers drain freely.

Engines: Outboards and Sterndrives

Unless properly winterized, a marine engine can suffer costly freeze damage. The information below is basic guidelines. Before winterizing, read the service manual and carefully follow the instructions to the letter. If you're in doubt, leave the winterizing for the pros.

• Attach flushing device connected to a hose and freshwater source.

• Disconnect engine's fuel source and, in a portable fuel tank, mix up a decommissioning "soup" at this ratio: 1 gallon (3.375 liters) of premium high-octane fuel, 4oz (117 ml) of two-cycle motor oil and 2 oz (60ml) of fuel stabilizer. Connect tank to your fuel inlet and run engine at idle for 10 minutes and then shut down the engine. Remove small tank and reconnect your onboard fuel supply. Do not run engine again until spring.

• For carbureted engines (non-fuel injected), inject storage seal into the carb venturi while running the motor above idle or remove the spark plugs and pour an ounce or so of storage seal into each cylinder, then crank the engine after removing spark plug leads to coat the cylinders.

Attach a flushing device or place the drive in a large tub and run the engine on a decommissioning "soup."

"Fog" carbureted engines by spraying engine storage seal into the carb.

• Sterndrive: Drain the seawater section of your cooling system. Your service manual will guide you to these drains as they are usually not obviously visible.
• To winterize the engine block, you'll need 1 gallon of non-toxic propylene glycol antifreeze (3.78L) for each small engine (2.5L through 4.3L engines), 2 gallons (7.57L) for V-8 engines. Pull hoses off the thermostat housing and back flush each hose. For the exhaust manifold, for example, pour non-toxic antifreeze into the exhaust manifold cooling jacket via the thermostat housing hose. Once you see the antifreeze drain out, reinstall the manifold drain plug and reconnect the hose to the thermostat housing. Follow this procedure for each component of the cooling system. Using this procedure reduces or eliminates dumping antifreeze into the water on engine startup when launching in the spring.
• Sterndrive with closed-cooling systems: Use an antifreeze tester to check that coolant reads a freeze temperature of -35F (-37C) or lower. If coolant needs replacing, follow guidelines in your manual for draining, refill and bleeding the air from the closed-cooling system. Capture and recycle old antifreeze.
• Sterndrive: Remove air cleaner and spray an anti-corrosion protectant onto the carburetor and any other metal parts to prevent rusting.
• Sterndrive: Clean flame arrestor and PCV hoses, if so equipped.
• Sterndrive: Lubricate all grease fittings as recommended in your service manual. Grease universal joints, if so equipped.
• Sterndrive: Raise the sterndrive to the trailer position and check the exhaust, U-joint and cable bellows for cracks. On models with a rubber boot, separate the folds to expose the rubber and check for tears or cracks. This is a favored chewing exercise area for water rodents.
• Sterndrive: Place an absorbent pad in the engine pan to collect any fluids that weep from the engine.
• Check water intake port on the lower unit is free of marine growth.
• Drain and refill gearcase oil. Examine the old lubricant for metal parts, shavings and water, which turns the oil a color resembling café latte.
• Inspect sacrificial anodes and replace wasted anodes. Changing anodes that are only mildly wasted is cheap insurance that you'll have full protection next season.
• Touch up any scratches or bare spots on the lower unit or drive leg with a factory matched paint.
• Clean the outboard cowling and lower unit and apply a light coat of wax.
• Examine the engine for worn wiring or electrical connections, loose components or brittle fuel hoses.
• Inspect and clean fuel line screens and replace all fuel filters. Lubricate the O-ring on base of filter before installing. Make sure you have removed the old O-ring.

TIP

To Do List
As you're packing up the boat, make a list of all the things you need to do and items to be repaired, cleaned or replaced. With a little preplanning, you'll have less work to do in the spring.
— JM

• Change engine oil and top off power trim and steering fluid reservoirs, if so equipped.
• Clean and lightly spray the entire engine with an anti-corrosion spray protectant to inhibit corrosion.
• Check the propeller for bent blades, damaged hubs or nicks along leading and trailing edges. Check the area behind the propeller for fishing line wound around the shaft. When installing the propeller, apply 2-4C grease to the prop shaft.
• Remove propeller, especially if it's a stainless-steel or performance one that are tempting to thieves.
• Spray steering cables, throttle linkage and other moving parts with Teflon lubricant.
• Install a locking device for the outboard or sterndrive.
• Store the sterndrive in the full down position, spray the unit with a corrosion guard and cover loosely to allow for ventilation and to protect bellows from UV exposure damage.

Engines: Diesel Inboards

• For winterizing steps, refer to Nigel Calder's article "End of Season Maintenance" on page 9.

Electrical

• Disconnect batteries and clean battery terminals and casing with baking soda and water. Check electrolyte levels are 1/2" (12mm) above top of separators (lead-acid batteries only).
• Fully charge batteries, grease terminal bolts and then remove and store batteries in a cool, dry location on a wood or plastic board. When replacing batteries in service, remove excess grease from terminals and then recharge and install in boat.
• Disconnect batteries if leaving them on the boat. Batteries can be left on the boat

Shoring Tips

Bad: Never use cement blocks as they are prone to failure under boat loads.

Care must be taken when storing a boat on land. The boat must be properly and evenly supported, including the keel. Firmly block rigid cradles with wedges under pads so that each support bears about the same percentage of the load. Shoring up a hull with wood beams or jack stands offers a quick and convenient means of supporting a boat, provided the loads are evenly distributed. ABYC TY-28 recommends, as a general guideline, to place "no less than two pairs of stands, e.g., four stands, under boats. Conditions such as hull configuration and structure, windage, weather and ground conditions, or other exposures, may require using extra stands. Boats stored with masts stepped are more at risk, and may require additional support. Additional support may also be needed depending on the condition of the boat.

Space sailboat stands no more than 10' (3m) apart on centers, with the forward-most and after-most pairs of stands no more than 10' (3m) from the ends of the waterline. Set powerboat stands with the aft pair placed as close to the aft end of the waterline as structure permits, and spaced no more than 20' (6m) apart on centers.

ABYC further advises to never use stands to support the weight of the boat unless the stand is designed for this purpose. Apply stands as far outboard as practical and with the adjusting screw as close to perpendicular to the hull as practical. On vessels with extreme forward or aft overhang, place a stand(s) under the overhang perpendicular to the centerline. Tie each pair of stands together across the boat with at least 3/16" (4.7mm) chain to prevent lateral movement.

Good: Join jack stands together with chain so stands don't spread under load and collapse.

Frequently, check shores and wedges for correct position and loading while the boat is laid up.

— JM

without risk of freezing provided they are at least 75% charged. If batteries are discharged, they can freeze when stored below 20F (-7C).

• Check electrical connections, especially on distribution panels, for corrosion and spray with a moisture displacing lubricant.

• Remove dry cell batteries from flashlights, radios, etc.

• Inspect shorepower cords for chafe or nicks. Check plug ends for corrosion or overheating and replace as necessary. Spray ends with a rust preventative. Clean cords with a vinyl cleaner.

Safety

• Check condition of all personal flotation devices (PFDs) and clean or repair as needed.

• Check inflatable PFDs for operational status by manually inflating them and then deflate them for storage.

• Service inflatable PFDs with new bobbins and cartridges as necessary.

• Inspect lifebuoys, heaving lines, EPIRBs and other safety gear to ensure they function properly.

• Examine lifeline stanchions for looseness. Check plastic-coated lifelines for nicks and replace as necessary. If you see rust staining at cracks and ends of vinyl sheathed lifelines, you are looking at corrosion that means the stainless-steel wire beneath the sheathing is rusting. Replace as necessary.

• Check flares are current through, at least, the end of next season. If not, make a note to buy them at the beginning of next season.

• Check fire extinguishers are in date and up to pressure. If not, make a note to service or buy new ones at the beginning of next season. Weigh Halon extinguishers to check charge. Invert hand-held portable, dry chemical units several times to ensure that the dry chemical is not compacted.

• Remove all flammables (charcoal, fuels, paints etc.) and any portable propane canisters and stow off the boat.

• Examine first-aid kit and make a list of items to restock. Dispose of any out-of-date items.

Trailerables

• Check boat position on trailer is equally distributed on all bunks or rollers to prevent unwanted hooks or hollows in the hull caused by point loading or improper storage.

• Elevate tongue slightly to facilitate drainage of trapped water or condensation.

• To reduce load on tires and trailer suspension, jack up the trailer until tires clear the ground and then support the frame with axle stands placed on stable ground on either side of wheel axle. Be certain that trailer sits securely, with no possibility of sliding or falling.

• Check tires for wear and dry rot. Replace if necessary.

• Inspect chains, tie-downs, winch line and wiring for wear. Replace as needed.

• Remove trailer light lenses and spray sockets with lubricant.

• Check for loose nuts and bolts. Check wheel lug nuts.

• Check for corrosion and apply a corrosion inhibitor as necessary.

• Lubricate trailer rollers and other moving parts.

• Apply fogging oil to spring and shackle assemblies, winch ratchet and gear assembly, hitch and hitch ball assembly to provide long-term protection against corrosion.

• Lubricate the trailer and vehicle electrical plug with spray lubricant.

• Touch up rust spots on the trailer.

• Clean hubs with kerosene or butyl alcohol then repack with grease.
• Loosen trailer tie-down straps and winch line to ease pressure on boat bottom.

Sails

• Lay sails out on a flat, clean surface and check all stitching, batten pockets, luff tape, slugs or slides for chafe and wear.
• Hose sails off with freshwater to remove salt and surface dirt. Dry thoroughly.
• Neatly fold sails and stow off the boat in a warm, dry location where sailcloth-loving rodents cannot get to them.
• Consider taking sails to your local sailmaker for cleaning and repair. Many sailmakers store sails during the off-season for a small fee or free if they are making repairs.
• Inspect mainsail and jib covers for tears and chafe and repair as necessary.

Masts

Unstepped masts are a best choice to eliminate the effects of windage and related stresses caused by rig vibration that can damage the mast, rigging, deck, deck level fittings and hull plus it makes close-up rig inspections possible and provides a support for the storage cover.

• Unstep the mast. Leaving it up, whether the boat is in the water or on land, subjects the deck, hull and rigging to the stresses caused by harmonic dynamics that, over time, can cause cracks and crazing in gelcoat that eventually lead to water intrusion into the laminate and core.
• Lay mast so it is well supported every 6' (1.2m) or so and in a way that it doesn't rest on any standing rigging.
• Wash running rigging and furling gear (if equipped).
• Run a soft cloth or ladies' nylon stocking along shrouds to check for snags.

Managing Mildew

Davis Instruments

StarBrite

Add moisture from condensation, humidity and warm temperatures in an enclosed, stagnant area and you have the perfect recipe for mildew. Mildew is usually disguised as a black, sometimes white growth, produced on surfaces by molds. Molds are living fungi plants that thrive in a damp, warm environment and a boat offers the ideal climate for molds to grow, even in winter when sunshine creates a greenhouse effect inside a boat.

On boats, mildew molds feed on fabrics, painted surfaces, window frames, wood and other surfaces. As molds grow and reproduce, they cause considerable damage. Optimum growing temperatures range between 77F to 86F (20C to 30C) with a relative humidity from 70% to 93%. (Below 62% humidity, mold growth stops.)

There are several products that, when used independently or in combination, help to reduce moisture and keep your boat dry. Of the moisture-absorbing crystal devices, Damp Rid (www.damprid.com) Hanging Closet Freshener is one product I have used for many winters. Hung in lockers, vee berths and engine compartments, non-toxic Damp Rid has two compartments, the upper contains calcium chloride crystals that absorb excess moisture and, as these dissolve, they fill the bottom bag with liquid. Each crystal absorbs more that twice its own weight in ambient moisture and, in about 8 weeks or so, the crystals completely dissolve and a bag full of water remains. Once it's full, dispose of the bag and hang a new one. StarBrite No Damp Dehumidifier functions in a similar way except that the crystals are in a refillable plastic container and a non-spill tray traps moisture through a one-way membrane.

For cabin areas, both the Davis Air-Dryr and GoldenRod are small and effective dehumidifiers. They operate on 110-volt power and heat the damp air to a point where moisture is held in suspension (above dew point). As warmed air rises, cooler damp air is drawn in, where it too is heated.

If your boat is poorly ventilated, and humidity and resultant mildew is an ongoing problem, you'll need to dehumidify the air with an electric dehumidifier. When installed, close all vents and hatches or you'll be dehumidifying the outside air as well. Arrange for the unit to drain automatically, if possible.

Using unattended 110-volt appliances inside a boat in storage may be prohibited by the boat yard and/or local fire prevention statute. Make sure you check the rules before you hook these devices and walk away feeling good about it.

Should you discover mildew in the spring, clean surfaces with a mixture of hydrogen peroxide, boat soap and water. Refer to DIY 2007-#2 issue for application details.

— JM

Insurance Alert

Have you added equipment or made changes to your boat? Have you changed the storage location? Are you planning a winter trip with the boat?

If you answered yes to any of these questions, contact your insurance agent to update your insurance policy to make sure it is in good standing for the off-season.

Provide a list of the new equipment to ensure that your boat is insured for the proper value. Let your agent know where your boat will reside this winter. Also, if your policy contains a "Lay-up Warranty," with dates specified, e.g. November to March in northern climates, you'll need to extend your insurance coverage if planning a trip south this winter.

— JM

Steve Kalman

Mounting several inexpensive push-on, snap-on or self-adhesive solar-powered ventilators directly to the shrinkwrap, along the entire length of the cover and facing in all directions, provides the needed airflow. Adding a zippered access door lets you work on your covered boat.

A cost-effective solution to preventing punctures and tears where shrinkwrap stretches across stanchion tops, windshields and other irregular corners, is to cover the potential offending parts with pieces of pool noodles, secured with wraps of PVC tape.

• Inspect all running and standing rigging, terminals, blocks and sheaves. Label each fitting for easier reassembly.
• Remove spreaders, masthead instruments and navigation lights to protect against damage or wrap the latter two in bubble wrap or foam covered with plastic and ends sealed with tape.
• Wrap electrical connections in plastic. Label each connection for easy reassembly.
• Bundle the running and standing rigging and tie to the mast with line or cord. Do not use adhesive tape of any kind.
• Spray turnbuckles with a moisture displacing lubricant and cover with plastic bags.
• Never store a painted mast wrapped in plastic. While it protects it from dirt and rain, the heat from the sun blisters the paint faster than any chemical stripper.
• Secure the tiller or wheel to keep the rudder from swinging.

Under Wraps

• If you store your boat outside, keep your boat clean and dry with a snug-fitting canvas cover, polyethylene tarp or shrinkwrap (except on painted boats since it can blister the paint).
• If "tenting" your boat, leave a 2' (609mm) opening at the bow and stern for ventilation.
• Cover mast end and engine vents to prevent unwanted nesting pests.
• Hang fenders or place foam pool noodles between the topsides and cover to protect boat from abrasion by the cover itself and provide ventilation to retard mildew. Use cloth fender covers to prevent paint from rubbing off on painted hulls.
• Shrinkwrap costs about 25% more than a premium tarp but, when installed correctly, is a better option because it fits glove-tight, so it won't abrade or damage boat surfaces and its high-tension framework sheds snow and ice better. When spring arrives, remove the cover, stuff it in a pre-paid recycling bag from Dr. Shrink (www.dr-shrink.com) and ship it via UPS back to them.
• Leave hatches and ports open a crack to ventilate the cabin, if possible without compromising security.
• Make sure the cover is well secured with sufficient tie-downs.
• Never attach cover tie-downs to jack stands or support blocks.
• Place vents along the entire length of the cover and facing in all directions so the boat can "breathe."
• Consider installing a door in the cover for easy access for routine inspections under cover.
• Before heading home, leave a companionway key labeled with your boat's name, your address and phone number with the marina manager to facilitate contact in an emergency.

Ground Work

For boats that are stored outside, the following list of routine checks will help guide you through performing them at regular intervals during winter.
• If you're unable to visit your boat while it's out of commission, arrange for someone to check it in your absence.
• As soon as cold weather sets in, check that you didn't leave any item on board that can freeze. Check that all cabin cupboards, lockers, drawers, access hatches, berth tops and floorboards are open to ensure adequate flow-through ventilation.
• Check condition of boat cover. Look for chafing against hull and damage to fabric. Secure tie-downs if needed. Remove excess snow accumulation.
• Check cradle, lateral shores and wedges for even distribution of the load and adjust as necessary.

• Inspect jack stands, as frost heave of the earth beneath them can alter their position. Do not attempt to adjust them yourself; notify yard personnel.
• Turn engine over a few times by hand to lubricate bearings and cylinders.
• Operate seacocks to prevent seizing. During the winter, disassemble, clean and grease seacocks.
• Turn prop shaft at regular intervals.
• Check for ice damage to cockpit and cabin.
• Check that boat interior and bilge are dry and there are no leaks.
• If batteries were left onboard, check water levels (lead-acid only) and recharge every 30 to 45 days. Do not fast charge and never leave a charger intended for automotive batteries unattended while in operation. Never use such a charger in a gasoline engine space. These chargers are not ignition protected and a spark from one could ignite volatile vapors onboard.
• Run rechargeable handheld devices (turn VHF radio on to receive only) until battery is flat and then fully recharge to preserve battery capacity and charge memory.
• Regularly give dry chemical fire extinguishers a shake and turn upside down to prevent contents from settling.
• If a survey is required within the next 12 months for insurance purposes, contact a qualified surveyor well in advance of spring launch.
• Consult your to-do list and confirm any work arrangements in writing.
• Take advantage of the off-season to take a course, catch up on your nautical reading, including all those *DIY* articles you've been saving, and update your personal and boat log.

About the author: After 14 years at *DIY's* helm, Jan Mundy and co-founder Steve Kalman have cut the lines and plan to spend the next year cruising the Great Loop waterway in their new pocket trawler, *Jessie M*, a Rosborough RF-246.

E-10 in Winter

Recommendations on storing ethanol-enhanced gasoline.

By Bob Adriance

One of the unfortunate properties of ethanol-enhanced gasoline is its ability to attract and absorb water. Ethanol-enhanced gasoline can absorb roughly 10 times as much water as MTBE, the now-banned fuel additive that ethanol replaced, and still burn safely through the engine. However, if ethanol becomes saturated, which can happen when it sits for long periods, the ethanol separates from the gasoline, forming two separate solutions. This is called phase separation and it's bad news for marine engines. An engine won't run on this water-soaked ethanol solution, which sinks to the bottom of the tank and is highly corrosive.

There is no quick fix. When MTBE becomes saturated with water, it remains chemically bonded to the gasoline (MTBE doesn't phase separate) and a water separator can eliminate the excess moisture. With ethanol-enhanced gasoline, however, once phase separation occurs, additives and water separators can't help; the only remedy is to have gasoline/ethanol/water pumped from the tank.

While all of this may sound discouraging to anyone planning to lay up their boat with ethanol in the tanks over the winter, the good news is that E-10 has been a fact of life in certain areas of the Midwest for several years and there have been relatively few problems. Several marina operators, surveyors and boat owners in the Chicago area who were contacted had the same reaction to ethanol. "It's no big deal."

No big deal? How can E-10, which attracts moisture and can fall apart, be expected to survive the winter? With any fuel that will be sitting for a long time, it is important to add stabilizer, an antioxidant, to extend the life of the fuel. [Ed: *DIY* recommends adding stabilizer with every fuel fill up as E-10 shelf-life can be as short as 30 days.]

What a stabilizer won't do, however, is prevent phase separation. Just how you do that is subject to some debate. Several sources, including one prominent engine manufacturer, recommend running the tank down to almost empty and then adding stabilizer. The following spring, the tank can be refilled with fresh gasoline. Lew Gibbs, a senior engineering consultant at Chevron, worries that leaving a few gallons of gasoline might attract enough condensation to cause phase separation. If that were to happen, the highly corrosive ethanol/water mixture would settle to the bottom of the tank and would remain there even after the fresh fuel was added in the spring.

Gibbs said his first choice would be to completely empty the tank when the boat is laid up and then refill it the following spring with fresh gasoline. No ethanol means no ethanol-related problems. Unfortunately, completely emptying a built-in tank safely is nearly impossible. His next choice, one that's more practical, is to top off the tank to 95% full (to allow for expansion). A tank that's almost full reduces the flow of air into and out of the vent, which reduces condensation on tank walls. Any condensation that does form will be absorbed by the gasoline. (Note that the National Fire Protection Association [NFPA] also recommends tanks to be topped off to minimize explosive vapors.)

Gibbs said the worst choice, which was confirmed by marina owners in the Midwest, is to leave the tank half full over the winter. Jerry Metzger, the general manager of Chicago Harbor's nine marinas, said phase separation problems typically occurred when boats had been stored over the winter with tanks that were a quarter to half full. Because marine fuel tanks have open vents, the tanks breathe more and attract larger amounts of moisture. Metzger says boaters in the area have learned to fill the tanks before the boat is laid up for the winter.

Note, however, that phase separation can occur anytime E-10 sits for a long time. On Long Island Sound, which has been using ethanol-enhanced gasoline for several seasons, Mitch Kramer at TowBoatU.S. Oyster Bay said they haven't had any problems with their own boats, which are used every day. Kramer says the problems now on Long Island Sound seem to be with boats that are used infrequently. Perhaps because of high fuel prices, some owners don't use their boats as often and are also less likely to top off their tanks. Half-empty tanks that sit for long periods are more likely to attract moisture, which causes phase separation. The key: Use your boat!

Bob Adriance is the editor of *Seaworthy*, the loss-prevention news-journal of BoatU.S. Marine Insurance. To subscribe, go to www.BoatUS.com/seaworthy

Preventing Phase Separation Do's and Don't's

DO:
Add Stabilizer.
Top off the tank.
Use your boat frequently during the season so that gasoline doesn't go stale in the tank.

DON'T:
Leave the boat's tanks partially filled.
Let the boat sit idle for months or over the summer.

PULLING PROPS

With the proper tool and know-how, removing a propeller, in the water or out, is simple and quick.

Story and photos by Bob Musselman

Removing or installing an inboard propeller will make most boat owners wish they'd studied contortionism or had grown a third hand but, with the right tools and a bit of knowledge about the drive train, the removal and installation of the prop is a straightforward procedure. Best of all, these tools are easily used on a boat in the water.

Propellers for inboard engines are bored to a female taper that matches the male taper on the shaft. A square key that rests in the keyway slots of the prop and the shaft with half of a key's length in the prop and half in the shaft, keeps the prop from spinning on the shaft. The thread size, taper bore dimensions and keyway size are determined by a SAE standard for American-made shafts and a metric standard observed elsewhere. [Ed: You can find the SAE standard reference, as it applies to boat shafting, incorporated in ABYC standard P-6, Propeller Shafting Systems.]

The taper fit, when it's correct, is a tight one and removing the propeller is usually not easy. A tap on the forward end of the propeller hub probably won't produce much movement and it's difficult to get much of a whack in the small space between the propeller and the strut. Don't bother with a gear or wheel puller as they aren't made for the job. Fortunately, there are propeller pullers that will do the trick.

Puller Options

A scissors-type puller is a favorite among professional divers because it's quick and easy to use. On one end, the jaws clamp against the end of the prop shaft and behind the propeller hub. Turn a worm gear on the other end and the jaws squeeze closed. The resulting pressure pops the prop loose.

Another option for do-it-yourselfers is a plate-type puller. One flat plate goes on the end of the shaft and another plate with a horseshoe-shaped notch fits over the shaft behind the propeller. Threaded rods run between the blades and are secured outside each plate with a nut and washer (three rods for three-blade props, four rods for four-blade, using different hole patterns). Simply tighten the nuts and the prop pulls loose.

Scissors and plate-type pullers have similar limitations. There must be enough room between the prop and the strut to accommodate the forward plate or the scissors jaw and there must be enough blade spacing to accommodate the puller rods and the scissor arms.

Plate puller installed on four-blade propeller. The plate with the U-shaped cutout fits behind the propeller, between the prop and the strut, the flat plate mounts on the shaft end and threaded rods run between the blades. To use, tighten the bolts on the end of the rods and the prop pulls loose.

Small inboard ski boats are enough alike, having 1" or 1-1/8" (25mm or 28mm) shafts and 13" or 14" (330mm or 355mm) diameter propellers, that a non-adjustable C-clamp puller fits just about all of them. The clamp is placed behind the propeller and a screw is tightened on the end of the shaft. Most three- and four-blade ski boat props come off easily with this puller.

With any of these pullers, the prop nut or nuts are loosened but not removed. The prop often lets loose

Scissors-type puller at work. Crank the outside handle and the inner jaws squeeze together and loosen the propeller.

Prop knocker installed on four-blade propeller with 2-1/4" (57mm) shaft, tightened against the end of the shaft. A few good whacks and off comes the prop.

with serious force and the nuts keep it from hitting nearby body parts, the deck or the bottom of the bay (if you're working in the water). If you're in the water, it's a good idea to secure the puller to the shaft or strut with a safety line.

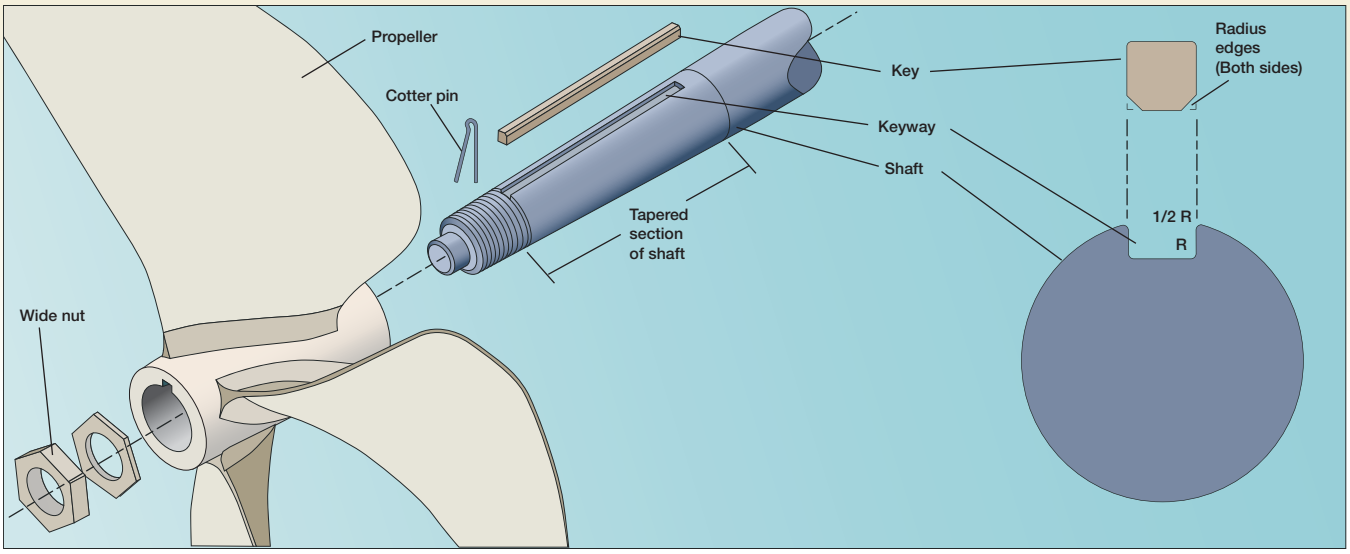
What if a puller won't work or won't fit? Try a prop knocker. It's a big bronze alloy plug that threads onto the end of the shaft and bottoms out before the knocker reaches the prop (propeller nuts are removed). Simply hit the knocker with a sledge and the prop comes loose due to the harmonic vibration. All but the most stubborn propellers seem to respond to this treatment.

There are a couple "knocks" against this method. It can be difficult to get a good hit on the knocker, especially with smaller props and shafts and you'll need a different knocker for every shaft size because thread sizes vary. If you only need one for your own boat, however, a knocker is cheaper than a puller.

To tackle the puller problems that big blades and big hubs can present, many props now have puller holes drilled in the aft end of their hubs. This allows screwing threaded rod into the hub and placing a puller plate that matches the hole pattern over the holes and up against the end of the shaft. Nuts are used to pull the plate against the end of shaft and the pressure plus maybe a whack on the end of the puller plate pops the prop loose. Some boat yards use a hydraulic ram between the plate and the end of the shaft to force the issue.

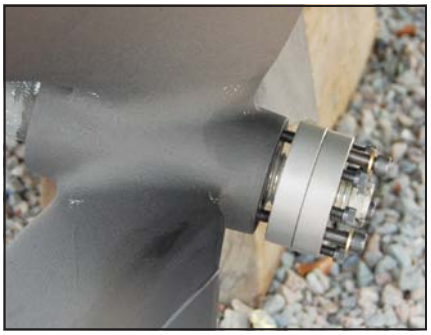
If your propeller has puller holes, the best option is the Prop Smith tool. Each Prop Smith is made for a specific size shaft (it threads onto the shaft) and adheres to an industry adopted puller bolt specification. It's not adjustable and it's not universal. Using plates and bolts, it gently pulls the prop off and just as gently pushes a prop back on, which can be a trick in itself if you're talking about a large, heavy propeller.

What about heating a propeller to expand the hub and make it easier to remove? Avoid that except in cases where the prop won't budge under any amount of pressure. Cooking metal can change the molecular structure of the metal. Use heat only as a last resort.



Michigan Wheel/Joe VanVeenen

Shaft and propeller components in a typical inboard engine installation.



Prop Smith threaded on the end of the shaft. Bolts thread into holes in the propeller. When tightened, the bolts pull off the prop. The split plate design also allows reinstalling the prop by tightening the smaller bolts, pushing the forward plate toward the prop so it slides up the shaft taper until it seats.

C-clamp style puller installed on inboard engine ski boat. Tighten the bolt on the end of the clamp and off comes the prop. This device fits three- and four-blade ski boat-type propellers and other small props on 1" (25mm) and 1-1/8" (28mm) shafts.

Assembly

To reinstall a propeller, fit it first with no key. There should be no rock or wobble and, if there is, check for burrs in the propeller bore or on the shaft. Some installers use valve-grinding compound to "lap" the propeller on. It works like liquid sandpaper to smooth high areas on the shaft and propeller bore. You can even use bluing compound to check the fit. Contact of 75% to 85% is considered very good.

When the prop fits well, use a pencil to mark how far up the propeller goes on the taper. You'll want to make sure that it goes on just as far with a key installed as it did without the key and that it's not binding on the key. There should be about 1/4" (6mm) draw for the nut to tighten up on the propeller, not against the end of the shaft.

With the prop installed, it's time to install the key. It can be brass or stainless steel but many yards and shops prefer brass because it inflicts less damage on the keyways as the prop tries to move back and forth on the taper. The key seats, especially on the shaft, should be radiused at the bottom to prevent crack-causing stress risers and the key should be radiused on the edges to match. This is special key stock obtained from a propeller or marine machine shop, not a hardware store.

The key should be a tap fit. Tap in, tap out. That keeps the prop from rocking, which could cause fatigue failure in the shaft. If the key is loose, get a new one. If it's still loose, you might have a worn key seat, which is a reason to start looking for a new shaft or propeller.

Install the key in the shaft and then slide the propeller on, making sure the key doesn't slide up the shaft. The prop should come to rest on the mark you made before. No lubrication or grease is necessary. The tight mechanical fit squeezes it all out anyway.

Nuts are either brass or stainless steel and, here again, brass is usually preferred. Stainless against stainless tends to gall, making the nuts hard to remove and damaging threads.

If you have a single castle or Nylock nut, tighten it against the prop. Avoid using a block of wood wedged against the propeller and the hull, as this can damage sensitive prop edges. Use a stainless-steel cotter pin to secure the castle nut or provide a safety for the Nylock.

SAE standard calls for a twin jam nut/full nut setup, and old timers argue until the beer's warm about whether the thinner jam nut or full nut threads first. One common procedure is to use the full nut to seat the propeller, then remove it and install the thinner jam nut against the propeller. Then tighten the full nut against the jam nut. Add a stainless-steel cotter pin for security. Tour any boat yard and you'll find little agreement on which way is correct.

For information about scissors pullers, go to www.mindermanmarine.com; for the plate puller, www.waltergear.com; for ski boat prop pullers, www.ojprops.com; for Prop Knockers, www.buckalgonquin.com and Prop Smith at www.propsmith.com.

About the author: Bob Musselman is the owner of Admiral/C&B Propeller (www.acbprop.com) in Tampa. He is a 20-year-veteran of the propeller industry and a board member of the National Marine Propeller Association.

UPGRADE

A Cool Project

The advent of new, more compact air-conditioning units at prices of around $90 makes the idea of adding thermal comfort very appealing.

(left) Before: Original forepeak with anchor line storage. (right) After: Modified forepeak now holds a household air conditioner that is easily removed for storage off the boat or for quick access to the forepeak, if needed.

Story and photos by Gary Gerber

If one lives and sails in warm climates, particularly humid climates, the addition of an air conditioner (A/C) makes life aboard the boat more palatable when docked.

I know of several installations where the A/C unit must be removed from its "in use" position and stored aboard securely when underway. I wanted to avoid this by installing a permanently and securely mounted unit for the season yet still meet all the performance parameters of cooling, exhausting, drainage and without interfering with any vessel operation. Fortunately, in our Morgan 33 it turns out the forepeak where the anchor line is stored meets my parameters. It has ample air venting and it drains into the bilge, plus the forepeak bulkhead is adequate to fit an A/C unit. I had already wired our Morgan 33 throughout with 110-volt AC receptacles and a circuit breaker set up for shorepower so this consideration was covered.

I selected a 5,000 BTU unit that measures 11" high, 17" wide and 12" deep (279mm by 431mm by 304mm) and weighs about 25lb (11.3kg). After double checking the mounting clearances and determining the location to be suitable, I decided that since I needed access to the forepeak to reach the anchor line and to change the navigation light bulbs, the installation must allow for quick removal without tools for emergency access.

Though this installation is unique to my vessel, it's very possible to mount a permanent, functional domestic household type A/C unit in other sail or powerboats using the information below as a guideline.

Pre-Fab

Since the forepeak area is very confined, I elected to build a plywood replica on a stand in order to do all the fabrication and fitting in my shop and to insure my calculations were correct (**Figure 1**).

The trapezoid-shaped access opening in the forepeak bulkhead cut by the boat builder was not symmetrical so I made a paper pattern of the outline of the A/C unit to determine where to cut the plywood. For a safety measure, I laid out a second plywood pattern that provides reinforcement and supports the A/C unit. This second reinforcing frame was screwed to the existing bulkhead from inside the forepeak.

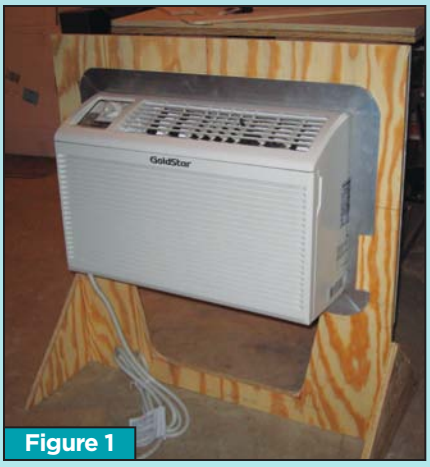


Figure 1


Figure 2


Figure 3


Figure 4


Figure 5


Figure 6


Figure 7

To mount the A/C unit, I fabricated a frame using .125 aluminum angle, 1-1/2" by 1-1/2" (38mm by 38mm) that was screw mounted to the unit using the existing holes normally used for window mounting brackets (**Figure 2**). I put a liberal radius on the frame corners so I wouldn't damage my boat in the event I set the unit on the cushions.

A plywood shelf, measuring 5" by 17" (127mm by 431mm), attaches to these angle brackets on the backside of the reinforcing frame (**Figure 3**). This allowed me to slide the unit into the opening without having to support the weight on a rocking vessel. This shelf is removable by hand, unscrewing bolts from the underside of the shelf; no tools are required (**Figure 4**). Utilizing the steel horizontal bracket that came with the unit, I made an additional horizontal support at the bottom of the A/C (**Figure 5**). This bracket unscrews by hand and was mounted using eyebolts. By removing this bracket and the shelf I can snake my torso into the forepeak, if necessary.

Small pilot holes for the hanger bolts were drilled in the reinforcing wood frame while it was mounted to the bulkhead mock up. After painting this frame assembly it was clamped to the forepeak bulkhead from inside (**Figure 6**) and drilled through the small pilot holes through the bulkhead. After tracing the outline of the frame, I used a saber saw to cut away the forepeak bulkhead to match the frame. The frame was mounted to the bulkhead from inside using 3/4" (19mm) long stainless steel pan head screws. Pilot holes were then enlarged to accept 1/4-20 by 2" (50mm) stainless-steel hanger bolts that would secure the A/C unit to the bulkhead (**Figure 7**). Pilot holes were enlarged in the A/C aluminum frame to 5/16" (7.9mm) diameter to ensure a smooth fit over the 1/4" (6m) hanger studs.

For cosmetic purposes I made a 1/4" by 2" (6mm by 50mm) wood fascia frame, stained with Minwax to match the existing bulkhead (**Figure 8**). This fascia served to dress up the mounting and to cover the exposed corners of the original access opening.

A condensate drain line was then connected to the back of the A/C unit. The appliance can be lifted and slid into place with the hanger bolts passing through the


Figure 8


Figure 9

Figure 10

holes in the aluminum frame and then secured to the bulkhead with 1/4-20 threaded black plastic knobs (see bottom photo Figure 7).

Even with the A/C installed there is access to the forepeak since the access opening extends below the unit (**Figure 9**). A matching stained wood facia mounts to the bulkhead using Velcro strips to dress the opening (**Figure 10**). The power cord simply runs the length of the port side shelf to the AC outlet on the amidships bulkhead. In the event I'm sailing without the A/C unit installed, I fabricated a blank panel as a finish cover for the altered forepeak opening (**Figure 11**).

Limitations

This A/C unit has performed perfectly. I have sailed in 15- to 18-knot winds under full sail and it is rock solid in the mounting. I will say that using a "home" unit didn't bother me from a durability standpoint (i.e. salt air) since there are waterfront homes everywhere with window units. When boating season is over, I take the unit home. Should I need access into the forepeak quickly, the A/C unit is easily removed by hand without tools.

At "reasonable" summer temperatures of 75F to 90F (24C to 32C) the heat exchanging capabilities are adequate. The warm air from the A/C unit exhausts through the cowl vent allowing the A/C unit to cool the closed boat interior, especially the forward cabin, if the passage door is closed. However, in a recent 100F (37.7C) temperature heat wave the unit could not exchange heat and did not cool effectively. Boaters in the warmest climates will have to consider the heat exchanging capabilities of their installations.

About the author: Gary Gerber and his wife Joyce have sailed *Captiva*, a classic 1970 Morgan 33 cruising sloop, for 33 years, now based on the Chesapeake Bay.

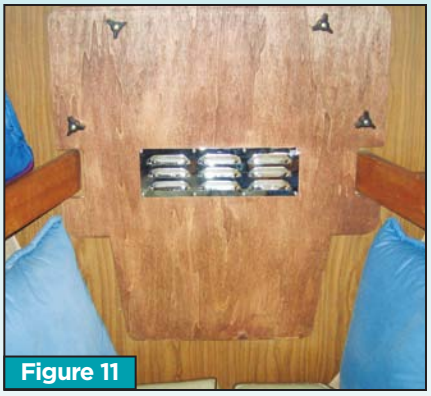
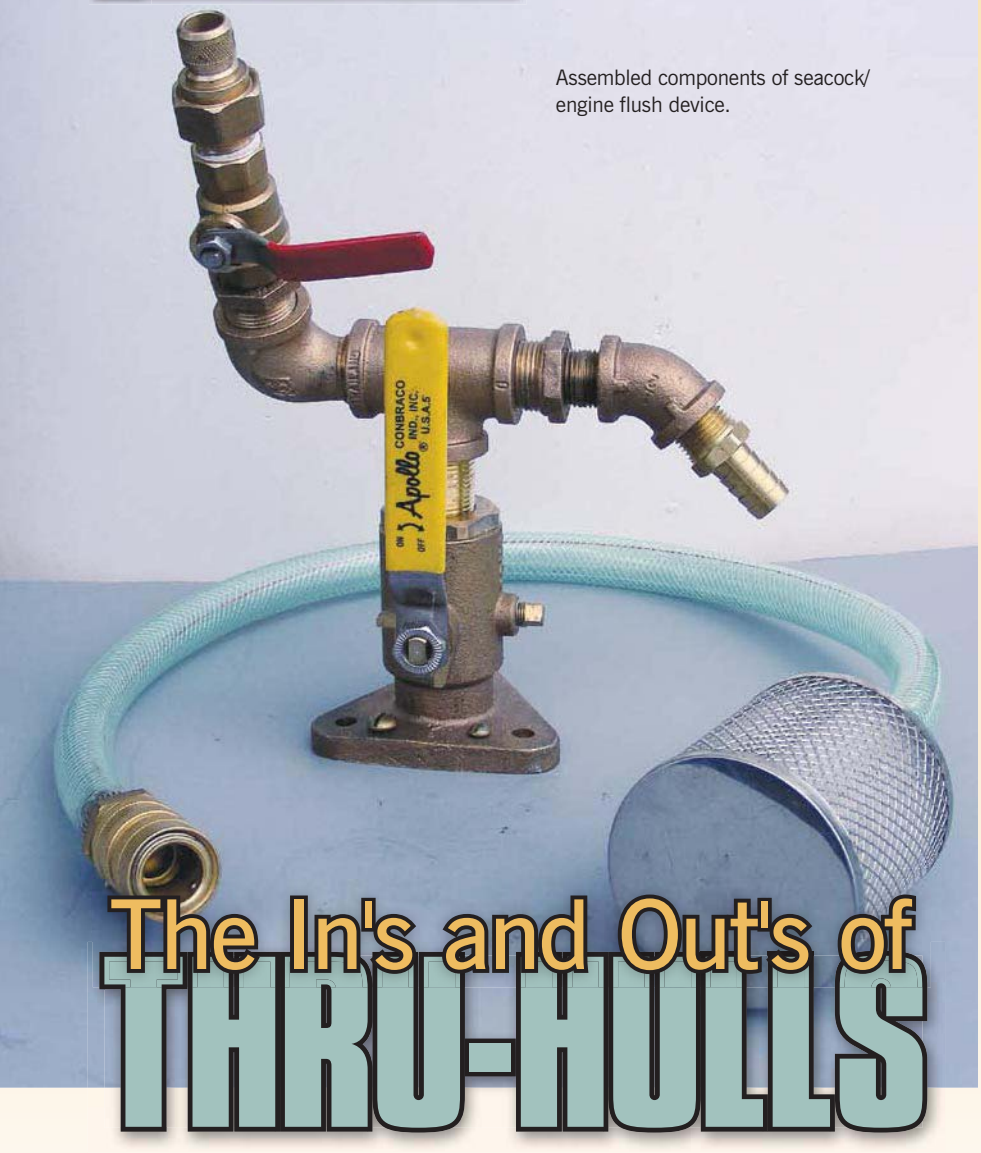


Figure 11

DIY BILL OF MATERIALS

1 5,000 BTU, 110-volt, 5-amp Goldstar air conditioner	$90.00
1 1/2" thick, 2' by 4' plywood (to build test stand)	$8.00
1 1/2" thick, 2' by 4' cabinet grade plywood (reinforcing frame)	$12.00
1 1/8" thick, 1-1/2" by 1-1/2" by 72" aluminum angle (mounting frame)	$27.00
1 pair 5" steel angle support brackets for guide shelf*	$4.18
1 quart (946ml) white epoxy paint	$6.50
2 pieces 1/4" thick, 3" by 36" bass wood (decorative fascia bezel)**	$8.00
1 pint (.472L) Minwax wood stain***	$4.50
4 1/4-20 by 2" stainless-steel hanger bolts	$8.00
4 1/4-20 black plastic mounting knobs	$8.00
1 1/4-20 1" stainless-steel eyebolts (secure horizontal reinforcing frame)	$1.40
14 3/4" #8 stainless-steel pan head screws	$3.80
2 1/4-20 stainless-steel T-nuts	$.90

Notes:
Prices are rounded off and may vary.
* These are plated steel, which were epoxy coated, are very sturdy and inexpensive and should outlast the A/C unit. Stainless-steel brackets were not readily available at this length.
** Basswood is available at Home Depot or model shops also in poplar and oak, items discovered after fabricating the bezel.
***The walnut stain did bring out the grain so the fascia blended nicely with the bulkhead laminate face.



Assembled components of seacock/ engine flush device.

The In's and Out's of THRU-HULLS

A knowledge of good plumbing practices and the materials to do the job right is critical to keeping water out of the boat and making sure it's coming in when you need it.

Story and photos by Paul Esterle

The seacock for the cooling water inlet to my diesel engine told me, in no uncertain terms, that it needed replacement; the handle broke off. Luckily, the boat was on the hard and I was in no danger of sinking. The seacock itself was an antique of the '70s, an old Groco model with a heart of rubber.

This style sea valve housed a rubber cylinder in the body of the seacock. The cylinder had a hole through the side to allow water through the unit. A handle on one end rotated the rubber cylinder to turn the flow of water on or off. A tee handle on the other side pushed a bronze plate against the end of the cylinder to compress it and seal the unit from leaking. After being a reliable performer for 30 years, the rubber had hardened in place to the point that the handle broke off rather than turn the cylinder.

I was prepared for this eventuality. I had purchased replacement seacocks for all units on my boat. These were modern flanged bronze seacocks with stainless-steel balls and Teflon seals. Since this was the engine cooling water intake and I continue to have a need to winterize the engine, I decided to upgrade the installation by adding an easy way to attach a flushing and winterizing connection.

I had field-tested a QuickFlush unit (www.marinetechgroup.com) for an inboard/outboard engine and still had that unit on hand. I decided to cannibalize that unit to build my new seacock/engine flush installation.

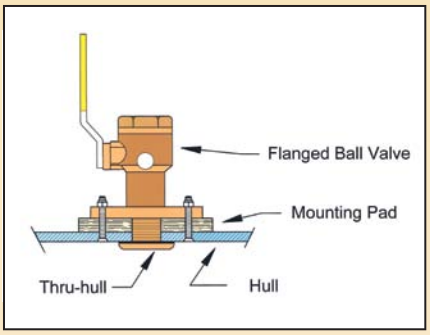
The failed 30-year-old Groco rubber plug seacock.

Another option is Forespar's Engine Flush Out Valve system (www.forespar.com). The idea behind either design is to provide a port to allow you to connect a hose. By hooking up a hose to the flush port, placing it in a container of antifreeze and turning off the ball valve at the seawater inlet, you can suck antifreeze through the cooling loop of your engine. [Ed: Always use propylene glycol antifreeze, rather than ethylene glycol, since the latter is toxic and should not be discharged overboard.] You can also hook a garden hose to the flush port and run your engine on the hard or flush a seawater cooled engine with fresh water while at the dock.

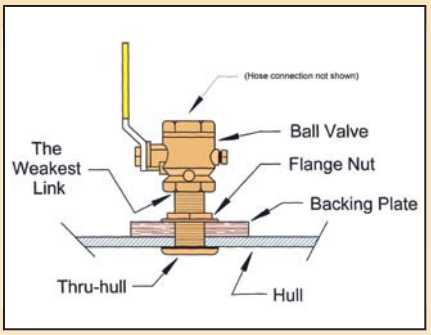
A versatile addition to any boat, just make sure any inline pickup can be closed with a valve and the fitting sealed with a threaded cap when you are finished and you restore the seawater intake flow to the engine. Never leave the garden hose connected to the intake line. If it can be a source of flooding, it will.

Plumbing Jargon

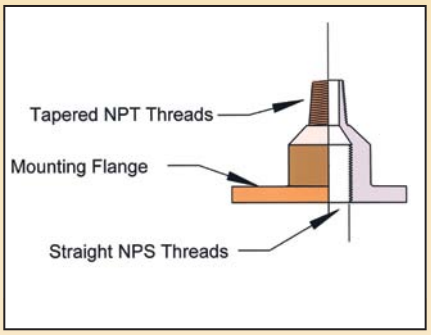
A bit of terminology here before we actually proceed with the project. The thru-hull is the part that passes through the hull. It can be flush, mushroom headed or have a strainer attached. It is usually threaded into the base of a seacock or ball valve. To meet the ABYC standard (H-27) for the definition of a seacock (sea valve), a valve on a thru-hull fitting at or below the maximum-heeled waterline must have a handle that indicates whether the valve is open or closed. This effectively eliminates gate valves for use as sea valves on boat thru-hull fittings below the waterline and for good reasons. In addition, to



Flanged style seacock installation.



Ball valve used as a seacock.



Groco flanged adapter for taper threaded ball valves.

be a real seacock, the assembly, which includes a closed valve installed on the thru-hull, must stop the ingress of water even when subjected to a static force of 500lb (226.8kg) applied to the inboard most end of the assembly.

You sometimes see a thru-hull installed with a nut on the inside. A ball valve is then screwed onto the stem of the thru-hull. This then brings up the question of threads. Thru-hulls have straight threads (NPS). Proper flanged seacocks also have matching straight threads. A ball valve may or may not have straight threads on the bottom end. Problems arise when a ball valve with tapered threads (NPT) is screwed onto a thru-hull with straight threads. Only a few threads will properly engage. It will look okay but is a potential point of failure. Make sure the fittings you use have matching thread types. This applies to both metal and plastic fittings.

If you choose to use a ball valve with tapered threads on both ends, use a Groco adapter. This item has a flange, like a standard seacock but has a stem with tapered threads to match the ball valve.

Removal and Prep

Back at the boat, the first order of business was to remove the old thru-hull from the seacock. A thru-hull has two internal ears inside the opening. I have seen any number of solutions for loosening up the thru-hull, with varying degrees of success. The thru-hulls on one of my boats were so firmly bedded in place that I had to grind them off with an angle grinder. [Ed: Another alternative to this traumatic method is to leave the fitting in place and seal it with a threaded cap and then install an entirely new assembly near the old location; much less destructive with little increase in the bill of materials.]

I did make the investment in a thru-hull tool. This tool fits inside the thru-hull opening. Slots on the side of the tool engage the ears inside the thru-hull. The tool is stepped to allow it to be used on a variety of different sized thru-hull fittings. With not much hope of success, I placed the tool in the thru-hull, fitted a pipe wrench to the tool and then placed a pipe on the pipe wrench handle for extra leverage. To my surprise, the thru-hull slowly backed out of the hull. The sealant was still pliable and sealing after 30 years in place. [Ed: You may need an extra pair of hands inside the boat to actually separate the thru-hull from the valve unless you have already removed the valve from the thru-hull stem. Thru-hulls and their valves are sometimes married till death do they part and the thru-hull release on the outside may be just twisting the entire assembly inside unless the valve body is bolted to the hull. This is often not the case with ball type valves, which are simply mated to the hull with flanges that tighten as the valve is seated on the thru-hull fitting threads. Know before you go there.]

Inside the boat, it was time to remove the old seacock. The unit was installed at the bottom of a narrow compartment alongside the engine box. I could stick my head in to see what I needed to do but then couldn't get my arms in to do it. The only option was to stick my arms in and work by feel. I managed to get one of the bolts out of the thru-hull flange but couldn't get the other one. I finally resorted to hitting the thru-hull in an attempt to break the flange off. At which point I discovered that the thru-hull was, in fact, held on by only the one lag bolt and the cured sealant.

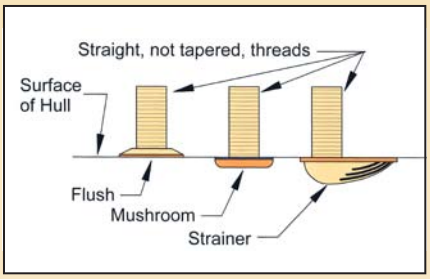
A seacock should be installed on a backing block to spread the compression and torque forces, from turning the thru-hull on and off, over a wider area of the hull. Typically, these are made of 3/4" (19mm) plywood bonded to the hull. I assumed that the pad under this seacock was old and possibly deteriorated. I hit it with a hammer to break it loose and it was like hitting a rock. The sealant did its job and the seacock mounting pad was as solid as the day it was installed. I could reuse the existing seacock pad without any problems.

I had actually made up a couple of new pads just in case I needed them. I cut mine from a piece of 3/4" (19mm) marine plywood using a series of hole saws. I started with the large hole saw for the outside of the pad. I cut in about 1/4" (6mm) and then turned the plywood over and did the same from the other side. I then changed to a smaller hole saw and cut the center opening. With the center cut out, the pilot drill in the center of the large hole saw had no place to go. The previously cut groove was deep enough to center the large hole saw.

I sanded all the edges smooth and then screwed the seacock to the pad using the thru-hull. I then pilot drilled the mounting holes for the three mounting fasteners on the seacock flange.

That, in turn, leads to the issue of fastening down the seacock on the pad. The old seacock had a single lag bolt into the pad but not through the hull. Other sources recommend thru-bolting the seacock with countersunk bolts. I had several issues with the thru-bolt idea.

First of all, the original thru-hull lasted 30 years with only one lag bolt in place. I suspect that bolt was only there to prevent the seacock from turning while the thru-hull was tightened. Second of all, I wasn't thrilled with the idea of three additional holes in the hull to seal. Last of all, the bolt pattern on the thru-hull flange was smaller than the size of the existing thru-hull and thru-hull pocket, requiring some fancy recessing to clear

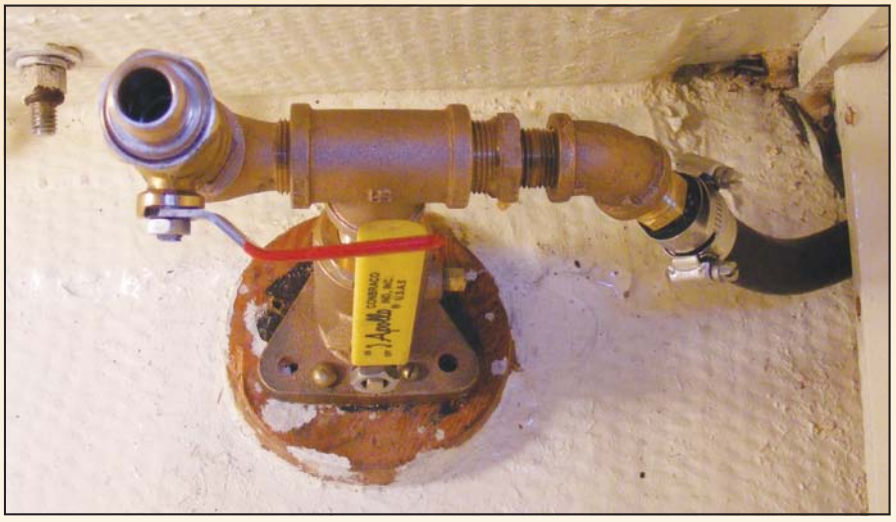


Forespar

(top) Thru-hull types. (bottom) Forespar Engine Flush Out Valve provides a source of engine cooling water and freshwater flushing or winterizing with antifreeze in one single valve system.

Thru-hull tool the author used to remove the old thru-hull,

Note the difference in size between the flange on the old thru-hull fitting and the new one. Luckily, the old one was in perfect shape and could be reused.



Final configuration of the new seacock/engine flush configuration with emergency hose and strainer. The hose will be lengthened.

the thru-hull flange. I decided to simply lag bolt the seacock to the existing pad and not penetrate the hull.

That also brought up another point. I had purchased new thru-hulls to go along with the new seacocks. When I removed the old thru-hull, I discovered that the new ones, while having the same stem diameter and threads, had a much smaller diameter for the head. I would have had to fill in part of the thru-hull pocket in the hull to be able to use the new thru-hull.

It was now time to start building the seacock and fitting stack. The seacock and thru-hull were 3/4" (19mm) while the engine coolant hose was 5/8" (15mm). I started with a close nipple and a 3/4" (19mm) tee off the top of the seacock. The aft branch of the tee would be for the flush connection while the forward branch would be the outlet to the engine. An elbow on the flush end of things aimed the quick disconnect for the flush connection upward, making it easier to access from above.

Reinstallation

With the fitting stack loosely assembled, it was time to try it in place. One thing was immediately evident. The seacock was on the hull at a pronounced angle. The quick disconnect branch had to be rotated to clear the side of the compartment. The cooling outlet was also too high, forcing a kink in the hose. A 45-degree elbow aimed the hose barb at a downward angle, solving this problem.

With the configuration finalized, I took the stack off the boat for final assembly. Before taking anything apart, I made a full-size pattern so I could replicate the angles. With the diagram in hand, I disassembled the pieces. Some folks like to use Teflon plumber's tape when assembling a project like this. I prefer old-fashioned pipe dope liberally applied to the threads.

Back at the boat, I spent some time cleaning off the old sealant from around the thru-hull pocket. I temporarily installed the seacock and thru-hull and then marked the holes on the pad for the lag bolts. I drilled pilot holes for the lag bolts and then applied a liberal amount of polyurethane adhesive sealant to the seacock flange before lag bolting it into place. I tightened the bolts just enough to locate the seacock but not enough to squeeze out all the sealant.

Back outside the boat, I applied a liberal amount of sealant to the head and stem of the old thru-hull (it was still in perfect shape). Next, I threaded the thru-hull back in using my pipe wrench and thru-hull tool. Again, I did not tighten the thru-hull excessively tight so I still had a good thickness of sealant in place.

It's now a simple matter to flush or winterize my diesel and I have a seacock that can be counted on to operate. The best of all worlds.

About the author: An inveterate DIYer, Paul Esterle is a boating writer and editor when he isn't working on his fleet of old boats.

Rattle-Free Anchor Storage

This anchor "lock" is easily adapted to fit your particular anchor and anchor roller.

Story and photos by Jane Lothrop

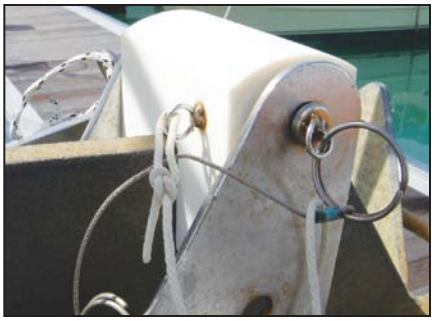
Anchor rollers are made to fit a wide range of anchor types and, like any other "one size fits all" scenario, usually fall short of perfection.

Our 55lb (25kg) Delta Fastset was quite a rattle generator until I finally came up with a design that actually worked. I started with a block of wood cut to fit between the "ears" of the anchor roller and then drilled a hole in the block of wood through which the anchor lock pin fits snugly but not so snugly that it would be difficult to insert or remove. A slot was cut into the wood block to fit over the anchor shank. Because our anchor sits at a slight angle, it took several trial forms to get the alignment right. The completed wood block was taken to our favorite machine shop to be duplicated in a hard plastic material, such as high-density polyethylene, Delrin or other non-absorbent material.

After a bit of final adjustment, security lanyards were attached to the finished lock block, lock pin and R-pin to make sure that they stayed onboard. Now, the anchor rides snugly and quietly in any sea condition.

We remove the anchor and store it in the sail locker when making extended offshore passages. A bridle, protected by chafing gear, for the sea anchor is then affixed to the Samson post and lead back to the cockpit so we can deploy the para-anchor from the safety of the cockpit. We had the unfortunate opportunity to prove that this arrangement works perfectly during our Tasman Sea crossing in June 2003.

About the author: Frequent contributors to DIY, Jane Lothrop and her husband, Harry Hungate, live aboard their Corbin 39, Cormorant.



Delta Fastset on anchor roller with lock block.

Anchor lock block, pins and security lanyards.

MADE FOR SHADE

This easy-to-make, full-batten deck shade can remain up no matter how strong the wind gets.

By Jane Lothrop

The awareness of the damage caused by ultraviolet (UV) radiation is increasing rapidly and it is just plain hot when the sun beats down on unprotected decks. It only takes a look around any marina to see that there are many solutions to the problem and we've probably tried them all in our 11-plus years of cruising in our Corbin 39, *Cormorant*.

Our first deck shade was professionally made and was the typical design, tied around the mast at its forward end and then over the boom with a split for the topping lift aft and with side ties to shrouds and backstays. It was huge and it took both of us to get it up or down. When the wind came up, which somehow always happens just after you have settled into bed, it made a loud, annoying flapping noise and had to come down every time the wind got over 20 knots. Even when deployed under ideal conditions, it wasn't very useful, because a high canvas only gives shade when the sun is directly overhead. In the late afternoon, when the sun is at its hottest, it comes at a lower angle and the only way to get shade is to add side curtains to the already overlarge top section. More complications, more things to tie down and roll up and an even bigger bundle of material to put away somewhere when it is time to raise the anchor or drop the docklines.

Professionally made or not, it just wasn't working, so after a year I started trying to do better. I had lots of expensive fabric from the old shade to recut so I started with that. First, I tried putting battens crossways on the ends. One of the problems with making a shade for a boat with a canoe stern like ours is that the narrower stern means that it is hard to tension the full shade well. If the shade is allowed to narrow along with the boat, then it covers even less area. Since we have both upper and lower shrouds, the forward end of the shade was well aft of the mast. The battens helped and, with the addition of zip-in side curtains, we used my redesigned shade through the western and eastern Caribbean, through the Panama Canal and down to Ecuador and then across the Pacific to New Zealand. We were still never happy with it and we often just did without it rather than go through all the work of putting it up, taking it down when the wind came up, putting it back up, etc. It ended its life as a low shade tied to the lifelines, while our boat was on the hard in New Zealand for a refit in 2001 to 2002.

Figure 1

For years, I had been looking at the big arched curved batten shades in the boating catalogs but the expense and the size kept me looking, not buying. Then,

Figure 2

in 2003 when we were enjoying a few weeks on a mooring at Musket Cove in Fiji, I saw a beautiful New Zealand boat with a cover that looked just perfect to me. The big difference was that it was under the boom rather than over, so the deck was shaded at all angles of sun, the hatches could be opened in the rain, and I thought it would stand up to the wind. As soon as we got back to New Zealand in November 2003, I made one for our boat. It was easy, it did the job and, no matter how strong the wind was (and it did get over 50 knots), it didn't make noise and we never had to take it down.

That cover was made with Stamoid and there is a lot to like about this fabric: very easy to work with since it is light and strong; does not ravel; does not stretch on the bias and is also completely waterproof without needing recoating like Sunbrella does. What I did not know was that it does not stand up to the tropical sun. By May 2008, it was time for me to make a replacement. I had a few modifications in mind but, basically, I just made another, even better, one. The total project took just two days to complete.

The Design Phase

My goal was to make a shade that had enough height to let air flow easily, was wide enough to cover the hatches so rain would fall on the deck rather than through the open hatches and could be attached to existing hardware by webbing buckles which could be preset for easy use.

Step 1: Measure the total length from the forward edge just aft of the mast to a point near the traveler or dodger. I chose a point aft, which would cover the pilothouse hatch and still be forward of one of the boom bails so I had something to tension it to.

Step 2: Find a good batten length. I used three battens with the forward two battens being 110" (279cm) each and the aft one 85" (216m). The difference was necessary because we have a pilothouse but if you have a regular deck, probably all three would be the same. For battens, I used the most inexpensive ones I could find, 13/32" (10mm) diameter round or square. These are easy to work with, light and plenty strong.

Step 3: Calculate the amount of material needed. I used 60" (152cm) wide Sunbrella so, since the battens were 110" (279cm), I made a center seam to get one large piece of material. Other supplies were eight 1" (25mm) plastic buckles, two 3/4" (19mm) plastic buckles (the jib sheet cars I use to hold the forward end of the shade down were too narrow to hold the sheet and the 1" (25mm) buckle at the same time), plenty of 1" (25mm) webbing, enough 3" (75mm) webbing to make a batten pocket for the center, and two snap hooks big enough to fit in the vang car under the boom and in the boom bail for holding up the center and tensioning the aft end.

Cutting and Sewing

While the fabric will last for years, unless you are using Goretex thread, the stitches will degrade in the sun and need to be replaced every year or so.

Step 4: Sew your center seam, if you need one, and then lay out the full fabric for marking. Try to plan well so you only have to lay out and mark it once. It is not easy carrying around so much material. Allow 2" (50mm) at the ends for making the batten pockets. Measure and mark the location of the middle pocket where you will sew on the webbing later. Check this carefully. My middle pocket was not in the true center, because I used the center aft hatch hinge pins as a tie-down point. Thus the location of the hatches determined the center. Mark your seam line and your cut line on the long edges. I used a blue chalk pencil for all the marking, since it is easy to see and brushes out afterward.

Step 5: Before sewing the batten pockets, sew on the center webbing fore and aft (**Figure 1**). Once you have folded the material over to make the pocket, you can't sew through it without blocking the pocket. If you prefer, you can wait until the pockets are done and then sew the webbing just behind the pocket but you will need a reinforcing piece of webbing on the underside to share the load. For the center, sew 1" (50mm) webbing to the middle of the 3" (76mm) webbing before you sew it onto the fabric.

Step 6: Sew the batten pockets and the edge seam. I sealed one end of the batten pockets as I made them and left the other open temporarily so I could fit it on deck. After fitting, I hand-sewed the open end of the batten pockets. We just leave the battens in, roll the shade up, and tie it on deck when we are underway.

Step 7: Finally, sew on your webbing and buckles to fit at the ends of the battens and create the curve. Exactly how long these will be and where and how they fit depends on your own deck arrangement. Some of mine are visible in **Figure 2**.

Relax, Admire and Enjoy

The deck shade can be put up or taken down by one person in less than three minutes. It leaves the side decks completely clear, so there are no lines to trip over in the dark when the anchor is dragging or strange noises are heard. It shades the deck, keeping us cooler below and even lets us keep a hatch or two open in the rain.

I made this new shade slightly larger than the old one so that it would cover the edges of the hatches, so I cannot say for sure that it can withstand the 50-knot winds that the first one did. We have already had a few thunder squalls and it sits tightly and silently in place. This was an easy project and one that we know from experience will give us years of enjoyment.

About the author: Jane Lothrop and her husband Harry Hungate have lived aboard and cruised on *Cormorant* their Corbin 39 since 1997. After extensively cruising Southeast Asia, they crossed the Indian Ocean, transited the Suez Canal and plan to spend winter 2009-10 in Turkey.

Protect your boating investment with chafe prevention before summer squalls or hurricane threats start keeping you awake worrying whether your boat is secure.

GOT CHAFE?

Davis Secure Removable chafe guard made of abrasion-resistant polyester provides good protection and the hook-and-loop fastening makes it easy to reposition.

Story and photos by David and Zora Aiken

Whether tied in a slip or at a dock, tethered to a permanent mooring or anchored out, the boat is still in constant motion, shifting position with every breeze, current, wave or wake. With this dynamic comes the related and constant movement of the lines, each one rubbing on every surface it contacts. After enough time, any rope will develop a fuzzy look along the rubbed sections. The fuzz indicates the start of abrasion. Saltwater and dirt, embedded in the line, encourage the damage, with the long-term result being a badly chafed line with not if but when propensity to part company with its keeper, a piling, a cleat, etc. Protecting the line protects the boat. Thus the use of chafing gear becomes an important consideration for the boat owner.

Traditional chafe protection included patches of leather or heavy-duty fabric covering the vulnerable sections of the lines and tied in place; where a dock line goes through a chock or touches a stanchion or toerail on its path to the dock; where a mooring pennant or anchor line passes through chock or bow roller and drops off the bow and down to the water.

Lengths of hose have also been used commonly for abrasion prevention, though in certain applications, that use has prompted questions and cautions, as the original problem of chafe has been joined by a new concern. On boats anchored or moored in severe weather, lines can fail from reasons other than external chafing. They can fail internally as the fibers melt from the heat generated by friction when under load.

Critical Connection

During a storm, a boat's nylon anchor rode (or mooring line) shifts back and forth through the chock, often at a sharp downward angle. The accompanying "cycling" (stretching and contracting of the line) creates friction between the fibers and builds up a great amount of heat inside the rope. When lengths of hose are used for chafing gear, the problem of excessive heat is compounded. Not only does hose confine the heat, it also prevents water from getting to the section of rope that could benefit from a cooling shower or spray.

According to a report in the BoatU.S. *Seaworthy* magazine, in an example of a failed mooring pennant, no signs of abrasion were visible but lumps of plastic were found at the ends of the failed strands. The same gale that resulted in this failure sank seven boats and beached eight others.

For anchor and mooring lines, nylon is still the favored material because of its ability to stretch and absorb shock. Polyester (Dacron), while more abrasion resistant than nylon, allows very little stretch (about 8% as compared to about 40% for nylon). One way to gain the advantage of both types of rope is to use them in combination. A short length of polyester rope can be led from the cleat through the chock. Then the polyester can be connected to nylon line for the main length of the pennant or anchor line, using an eye splice, not a knot. Chafing gear should still be added, using fabric sleeves or leather, as these materials allow water to get to the line to help prevent excessive heat.

A section of white hose secured with cable ties covers the bow line as it passes through the chock.

For most docking situations, such extreme care is usually unnecessary. Use chafing gear at all potential sources of abrasion and, with watchful attention, minor abrasion will be spotted and addressed before a fiber chafes through.

Heavy-duty hose prevents line from chafing against dock edge.

Time to replace chafing gear.

(top) A fabric sleeve protects the line and a metal rub strake prevents damage from the chain. (bottom) Stainless-steel rub strake provides a smooth surface for line to cross and, at the same time, it protects the varnished surface of the toerail.

Gear Options

If you don't have any spare pieces of leather hiding in the lockers, buy a handy kit that includes prepunched leather patches, twine, a needle and instructions to make a professional-looking job.

Good results relative to both chafe and heat prevention have been reported with the use of chafe sleeves made of polyester. The fabric is abrasion resistant and it's guaranteed against deterioration from ultraviolet exposure for three years. The sleeves can be slipped on and tied in place (ties provided) or a hook-and-loop-closure is available on sleeves that are split lengthwise for easy attaching (and moving), especially convenient when the release of more anchor line necessitates repositioning the chafing gear. The white sleeves make a neat job of chafe protection.

Hose is still used successfully for chafe protection on many dock lines that are not subjected to the heavy cycling and heat buildup that may occur at anchor. Hose pieces slip over the end of the line, or slit lengthwise and placed over the section of line that needs protection. Tie ends to the line to keep the hose in place. All types of hose have been used for this purpose: water, fire, garden, PVC tubing. However, some rubber hose may break down from exposure to sun and summer heat, which softens the interior and leads to a mushy and line-staining mess.

Any heavy-duty fabric can be put to secondary use as chafe gear, wrapped around the rope and taped or tied in place. Even duct tape finds yet another use. First wrap the rope with a fabric patch (to keep the goo off the rope), then follow with multiple turns of duct tape or use a no-adhesive residue duct tape (3M 051131998377). Sailors might use self-bonding rigging tape. Some dock tie-ups may benefit from the use of a combination polyester/nylon line (mentioned on page 38). If the dock is in an exposed location, the need for better protection may be warranted. Longer lines may also be more vulnerable, as are lines that must pass over a potential chafe site at a sharp angle. Even with the abrasion-resistant polyester section, always add chafing gear.

Other factors can influence a decision to use the combination dock lines. One boat owner uses a short section of chain to lead through chocks. The chain is covered with chafing gear to avoid metal-on-metal abrasion. For part of each year, he is away from the area where the boat is docked and is unable to regularly check or to adjust or change lines as needed and he is hesitant to put the responsibility on friends. For him, the arrangement provides an extra measure of security.

Prevention Tips

Chafe prevention is not confined to covering small sections of lines. At anchor, the other end of the line could suffer chafe too (one reason for discouraging the use of all-rope rode). Attaching a short length of chain to the anchor rode is a reasonable precaution, so bottom debris will rub on chain, not on fiber. The small investment in chain is much preferred to the alternative of losing an expensive anchor to chafe. The addition of chain works on pilings, too. Make the loop from chain and attach the line end with a shackle or a large D-ring that allows you to remove the line when leaving the slip, leaving the chain on the piling for use when you return.

At anchor, releasing a few feet of line from time to time changes the points of potential chafe. Changing the anchor rode end-for-end occasionally can also help you get more life from the rope. (End-for-end works for dock lines, too.) Eventually, you'll replace the entire line but it will have worn more evenly. Cut out the good sections to use for dock lines. [Ed: any line, whether dock or mooring, that has been subjected to extreme pull as it might from a storm, should be immediately replaced since stretching has likely severely weakened it. It's also near impossible to splice a loop in stretched line.]

Check the chocks. Naturally, these should have smooth, rounded surfaces, nothing to snag a line. If they're nicked or pitted or have any sharp edges, fix or replace them.

Check the lead on all dock lines. Change awkward leads if possible but, failing that, at least try to protect all surfaces that may be rubbed. A stainless-steel rub strake (bronze is handsome on a very traditional boat) fitted to the top of a toerail keeps the line from chafing and keeps the rail's varnish intact.

Redundancy is a good thing, an obvious way to prepare for an impending storm. Whether tied in a slip, dock, or canal or lying to a mooring or at anchor, the more lines out, the less strain per line and the better the boat's chances of weathering the storm.

About the authors: David and Zora Aiken have been liveaboards for more than 20 years and are authors of *Good Boatkeeping* and *Cruising: The Basics*.

Sleeping Cabin Renovation

8

BLISTER FACTOR
INDICATES THE DEGREE OF DIFFICULTY WITH 10 BEING THE HARDEST AND 1 BEING THE EASIEST.

A boat is a compromise at best and less than ideal interior accommodations need not be a deal breaker, especially if you have the skills, patience and time to implement the necessary modifications.

(left) The original layout. (right) Remodeling complete.

By Garrett Lambert

A few years ago we found a "newish" boat that met all our purchase criteria except for the sleeping arrangements. We'd seen many other boats but they all had other deficiencies of one sort or another that we deemed impossible to overcome for any number of reasons.

As a reasonably competent amateur woodworker, I felt confident I could remedy the berth problem by changing the side double to either an island queen or a vee berth, both options that were available when ordering the boat new. Just tear out the old and then build and install the one we prefer. On that basis, we bought the boat and decided to use it for a season to be sure that the work really was necessary.

In the interim, technical, economic and logistical questions soon presented themselves. On a floating boat, nothing is level or plumb, straight lines are few, all curves are compound, working space is really cramped, doorways are small and it's best to not screw anything to the outside walls. To preserve and enhance our investment, the workmanship must equal the quality of fine furniture and, even to a keen eye, be indistinguishable from the rest of the boat. Because the marina is 25 miles (40 km) from my home shop, it was a sure bet that the necessary tools or components would sometimes be in the wrong place. I began to have misgivings.

Unfortunately, the experience of an otherwise great season afloat confirmed that the conversion was a necessity. Choosing between a vee berth or an island queen bed took care of itself once we realized that the latter would require sacrificing the forward head compartment. A search for inspiration found a few 40' (12.1m) trawlers with vee berths for sale on the Internet and I collected all the photos. Interestingly, no two were identical, but all followed the same basic pattern. The unusually wet winter in the Pacific Northwest was a factor in planning the project because there would be no pressure to complete the project in a hurry.

Photos collected from same model boats for sale on the Internet show various options.

Out With the Old

Knowing what had to be done, I gathered my tools and courage and passed the point of no return by starting to rip out the original furniture. Because everything had been built in place before the superstructure was installed, it was a wrecking job and the only salvage was a set of three small drawers that I eventually installed in a new cabinet. In hindsight, it would have been far better to have tossed them, too, because keeping them forced me to make an additional set and a door perfectly matching them in construction, design and finish. That turned out to be a challenge.

With all the original furniture removed, leaving an ugly hole behind, there was a real moment of, "Oh my God, what have I done?"

Demolition of the vee berth complete.

Drawer Construction

The numbing effect of the reality passed and I sucked it up and went to work. I drew the position of the new furniture on paper and took measurements from that layout. Back in the shop, I transferred these to full-size drawings on sheets cut from a roll of heavy wrapping paper.

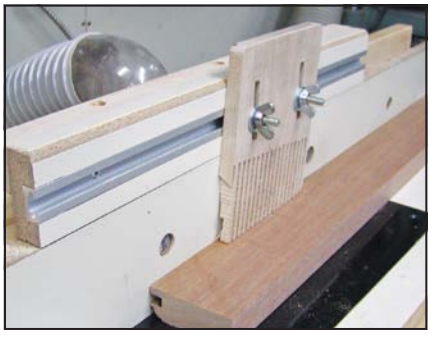
The original style and finishes used Honduran mahogany for doors, drawers and trim, and plywood laminated with Formica for frames. The combination works quite well with the wood providing an appearance of warmth and Formica adding the light look.

Making the frames was simple and quick. However, matching the three small original drawers was not. A far more sensible approach would be to treat the cabin as a different space with a different style of furniture (just like home bedrooms). These and the other drawers and doors throughout the boat were professionally made with equipment and cutters, not in an amateur's shop. (Of some interest is that boats made after ours used a much simpler design.). In any event, I figured I could achieve the same result with a pair of rail and stile router bits. This project was my introduction to coped joints. It also required the solution to a puzzle, i.e. matching the recessed drawer pulls. I left the puzzle to ruminate in my subconscious and moved on to figure out how the router bits worked.

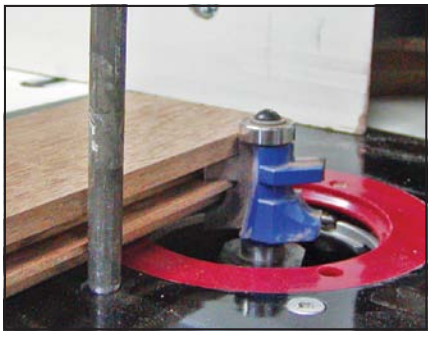
Rather than practice on the expensive mahogany, I used 3/4" (19mm) MDF to machine some test pieces. With my technique perfected, I pronounced myself ready to cut the mahogany. To rout the long profiles, I set the bit by eye to match the original drawers and ran the stock through with the face side of the material always down. The key to success is to set the bit heights to match perfectly, since each is a mirror of the other and the easiest way to do that is to use a piece that's just been cut as the guide.

With the bit height set and the jig made, I ran a test piece to ensure perfect alignment.

After cutting the 1/4" (6mm) panels, I assembled and glued the frames and then cut the backside rabbets on the table saw but the router would have done this as well.



The rail and stile router bits must be used with a router securely mounted in a table but the table can be as simple as a piece of plywood with a board clamped to it as a fence.



To cut the ends, I made a simple jig to hold the rails firmly at 90 degrees to the fence.

Assembling and gluing the frames.

Original drawer pull cutout.

Puzzling Pulls

It was time to construct the pulls, which are inset with the interior undercut all around in a very comfortable finger profile. I concluded that a custom ground router bit had been used. None of the bits in my already extensive inventory would do the job, even when used in combination. In the end, it required three bits, one of which I had to modify. What was I thinking when I decided to keep those three drawers?

Once again, a simple jig was required. I calculated the size based on the proportions of the original drawers. (This set is larger.) I first used a straight 5/8" (15mm) bit with a guide bushing to rout the mortise and then, using the same jig, I routed the undercut using a modified 3/8" (9mm) internal bullnose bit and top bearing. I simply removed the lower bearing and drilled out the supporting post. This bit made the interior undercut. A standard drawer pull bit completed the pull. Normally, it's used to rout a pull the entire width of the drawer but I installed a top bearing so I could continue to use my jig as a guide. This bit cut the sloping interior profile and the little external bullnose on the inside edge of the pull.

Simple jig made to cut the drawer pulls.

Shown in green is the original router bit. The modified one that the author purchased for $15 is blue.

Completed drawer pull.

The original drawers (visible on the right) plus the unfinished new drawers and door assembled in their cabinets on the shop floor.

Cabinets with finish applied and positioned in the cabin.

Deck of 3/4" (19mm) plywood screwed in place. This is covered by a felted fabric-on-rubber overlay.

Assembly and Finishing

With the drawer fronts complete, making the drawer boxes and the cabinets, which are knock-down in order to be able to get everything through the narrow doorways on the boat, was straightforward. Positioning these structures in the cabin was a bit tricky to avoid interfering with two hatches in the floor that access the bow thruster and a bilge pump. Once that was achieved, I screwed everything to the floor, added some shelves and painted the interior surfaces.

The next step was to install 3/4" (19mm) plywood decking to tie it all together and make the whole assembly rigid. This was covered with felted fabric-on-rubber overlay purchased from a carpet supplier. This carpet/fabric was pulled tight and stapled to the edges of the plywood and then I cut away the excess.

That done, I machined the curved bed rail. This consists of three straight pieces of 1-1/4" by 3-1/2" (31mm by 89mm) molding joined by two curved corners. The straight pieces posed no problem. However, to make the inside corners, I glued three pieces of mahogany together to make a thick block and used a band saw to cut out the shapes. I splined and glued the complete rail, leaving the ends a bit long so I could cut them to a perfect fit in place. Some handwork blended everything together.

To match the existing finish I bought two cans of Minwax gel stain, one Mahogany (too purple) and one Colonial Maple (quite orange and lots of fun). I measured half a cup of the mahogany stain into a container and started adding some of the maple, about a half teaspoon at a time. By keeping track of proportions and wiping swatches onto a scrap of mahogany until I got a perfect match, I was able to mix a larger batch, ensuring I had extra, and put it in a ketchup squeeze bottle. I stained all the wood by squirting on the mixture, wiping it onto the surface, letting it dry for 5 minutes or so and then wiping it off with clean rags until I had the right tone. Several coats of Minwax Semi-gloss Wipe-On Poly, with a very light sanding (400 grit) on the final coat built up depth, and a top coat of boiled linseed oil wiped dry gave it luster.

The portside berth is exactly the depth of the head compartment and automatically has a headboard. However, the new starboard berth extends beyond the front of a closet, so I made a panel to stop the pillow from falling on the floor and it also serves as a handrail when descending the stairs.

Heavy plastic sheeting produced a pair of patterns that I took to a foam shop. The shop cut out the 6" (15mm) thick firm mattresses and undercut the outboard ends to match the slope of the hull sides using a simple offset measurement. They also made the mattress covers out of fabric we supplied and delivered the finished product within three days.

Meanwhile, I made and installed a long shelf on the port side, which matches the one on the starboard side. I bought a carpet remnant and laid it over the floor.

It's very similar in color and pattern to the original. The only challenge here was very small working space and the number of awkward cuts required to fit it. Covering the edges with quarter round bridged the few gaps.

All that was left to do was machine and install some trim, and, because the berths are almost 35" (889mm) off the cabin floor, and I made a small stool so my wife can step up and down easily. With that, the transition was complete.

Looking Back

A small but important decision really helped make such a big undertaking doable. When I was struck by that early "Oh my God!" moment, I stopped and broke the total job into a series of discrete mini-projects. I limited my focus to the current job to avoid thinking too far ahead. Thus, completing each step was a satisfying milestone in and of itself and its success was encouragement to move onto the next. That approach fended off the potential for becoming completely overwhelmed and discouraged by the gazillion details that never seemed to diminish until nearing the end.

The costs were surprisingly reasonable. The big expense was for the mattresses and covers, which were slightly more than $700. (A second shop quoted double that, so do look around.) About 20 board feet (6m) of Honduran mahogany, three sheets of 3/4" (19mm) plywood, one sheet of Formica, a quart (946ml) of contact cement, the berth underlay, a carpet remnant and fasteners added another $400. I didn't keep track of my time but I'd guess it comes close to 200 mostly pleasurable hours.

This was not a trivial project by any means, but the rewards are so remarkable that I would certainly do it again. In fact, the result seems to defy the laws of physics. Each of the berths is a full size single bed and together are much larger than the double they replaced. However, the rearrangement also produced significantly more useable floor area and about four times more accessible storage (drawers and a cupboard with shelves versus next-to-useless spaces under the mattress).

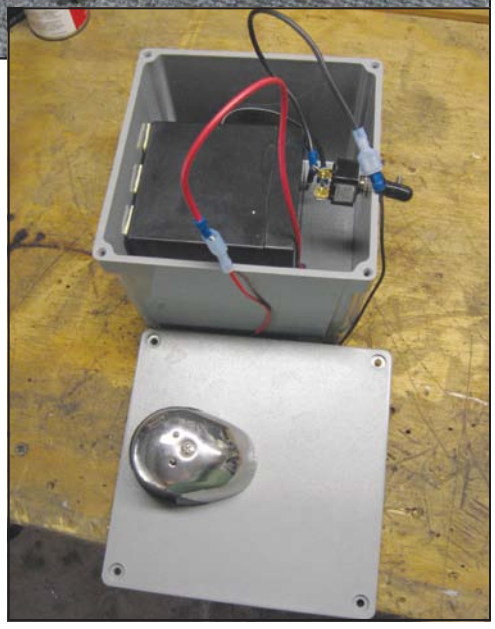
Best of all, no more climbing over each other for middle of the night trips.

About the author: Garrett Lambert cruises the Pacific Northwest in a 40' (12.1m) trawler and is a frequent contributor to DIY.

Basic Lighting

3

An easy-to-make, low power light box for boats without navigation lights.



By Dan Martin III

I needed to install navigation lights on my small fishing boat but did not want to run wiring to the bow for the bowlight. The only temporary lights I could find were the clamp-on style lights but based on my experience they are so cheaply made they don't last very long.

So I decided to make my own. I purchased a 6" (152mm) square weatherproof box, found in the electrical department at Home Depot ($15); a 12-volt, 4-amp hour gel-cell battery purchased locally ($16) and also available from www.BatteryStuff.com, PS1250; from West Marine an on/off toggle switch ($4) with rubber switch cover #1955038 ($8) and Attwood LED Bi-color bow light #9034463 ($53).

The battery fits inside the box and is secured with double-sided tape. The toggle switch mounts to a side panel along with the switch cover for a weatherproof fit. The light mounts to the top and is wired to the battery with a 1-amp fuse on the positive wire. The completed box has side screw mounts for permanent mounting or can be secured with Velcro or bungee cords.

Added to the above costs was $10 for wire, a fuse lead and other miscellaneous items, totalling $106 for a navigation light that should last for years. Considering the light's very low power draw, I guess that with normal usage, this setup will require battery charging just once a season.

About the author: Dan Martin is an avid fisherman who has owned 20 "project" boats.

Feeding Diesel Stoves

8

A simple, gravity-feed diesel day tank is a welcome and trouble-free addition to any diesel stove heating system.

A stand-alone rotary vane pump is the best choice for supplying fuel to the stove.

By Rich Ian-Frese

A gravity-feed day tank is the most practical, effective, silent and trouble-free way of delivering diesel fuel to a diesel stove heater. The main diesel fuel tanks on most boats are typically located at the level of the cabin sole or lower, deep in the bilge, to help keep the center of gravity low. Vessels with main diesel fuel tanks located beneath the level of the stove's oil metering valve (i.e., the small, external fuel reservoir located near the bottom of most diesel-fueled stove heaters, such as the popular Dickinson, Refleks or Sig-Marine models), often transfer fuel by way of a low-pressure, reciprocating (on-demand) fuel pump that is generally regulated to a pressure of about 2.5 psi to protect the stove's oil metering valve. There is nothing unusual about this scenario; in fact, it is a rather typical arrangement but it is not the most elegant or reliable means of delivering diesel fuel to the stove on a 24-hour basis throughout the winter season.

The better way is to gravity feed diesel fuel directly from a day tank located at least 12" (304mm) higher than the stove's metering valve. To fill the day tank, one can transfer diesel fuel from the main tanks to the day tank via a diesel fuel rotary vane pump, a pump that is specifically designed for the task of efficiently transferring diesel fuel from one tank to another tank. Alternatively, one can fill the day tank without the use of a transfer pump. This can be accomplished through a diesel fuel deck fill (similar to the one used for the main tanks). Even simpler, fill the day tank directly through an easily accessible fuel port with integral fuel cap, located at the top of the day tank. This allows filling the tank manually, using a portable fuel container with a nozzle or siphon hose.

The advantages of a gravity-feed day tank are: simplicity; energy efficiency; silent operation and the elimination of a full-time, on-demand fuel pump for diesel fuel transfer. Essentially, there are no fragile components that are likely to fail in this type of fuel delivery system. Moreover, a gravity-feed day tank can serve as a redundant backup to the main diesel tanks in the event of an electrical pump failure. An electro-mechanical rotary vane pump failure is unlikely, considering how infrequently the pump is put to work. Unfortunately, the same cannot be said of the less rugged, low-pressure, reciprocating fuel pump, which is always on the job and constantly responding to demand.

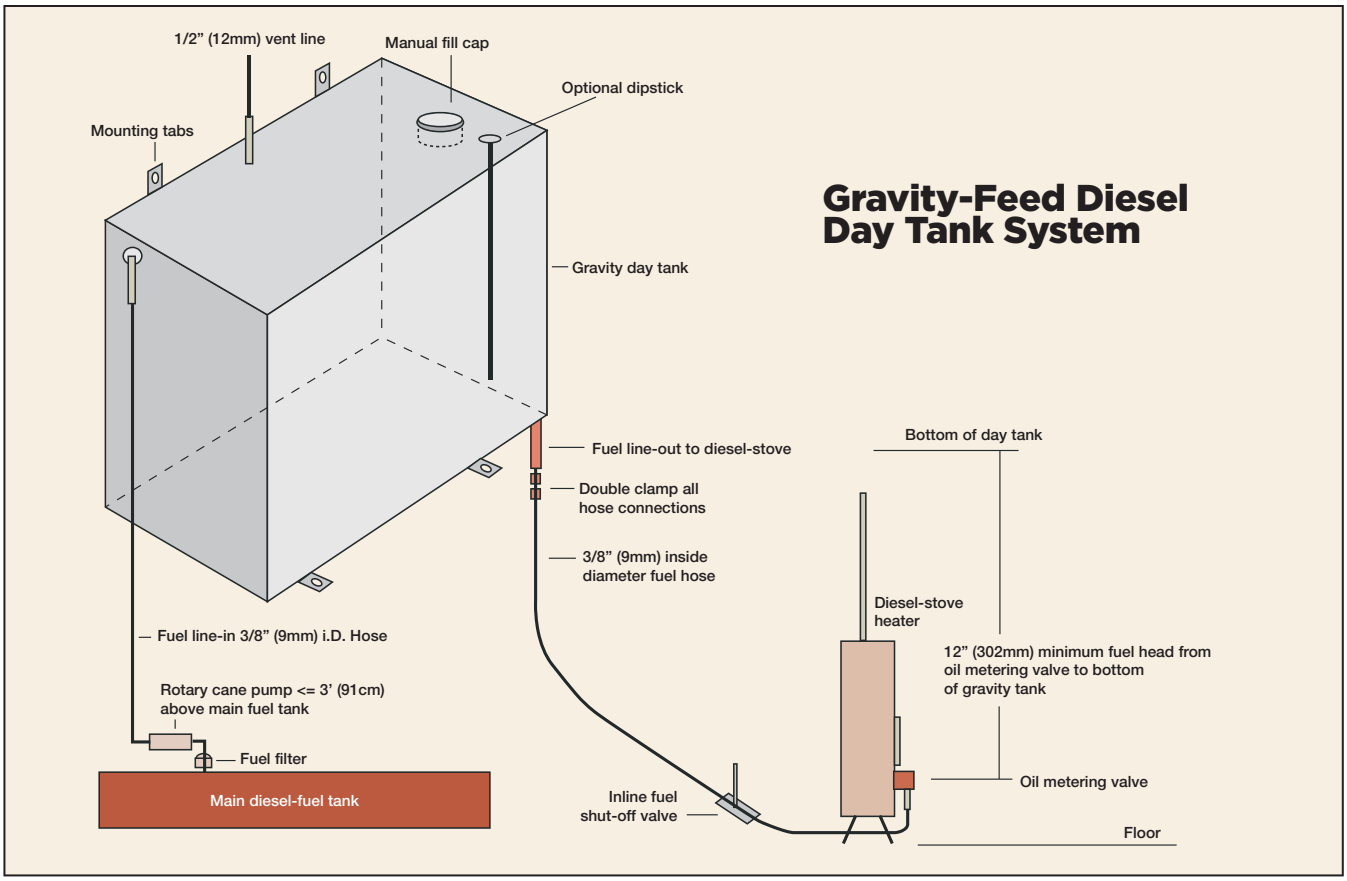
Pump Benefits

A rotary vane pump can deliver fuel, through 1/4" (6mm) to 1/2" (12mm) fuel line (USCG B-1 hoses), pulled from the main diesel tanks. It can easily fill a 10-gallon (37.8L) day tank in just a few minutes. Let's assume, in this example, that the main tanks are about 10' (3m) away from the location of the gravity-feed day tank and 3' (.9m) lower, as well. A 10-gallon (37.8L) day tank should run a diesel stove heater for close to a week if the stove is consuming, more or less, 1.5 gallons (5.6L) of diesel fuel per day. If one uses a diesel stove heater for six months of the year, the rotary vane pump needs to work for about a total of 4 hours for the entire season. All pretty easy on the pump and only a drop in the bucket for the battery banks.

Compare that to a low-pressure reciprocating fuel pump that supplies fuel to the diesel stove heater directly from the main tanks. The stove would use the same amount of fuel each day but the pump would work endlessly. In other words, it would never shut off during the entire six months and that is a lot to ask of any pump.

Typically, the reciprocating fuel pumps used to deliver diesel fuel to diesel stove heaters pump fuel on demand. This means that the pump intermittently turns on for a second and then turns off. It does this about once every seven seconds or so, 24 hours a day, until the end of the heating season. That translates into a pump that is working about 600 hours per six-month heating season.

It is not difficult to choose between a rotary vane pump and a reciprocating fuel pump. In the same period of time, the rotary vane pump only works hard for a remarkably short 4 hours, as compared to the 600 hours that the reciprocating fuel pump labors to transfer the equivalent amount of diesel fuel. A number of manufacturers produce diesel rotary vane pumps. The Jabsco-ITT vane pump (www.jabsco.com), model number 18680-



Schematic of gravity-feed diesel day tank system.

0920, is economical and practical for diesel fuel transfer to a gravity tank. Any well equipped marine supply store carries the correct fuel line hose and fittings to complete the job.

Similarly, it is not difficult to evaluate the merits of a dedicated gravity-feed day tank to supply diesel fuel directly to a diesel stove heater, when compared with the option of electro-mechanically pumping diesel fuel directly from the main diesel fuel tanks. The real decisions that come into play are those that regard the design, fabrication and installation of a gravity-feed day tank that are compatible with the existing diesel fuel delivery system.

Design Considerations

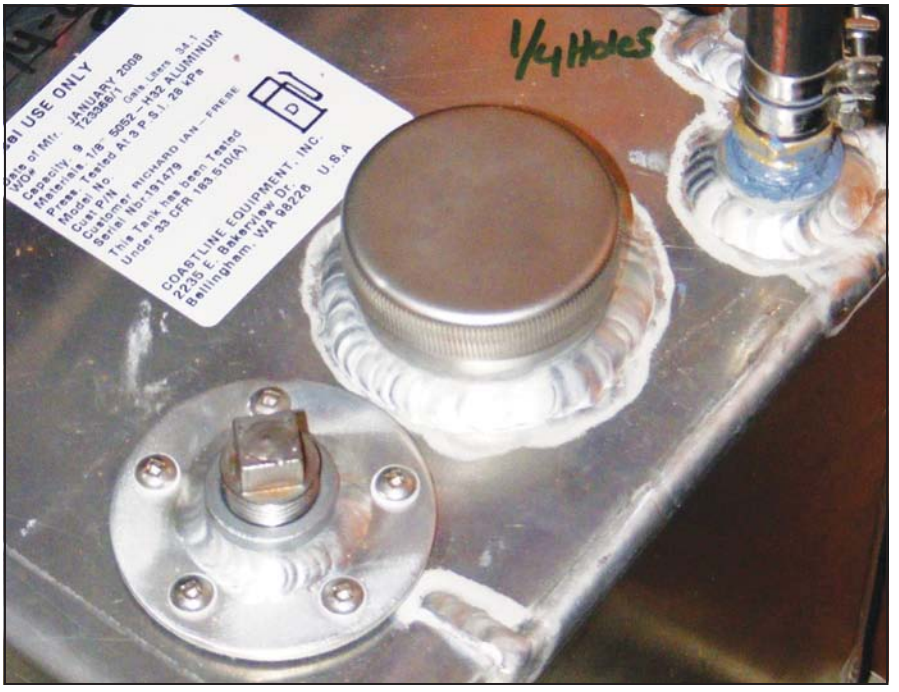
Designing a gravity-feed diesel day tank requires consideration of a few factors. These include: size of tank, location of tank, height of tank and options for filling the day tank. The day tank should be large enough to contain at least one day's worth of diesel stove fuel.

Most stoves use less than 2 gallons (7.5L) of diesel fuel per day so a day tank with a capacity of at least 2-1/2 gallons (9.4L) should be considered. A 10-gallon (37.5L) day tank, for instance, needs refilling maybe once every five to seven days if the stove is used on a full-time basis. A larger day tank may be practical if space permits; however, when a gravity tank is used, a minimum head of fuel measures 12" (304mm) but not more than 8' (2.4m) above the stove's oil-metering valve, consideration should be given to keeping the center of gravity as low as possible when contemplating the virtue of a larger and, therefore, heavier tank.

A 10-gallon (37.5L) capacity gravity tank is a good size but smaller or larger day tanks may be a better fit. It depends on the space available, the ease of access to that space, the ability to mount the tank securely and how frequently one is willing to top up the tank. Obviously, the smaller the tank, the more often it needs to be refilled.

Converting Dimensions into Volume

The fuel capacity of the tank is determined by a simple formula: total cubic inches/231 = volume in gallons. For example, a rectilinear tank with inside wall dimensions, given in inches: 10 wide



Tank connections for fill, dipstick and fuel supply.

by 22 long by 12 high equals 2,640 total cubic inches and 2,640 cubic inches divided by 231 equals 11.4 gallons. So, the dimensions of any available space can easily be converted to calculate capacity in gallons and the tank can be designed and fabricated to accommodate almost any space.

The only limitation is the number of gallons that can be accommodated by the dimensions of the space where the tank will sit. The space can be anything from a convenient bulkhead, where the day tank is designed with a narrow profile, to an unused nook or cranny where a narrow profile is nonessential.

System Considerations

Ideally, the day tank will be in close proximity to the diesel stove heater to help reduce the length of fuel hose required to connect the tank to the stove. By keeping the day tank-to-stove distance as short and straight as possible, the friction on the fuel that runs through the rubber hose is kept to a minimum. Generally, the closer the day tank is to the stove, the better. The path of least resistance promotes smoother fuel flow.

The tank must be vented to the outside with 1/2" (12mm) ID fuel line and, as with all fuel lines, as straight as possible to avoid air locks; a gentle, wide-angle turn is okay as long as the fuel line does not compress, kink and collapse. All the other fuel lines should be 3/8" (10mm) ID (or minimally 1/4"/6mm ID) and all hose approved for diesel use and properly clamped at each connection. Always filter the fuel before it reaches the pump or day tank; a small Racor filter is ideal.

[Ed: It's easy to overlook the fact that a small diesel fuel day tank is not a big deal in terms of safety but the same standards apply for its fabrication and installation and to the fuel system itself. ABYC H-33, Diesel Fuel Systems, requires that hose serving a day tank be USCG Type A or SAE J1527. While no law sets this standard, the potential for a fuel leak should be enough motivation to comply.]

When using a fuel pump, a fused switch or circuit breaker near the tank is preferable so that one can monitor the tank's fuel level while refilling. If you can see the level of the fuel in the tank as it's being filled, you can easily stop the flow with the handy on/off switch when the tank is topped off, preventing any spillage. An external sight gauge mounted on the tank may be used to determine the fuel level; however, a dipstick, or simply inspecting the inside of the tank through the fill cap is less complicated and safer. A sight gauge is, of course, convenient for casual inspections but it can be damaged accidentally and the extra fittings it requires translate into more potential opportunities for fuel leakage. Keep the design simple.

[Ed: The following is part of the ABYC H-33 sight gauge requirement. "If a sight gauge is used, it shall be equipped with a shutoff valve at the top and at the bottom of the gauge…." Instructions for operating the sight gauge and a warning of the potential for leaking fuel should be posted in view of or on the tank.]

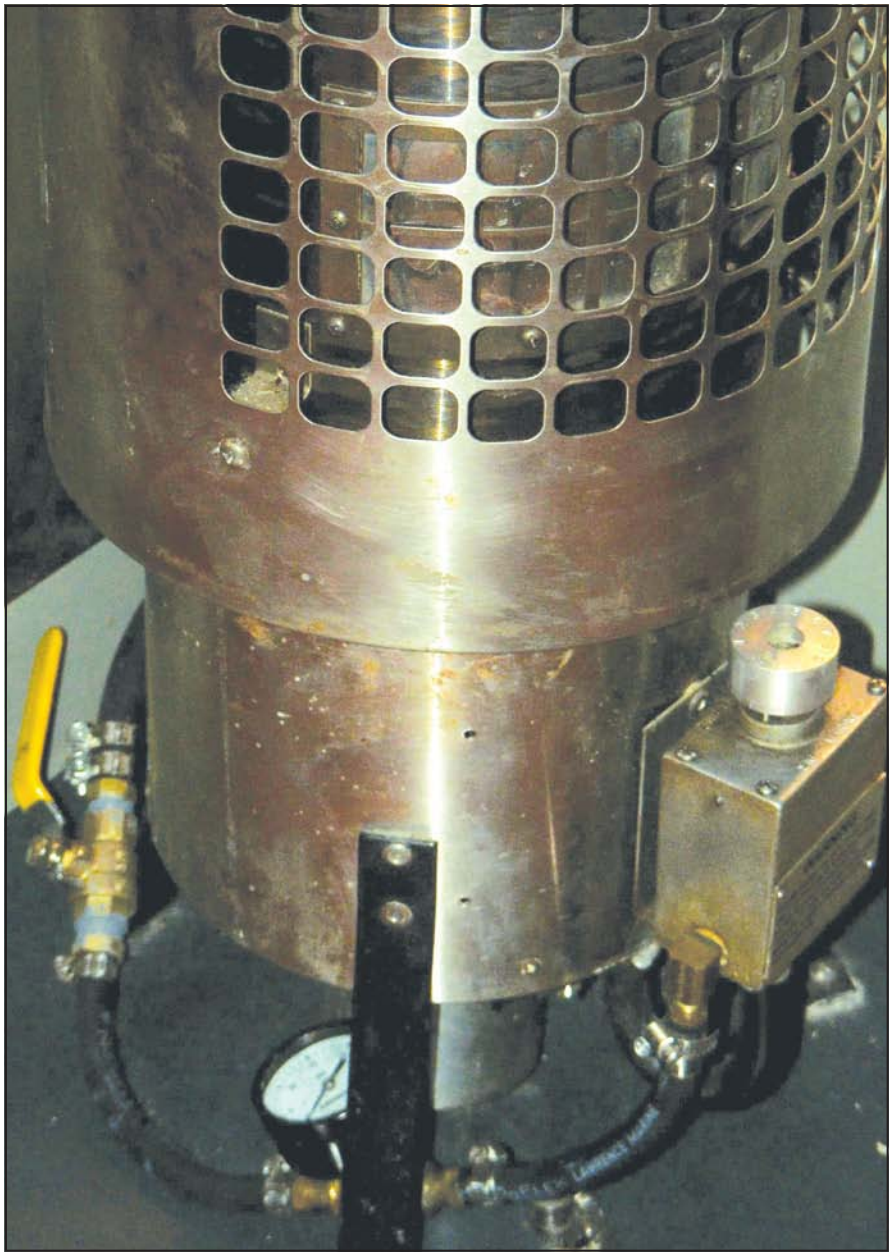
When a transfer pump is a component in the system, a fuel inlet line leading from the rotary vane pump to the top of the day tank is required. A fuel outlet line for the gravity feed, leading from the bottom of the day tank to the stove is required, regardless of whether a pump is included in the system or not. A fuel shutoff valve, mounted near the stove, must be installed directly into the fuel outlet port on the day tank or inline, between the fuel outlet port on the day tank and the fuel inlet port on the oil-metering valve at base of the stove.

A removable inspection port at the top of the tank is handy for cleaning out the inside of the tank, when necessary. The inspection port is an optional feature and when fitted with a screw-out dipstick, it also serves to provide a quick fuel reading.

If using a self-priming, rotary vane pump in the system, do not mount it higher than 3' (91cm) above the bottom of the main fuel tanks, for best operation. The main diesel tanks need not be close to the rotary pump or the gravity tank, although, as in a previous point, closer is more efficient; straighter and shorter fuel line runs create less friction and less friction equals both less work for the pump and a day tank that fills faster.

Fabrication

A diesel day tank can be fabricated to specifications by a reliable local machine shop or by a sheet metal fabricator. Coastline Equipment, in Bellingham, Washington does a nice custom fabrication and the cost is economical. They also pressure-test the tank to meet the standards' requirements and ship anywhere (www.coastline-tanks.com). When specifying the tank's dimensions and construction, include welded tabs on the perimeter of the tank for easy and secure mounting. Aluminum is an excellent material to specify when building the tank. Use 1/8" (3mm) 5052 H-32 aluminum. [Ed: Consider purchasing off-the-shelf polyethylene tanks, which don't corrode, are lightweight, come in a wide variety of shapes and sizes and are in compliance with ABYC standards.]



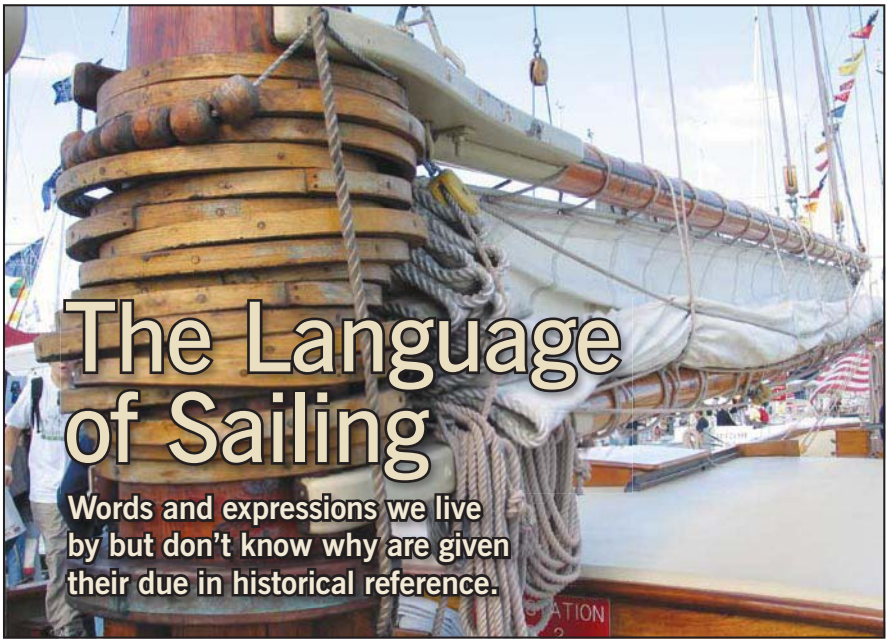
Shut-off valve mounted in fuel hose near diesel heater.

Costs

The total cost of parts and equipment depends on a few variables, including: whether an electrical vane pump is used; size and shape of the tank; fuel hose length; number of hose barbs and hose clamps required and length of electrical wire and number of associated connectors needed from the fused pump to the on/off switch or circuit breaker. The inline shutoff valve is required whether or not one uses an electrical component in the system or not.

As a guideline, the total cost for a custom 10-gallon (37.5L) aluminum day tank with shipping costs included, diesel vane pump, fuel line and fuel line fittings, electrical wire, inline fuse or circuit breaker and shutoff valve is about $500. Of course, the costs can be lower or higher dependant upon the variables. For example, a manually filled, gravity-feed diesel day tank that requires no electrical or mechanical components cuts the cost by one-half.

About the author: Rich and Cat Ian-Frese live aboard *Anna*, a Tayana 37 cutter. They recently returned to Seattle from Alaska where they relied on their Sig-Marine 180 diesel stove and gravity-feed diesel day tank to keep them comfortably warm and dry.



The Language of Sailing

Words and expressions we live by but don't know why are given their due in historical reference.

Jan Mundy

By Roger Marshall

Whatever happened to baggywrinkles, Turk's heads, codlines, and oakum? Where did devil's claws, diamond knots and gammon irons go? These terms are just a small part of the rich heritage of sailing language. Unfortunately, knowledge of that heritage is rapidly becoming invisible to each new generation that becomes involved in sailing. Even "right" and "left" is replacing "starboard" and "port."

Sailor talk has given many colorful sayings to contemporary language. For example, the terms lay day, crow's feet and figurehead all have nautical origins, as do the expressions like flog a dead horse, have a square meal, stay on an even keel or the cut of someone's jib. Each of these sayings has lost its original meaning, once part of everyday language for the crews on sailing ships of times past. Today, we have modified the meanings to suit our own needs and few of us ever stop to consider the origins of such expressions.

Brief explanations of their origins, along with the meanings of the other seven terms mentioned in the first paragraph are given below.

Baggywrinkles: Pieces of marline woven into a lift or stay to help prevent chafe on the sails.

Codline: Any small diameter line. It was originally woven from 16 or 18 strands and used for cod fishing.

Crow's foot: Refers to a method of attaching a clew or reef point to a sail. The rope was sewn in a pattern that radiated away from the reef point. This is why we refer to the radiating lines at the edge of the eyes as crow's feet.

Cut of his jib (as in, "I don't like the cut of his jib"): In sailing days of yore, when the British and French were frequently at war, their ships' sails were cut differently and the cut of the jib was part of the ship's identity. As another ship approached on the high seas, the jib was usually the first sail that came into view. If a British crew didn't like the cut of an approaching ship's jib, it meant that the ship was probably French and an enemy. Today, we use the same expression as a common saying to suggest suspicions about another person's character or motives.

Devil's claw: A stopper knot used on an anchor chain to hold it in place after the vessel has anchored.

Diamond knot: Another form of stopper knot. Running the ends through the knot twice makes a double-diamond. There is a British beer known as Double Diamond. Over-imbibing it could be a real stopper!

Gammon iron and crance iron (crance is sometimes spelled cranse or cranze): Refer to the metal bands on the ends of a bowsprit. The gammon iron is at the inboard end at the stemhead and the crance iron is at the outer end. Both irons have rings to take the lower ends of the headstay and outer forestay.

Figurehead: In olden times, a European ship had a figurehead carved and painted at the bow. Often, the figurehead expressed some aspect of the ship's name. For example, a ship named Leopard, used to charge at other ships, might have a fierce leopard as a figurehead to represent the vessel's strength. The use of figureheads has died out in favor of the ship's crest but the term still remains to refer to a person who holds a nominal or symbolic position of power.

Lay day: The day that a ship "lay" in port to load or unload cargo. We often use this term today in various sports to refer to a day when no game is played.

Oakum: Material used for caulking and made from old hemp rope (usually tarred) that has been picked apart. It is hammered into a seam on a planked hull using a caulking hammer. It is later covered with pitch to make the seam watertight.

On an even keel: The vessel is sitting upright when the tide goes out. Today, it refers to a person who is levelheaded and is emotionally stable.

Square meal: In olden days, plates were made of wood and were square. When a seaman joined a ship he was entitled to his board and three meals a day on a square plate, hence three square meals a day.

Turk's head: An ornamental knot woven at the end or around another rope to make a stopper. Nowadays, about the only place you'll see a Turk's head (the rope work) is on a steering wheel to mark a wheel position for centering the rudder.

If your baggywrinkle has chafed your crow's foot or your oakum is hanging out, take a lay day, put a new diamond knot or Turk's head in the line and whip its ends with some codline to get back on an even keel so that your company figurehead can say, "I like the cut of his jib."

About the author: Roger Marshall is the author of 12 books and his latest book, *Fiberglass Repair Illustrated*, is soon to be released.

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