DIY boat owner

2001-#4
the MARINE MAINTENANCE MAGAZINE

COLUMNS

Departments

ELECTRICAL

How to Charge Multiple Banks

Adding electrically powered amenities to your boat increases the demands on your battery capacity. Adding battery banks is a solution, but producing enough power to efficiently charge the expanded system becomes the problem. ***By John Payne***

REFIT

WINDOW DRESSING

New windows, ports or hatches add comfort to interiors and can increase the resale value. If your boat could benefit from more light, better ventilation or a drier cabin, perhaps it's time for a refit.

7 STEPS TO A PROFESSIONAL HATCH REPLACEMENT

MAINTENANCE

DON'T HAVE AN OWNER'S MANUAL?

Unlike automotive manufacturers who always provide a detailed manual to the vehicle's systems, few older production boats (and many new boats) were supplied with such information. Here's how to create an Owner's Manual for your boat. ***By Nick Bailey***

UPGRADE

INSTALL A MODERN WATER SYSTEM

Imagine showering and washing dishes all at the same time, and never losing water pressure or a change in water temperature. It's now possible with this new high-tech, multi-fixture pump. ***By Zora and David Aiken***

BOAT REFIT

RESTORING A MAC V222

The energy to restore an abandoned 22-footer is fueled with energy, vision, optimism and the passion to sail. Here's how one determined sailor rebuilt a bargain boat on a budget. ***By Brian Gilbert***

CURRENTS

Edited by Jan Mundy

DIY SEMINARS

DIY boat owner Magazine is hosting a series of maintenance, repair and troubleshooting seminars at various BoatUS stores. Seminars begin at Florida locations in February, and end at the Rochester, New York store in June. Call for details — 1-888-658-BOAT (2628) or log onto DIY ONLINE at www.diy-boat.com

Double Number 3

If you were one of the few DIY readers who received two copies of the last issue, please share your good fortune with a friend, club or marina pals. It appears that our mailing house duplicated hundreds or so labels due to a computer glitch.

Kudos From Down Under

DIY is a great magazine. I found it at the local newsagent. I have passed on your website link to all my boating mates.
Ian Maxwell, Gold Coast, Australia

Amateur-ability

I've just read Nick Bailey's article on repairing sloppy rudder bearings in 2001-#3 issue. The theory behind this is wonderful, the reality fraught with disaster. Do this even slightly incorrectly and you've got a rudderpost epoxied to a post tube. There is absolutely no margin for error and no quick fix for a mistake. I would strongly suggest that this is not a job for anyone unless they have Bailey's expertise. Prepare yourself for a barrage of nasty letters and worse from owners with seized rudders.
Ken Morgan via email

Nick Bailey replies:
Of course Ken is absolutely correct. Unfortunately, a lot of repairs on boats require special care, such as thru-hulls, fuel systems, electrical work, major glass repairs, standing rigging and the like, or the consequences could spell disaster. Nonetheless, the repair option detailed in this article is one used by professional repair yards. Most times, we (Bristol Marine) prefer the more expensive option of cutting out and replacing the sloppy tube, which is just about the only other option unless you can ream the tube and fit a sleeve. Maybe repairs or installations suggested in DIY articles should have a scale of difficulty or "Risk Level" rating. Maybe I'm giving DIY readers to much credit. A little knowledge is a dangerous thing. Know your skill level, and when to bring in a professional.

Help Yourself

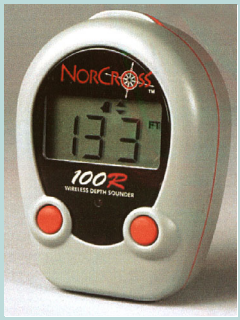
Thank you so much for helping me out with my concern on fuel tanks. All the articles I have ever read about buying boats has yet to spell out the difference on tanks to buy and why. A subscriber for life now!
Bill Schrader, Ramsey, Minnesota

I really appreciate and admire your readiness to help all those lost in technical issues and the inexperienced.
Janusz Czura, Toronto, Ontario

DIY's Technical Helpline is a free service to all subscribers. When you need help, send your question to info@diy-boat.com.

Wireless Depth Sounding

Coming to a store near you is MarineLink (US$260), a wireless depth sounder. This compact, portable depth sounder transmits depth readings up to 61m (200') to a handheld screen as you move about anywhere onboard.



Readings are updated four times per second, and it uses 250 watts. No more standing at the helm to view a traditional readout. But does it float? For more info: www.norcrossmarine.com.

Another Do-it-Myself

I need the wiring schematic for my 1979 9.1m (30') Trojan.
Doug Guthrie via email

It's doubtful you'll find wiring schematics for older boats. Even now, few production builders supply them with new boats. You're on your own to produce a schematic.

-Tip- Is the 12-volt DC negative conductor supposed to be black or yellow?:

Either color can be used on boats in North America. Yellow was added as an option to differentiate between the AC systems line conductor and the DC negative on boats with both AC and DC electrical systems. On boats without AC power, yellow may be used for the DC negative line.
Courtesy ABYC

More Ducky Dotes

Ducks are fine, but not on my swim platform. Their unsightly duties are much more than merely a nuisance. Owl decoys, rubber snakes and large balloons replete with oversized eyes and bright dangly things turned out to be no deterrent. I've solved the problem with a single section of fruit tree bird mesh, available at garden and hardware centers. Stretch and secure the net across the taffrail, around the corners just a bit, then down over the platform to water level. Weight the net with at least six fishing sinkers. Don't forget to remove the fowl cover before striking out again.
William Harris, Timonium, Maryland

Can't fool 'em fowl!

Another variation on a fowl swim platform cover made of plywood.

Instructions for charting a power system appear in DIY 2000-#2 issue.

Not the Martini Crowd

Thanks so much for your help. You folks are great to work with. Many magazines leave boaters in the dust with articles on megayachts and boats so new and over priced with such fandangled new-age equipment that us common boaters can't relate. Several list serve members on Trawlerworld.com speak very highly of your publication, and that's how I got turned onto DIY. Many of us need to do our own work as the cost of specialized marine mechanics and increasingly rare professional boatyards is too prohibitive for we who still buy chili and hot dogs for the weekend cruise meal.
Gary Grice, Folsom, California

Manuals Wanted

I have been looking for both mechanical and electrical manuals for my 1987 9.1m (30') Sun Runner. Can you tell me were I can go to find this information?
James Warrington, Ocean City, New Jersey

We hear this question more than any other. Unlike cars, boat (and RV) manufacturers have never offered "manuals" for owners. All that is usually included are flyers from the various manufacturers who supplied the components. That is why past DIY issues have focused on how to make your own wiring schematic, etc. Fortunately, engine service manuals are available. As for the components onboard, make a list of each brand, model, etc., and see if you can locate the manufacturers on the web. Considering your boat is 11 years old, this may require some digging.

Boat Refitting

I thought I had read every available boating magazine until a friend showed me DIY. I'm sold. Sign me up. I'm half way through the 7-year refit of "River Queen," and I need lots of help. I've documented the entire project on my website at http://home.inreach.com/wolfman/riverque.htm.
Michael Wolfe, Stockton, California

Nothing's Free

I take exception to a letter titled, "Customer Service Wanting," in DIY

Boat Show Demos

When the going gets tough, it pays for the whole family to know what to expect. When touring boat shows, keep a lookout for free demonstrations offered by many equipment exhibitors. Winslow Liferaft, for example, hosted a liferaft deployment drill at the St. Petersburg, Florida show last November. In these photos, senior technical representative Charles Daneko briefly discusses proper procedures, then volunteer Rachel Britnell of Pensacola, Florida pulls the ripcord, and in less than 15 seconds, the raft is fully inflated. A very impressive show indeed!

Mildew Remover for The King

When Elvis put away his gold lamé jacket after a stint in Malaysia it developed a mildew stain. Not too sure how dry cleaning would affect his expensive jacket, he browsed the web for help and logged onto captphab.com. A call to the company resulted in the shipping of a bottle of Odor & Stain Remover. A few weeks later, the company received a photo from Elvis signed, "Thanks Captain Phab, it worked!" Elvis' true identity is entertainer Scot Bruce who bears a remarkable resemblance to The King.

2001-#2 issue, about the fellow who had service problems with his Suzuki engine. Good marine mechanics are hard to find, but as a mechanic myself, the last thing I want to do is to share my expertise over the phone for free with some cheapskate. When are boaters going to realize that you cannot penny pinch when it comes to replacement parts? Suzuki carburetor kits are expensive! That's the price of owning a boat, regardless of the size.
Martin Laprade, Montreal, Quebec

WANTED

DIY reader Loretta McGinn was given a 1974 Essex sailboat minus the centerboard and is looking for plans to build a replacement. Contact her at tlkids65ll@aol.com.

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Engine Keeper

If you mess with the new "smart" engines, a computer recognizes that something has changed and automatically reduces power to an idle. Additionally, some new engines (i.e. Mercury or MerCruiser since 2000) have a black box. Similar to units installed in aircraft, a computer automatically saves the systems operating information 15 minutes prior to an engine failure, so dealers can extract the data. While this is unquestionably the greatest advance in marine engine technology since the invention of the raw-water rubber impeller, it also means no more modifications, and dealers will know exactly what occurred when someone says, "I don't have a clue what happened!"

Say "No" to Pressure Washing

The Tech Tip column in DIY 2001-#3 made a positive reference to probably the most harmful pieces of equipment for use on wood (especially teak). As a broker, boat owner and interested observer, all too often I have witnessed owners using pressure washers to clean their abused teak. Though these machines seem harmless, they tear all the soft fibers from their valuable wood and end up with deep grooves that only trap more water, dirt and pollutants. Sanding to an even surface is the only corrective measure. Soon, they'll need to replace the decks and other brightwork. Almost as bad are the bristle brushes used to scrub teak decks. This also tears out the soft fibers. Those who should know better, the professional boat detailers, do it too. All you need to clean teak is a soft white Scotchbrite pad, judiciously used on bare wood, or in the case of treated woods (varnish or similar coating), a soft rag and water at least every two weeks. Wash all traces of soap (I use Joy dish detergent) after every cleaning. The use of bristle brushes does just as much damage to gelcoat surfaces, creating rough surfaces over time that are more prone to UV damage and mold adhesion (those black spots). They remove your protective wax as well, further damaging what might have been a glossy surface. A soft rag and some joy (or like product) can go a long way to preserving both the wood and gelcoat on your boat.
Butler Smythe, Annapolis, Maryland

DIY Editorial Index

We didn't have space for the annual Editorial Index that is always published in the last issue of every year. You can review or print a copy of the complete 1995 to 2001 Editorial Index online. Just go to www.diy-boat.com and click on "Archives." Or call us toll-free at 1-888/658-BOAT and we'll fax or snail mail a copy.

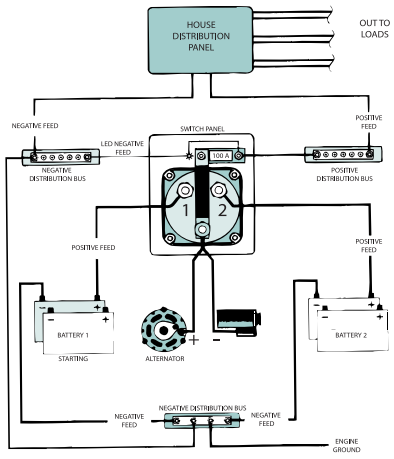
Talkback Q+A

– Technical Helpline 1(888) 658-2628 –

Switch Amiss

Q: A friend helped us with some rewiring onboard, but now the master switch, which controls the house and starter battery banks, is malfunctioning. In the "1" position, only "All" is working. The bilge pump used to work when the switch was turned off, but it doesn't any more. Electronics scares me a little and I don't know if we should just hire someone to fix it or if we can do it ourselves.
Cornelia Bodo-Price, "Muchacha," Delta, British Columbia

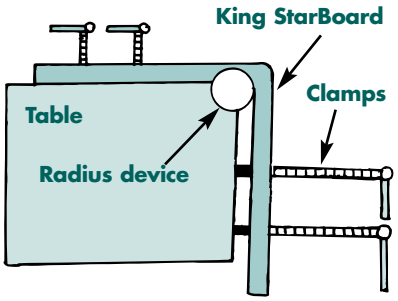
A: It sounds like the switch is wired incorrectly. In a typical system the positive terminal of the house battery bank is connected to "1" terminal on the battery switch, the engine battery is connected to the "2" terminal. All loads and charging sources are connected to the common terminal of the battery switch, except for the bilge pump(s), which is connected directly to the house battery bank. Check to see if your system is wired this way. If it is, the battery switch may not be functioning. Be sure cables are disconnected from the batteries before servicing or you'll get a shock.
— Kevin Jeffrey



Bending Starboard

Q: I plan to build a hood to cover an external camera mounted on my trawler's steadying mast. It will have a base plate measurement of 10cmx12.7cm (4"x5"), a height of 10cm (4"), and a curved top to shed water. Is it possible to bend StarBoard with a heat gun?
Jennings R. Backus, "Saint," Tarpon Springs, Florida

A: You can bend StarBoard with a heat gun, though a strip heater offers better control of the shape. Heat the area from both sides to about 101°C (215°F), then transfer the piece to a forming jig. Clamp securely, then slowly bend to the desired curve. StarBoard has a memory and will rebound slightly, so overbend the piece. We covered this in the DIY 1999-#4 issue and it's also covered on the MRT StarBoard CD.



ALISON HOOD

— Jan Mundy

Old Fuel Remedy

Q: My Volvo diesel was just rebuilt and the marina is suggesting I have the fuel tank flushed and cleaned to remove any algae growth. They want US$350 to clean a 151L (40gal) tank. Can I do this job? The tank has a drain cock, and is half full with 18-month-old fuel. A fuel sample is clear in color.
Kenneth Anderson, Ft. Myers, Florida

A: I'm sure the engine rebuild was a costly service, so the marina is naturally taking the conservative position by suggesting you have the tank cleaned and flushed. But 18 months for diesel fuel is not a long time. If you tapped the fuel (taken from the bottom), let it settle, and it appears to be clear (no water), then if it were my boat, I would fill the tank, add the necessary biocides and go boating. You must have a fuel-water separating filter, and I would monitor this regularly for water contamination. Another device is the Algae X. I don't know if it's hocus-pocus or scientific, but the theory is sound, and for an extra $100 it's still cheaper than a tank cleaning. If it works, you'll never have to clean your tank again.
— Jan Mundy

Mending Flaking Insulation

Q: On my 1981 CS33, the vinyl coating on the insulation surrounding the engine is beginning to peel off. I'm concerned that some of these flakes may get sucked into the air intake. Is there any type of coating that I can use to cover the existing foam insulation?
Bill Hunter, "Largo," Victoria Harbour, Ontario

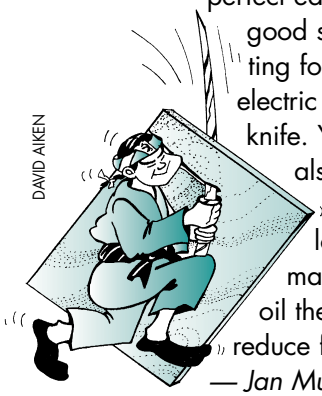
A: It's not uncommon for insulation to decay due to exposure to oil, fuel and other contaminants. What is likely happening is that the decayed foam is pulling away from the vinyl layer. You could try taping the facing material. Since manufacturers don't sell replacement facings, you'll need to plan to replace the foam. Engine soundproofing materials are much

superior to products used 20 years ago. Refer to DIY 1996-#4 issue for complete instructions on installing engine soundproofing or contact the insulation experts at Soundown (Tel: 800/359-1036, Web: www.soundown.com).
— *Jan Mundy*

Foam Shears

Q: What tool or device can be used to make clean cuts on foam? *David E. Cooper, Sr., "Yellow Rose," Chestertown, Maryland*

A: Professional canvas shops use an expensive fabric cutter with a reciprocating blade to get a perfect edge. I've had good success cutting foam with an electric carving knife. You could also use a very sharp, long blade machete and oil the blade to reduce friction.
— *Jan Mundy*



Gori-Less

Q: This summer, the folding propeller dropped off the Volvo MC 11 saildrive on my Niagara 35. I've heard that there are problems with this engine losing props. Is my information correct and can the problem be remedied?
I.G. Whitehall, Ottawa, Ontario

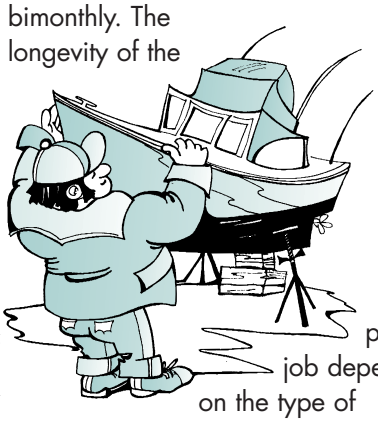
A: Volvo saildrives have been in service since '78 and are very reliable. According to Dave Harris of Harris & Ellis, the folks who represented the Niagara and Nonsuch line and other Mark Ellis-designed boats, the fact that you lost your prop has nothing to do with the drive system. These engines were equipped with a cast iron Gori prop. Being made of iron, this folding geared prop corrodes quickly in saltwater. Due to corrosion, vibration and wear, the blades separate from the prop retaining pin and fall off. Another problem is the hub, which is separate from the blades. The hub is glued onto the blades and has a rubber shock absorbing spline that sets into the splined shaft on the outdrive. Though not a common occurrence, if the prop was repaired and glued back onto the hub, it's likely to fail. Apparently, Flex-O-Fold makes a bronze replacement prop for your engine. Contact the company at amsales@ flexofold.com, www.flexofold.com.
— *Jan Mundy*

Formula for Faster Bottoms

Q: Have you any experience with what's called the "Carolina Coat?" Apparently, a hard Teflon-based antifouling paint is applied to the hull bottom, and a softer ablative paint to the waterline for better protection when at rest.
Dale Hubbard, Randolph, Massachusetts

A: Jim Seidel of Interlux explains: Carolina coat was developed by sportfishing boat captains in the Carolinas to help them get to the fishing grounds faster and/or save them fuel. It's now being used with great success by boats all over North America. The system is simple. The planing surfaces of the boat are painted with VC Offshore (a hard Teflon antifouling). This area is then wet sanded and burnished to be super smooth, but antifouling effectiveness is somewhat reduced. The areas that receive the most sunlight, or are in the water when the boat is at rest at the dock, are painted with Ultra or one of the Micron paints. This provides the best antifouling where it's needed most and the smoothest surface to help

the boat perform better. Boats that have the best success with this system those that are used regularly and have the bottom scrubbed bimonthly. The longevity of the



DAVID AIKEN

paint job depends on the type of paints used. If you chose to apply Micron Extra and VC Offshore, the latter would have to be reapplied every season, but the Micron Extra would last a couple of seasons. If you choose to use Veridian instead of VC Offshore the entire job will last several seasons.
— Jan Mundy

Drive up Trim

Q: I'm having problems trimming the Volvo 7.3L Duo Prop on my 1995 7.3m (24') Sea Sport. The gauge reads completely "up" when the drive is still below the keel. This becomes a problem after loading, when driving away from a steep ramp often scrapes the outdrive skeg. Is there a way to adjust engine tilt to increase the height? Also, what is the correct degree of tilt the drive is suppose to go? All functions of the trim-tilt seem to work fine. *Ernie Holt, Ephrata, Washington*

A: Put bigger wheels on your trailer — just kidding! Unlike outboards which have one trim switch to operate the outdrive, stern drives have a trim switch and a trailer button. The trim gauge reads only the action that takes place on your trim switch, the one typically in the handle control. When the boat is on the trailer, the engine is turned off and you want to lift the drive, press the trailer button. Check your owner's manual for location and operation. Often it's hidden in the dash or a remote control box. Press the trailer button and you'll hear the pump spooling and when it starts to load up, you'll know you're at the top.
— Jan Mundy

Fuel Pump Wiring

Q: I'm installing a Racor double fuel filter and 12-volt fuel (diesel) pump on my sailboat, which has a Yanmar 50 hp engine, to improve fuel filtering and to allow bleeding of the fuel system without the danger of running the engine. The fuel pump is a pass-through type, and will not operate during routine engine operation, but just to bleed the system after filter changes, or when necessary. Where is the best place in the engine room to tap into 12-volt power without causing new problems or confusion? I'd like to avoid routing back to the battery or switch panel, if possible.
Jeff Faig, "Annapurna," San Francisco, California

A: It's common to wire the electric pump to a push-button switch from inside the engine compartment. This way one person can bleed the engine. Run the wires from the electric pump to the switch, then run wires from the switch to a convenient DC source, preferably a circuit that would be on when servicing the engine (such as the engine compartment light).
— Jan Mundy

TECHNICAL HELPLINE

Need help with a problem? Unable to find information on products or do-it-yourself projects?

Help is FREE when you subscribe to DIY

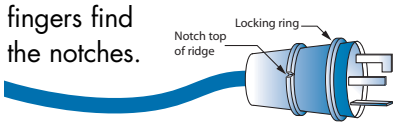
Send your questions to:
TALKBACK *via mail or e-mail. Include your name, subscriber ID number (if known), boat name and home port. Describe symptoms in detail and include manufacturer, brand, year built and other pertiment information.*

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

E-MAIL: info@diy-boat.com

Tech Tips ✓

PLUG ORDER: To easily align shorepower plug ends, especially at night, connect the ends, then cut a V-notch into the top of the ridge behind the locking ring. When plugging in, just rotate the plugs until the fingers find the notches.



Tim Amy, "Hina," Vernon, British Columbia

OVERHAULING SEACOCKS: Next time you haul out, Spray Super Lube into seacocks from the outside while someone inside the boat turns the lever to open and close them. This lubricates the ball, tests all your valves and gives you some peace of mind. *Sandra Turney, "Sandy's Beach," enroute to the Bahamas in a Contessa 26 after a 7 year refit.*

Q-TIP PAINTBRUSH: Cotton swabs make great touch-up brushes. They're dripless and can be thrown out when the painting's done.

HANDY GLUE BRUSH: The easiest, least messy method to spread glue is with a small glue brush. When you don't have one, an old toothbrush does as good a job of spreading the glue and it's wide enough to cover edges of thin boards in one pass.

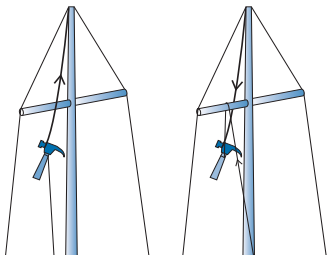
Tech Tips welcomes contributions from readers. If you have a boat-tested tip you'd like to share, send complete information along with your name, boat name and home port to:

DIY Tech Tips
P.O. Box 22473
Alexandria, VA 22304
or
E-mail to info@diy-boat.com.

RACQUET STORAGE: Cut the handle off a tennis or racquetball racquet. Keep the strung end, and make a wood base mortised to fit the handle end, mount the base to a vertical surface. Drop tools into the string holes for storage.

STORAGE HELPER: When you're in need of extra storage for non-combustible items, don't forget the space under the engine compartment.

MISLEAD HALYARD CORRECTION: If, after stepping the mast, there is a halyard on the wrong side of the spreader, tie a light line, double the length of the deck-spreader distance, to a hammer, and the hammer to the end of the stray halyard. Haul up using the other end of the halyard until the hammer is 61cm (2') above the spreader. Then step back (or forward) from the mast, and using the light line set the hammer swinging. As it swings in an arc over the spreader, release the line so the whole assembly does a controlled fall carrying the halyard down to the deck on the correct side of the spreader.



Vicki De Kleer, "Sparrow Hawk," Bronte, Ontario

PAINT PRESERVER: To renew weathered paint, soft sponge wash the surface with a mild liquid dish detergent (i.e. Joy) added to freshwater, let dry, and then cover with a marine polish with a UV inhibitor to protect the finish.

ShopTalk

Spiling Steps

MAKING THINGS FIT

Story and Photos by Wayne Redditt

Usually, making a new pattern is the first step when making a new or replacement part for your. Pattern making is somewhat of an art. Sloppy patterns usually mean a poor fit.

Most fitting comes down to basic skills. The most important of which is measuring, and the methods used to measure. There are few things that will offset the best machinery, tools and materials as measuring. With the ever-increasing cost of materials, it's important to check, double, even triple check before making any irreversible cuts. Since boats in general have very few plumb, level or square components, pattern making requires a slightly different approach than is typical of the house carpentry or cabinet making trades.

Spiling or scribing is the most often used method to transfer curved dimensions from one component to another. Used primary to measure hull planking, interior floors, bulkheads, spiling is also used for any joinery that intersects the curvature of the hull or cabin.

To spile or scribe you must recognize that parallel measurements are essential. It's fruitless to scribe along a curved object perpendicular to the curvature. The resulting line may look good and fair, but cutting to it will not produce a fit. To illustrate the steps, I have used a mold station for a kayak. This method works whether you are measuring to the inside or the outside of a curve.

Figure 1 shows the mold station with a series of lines drawn parallel to the sheer when level. The lines are analogous to the lines on graph paper, in that they are references for transfer of measurements.

Figure 2 shows the edge of the mold station being transferred by divider. The divider is set and locked at any distance. At each line, the edge distance is set off from the intersection of the line with the mold, along the line itself. In this way, each transfer is parallel to the sheer. The reference (in this case the sheer) may be any arbitrary line. As long as all transfers are parallel, they will duplicate the shape. Finishing the job means joining the dots. Obviously, the more parallel lines you use, the greater the accuracy. In practice, most joiners would use a scriber with a marker or pencil attached, and would eyeball parallel as they swept the curve out in one continuous motion. This takes practice of course.

Figure 3 shows a method of drawing a fair curve through the points. In this case, I have used a piece of aluminum welding rod, and some lofting weights. Any springy batten would do, and you may hold it in position with clamps, nails or an assistant.

Figure 4 shows a method used to reduce the dimension uniformly along its length. The circular object in the photo is a piece of one-quarter inch Plexiglas that has been shaped into an accurate circle. At its exact center is a center drill hole. The hole allows placement of a pen or pencil on the center of the circle. Rolling the device along the anchored batten will transfer the exact shape of the curve minus the radius of the device. This is

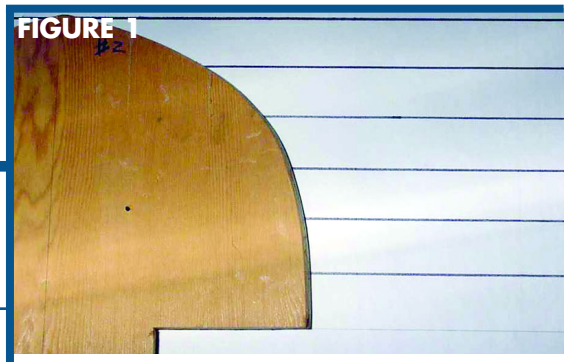
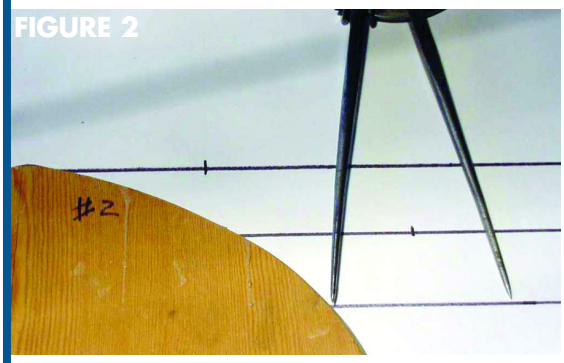


FIGURE 1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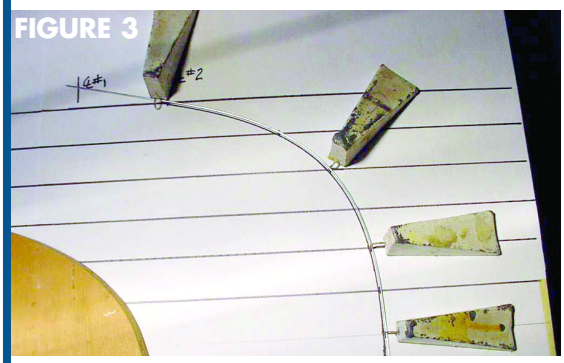


FIGURE 3

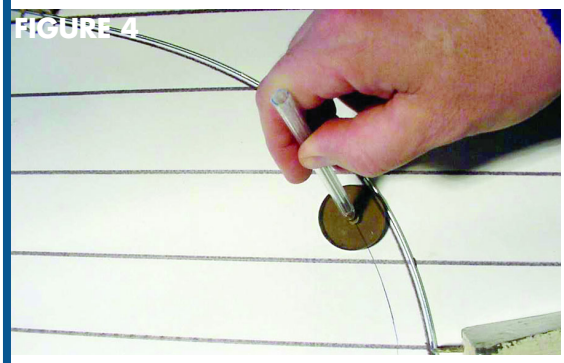


FIGURE 4

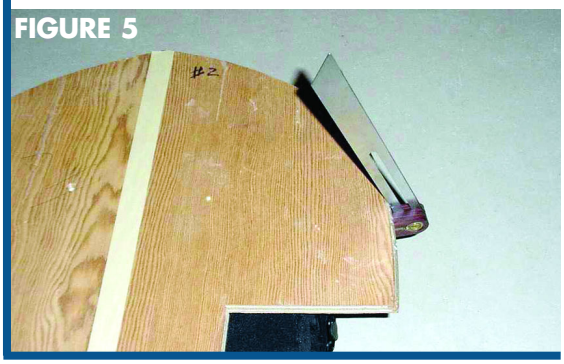


FIGURE 5

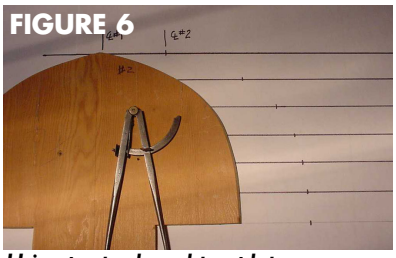
particularly useful if you are measuring the outside of the hull and wish to create an internal component like a frame or bulkhead, which requires the planking thickness deducted from the dimension. A new tool must be made for every thickness required.

Transfer the outline to wood or other material. When cutting, it's best to cut slightly outside your traced line. It's easier to remove small excess than to replace material, or, more likely, cut a new piece. Another consideration is compound bevel edges where the boat curves in more than one direction at any given spot. Be sure that your measurements and cuts are always taken to the large side of any bevel **(Figure 5)**. Then you may bevel the material to the small side without fear of making the overall part too small.

Whenever possible, level the boat you are working on, fore and aft and athwartships. This greatly simplifies measurements both externally and internally, since you may use level and plumb as a reference. A well-placed straight edge that is level may be used to hang a plumb bob into the bilge for example. The combination of level, plumb and straight edge creates a perfect grid for measuring.

To measure the contour of a floor timber, you could locate center on the straight edge by measuring. Lay out equally spaced markings along the straightedge from sheer to sheer. Move the plumb to the marks and lower the point into the bilge until it just grazes the hull. Measure the distance and make a note of it. Do the same for all the marks along the straight edge. You now have the exact contour of the hull bottom at that location, relative to the reference straight edge. You may transfer the contour, removing whatever reference dimension is necessary to locate the top of the floor timber. Transfer to a cardboard template to ensure that you have not made any mistakes. If the cardboard fits, trace it onto your wood and cut with confidence. Remember to account for any bevels first.

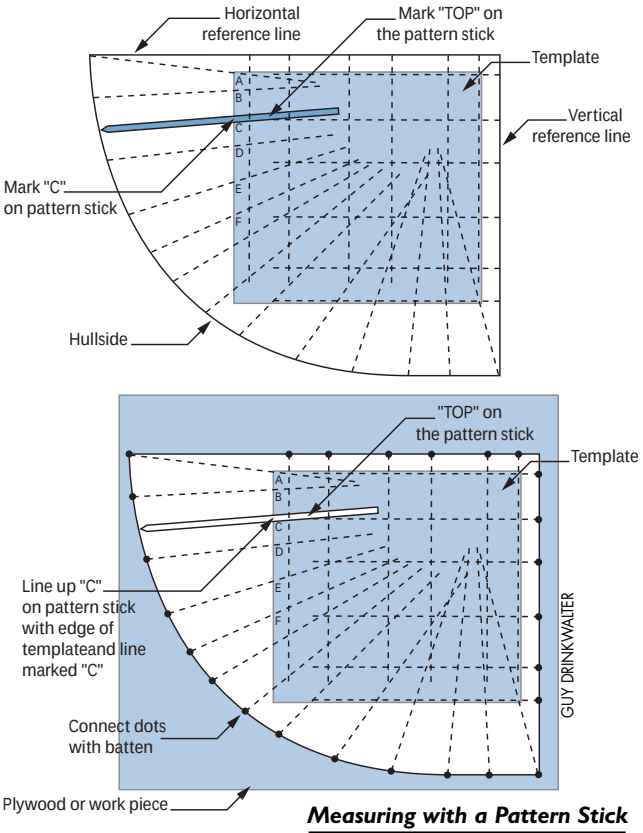
You will often find yourself in a tight spot inside the hull where you will have to take measurements to transfer to the material to be cut. When it's not possible to bring the uncut material (i.e. a large piece of plywood) into the area for direct transfer of the contour, you may wish to make a template from some suitable sheet material like cardboard. I find corrugated cardboard useless for this job and the material of last resort. Poster board (even cereal boxes) and other single ply cardboard are far more suited to the task. To simplify this, I usually use small pieces, and tape them together as the shape develops **(Figure 6)**. Use plumb bob and level or fixed objects in the boat, such as a floor timber, for vertical and horizontal reference planes. Scribe the curved portion using the method described above. To fill in the remainder of the area, fit sections utilizing straight edges if they present themselves, and masking tape to hold it all together. Remove from the boat, tape the pattern to the work piece, and mark the contour from the scribed line, allowing for the offset.



Using poster board templates

An alternative method of measurement proves useful for most joinery tasks. Using a wooden pattern stick to transfer measurements without a tape measure prevents misreading the dimensions **(Figure 7)**. Tape a cardboard or poster board template to a nearby bulkhead, floor or other solid object. Add a couple of vertical and horizontal reference marks for orientation of the work piece later. Mark the top edge of the pattern stick with a notch or pen. Place the pattern stick on the template so it extends to the hull side or the perimeter of whatever object is being measured, and scribe a position line using the stick's top edge directly onto the cardboard with a pencil or pen. Then, mark the distance from the edge of the cardboard to the object on the stick. To avoid mistakes, write the number of the line beside the tick on the stick and on the cardboard. In this way, dozens of measurements are taken with the stick, transferring a very accurate profile of the contour without taking a dimensional measurement. I always use 9mm (3/8") square white pine or spruce sticks, in various lengths, and a pen for taking patterns. When it becomes no longer legible, you can plane off the marks and go at it again. Transferring the measurements is a simple matter of removing the cardboard, taping it to the work piece, lining up the position lines, and reversing the procedure. Place the pattern stick on each position line, lining up the mark on the stick with the cardboard edge, and make a dot where the stick end meets the work piece. For example, slide the stick along the drawn line C, lining up mark C on the pattern stick with the edge of the cardboard, and mark the work. Use a flexible batten to connect the dots, and then cut out the piece.

FIGURE 6



Measuring with a Pattern Stick

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

-Tip- Measuring Rules

When you're without a ruler, there are some everyday items that you can use as accurate measuring devices. A US dollar bill, for example, measures 6-1/8" wide 2-5/8" in length. A Canadian bill measures 5-15/16" by 2-3/4". As long as you have a buck or two in your wallet, you'll never be without a measuring "stick." There's also the Rule of Thumb. If you know your thumb length, you can estimate any dimension.
— Jan Mundy

ELECTRICAL

HOW TO CHARGE MULTIPLE BANKS

Adding electrically powered amenities to your boat increases the demands on your battery capacity. Adding battery banks is a solution, but producing enough power to efficiently charge the expanded system becomes the problem.

By John Payne

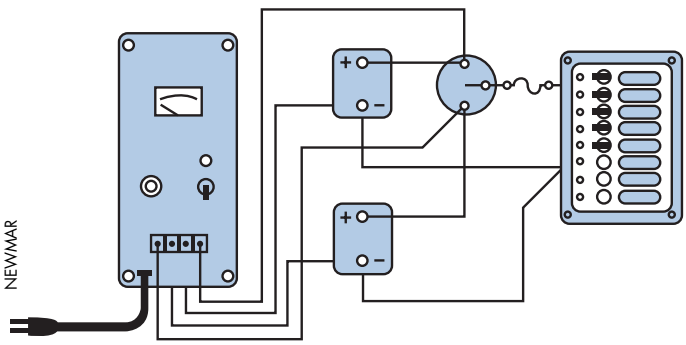
Repeated battery charging is normal practice for the majority of marina-based boats. While it's generally a single house battery bank on charge, many boats have multiple house banks and twin engines with batteries dedicated to each purpose. In these cases, a separate battery charger is generally required, or a method of splitting the charge from a single charging source to each battery bank is necessary.

The methods used for alternator charging configurations are similar, however there is a range of alternative charging methods for battery charging along with specific products to simplify it. Regardless of the system being used, maintenance-free flooded cells, gel cells or AGM batteries do have different charging requirements and this must be considered prior to selecting and installing any charging system. Batteries, when fully charged, can loose water rapidly if the output voltage is not precise and compensated for the ambient temperatures. Spend the money on a quality charger designed for marine use, such as the precise output switch mode types now on the market. Starting and deep cycle batteries have different charge characteristics. Consider these, along with factors such as the varied battery ages and battery capacities, all of which are affected in charging. You can also put a charger on an automatic timer for performing maintenance charging duties.

Charging Configurations

There are typically five charging options. Each depends on the boat's specific situation and installation configurations, and your budget.

Figure 1 Dual Output Charger



Multiple Output Battery Chargers **(Figure 1)**. You select an appropriately rated marine battery charger with multiple outputs, where each battery bank has separate and isolated charging outputs. This prevents any interaction between battery banks or charging systems, and is an efficient way of having two or more separate chargers. The multiple output battery charger is probably the best option. Units are available from Heart Interface, Mastervolt and Newmar, and range in price from US$300 to US$800.

Diode Isolators **(Figure 2)**. This option uses a diode isolator system to split the charge between two or three battery banks. Three battery bank systems use two diode isolators, and link the diode isolator inputs. Battery chargers with battery sensing are required to compensate for the problems of voltage drop across the diode. Prices range from US$150 to US$350.

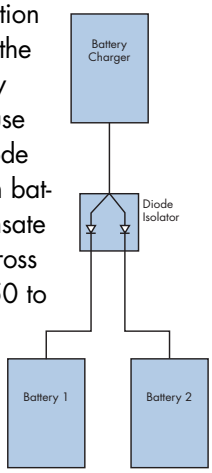


Figure 2 Installation of Diode Isolator

Relay or Solenoid **(Figure 3)**. A relay or solenoid system is installed to direct the charge current to each battery bank. This is activated either with the monitored charging voltage using an activation relay or via a manually operated switch. The configuration effectively parallels all of the batteries to form a single battery bank. Possible systems include the Newmar Battery Bank Integrator (BBI). When a charge voltage that exceeds 13.3 volts DC is detected, the unit is activated. A low contact resistance relay closes to parallel the batteries for charging. When charging ceases, and voltage drops to 12.7 volts, the relay opens, isolating the batteries. The unit also incorporates a voltage comparator and time delay circuit that prevents the unit cycling in the event of a voltage transient or load drop on the circuit dropping voltage below the cutout level. Another similar device is the PathMaker from Heart Interface **(Figure 4)**. It allows charging of two or three batteries from one alternator or battery charger. The unit is based on a high current switch rated at 800 and 1,600 amps for alternator and charger ratings up to 250 amps. It also incorporates an LED status indicator. Price ranges from US$150 to

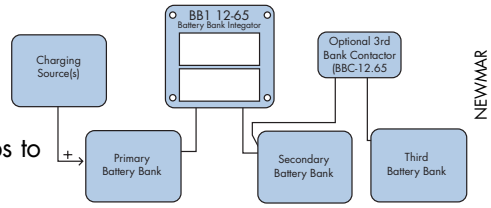


Figure 3 Typical Installation of BBI

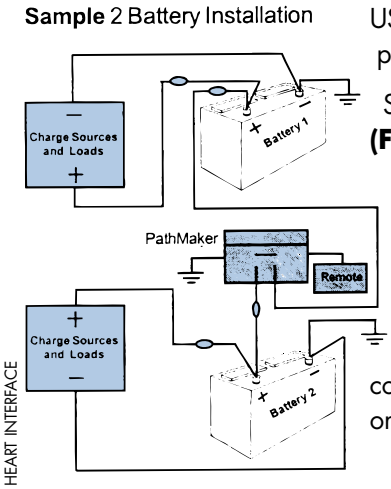


Figure 4 Sample Battery Installation with PathMaker

US$300, including all components.

Smart Charge Splitters **(Figure 5)**. The last option is the use of an intelligent charge distribution device, such as the Ample Power Isolator Eliminator. This is a multi-step regulator that controls charge to the second battery bank, typically the one used for engine starting. Temperature compensated like an alternator control system, it's effectively a secondary charger that uses the main battery as the charging source, or as a surrogate charger. Another similar system is Ample Power's AutoSwitch unit

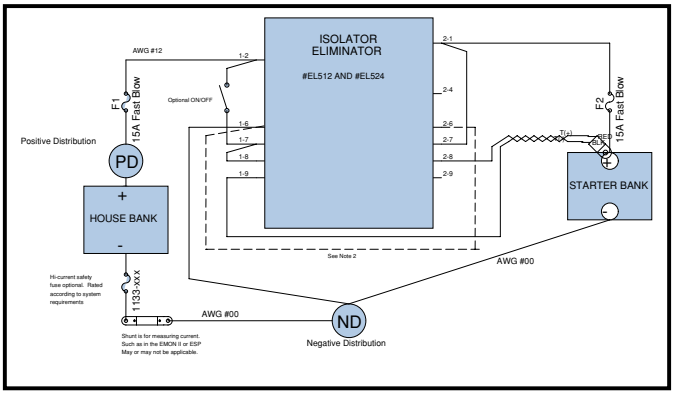


Figure 5 Typical Installation of Isolator Eliminator. The Eliminator maintains the correct voltage of the starter battery bank, while all other loads and all charge sources connect to the deep-cycle house battery bank.

(Figure 6), a smart solenoid system. An electronic sensing circuit enables the user to program the setting of the different modes. One mode is a timed function that terminates the charging to the second paralleled starter battery bank once the preset time period expires. There is also a voltage mode that disconnects the second battery after the preset voltage level is reached. These smart devices are a safer alternative as they reduce the chances of overcharging secondary batteries, such as the starter bank. Installed prices range from US$250 to US$500.

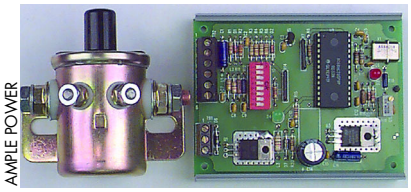


Figure 6 AutoSwitch

About the author: John Payne is author of "Marine Electrical and Electronics Bible," published by Sheridan House. A marine electrical engineer and consultant in commercial shipping and the offshore oil industry, his website is www.marineelectrics.org

ELECTRICAL

BREAKING THE GROUND CIRCUIT

The first article in a series on bonding, corrosion and grounding systems discusses galvanic corrosion and the steps to protect metal components immersed in seawater from damaging corrosion-producing voltages and currents.

By Susan Canfield

Any boat that spends a lot of time plugged into a marina's shorepower system is susceptible to galvanic corrosion induced by neighboring boats. Every boat that plugs into the marina service connects to every other boat plugged into that system via the green AC grounding wire. The effect of this situation creates a giant battery or galvanic cell **(Figure 1)**.

Figure 2 illustrates two boats moored side-by-side in a marina. Each is correctly wired with the AC grounding conductor connected to the off-engine DC negative bus and to the bonding system (if installed). Metal fittings on the bottom of the boat on the left are bonded and protected by an external zinc anode. The underwater hardware on the boat on the right is not protected. The zinc on the first boat is the negative plate in our giant battery. The running gear on the second boat forms the positive plate. When both boats plug into shorepower, the green AC grounding wire completes the circuit between the battery's two terminals. Galvanically generated DC current flows along the AC grounding wire and between the underwater metals via the electrolyte. The zinc anode — the least noble, which is, the most galvanically active metal — corrodes first. Powerboats with aluminum outdrives are particularly vulnerable. As a least noble metal, the aluminum outdrive becomes the sacrificial anode for surrounding boats without adequate zinc (anodic) protection. In this galvanic cell, the wetted surface of the aluminum, one of the least noble metals, is the anode, for surrounding boats with inadequate zinc protection.

Cutting or simply disconnecting the green AC grounding wire will eliminate the risk of galvanic current caused by other boats, but doing so creates a dangerous, potentially fatal shock hazard for anyone onboard and for swimmers who may be nearby while the boat is plugged in. Stray AC currents as low as 5 milliamps can cause muscle seizure and drowning. Don't cut or disconnect the green AC grounding wire. There is a better solution.

Corrosion Control

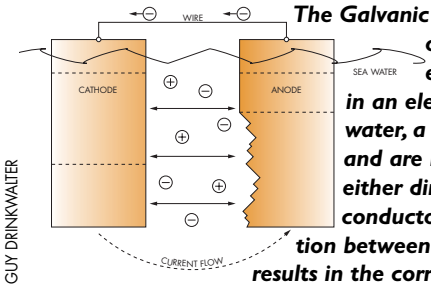
Fortunately, you can effectively block the galvanic cell created when a boat plugs into a marina's shorepower system (and the galvanic corrosion that it induces) by installing a galvanic isolator **(Figure 3)**. These devices are designed to protect a boat from passing or receiving low voltage galvanic current (up to 1.2 volts), while permitting dangerous AC voltage to pass safely via the green wire to the shore ground. Isolators contain one pair of diodes connected in parallel with a second pair conducting in the opposite direction. Diodes must be heavy duty to carry short-circuit amperage long enough for the circuit breaker to trip. Unfortunately, some isolators lack this capability. Other isolators parallel a capacitor — an electronic component that passes AC but not DC — so that a diode failure does not disconnect the grounding wire, a potentially hazardous condition.

When shopping for a galvanic isolator, look for one that meets the American Boat and Yacht Council (ABYC) standard and is labeled to indicated that it has been tested by an independent laboratory, such as Underwriters Laboratories, for compliance with that standard. Be sure that the current rating of the isolator you choose is at least the same as your boat's main shorepower disconnect circuit breaker. When installed in a compartment containing a gasoline fuel tank or a gasoline-fueled engine or generator, the isolator must also be labeled as "ignition protected." All other factors being equal, galvanic isolators with a capacitor in addition to the usual diodes perform better than an isolator with diodes alone. They also cost two or three times more, but this difference becomes insignificant when weighed against the potential costs of galvanic corrosion.

If you already have a galvanic isolator installed in your boat, check to be sure it meets the ABYC standard. If in doubt, call the isolator's manufacturer. If your isolator doesn't measure up, upgrade to one that does. The vast majority of galvanic isolators currently installed in boats give no visual indication of diode failure. It's critically important to periodically check isolator function using a circuit tester or multimeter. Refer to the owner's manual for information on testing your galvanic isolator.

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

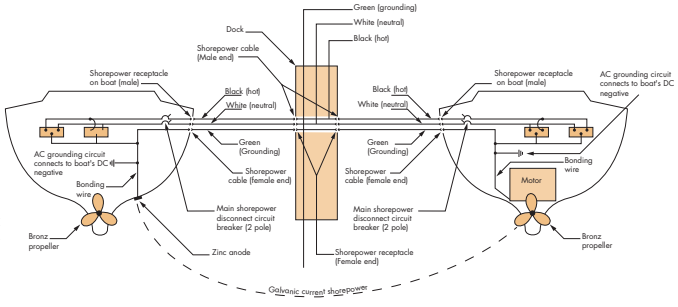
Figure 1



GUY DRINKWALTER

The Galvanic Cell: Galvanic corrosion occurs when two different metals are immersed in an electrolyte, in this case seawater, a conductor of electricity, and are in electrical contact either directly or via an external conductor. The electrical interaction between the dissimilar metals results in the corrosion of the less stable metal (more electro-negative potential), and protects the more stable metal (more electro-positive potential) from corroding. The combination of metals is known as a galvanic cell. In the electrolyte, the resultant electrochemical reaction causes negative ions to flow from the cathode to the anode, and positive ions from the anode to the cathode. Thus, the anode corrodes, while the cathode is protected.

Figure 2

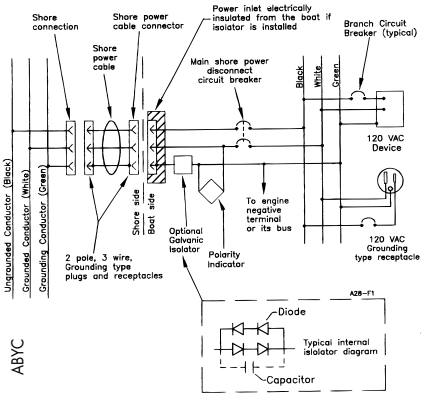


GUY DRINKWALTER

Galvanic Activity: When boats plug into a marina's shorepower system, the green AC grounding wire is the external conductor in a giant galvanic cell. Galvanically generated DC current flows along the AC grounding wire and between the underwater hardware via the electrolyte (seawater). The resultant galvanic activity causes the zinc anode to corrode first. When the zinc is depleted, the next least stable metal will start to corrode.

A galvanic isolator installed in the boat's shorepower grounding conductor breaks the grounding circuit. Mercury Marine's Quicksilver Galvanic Isolator kit (Part 18478a3, US$189/CDN$237) is UL listed and ignition protected, with a current rating of 60 amps. It uses a capacitor, which passes AC but not DC, so that a diode failure does not disconnect the grounding wire, a potentially lethal condition.

Figure 3



ABYC

Typical Isolator Hookup: When installing a galvanic isolator, ABYC standards require that it be placed in series in the incoming AC grounding wire immediately downstream of the shorepower inlet. If your boat has two shorepower inlets, you will need two separate galvanic isolators, one for each inlet. It's important that an isolator be installed in a ventilated, dry, and accessible location.

Refit

WINDOW DRESSING

New windows, ports or hatches add comfort to interiors and can increase the resale value. If your boat could benefit from more light, better ventilation or a drier cabin, perhaps it's time for a refit.

Story and photos by Jan Mundy

It's a fact of life for many boats. The windows and ports leak. This is largely due to the nature of boats, and to a lesser degree, to normal exposure to the elements. The flexing of hulls and decks alone can cause a breach in the seal between the window frame or portlight and the cabin sides or deck.

Sliding windows on older cruisers usually consist of aluminum, plastic or wooden tracks, mounted on some sort of support on the bottom inside the cabin wall and on the top edge. The sliding track mechanism is so badly deteriorated that a heavy downpour soaks the cabin cushions and carpet. Salt, UV rays and other factors deteriorate the flexible seals so they no longer keep the water out. Even a pinhole break in such a seal can cause water to migrate inside the cabin. And for many models, exact replacement seals are not available. Rebedding may solve the problem short term, but inevitably, the leaks return.

Some owners replace windows to add ventilation, exchanging fixed for opening ones. This is often the case with motorsailers or catamarans, and a popular refit for trawlers and larger cruisers. If any of these conditions describes the windows or ports in your boat, it may be worthwhile to replace them with a more watertight solution.

Estimated Outlay

There are only a handful of manufacturers of marine windows, hatches and ports and all build on a custom, one-off basis. There were (and likely still are) no standards in window shapes or sizes among boatbuilders. Consider a boat with 14 windows. Possibly only half of the windows will be the same size. That means that the window supplier has to design, cut and assemble each window separately. Cabin windows for a C&C 30, for example, average US$800 to US$1,000 per window. For each side slider on a 10.6m (35') powerboat, you can expect to pay up to US$500. Add to this the yard bill, if you don't install them yourself, and you can more than double the purchase price. (FYI: On a new boat, windows comprise less than 1% of the cost.)

Refit Options

Ideally, the original manufacturer should replace hatches. If that isn't possible, there are manufacturers of production-built hatches, such as Atkins & Hoyle, Bomar, Lewmar, Vetus, and others. If you're lucky, you'll find one that dimensional is roughly the same size. If not, you're into a custom hatch with custom costs. Some boats have wooden hatch frames with an acrylic or tempered glass lens. Your best option here is to salvage what you can, or pay the price for a custom-built replacement. (For instructions on replacing a hatch lens, see "7 Steps to Professional Hatch Replacement" on page 20.)

Portlights (windows that open) are surely a custom item made to any size. Sometimes, large portlights can be exchanged for sliders. Problems occur when mounting in a cambered or curved surface as sliders must be mounted in a near vertical wall for the seals to be waterproof.

Sailboat windows traditionally mount from the outside with the frame screwed to the cabin sides. There are two refit options: either the size of the opening is increased to accommodate a larger window and thus remove the screw holes; or the holes are plugged, requiring cosmetic finishing on the outside, and a preferred option where the interior is finished with an attractive trim piece. New sliders in older powerboats usually require refinishing the interior trim as well. On boats with exterior wooden window frames, such as Grand Banks trawlers, you could opt to install a wood fascia over the new frame. Window openings can be enlarged usually by a couple of inches without affecting the structural integrity, though manufacturers don't recommend drastic changes to the original window openings.

Various sizes of deadlights (fixed windows) are readily available. For custom sizes, you have no option but to order replacements from a custom marine window manufacturer, such as Aluminum 2000, American Marine Products, Boman, Diamond/Sea-Glaze, and others. Deadlights are available in tempered glass for flat surfaces. For mounting in a cambered or curved surface (horizontally), manufacturers offer

When is a Port a Portlight?

According to "Chapman Piloting" a porthole is an opening in the hull to admit light and air. The glass covering the porthole is known as a portlight. If the glass opens it's called a portlight. A deadlight originally described a solid cover over a porthole, but today refers to a non-opening port.
— JM

replacements in acrylic or polycarbonate plate, provided the total wall thickness (hull and liner) isn't excessive, typically no more than 25mm (1").

Windows are not designed to carry any weight nor support weight. For cruisers with large cabin house windows, and especially those with a flybridge, often the structure needs reinforcing before installing new windows.

Selecting New Windows

Modern window and portlight frames are typically made of extruded aluminum bent in a press into the desired shape, or cut to size with mitered corners. Take a close look at the construction and design of the new windows. Are the frames welded or riveted? How does the frame fasten to the hull? How is the pane held in place, and how easy is it to replace? What is needed to replace a seal? Are screens removable? How do the windows drain?

Top quality windows have welded frames with a clamping ring to eliminate any exposed fasteners and window panes contained in neoprene seals. Sliders should have a synthetic pile material to prevent water from migrating behind the panes when closed, and deep condensation dams to empty water on the track through drain holes on the outside frame.

Many windows are available with tinted glass, and frames in various colors, usually two shades of white and black, with either an anodized powder coat or poly–urethane painted finish. Panes are available in acrylic, polycarbonate, or tempered glass.

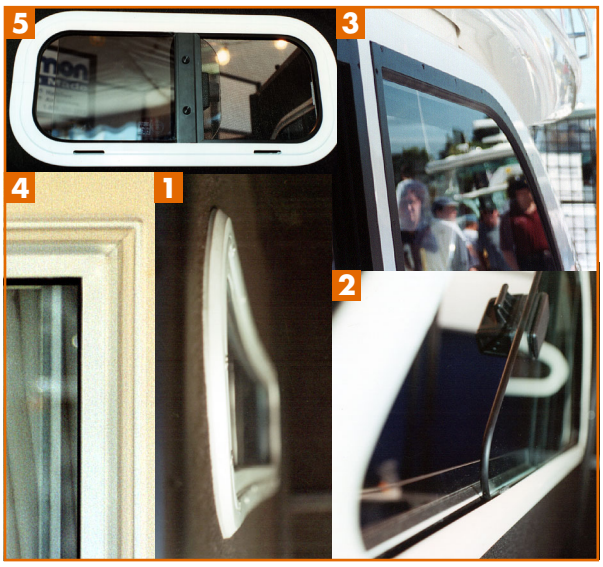
Getting Started

Once you've decided to replace windows, obtain quotes from the manufacturers. They require rough measurements and preferred options to supply an estimate. Once you agree on a price, and you are confident that the company supplying the windows can do the job, place your order.

Before construction can begin, the manufacturer needs to know the opening dimensions, wall thickness, desired finish, glass tint and other options. Some prefer to work with dimensions rather than paper templates. Likely no two windows are the same, so you will need to measure or make a pattern of every window. Don't remove the windows until you and the manufacturer are absolutely certain of the finished size. Once old windows are out, you won't get them back in.

It takes six to eight weeks before receipt of new windows. Installation takes about 2 hours per window, if you know what you're doing and everything is measured correctly. This time doesn't include removal of the old window, cleaning of the mounting surfaces, etc. This is not a job for amateurs. Unless you are very confident in your abilities, you are better off hiring a yard, one experienced with installing windows, and preferably installing that particular product. (Ask the window manufacturer for recommendations).

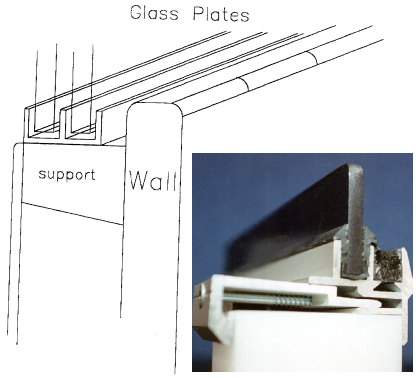
Refit



Construction Details: (1) Deadlights can be installed in a camber up to 10% off horizontal. (2) Secure closure system. (3) Less–expensive external mounted windows with screws visible on outside frame. (4) Mitered cornered frames for mounting only on flat walls. (5) Condensation dams on opening and screened portlights and sliders allow water that collects on the inside of the track to drain to the outside.

In Retrospect

Considering the expense and amount of work involved in a do-it-yourself window refit, you may wonder if it's worth it. I asked DIY reader and contributor Dwight Powell that very question. Dwight had no experience installing windows before replacing and modifying all the cabin windows in his 1968 Chris-Craft Cavalier.



Sliders: (top) Original design commonly found on older cruisers. (bottom) Profile of a modern clamp latching system. More expensive than an externally mounted frame, it has no exposed fasteners.

Planning and interior finishing were the most demanding part of his refit. Installation requires intermediate woodworking skills and if you're working with wood, some experience with epoxy resin. He recommends first drawing a profile of the boat as is, then draw or overlay the window treatment to get a view of the finished look. "Boats are as much about lines and looks as function, comments Dwight."

For additional reading on windows, refer to "Refitting Windows" in the Projects column, DIY 1996-#1 issue, and "Facelift for a Classic Chris," DIY 1999-#2 issue.

7 STEPS TO A PROFESSIONAL HATCH REPLACEMENT

Story and photos by Jan Mundy

Deck hatches usually have lenses made of acrylic or polycarbonate. Boat cleaners, sunlight and pollutants gradually degrade these "plastics" until a web of crazing clouds the view through them. Removing the old lens and replacing it with a new one isn't difficult, if you know how. Fred Blair of Custom Marine Services (Tel: 416/282-8083), a mobile boat repair service based in Ontario, kindly agreed to share his expertise with DIY readers. Warehouse Plastic Sales (Tel: 800/268-6784; Web: plastic4boats.com) supplied the project boat and the replacement material.

Twelve years in the Florida sun had literally "baked" the lens on this J35's foredeck hatch. The lens appeared cracked and scarred, but surprisingly the surface was smooth to the touch. Repeatedly cleaning with an ammonia-based product, combined with intense UV exposure, apparently had caused the damage.

This job is best done off the boat on a sturdy surface. The first task is to remove the hatch top from the deck frame, then remove the lens. This took less than two hours. Fortunately, fasteners weren't corroded, and nuts were exposed so it wasn't necessary to remove the cabin liner. There was no need to replace the gasket as it was in good shape. While working on the hatch, you'll need to cover the opening in the boat with plastic sheathing, or devise some other protection to the interior.

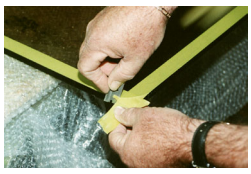
Measuring 63cm (25") square and 9mm (3/8") thick, the replacement lens in bronze Acrylite cost $100. The milling charges for WPS to cut and drill fastener holes was $50. If you don't have the proper tools to fabricate plastic, this job is best done by the supplier.

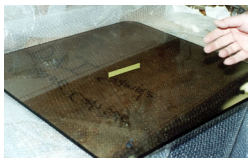
Follow these procedures for a leak-free hatch lens. A professional budgets six to eight hours for this job and charges up to $600 installed.

Step 1 Remove the original caulking from the groove in the hatch frame using a sharp chisel. Be careful not to nick the inside gasket. Removal could take hours, depending on what compound was used. It's not necessary to remove all the compound, just the loose residue, to ensure good adhesion. Lightly sand with 80-grit paper to remove loose bits. Clean the groove with a whisk or vacuum.

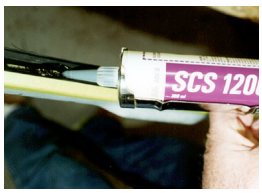
Step 2 Mask the frame edge. Fred uses 3M 233 tape in 19mm (3/4") width for this job. Overlap each piece and extend the tape ends to provide a good grip later when removing it. Tape across corners, then using a sharp, single edge razor blade, "saw" the tape following the contour of the frame. Press tape down firmly. This way the caulking won't run under the tape, and you'll achieve a straight, finished caulking line. As most hatches have a separate gasket, normally, you would mask the outside and inside edges. Since this hatch has an overlapping gasket that wraps around the inner aluminum frame, any sealant that oozes out can be trimmed later.

Step 3 Place the new lens on a protective surface (Fred used bubble wrap), and remove the paper mask. Once the paper is removed, handle it carefully as plastic scratches easily. Before starting, remove wristwatches and slide belt buckles to the side. Determine which is the front, back, etc., and put a piece of tape on the underside, or whatever suits best, for reference later. Mask the lens edge, using your thumb to feel the edge and position the tape. Alignment isn't critical, but the neater you get it the straighter the finished edge. Trim the corner with a razor blade using a sawing action.





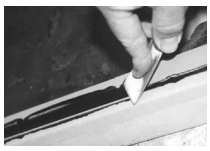
Step 4 To caulk plastics, Fred uses only GE1200, a construction-grade silicone available in black, clear or white. This product requires no prep, it has a working time of one hour, and cures overnight. Again, because of the gasket, application differs from other hatches. Normally, you fill the groove with sealant and any excess oozes out onto the taped edges (see Step 2). Instead, Fred carefully caulks the outside frame edge so it just overlaps the bottom ledge. He'll fill in the gap from the top, once the lens is placed. With two mating surfaces, the bottom and sides, chances of getting a good joint are good. Smooth with a gloved finger to remove the lumps and spread the sealant evenly.



Step 5 Lay the lens in the frame,

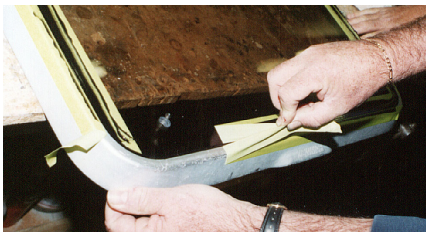
carefully checking the front and back positioning before dropping into place. Center the lens in the frame. This silicone has a working time of just 20 minutes at 10°C (50°F); with normal summer temperatures, you'll need to hustle. Lightly press down, applying just enough pressure to seat the lens in the frame. If the hatch frame is bowed, then you'll need to weigh down the lens. For this, Fred uses a wooden block placed over a protective cloth in the center of the lens, then lays a batten across the block and clamps it to the frame.

Step 6 Caulk the gap between the lens and frame edge. Apply pressure to squeeze the caulk into the gap



and remove any air. Run a 25mm (1") putty knife along the tape to smooth the caulking. Hold the knife at an angle so it doesn't run off the masking tape. There is often a height difference between the frame and lens. When the lens sits lower, run the knife flat along the frame edge, leaving a slight bevel up to the lens. Recaulk any low spots or air pockets, and level with the putty knife. On hatches with a narrow gap, run a finger along the edge for a neater finish. Don't do this where the gap is wide (in this case) or you'll make a definite groove.

Step 7 Remove the masking tape now. Don't wait until the silicone hardens or the tape may lift it. Start at the corners, pulling back the top tape layer on the frame. Then pull up the tape on the lens side, join the two and pull off both at the same time. This prevents caulking strands from dropping off the tape onto the frame or lens. Angle the tapes back when pulling, not up, which may pull out the caulking or lift the lens. Wait until the sealant cures to remove any tape or sealant residue, then scrape off with a razor blade. Hold the razor blade flat when trimming. To remove caulking off the lens, let it cure, then rub with your finger and it will roll off. Uncured sealant can be removed with Varsol, if needed. If it leaves a film, clean with a specialized plastic cleaner when the silicone has fully cured.



DON'T HAVE AN OWNER'S MANUAL?

Unlike automotive manufacturers who always provide a detailed manual to the vehicle's systems, few older production boats (and many new boats) were supplied with such information. Here's how to create an Owner's Manual for your boat.

-Tip- Sample Owner's Data

ABYC technical information report, T-24, Owner's Manuals, offers boatbuilders recommendations on how to develop owner's manuals. If you would like a copy in PDF format, send an email to tech@diyboat.com, or log onto www.diyboat.com and click on "Current Issue" to print a copy. — JM

By Nick Bailey

In our DIY boater community, boats have a long history of passage through several unknown previous owners and an often long extinct manufacturer. So, when you go into your local marine store and ask for a freshwater pump rebuild kit for your 1971 Pleistocene 27, don't be surprised if you get a blank look from the part-timer behind the counter. The parts counter boss, a grizzled veteran, then steps in and informs you that Pleistocene used four different pump models between 1969 and 1972 and you had better come back with the make, model and serial number of that pump.

At this point, to save the return trip (and your pride), you present your carefully assembled Owner's Manual, a 3-ring binder affair. It includes complete details of all onboard equipment including make, model and serial numbers together with installation instructions, diagrams and detailed parts lists.

OEM Ranking

You can judge the cost of a new boat by the size and complexity of the builder-supplied owner's manual. Many custom boats, and some production boats, come with a binder that contains a copy of the sales brochure and other PR stuff, and several pages detailing the manufacturer's warranty. This manual may or may not contain comprehensive operating instructions, but will definitely include pages of safety warnings. Separate brochures (even operating manuals with high-end boats) for each item of installed equipment, including the engine, are often found in the binder. Unfortunately for boat buyers, many Owners' Manuals are more of an advertising medium than a practical, informative, useful service tool. As for older boats, owners are left in the dark, as most are sold without any stats! [Ed: Imagine buying a car where the manufacturer didn't include any reference material on tire pressure specs, for example, or engine oil capacities, even how to change the radio's clock?]

Power of Information

Regardless of whether you are expanding the original owner's manual or starting one from scratch, it helps to be a bit obsessive compulsive when researching your boat's equipment and systems. Assume you are preparing the manual for use by someone else. This way, you won't presuppose any details, and it becomes an essential tool for a surrogate captain (or the next owner).

Your Owner's Manual should include all the vital statistics including weight and dimensional specs, equipment model and serial numbers, recommended trailer configurations, cradling methods, and lifting sling locations. Also wiring and plumbing diagrams [Ed: See DIY 2000-#2 for details for charting an electrical system] with more detail than just a rough schematic. Details such as wire sizes and run lengths, color codes, fuse or breaker sizes are useful to know as are all hose dimensions and routing, placement of seacocks, etc. Though time consuming, once created, these schematics save you time in any future service, and at the same time you'll become familiar with your boat's layout. Better manuals also include detailed size information on all rigging and fittings.

A comprehensive manual should record step-by-step servicing procedures and maintenance checklists. Also detailed information about seasonal procedures. This saves a lot of head scratching and guesswork, particularly when dealing with "seasonal amnesia." At the time you're doing the work, you may think a task is pretty simple, and you'll remember every detail, but familiarity can vanish during the off-season. Include a step-by-step section on winterizing and spring commissioning, as well as all haulout details, complete with a master checklist.

Sailboat owners will want to record data on mast stepping (Are the uppers fore or aft of the lowers?) and lowering; rig tuning (What were the measurements from last year's killer rig?); and schematics on the deck layout

of all control lines (Do we lead the reef or the Cunningham to the inboard clutch?). A few photos or a sketch in your manual can save a lot of time. This is information you seldom need, but it deserves to be at your fingertips instead of lost in the fog of seasonal amnesia.

There's also basic boatkeeping to record, particularly information about battery management and fuel systems. Is the house bank battery switch position 1 or 2? Should we start the engine with the switch on "Both"? Does it matter for charging? How to bleed the fuel system after changing a clogged filter? Can I hand crank the engine? How to operate the decompression levers?

A boat with its own comprehensive manual explaining the onboard systems, especially aftermarket items you may have installed, also saves the owner time and money when having anything professionally repaired. The service tech won't have as much trouble trying to figure out your systems.

Information Sources

Once the installed equipment is identified and recorded, check out the manufacturers' websites to download information, or simply pick up brochures or catalogs at your local chandlery. Engine manufacturers have parts and service manuals available, even for older units. In some cases archives exist from which copies can be purchased or downloaded. Owner's clubs and class associations are also good sources for out-of-print information.

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

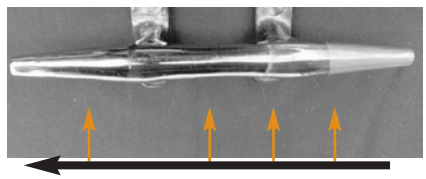
RESTORING HARDWARE TO NEW

Before and after: replated hardware looks better than new! Estimated replating costs: Bronze Porthole, US$100; Chrome-plated bronze Barient 25 winch, US$95; Bronze turnbuckle, US$30.

Salt, acid rain and other air and water-borne pollutants all contribute to the deterioration of metal hardware and fittings. In time, metal finish may oxidize, castings often become pitted from corrosion, or the plating erodes. Eventually, brass cabin lights, chrome-plated engine controls, stainless steel trumpet horns, bronze cowl vents or Zamak (pot metal) stanchion bases loose their luster. You can replace the fitting with a new one, or choose a more economical course and have it restored. Besides a cost savings, the latter option is desirable for older boats with custom fittings, where replacement often demands major reconstruction so they fit properly, (the "square peg in a round hole syndrome"), or you just have a strong attachment to your stuff.

It took just 18 months in a closed, poorly ventilated saltwater boat to tarnish the bronze fittings in the cabin. Estimated cost to restore: US$600. Replacement cost: US$1,800 to US$2,400.

Upon investing in the replating process, I was surprised at the amount of work and procedures it takes to restore hardware to like-new quality. Take a chrome-plated bronze cleat, for example. First the part is cleaned in a caustic soda bath, rinsed in water, then placed in muriactic acid to strip the chrome, rinsed again, then hot sulfuric acid and reverse plate using current to strip the nickel and copper, and rinsed. The cleat is then polished with a buffing wheel or belt using various grits and compounds, depending on its condition and depth of pitting. Then it's into an ultrasound machine to remove the buffing compound, rinsed again, then more various acid baths, some positively charged, more buffing, followed by nickel then chrome bath with lots of rinsing between each operation. Somewhere between the acid baths, holes are patched with lead. According to Rob Maersch of Annapolis Polish and Plating in Annapolis, Maryland (Tel: 410/573-1077; Email annapolisplating@aol.com), replating involves a total of 32 different procedures. If the cleat were clear bronze, rather than plated it would be lacquer sprayed to protect the finish.



The four stages of the chrome plating process, right to left: strip chrome using an acid, rinse; strip off copper and nickel in a hot acid bath, rinse, then buff; nickel bath for about 20 minutes, rinse; chrome bath for about 2 minutes, rinse.

If replating is in your plans, the turnaround time during the boating season is three to six weeks, so don't leave this job until spring.

— Jan Mundy

Projects

Edited by Jan Mundy
Illustrations by Guy Drinkwalter

Just slightly longer than a regular screwdriver, the VSD comes complete with strainer and hose fittings.

WATER PRESSURE ON DEMAND

Imagine showering and washing dishes all at the same time, and never losing water pressure or a change in water temperature. It's now possible with this new high-tech, multi-fixture pump.

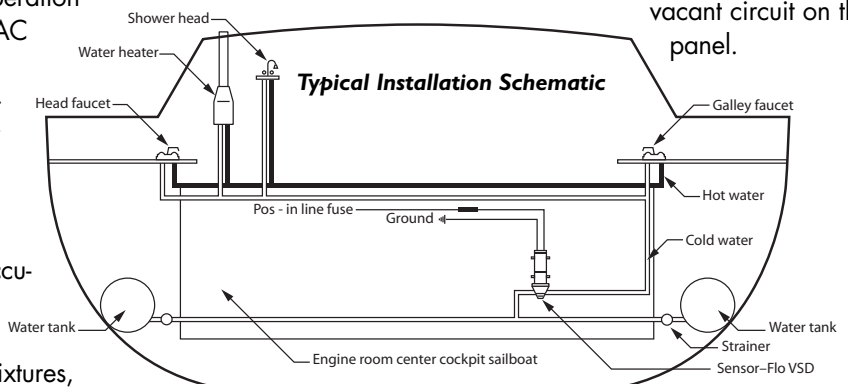
By Zora and David Aiken

It's been nearly four years since we installed a pressure water system onboard that used a Flojet accumulator tank as part of the system. [Ed: Installing a water pressure system using this device appears in DIY 1998-#2 issue.] This device provides the convenience of pressure water without having a noisy velocity pump turn on every time a faucet was opened, and also overcomes cycling and water "hammer" (vibration in pipes), typical of an inline pump-only system.

It's been a failproof system, and now Flojet has another improvement. The Sensor-Flo VSD (US$200) is a compact, variable speed pump whose operation replicates pumps used for wells or other AC applications. It operates without the need for an accumulator tank or separate pressure relief valve. Instead, changing motor speed controls pressure. As demand increases, the pump speeds up.

On learning the benefits of this new technology, we decided to remove the accumulator, and install the VSD. Available in two models, the smaller unit (14lpm/3.7gpm) manages one to three fixtures, measures just 23cm (9") long, and weighs 1.95kg (4.3lb). A larger model handles from 4 to 7 fixtures, is rated at 17lpm (4.5gpm), and is just slightly longer and heavier (3kg/6.3lb). Both models operate on 12 or 24 volts, and draw less than 1 amp (Some pumps draw as much as 10 amps when actuated).

Installation is simple, and the instructions are easy to follow. On our boat, the best location was on an engine room bulkhead next to the water tank, and near where the accumulator once sat. Although the pump mounts horizontally or vertically, the instructions cautioned that, in the vertical position, you should place the unit with the motor up, or higher than the pump. In this way, the motor stays dry if a hose or fitting should spring a leak. The absence of an accumulator tank also means there are fewer places for leaks to occur. Flojet's supplied inline strainer attaches directly to the pump, or you can install one between the water tank and pump inlet. Supplied hose fittings ensure proper connections. Flojet recommends wiring the ensure proper connections. Flojet recommends wiring the pump to an on-off switch on the positive lead from the power source, wired directly to a vacant circuit on the panel.



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Since the pump is self-priming, we half filled the water tank to supply sufficient water while bleeding the system of air prior to initial operation. To do this, turn on the power, open all faucets, then shut off each faucet as the water flows freely, starting at the one closest to the pump. When the last faucet is closed, the pump shuts off. When not in use, it's best to turn the pump off to eliminate any leaks activating the pump and emptying the water tank, or discharging the batteries. Fortunately, the pump can run dry without suffering any damage.

There are no switches, points or contacts to burn. Instead, an electronic microprocessor sensor that adjusts the voltage and the current to the motor as needed controls the variable speed drive, ensuring that output is precisely matched to demand. Turn on one faucet or many, it doesn't matter as the pump flow matches the demand and runs faster or slower as needed. There may be a fraction of a second delay between opening a faucet and flow of water, but it's hardly noticeable and certainly not significant. This means that Dave can be doing the dishes at the same time I'm showering, and there's no loss in water pressure or temperature. Unlike the loud annoying on-off cycling of conventional constant velocity pumps, the VSD works so quietly the only noticeable sound is that of flowing water.

The neatest thing is to put your hand over the pump housing when it's running. You can actually feel a slight pulse with a dripping tap, then as the tap is opened, you feel the pump ramp up in speed. The Sensor FLO VSD overcomes the annoyances and inconveniences with conventional water systems, and all in one compact, easily installed package.

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

SOLVE DIESEL SPILLS

Accidentally spilling diesel fuel into the water can be avoided. You'll have no more vent or deck fill spills with this easy modification.

Story and Photos by Butler Smythe

There is a solution to a common design problem that causes diesel fuel to spill overboard through the vent line when refueling.

It was not a kinked vent hose that gave us problems, but fuel trapped in the vent hose whenever fuel exceeded the tank's capacity or sloshed into the vent line. On our boat's centerline mounted tank, located under the cabin floor, the vent hose runs under the floor to the bilge-shaft area, and up to the vent that is installed just below the deck edge above the transom. If the tank is overfilled, fuel can climb up the fill line to spill on deck, or is forced out the vent line and into the water. Often, the head pressure from the fill line causes even more fuel to exit the vent. This occurs because a considerable portion of the hose run to the vent is horizontal to the floor, and boat trim can detrimentally affect proper vent line orientation. These are bad situations and theoretically correctable.

The next time you fill the tank, place your hand over the vent line to feel for air that is being forced out the vent line, seeking the path of least resistance. You can catch leaked fuel at the vent in a container, or force air into the vent line before refueling to push trapped fuel back into the tank. A more permanent solution is to route a downward sloping vent line to the tank by leading a new hose from the tank, up to hull-deck joint area and then aft to the vent on the transom, routing to maintain an upward run.

Don't install vents in a sailboat hull as they only invite water intrusion when the boat is heeled.

My modification routed a section of hose from the tank to the deck fill on the port side of the boat. I then solved both vent and deck spill problems by installing a Vetus Splash-Stop. This Dutch-made device serves two main purposes. It ensures the vent line can't retain fuel from a full fuel tank, yet allows it to continue to vent the fuel. If the fuel tank is overfilled and fuel reaches the top of the fill hose, the excess overflows into the Splash-Stop and subsequently drains back into the fuel tank through the return line on the bottom of the unit. Be aware that you still need to monitor fueling by sight and/or by sound.

Splash-Stop consists of a square-shaped plastic reservoir that mounts between the deck fuel-fill fitting and fuel-fill hose. When fuel tank capacity is exceeded, overflowing fuel flows into the container (capacity 2L/.5gal), instead of spilling onto the deck through the deck fill, or exiting out the vent. Excess fuel flows from the reservoir back to the fuel tank via a return hose that attaches to the vent connection on the tank. This connection also serves as the tank vent; a hose from the top of the Splash-Stop connects to the outside vent. Since deck fill diameters are not alike, be sure you purchase the Splash-Stop tank with the correct connections.

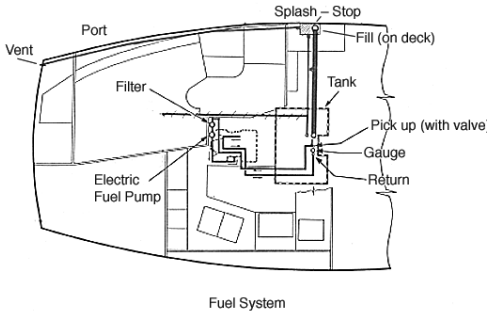
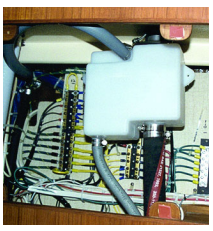


Diagram of modified fuel system and routing of new vent line.

Installation is simple, and varies depending on whether you chose, as I did, to reroute the vent line due to its original location. Problems occurred when cutting all the inaccessible cable ties holding the old vent line, and weaving the new hose through the electrical compartment (due to barriers in the floor liner). The new vent hose transits from the fuel tank to the Splash-Stop mounted in the electrical compartment, then from the connection on the reservoir along the interior panels just below the hull-deck joint, to the transom-mounted vent. Splash-Stop easily fastened to the deck-fill fitting, which was rebedded with 3M 5200. Shortening the original fill hose was easy before it attached to the bottom of the Splash-Stop.

Continue to be safe by carrying



Completed installation of Splash-Stop. A more compact, redesigned Vetus Splash-Stop is now available.

BRUSHABLE PAINT SOLUTION

My first experience with marine polyurethane paints was in the early '80s when I first painted the hull of my cold-molded Frances 26 with a two-component system. Using the "roll and tip" method the results were satisfactory, though a spray job would have improved the finish ten-fold, but the gloss was unparalleled. Three coats lasted 5 years before fading became noticeable and necessitated repainting.

Today's breeds of polyurethanes are typically single part (no addition of a catalyst or a timed moisture cure), and no other paint has the gloss or the longevity. But application still remains an obstacle. Even when applied by a skilled operator, a brush job still doesn't cut the mustard when compared to a sprayed finish. High humidity, hot or cold temperatures causing too fast or too slow a cure, too little or too much thinner, and other factors all contribute to that "brushed" look.

When DIY's show booth needed repainting last summer, I decided to overcoat the sea green Brightside with Toplac, a new paint from Interlux. Applied with a high-density foam roller and brushed out with a bristle (or use foam) brush, Toplac is the most forgiving paint I've applied. It lays down evenly, and flows out to completely hide brush marks. The end result is a high-gloss, mirror-like finish that's nearly as durable as Brightside. Oddly, brush hairs and bugs only stuck to the top layer so both were easily removed without damaging the finish when the paint fully cured.

Classified as a silicone copolymer (two-part) resin, it's apparently the silicone system that makes Toplac so easy to apply. I don't know what causes bugs not to stick, but consider it a bonus. It's available in nine colors, in 946ml/quart packages (US$30).

— Jan Mundy

a rag to catch any drips on the deck, and listen for fuel coming up the fill hose. Lastly, never overfill the tank.

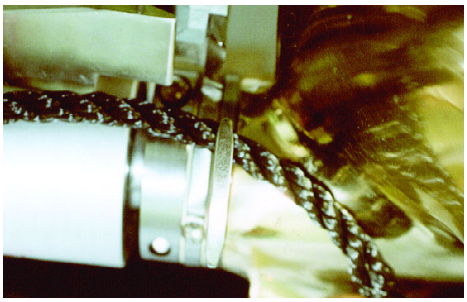
[ED: Now is a good time to examine all the fuel lines to make sure they comply with applicable standards (USCG or ABYC). The cost of renewing fuel lines is cheap compared to the effort of going back later. For complete details on selecting proper fuel hoses and the standards, refer to DIY 2000-#2 issue.]

About the author: Chesapeake sailor and U.S. Navy vet (retired), Butler Smythe, has owned several cruising boats and lived aboard an Island Packet 35 for almost 6 years.

LINE BUSTER

By Jan Mundy

If you cruise on waterways shared with commercial fishermen, and your boat is equipped with a Spurs or other shaft-mounted line cutter, you were likely unaware of the dangers below. Without a cutter installed, a crab pot line or fishing net could wrap around the prop and shaft, continuing to wind itself tighter and tighter, eventually bringing your boat to a dead stop. And if running at high speeds, you risk damaging the prop, strut or other underwater gear, and perhaps overload the engine, causing transmission or clutch failure, even shaft breakage. Either way, you're stranded, resulting in an unscheduled dive to cut fouling lines, or worse, a tow and costly haulout to affect repairs.



Made by Spurs Marine Manufacturing in Ft. Lauderdale, Florida (Tel: 800/824-5372; Website: www.spursmarine.com; Email: spurs@spursmarine.com), Spurs consists of two separate cutting blade assemblies: the rotary cutter with two blades mounted 180° apart, and the stationary cutter, all mounted onto the propeller shaft. With each revolution of the prop, either forward or reverse, the rotating section spins, passing the stationary blade and slicing any fouling at the same time.

We choose Spurs to install because it was the original line cutter, it's made in the U.S., and after four years as eavesdropping neighbors at the U.S. Sailboat and Powerboat shows in Annapolis, Maryland, we had heard mostly positive feedback. The cutter mounts on most boats with solid, folding or variable pitch propellers.

Sizing

Selecting the proper cutter for your boat is determined by five measurements (**see Figure 1**). Since it's designed to mount on the straight part of the shaft, the critical dimension

FINE FINISHING

Have you every wondered how some boatbuilders manage to achieve a varnish finish with a luster so deep that you can see your reflection in it, and one that is totally dust and speckle free? I asked a representative of Morris Yachts, the upscale semi-custom builder in Southwest Harbor, Maine, the same question. All it takes, according to the Morris method, is an air and dust-controlled spray booth and 12 or more sprayed on coats of a high quality varnish, such as Epifanes. — Jan Mundy

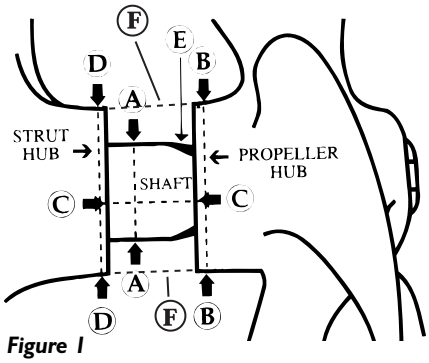


Figure 1
A Shaft diameter
B Propeller hub diameter
C Space between prop and stern bearing or strut
D Stern tube or strut hub diameter
E Length of exposed taper
F Height of cutter

is the length of the exposed taper (**shown as "E"**) between the prop hub and the stern tube or strut hub. With the propeller installed, use calipers to determine where the shaft taper ends (**Figure 2**). When installed on a tapered shaft, the device wears unevenly, reducing cutter life. Other important dimensions are the prop hub (**B**), and strut hub or

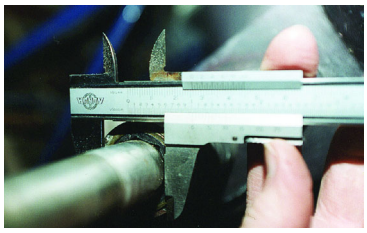


Figure 2

stern tube (**D**) diameters. Drawing a line (**F**) between the two, the cutter should mount flush to this line, so just the blades extend past the strut-hub OD. There are a variety of combinations and shapes offered, both for wedge blocks and cutters. Though not complicated, measuring correctly will ensure a proper fit.

On our demo shaft, the tapered portion of the shaft is under the prop hub (**Figure 3**). Spurs can mount on the tapered portion, provided the exposed taper doesn't extend more than 3mm (1/8") beyond the rotary cutter assembly (**Figure 4**). Where the taper extends further aft, you'll need to manufacture space, either by adding a custom spacer between the transmission and shaft coupling that slides the shaft back, or saw off a ring from the metal strut hub or stern tube (call Spurs for instructions). There are certain boats on which you cannot install a Spurs because of the exposed taper.

Installation

Installation is not difficult, provided you take precise measurements and

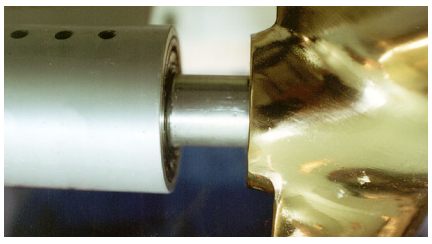


Figure 3

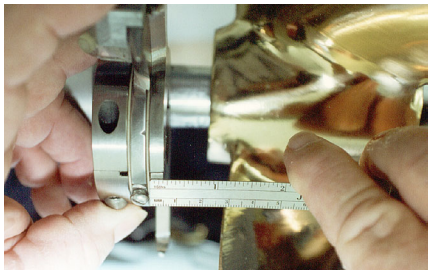


Figure 4

have the proper tools. The most demanding job is drilling and tapping the strut. Installation by a pro takes about two hours max. An amateur should allow an extra hour or two.

The cutter is loosely assembled first, then all bolts tightened firmly. Though not mentioned in the instructions, it's good practice to coat screws with a thread locker.

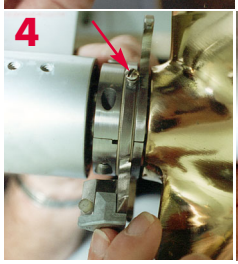
The first step is to thoroughly scrape and sand the shaft using emery paper. Partially disassemble the cutter, loosening the stationary blade screws just halfway to prevent losing the two small washers and spacers. Remove screws on rotating cutter assembly.

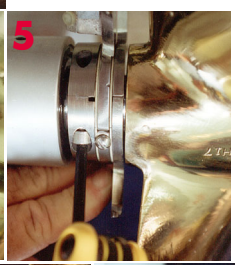
Position the two rotary cutters on the shaft as close to the propeller hub as possible, allowing for any exposed taper, as mentioned above. Insert the bolt in the hole where the two half castings join together on the even (unnotched) edge, and fasten loosely **(1)**.

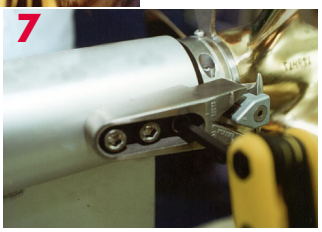
Insert the bolt into the hole on the notched half castings, known as the lip side, and torque the nut loosely **(2)**.

Install the U-shaped bearings **(3)**, then insert the stationary cutters into the bearings, and tighten the screw **(4)** securely. Position the cutter against the prop hub, behind the leading edge of any blade. Tighten securely the bolt on the lip side (notched) side **(5)**. This automatically aligns the stationary cutter groove to the shaft bore. Tighten the other bolt on the rotary cutter.

Next step is to mount the holding block on the portside of the strut for left-hand props, starboard side for right-hand props. Position the holding block on the strut so the cast line meets the tip of the wedge **(6)**. Be careful not too position the wedge beyond the line. It may appear that the wedge and holding block fit







tightly together, but this is not correct. Drill three, 17/64" holes in the strut, the center one first. Tap it for a 5/16x18 bolt, insert a bolt and torque the nut loosely. Now drill the next hole and insert a bolt, and finally the last hole. Securely tighten all bolts **(7)**.

Over-Ride Feature

If you catch a steel cable, chain or anything that Spurs cannot cut, a built-in fail-safe feature prevents permanent damage. As the propeller turns, putting pressure on the cutters, this causes the two forward bolts on the holding block to shear, and the holding block drops down on the third bolt and disengages the cutter. There are some drawbacks to this design. Once the bolts shear, the boat is still held fast by the cable, which still must be disengaged, and likely means a tow and haulout to reinstall the holding block.

Routine Maintenance

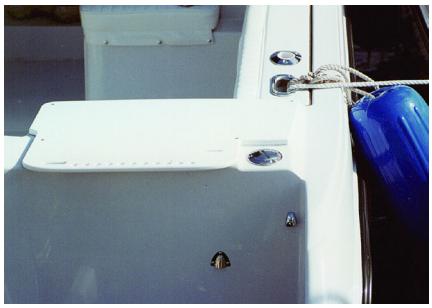
To prolong cutter life, you'll need to replace bearings and zincs regularly. During the annual haulout, check the zinc anode mounted on the wedge of the stationary cutter. This anode is the only protection this assembly has against corrosion. (The rotary cutter is

protected by the shaft or prop nut zinc.) Spurs recommends retrofitting older models that are equipped with a wire that bonds the stationary blade to the boat with a zinc anode. Since the Kevlar-Teflon bearings are water lubricated, replacement times vary depending on water clarity. Sediment and silt act as abrasives, accelerating bearing wear.

CUT & SERVE

In the last DIY issue of every year we publish a few project ideas for building nifty stuff of StarBoard. This year's offerings are simple to make using basic woodworking skills and tools.

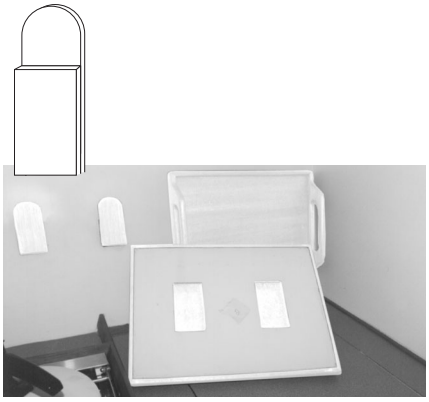
Every well-equipped "yacht" can always find a reason for having a gunwale or stern-mounted chopping board, especially when the fish are biting, and there's nowhere to clean them except in the galley, which likely



leads to an argument with the cook.

Make it of 6mm (1/4") StarBoard to any size that fits. Cut and drill holes for knives and other tools, perhaps some tapered holes for holding beverages, and for drainage. Drill and countersink for 6mm (1/4") screw fasteners. Dry fit the board, overlapping the deck so the tools, etc. hang freely away from the deck edge, mark screw placement and drill the deck. Attach your chopping board using 3M 5200 or equivalent sealant around fastening holes to ensure a watertight fit.

Many galleys are too small for a counter-mount serving tray and locker storage is scarce for one of any useful size. On boats with high cabin sides, consider a hanging tray. Fashioned of two pieces of 6mm (1/4") StarBoard, the tray hangs from brackets glued to the cabin sides. Cut two pieces in a rectangular shape to the desired dimensions. In one piece, make two identical cutouts, about 7.6 (3") wide by 12.7cm (5") long, using a jigsaw. (Tip: To cut perfect corners, drill 8mm (5/16") pilot holes in the four corners of the cutout, then insert the saw blade and cut a straight line.) This becomes the bottom. Screw together the two pieces putting a 19mm (3/4") spacer, about 25mm (1") wide, along the length of each edge. Finish the ends with handrails and the



sides with fiddles (see photos for details) cut from 19mm (3/4") StarBoard. Round the finished edges with a router.

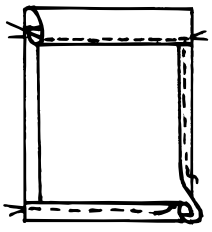
To make the hanging brackets, cut two blocks from 25mm (1") StarBoard stock, just slightly smaller than the cutouts in the tray back. Make a 8mm (5/16") deep notch, extending about one-third of the length down from the top on the inside. Nicely round the top edge and attach to the cabin sides with 3M 5200 and screws.

— By Jan Mundy

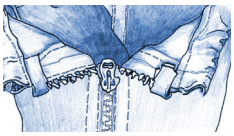
HEADSAIL SAC

Abrasion from dirt, mildew from rain and UV rays from sunlight are all harmful to sailcloth. If your boat has roller furling, you can just wind up the headsail, and provided it has a leach cover or a zippered sleeve that muffles the headsail, leave it permanently attached to the forestay. Hanked-on headsails, however, must always be removed and stored below. Unless of course, you make a headsail sac. For less than $100, this sac protects your headsails and frees up valuable space below.

Made of 100% acrylic (i.e. Sunbrella), the sac can be either rectangular in shape (easiest) or a triangle. To determine the size, tightly flake the headsail while connected to the headstay. From the clew, roll the sail, much like rolling a sleeping bag, and tie with a bungee cord. Now measure the width, length and height, allowing extra for a slack, but not baggy, fit. To these measurements add extra for a 16mm (5/8") seam width across the top and back, 38mm (1-1/2") double wide hem on the bottom,



Sample of single fold (A) and double wide hem (B).



Top collar and front zipper details.

and a 25mm (1") single fold on the front for a zippered (or Velcro) closure. (I prefer using either material to snaps to achieve a better water-resistant "seal.") Finished size for a small headsail is typically 91cm (36") on the headstay, 86cm (34") top width, 132cm (52") bottom width, and 81cm (32") back. Add 20cm to 25cm (8" to 10") to all measurements for a large headsail.

To assemble, sew the top and back seam, inserting a webbing loop with a stainless-steel ring into the top back corner. Turn under the bottom edge 38mm (1-1/2"), then turn under again, and sew along the top and bottom edges. Turn under 25mm (1") along the front opening, and sew on the plastic zipper or Velcro. For reinforcement, and to reduce chafe from the headstay, sew cowhide or webbing along the top collar. Sew Velcro along the bottom edge or fasten snaps, spaced every 15cm (6") or so. To bag your sail, close the front and bottom, attach the halyard shackle and take up the slack.

Everything you need to make this bag is available from Sailrite (Tel: 800/348-2769; Web: www.sailrite.com). If you'd prefer not to start from scratch, Sailrite also offers five sizes of headsail bag kits, sold complete with instructions, fabric, thread and all hardware.

— Jan Mundy

SAILBOAT

RIGGING

KEEL CONVERSIONS

If a deep keel is preventing you from anchoring in a favored cove, or excessive heel makes your boat uncomfortable or difficult to control, changing your boat's fin keel configuration is an affordable solution.

By Nick Bailey

Monohull sailboat design is always a compromise between elements that make the boat fast and weatherly, and those that make it a practical cruising boat. There are many obvious differences between a Farr 40, a finely honed racer that wins or looses by its upwind performance, and an bluewater cruising yacht, such as a Halberg-Rassey 42, not the least of which is keel depth. The racer draws close to 3m (10'); the cruiser less than 1.8m (6'). The owner of a cruising boat may not need the enhanced windward performance provided by a deep keel, and definitely not want the navigational restrictions that accompany deep draft.

How much keel is considered a handicap varies depending on the cruising area you choose. For example, the preferred draft for the inviting, shallow waters of south Florida and the Bahamas is 1.5m (5') or less.

Mods for Draft Reduction

A boat originally designed as a competitive racer-cruiser oftentimes ends up devoted exclusively to cruising. The high aspect ratio fin keel with a draft of 1.8m (6') or deeper that once contributed to good windward performance now presents a liability.

You could sell your boat and acquire a more cruising-oriented design, or keep the old boat and replace the keel. For a production boat with external ballast this option is relatively straightforward, particularly if a keel foundry has tooling for a shoal draft version. An expensive upgrade, a new lead keel from existing tooling complete with keel bolts and hardware costs roughly US$1 per pound plus yard and installation costs. A custom one-off keel costs much more.

Sample bulb, fin and wing keel configurations made of lead, stainless or bronze, are readily adapted to existing fin keels to decrease draft and maximize stability.

Another option, made popular by keel manufacturer Mars Metal (Tel: 800/381-KEEL; Web: www.marsmetal.com), is the torpedo bulb. Lead is cut off from the bottom of the existing external fin keel to reduce the draft by the desired amount. The compensating ballast, in the form of a split torpedo-shaped bulb, attaches to the sides of the keel. This bulb consists of a pair of matching port and starboard halves, together with all the necessary stainless fasteners to bolt the halves together athwartship through the sides of the keel at the lower edge. The bulb weight is precisely calculated to compensate for the amount of ballast removed, and is then tailor made to fit the foil shape of the existing keel. The new shoal draft configuration has less righting moment due to its shorter lever arm. (See "Estimating Ballast" on page 34 for calculation guidelines.) In practice, this typically means the new bulb weighs somewhere between 5% and 15% more than the cut off piece.

Boat performance suffers very little and cost is usually less than half of a complete keel replacement. The job is doable by the determined do-it-yourselfer but you will need access to a forklift, jacks and heavy timbers to handle the massive lead pieces that weigh in excess of 680kg (1,500lb). A bulb for a 38-footer averages US$3,000, with yard fees and installation adding another US$1,500.

Unfortunately, this option is only practical with an external fin keel made of lead. Cast iron is too hard and too difficult to cut or drill; internal ballast and full keel configurations require major hull surgery to reduce draft.

Mods for Increased Performance

There are instances where a boat is too tender, and heels too easily for the owner's taste, or a boat designed for light air is sailed in a region with prevailing windy conditions. Either situation requires depowering or reefing to "keep her on her feet." As the wind builds, most boats sail-

ing upwind with excessive heel, beyond 25°, become slow, uncomfortable, difficult to control and experience massive weather helm. Admittedly, many owners find it desirable to have a "stiffer" boat, one that carries more sail power at a reduced heeling angle. This requires what naval architects call righting moment, defined as the leverage applied by the weight of the keel that counteracts the force of the sails pushing the boat over. (See "Righting Versus Stability" on page 38).

Basic physics dictate that there are three ways to apply greater force through the righting moment lever, the ballasted keel. First, make the lever arm longer (same weight but a deeper keel), which effectively lowers the center of gravity, or a lighter rig. Second, increase the action of the force of gravity on the lever by adding more mass (same depth but a heavier keel). This also lowers the center of gravity. For most owners, these two, or any combination of the two, are the only practical options. Adding a torpedo bulb without any draft reduction also serves well, particularly because the added weight is mounted as low as possible for maximum righting moment. The third option, normally reserved for fast race boats, cants either the keel or the mast to windward, causing the lever to be closer to 90° to the force of gravity but increases the effective length of the lever arm.

There are limits to increasing righting moment before the added power starts to cause rigging and structural problems. Always consult a naval architect before making any major alterations.

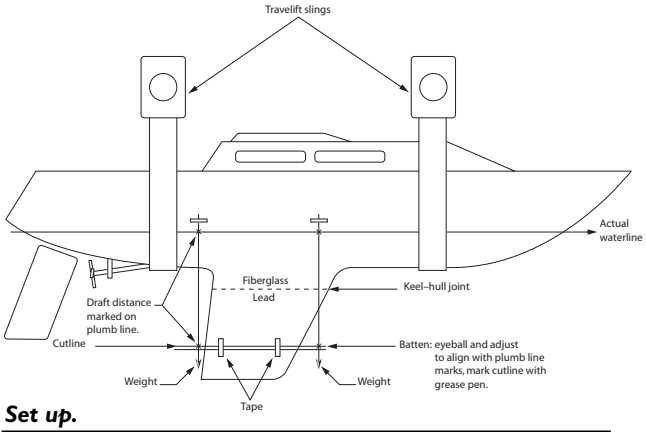
TORPEDO BULB INSTALLATION

Let's assume you own a late-'70s, 38-footer with fin keel and a draft of 1.98m (6.5') that you want reduced to 1.5m (5'). Albeit more draft reduction would be ideal, this also requires modifying and shortening the rudder.

Set-up

Haul out the boat and cradle carefully with the keel hanging free, placing extra support stands to avoid overloading the cradle pads. It's not mandatory to precisely level the boat in relation to the waterline, but it helps simplify measuring the cut line when reasonably level.

Investigate the existing ballast to be sure the keel bolts don't interfere with the cut. Trace the characteristic crack in the filler at the ballast-to-stub joint and/or sound the keel with a hammer, to find the ballast-to-hull joint, and determine where the lead bolts to the hull. In this hypothetical case, the hull's keel stub makes up the top 15cm (6") or so of the keel. The actual ballast portion proves to be 1.37m (4.5') tall. A cut to remove 43cm (17") will leave the top 1m (3.5') of ballast intact. Keel bolts are not a concern (confirm location with the keel foundry where possible), since they are typically found in the top 38cm to 51cm (15" to 20"). If the boat looks reasonably level, duct tape two plumb lines to the waterline so they hang just fore and aft of the keel at the desired 1.5m (5') draft. Sight along the plumb lines and use a batten to trace the cut line on the keel.



Set up.

Cutting

As metals go, lead is relatively easy to cut, and has a low melting temperature. Most professional boatyards use an oxyacetylene torch to cut the lead. Unless you are experienced with a cutting torch, a chainsaw is the best alternative. Cut slowly and keep the chain sharp.

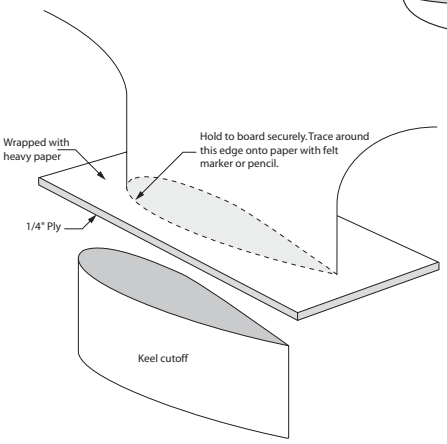
Lead is extremely toxic so be very careful with lead shavings, fumes, or dust. Wear disposable clothing, gloves and a respirator. Scrub your hands thoroughly after handling lead or lead contaminated items. Steel toe boots are definitely recommended for the person doing the cutting. Lay down a drop sheet to recover any cuttings and carefully clean any tools, including the chainsaw. You should also have a plan for the disposal or recycling of the cut piece. Some yards may be willing to take it off your hands at no charge. Be prepared for the massive cut off piece to drop; a support directly underneath will lessen the fall.

Framework of wooden braces and cleats supports the cut off piece.

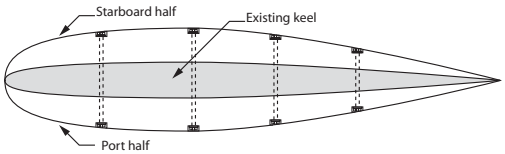
Shaping the Foil

Now make a template of the keel footprint for the foundry. Staple or tape a large piece of paper to a piece of plywood and lift it into place against the keel bottom. Brace the ply so that it can't shift, and simply trace around the perimeter of the cut edge. Forward the paper template to the foundry. This allows it to cast the split bulb with a foil that roughly conforms to the new cut edge.

Rigging



Making the paper template.



Bulb halves bolt together through the existing keel stub.

Since it can take up to three weeks before the bulb kit arrives, you should shore up blocking to support the boat under the keel or recradle the boat in its new shallow draft configuration.

Keel Prep

When the bulb kit arrives and has been unloaded with a forklift, the next step is to carefully mark the position of the thru-bolt holes on the keel. Use the predrilled holes in the new bulb to make a paper template, and then transfer the hole positions to the keel.

Boltholes can be drilled or "blown out" with an oxyacetylene torch. The torch does the job quickly but it might not be very precise, requiring additional filling and fairing later if the two halves don't line up correctly. Drilling 25mm (1") holes in lead is not impossible but is time consuming. Use a 1/2" drill with a side grip, set at a slow speed, with a twist bit (or wood auger) lengthened by welding a rod to the end. To prevent jamming the drill, clear the lead shavings by constantly backing out the bit, and apply cutting oil (or kerosene) liberally. Bits dull quickly so have spares or sharpen frequently.

Assembly

Once the holes are in place the bulb halves can be carefully jacked, or raised into place by a fork truck. Insert the stainless steel bolts together with the supplied nuts and washers, and then tighten to the recommended torque with a torque wrench. If you don't have a torque wrench, pull as hard as possible on the biggest wrench you can borrow or rent. It's important to clamp both halves firmly around the end of the keel.

Trim the bolt ends with a hacksaw. Smooth the joint with a wood hand plane or rasp, if needed. Fill and fair any gaps or voids with a mixture of epoxy resin thickened with microballoons to a mayonnaise consistency. Sand and apply two coats of primer, then antifouling paint. At last, you are ready to launch and go sailing.

After installing the Torpedo Bulb, the keel-bulb joint is faired with a mixture of epoxy resin and microballoons.

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

Overload Effects

I witnessed an extreme case where a heavier custom keel was retrofitted on a quality-built, 12m (40') production boat for competing in long distance offshore racing. The organizing body required a righting moment measurement greater than a certain value and this boat was just below the cut off. In moderately breezy conditions a month or two after fitting the new keel and luckily before the offshore event, the cored hull failed. The inner skin suddenly delaminated completely from the core material where the main shroud chainplate knees bonded to the inner skin. Inspection revealed a solid bond to the core, but the new chainplate loads exceeded the core bond strength. The boat had sailed for several years prior to the keel swap with no structural problems. —NB

Righting Versus Stability

Righting Moment is the force generated by the fact that the center of buoyancy and the center of gravity are not in the same place on any boat, particularly on a sailboat. The farther the center of gravity is from the center of buoyancy, the "stiffer" or more resistant to heeling a boat will be.

For most boats the center of gravity hovers around the waterline height, but the center of buoyancy has to be below that. To illustrate this, yacht designer Steve Killing sites older C&C 40s that have the center of gravity 7.6cm (3") above the waterline and the center of buoyancy 28cm (11") below the waterline. As the boat heels the center of buoyancy moves to one side and is no longer under the center of gravity so the boat doesn't tip over.

— NB

ESTIMATING BALLAST

Use these rule of thumb formulas for estimating the weight of the cut off piece, and the weight and dimensions of the new bulb keel, all in inches, are courtesy of yacht designer Steve Killing, who designed the Express sailboats built in the '80s, "True North" an America's Cup contender, and more recently, racing canoes, classic mahogany powerboats, and the Fusion 15, a new two person, non trapeze centerboarder.

How much ballast am I going to cut off?

1 Measure length (chord) and maximum thickness (chord width) of keel section at cut off point, and multiply together for "box" area of keel section at the cutoff.

2 Take the same measurements at the keel bottom and multiply together for "box" area of bottom of keel.

3 To find average for the top and bottom "box" areas, add values 1 and 2, together and divide by 2.

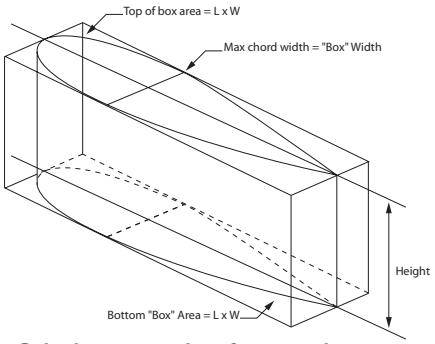
4 Measure the height of the cutoff.

5 Find the "box" volume of the piece to be removed by multiplying height times average area.

6 To adjust "box" volume for shape of foil section, multiply volume times .66 "box to foil" conversion factor*.

7 Divide volume in cubic inches by 1,728 to get cubic feet. Multiply cubic feet of lead times 700lb per cubic foot for weight of cut off piece, or 11,240kg per cubic meters for weight in kilograms.

*Note: "Box to foil" conversion factor of .66 is a rough estimating formula, and is based on NACA 64A foil section, a popular keel section used by C&C Yachts and other boatbuilders.



Calculating weight of removed piece.

How much should the new bulb weigh to give the same righting moment?

This depends on how much you shorten the righting moment lever arm by cutting a piece off the keel. Even without knowing the location of the centers of buoyancy or gravity, you can approximate using this calculation. There are two lever arms to calculate, one for the lead to be removed and the other for the bulb to be added. Lever arms are measured vertically and are from an imaginary point .9m (3') above the waterline (about which a typical 10.6m to 12m (35' to 40') boat rotates when it heels) to the middle of our blocks of lead. The first lever arm is measured to the middle of the old cut off piece and the second to the middle of each new bulb piece or at least to the center of the bulb mounting location on the side of the keel.

To maintain the boat's righting moment, our rule of thumb would say that if the new bulb has a shorter lever arm that is X% of the original, then the weight of the bulb must increase by the inverse percentage to compensate.

1 Our hypothetical 11.5m (38') sailboat has a lead fin 1.5m (5') in height, and a center of 76cm (2.5') below the hull. About 30cm (1') of the hull extends below the waterline for a total of 106cm (3.5') below the waterline to center of the original lead keel. Using these figures, add 91cm (3') distance above the waterline to the heeling rotation point to get a total lever arm of 1.98m (6.5').

2 Shorten the draft by 45cm (1.5'), and the lead piece removed has a center of 23cm (9") below the cut. The new bulb has a center of about 10cm (4") above the cut, for a total reduction in the lever arm length of 30.5cm (1.03'). (See below to calculate the size of the bulb.) This gives us a new lever arm length of 1.66m (5.47').

3 The change in righting moment can be expressed as 5.47 divided by 1.98m (6.5) = 84%.

4 Since the new lever arm is 84% of what it once was, the replacement ballast bulb should weigh more by the inverse amount: 6.5 divided by 5.47 = 1.19 or 19% more or 119% the weight of the original.

5 It's been determined that about 1,179kg (2,600lb) of lead is coming off, so we should expect to put back 2,600 x 119% = 1,403kg (3,094lb). As expected, this calculation confirms the new bulb kit will need to be heavier than the cut off piece to maintain the boat's righting moment with a shorter lever arm, in this case about 227kg (500lb) heavier.

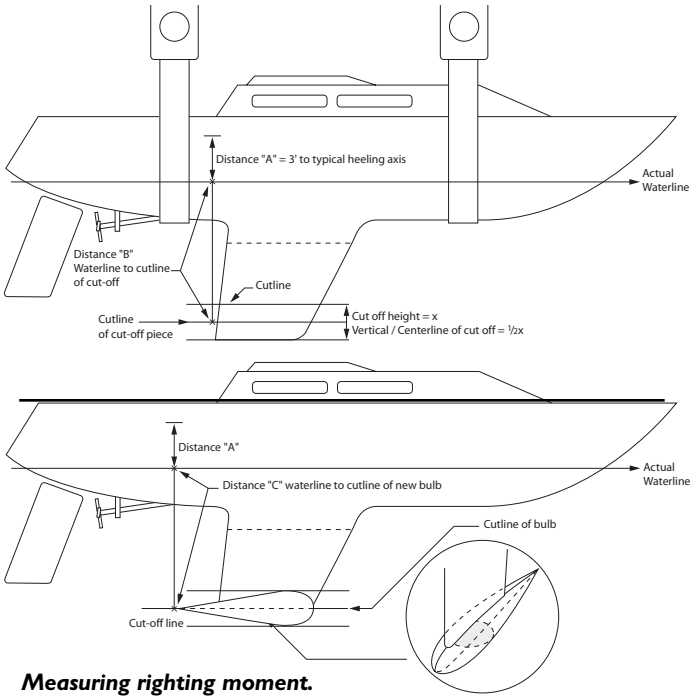
How much difference does the 500 extra pounds of displacement make?

Our hypothetical 38-footer has a displacement of around 6,804kg (5,000lb) so the extra 227kg (500) means a 3% increase. You would need to look very carefully to notice the difference at the waterline.

How big is the new bulb going to be?

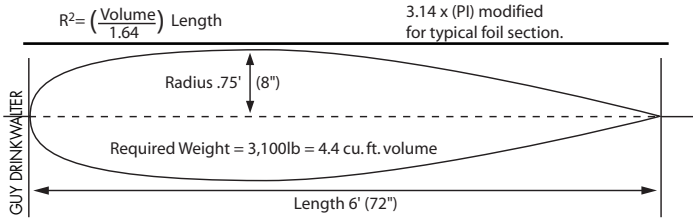
Knowing we have to add about 1,406kg (3,100lb) of lead, we calculate the bulb volume as 3,100 divided by 700lb per cubic foot = 4.43 cu ft. or x 1,728 = 7,650 cu. in.

We know the keel chord length



Measuring righting moment.

at the cutoff is about 1.37m (4.5') and we would prefer the torpedo bulb not be more than 45cm (1.5') longer than the keel cutoff or 1.82m (6') long. Volume calculation of a horizontal cylinder is Pi (3.14) x radius squared



Calculating theoretical size of bulb.

x length. To calculate a torpedo with a typical "foil" section, use 1.64 as a factor instead of 3.14 (Pi), and use the radius from the fattest point.

Based on the above the only thing we don't know about our proposed lead torpedo is the radius. Just how fat is this thing? So we solve the equation.

Since Volume = Length x 1.64 radius squared, then Radius squared = Volume divided by 1.64 x length. Plug in our known dimensions (in inches) and we get:

Radius squared = 7650 divided by (1.64 x 72) = 64.8."

If the Radius squared is 64.8" it's easy to derive the approximate square root to give a radius of about 8" or width at maximum "fatness" for each half of the keel bulb. Keep in mind the split bulb will be supplied with a curved inner surface to conform to the existing keel and won't be simply a torpedo with a straight split down the center so this calculated radius is an approximation at best.

—NB

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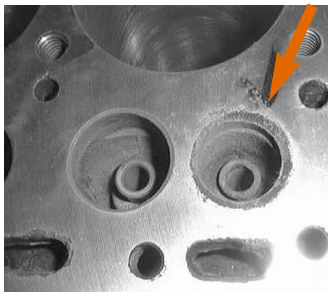
TROUBLE SHOOTING

ENGINE

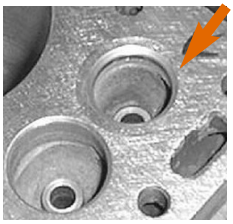
CONVERTING TO UNLEADED FUEL

Pre '70s inboard engines were not designed to use modern reformulated fuel. This can cause damage to the valve train and fuel system. Here's how to convert a lead burner to run reliably on unleaded fuel.

By Robert Hess



Recessed #4 exhaust valve.



Converted to run on unleaded fuel, recessed exhaust valve seat repaired with hardened valve seat insert.

Since the early 1920s, tetraethyl lead (TET) has been added to gasoline to prevent detonation, which is the spontaneous rough combustion causing sudden shock waves, also called "knocking," that sometimes makes a sound like a hammer hitting the inside of the engine. TET smoothes the flame front of the burning gasoline and air mixture as it flashes across the combustion chamber after ignition, preventing detonation. The level of protection against detonation is known as the octane rating and depends on the amount of anti-knock chemical in the fuel. Secondary benefits include cushioning the valve face-valve seat contact area to help prevent wear, and lubricating the poorly lubricated area between the valve stems and guides. The downside of TET is that it causes lead poisoning, especially in children, destroys the catalytic converters used in modern automotive emissions systems, and (paradoxically) under certain conditions leads to lead oxide corrosion that can damage valves and valve seats.

Unleaded Consequences

Catalytic converters were first equipped on cars sold in North America and in many other countries in the mid-70s in order to meet new federally mandated emissions standards. Since catalytic converters are destroyed by leaded fuel, along came catalytic-converter-friendly unleaded gasoline. As TET fuel became harder to obtain (and eventually banned), owners of older marine carbureted inboard engines (and autos) designed to run on leaded fuel, began to react to reports of engine damage caused by unleaded fuel. Because many engine manufacturers claimed their existing inboards would run on unleaded fuel without modifications, there was some confusion as to exactly which engines needed modifying, and what the correct modifications were.

Although chemicals other than lead are added to unleaded gasoline to raise the octane rating to control detonation (the primary reason for using lead), there was no substitute in the new fuel for the most important secondary benefit of the lead; namely, cushioning the contact between the valve and valve face to help prevent valve and valve seat wear. The exhaust valve and exhaust valve seat were the source of most engine failures because they were the hottest part of the engine (exhaust valve heads run nearly red hot) and their temperature was dependent on load. The valve face and valve seat protection offered by leaded gasoline gradually led to the production of many engines with the exhaust valve seat cut into the soft cast-iron material of the engine casting. (Most early marine engines were side-valve or "L" head engines, which had the valve seats cut into the block. Later engines have the valve seats cut into the cylinder head.) To cut costs, these engines used leaded fuel as a substitute for hardened exhaust valve seats. In practice, depending on the valve and seat design and the engine operating conditions (in essence the operating temperature of the exhaust valve), many engines really didn't need hardened valve seats for normal use anyway, and most customers were happy with the reliability of their engines. (Because older two-cycle outboard engines were not fitted with the same valves used in inboards, they can run on unleaded gasoline without any modification.)

Since the other secondary benefit of leaded fuel, the lubrication of the contact area between the valve stem guide, is considered to be of only minor importance, the conversion of engines with the exhaust valve seats cut into the cast-iron block or head, and left unhardened, is really an exercise in preventing exhaust valve seat damage caused by high exhaust valve temperatures. This is referred to as valve seat

"recession," because the valve seat gradually sinks into the casting as the hot exhaust valve wears it.

Conversion Options

Although the ultimate conversion (and most expensive) option is to have hardened exhaust valve seats installed when servicing the cylinder heads, several much cheaper options are available to run an engine on unleaded fuel. The goal here is to keep exhaust valves cool enough to avoid valve seat damage (below about 593°C/1,100°F), or act as a lead substitute to protect valve seats from damage. [Ed: Before deciding on a procedure, we suggest you contact your engine dealer or engine manufacturer for recommendations.]

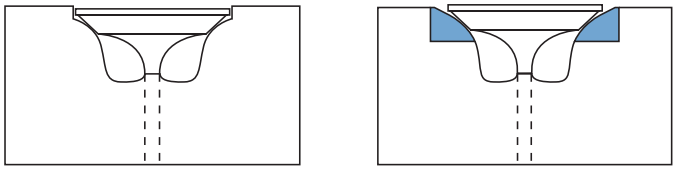
When older marine engines are never run at a load severe enough to raise valve temperatures high enough to cause valve seat damage, in many cases, no change in operating procedures or boat use is required. Numerous inboard gasoline auxiliaries, such as the Universal Atomic Four, fall in this category.

Another option is to reduce maximum combustion chamber temperature. There are four ways to do this. The first is to reduce maximum exhaust valve temperature by restricting boat maximum speed and load. This requires that the operator restrict throttle settings to avoid maximum power output, although full power would still be available in an emergency unless the carburetor full throttle setting is permanently blocked. Second, rejet the carburetor to a slightly richer fuel mixture so combustion temperatures are cooler. Be careful not to get the fuel mixture rich enough to cause raw gasoline to destroy the oil film on the cylinder walls and cause excessive piston ring wear (called "ring wash"). This will reduce maximum power output, and increase fuel consumption. As well, hotter spark plugs may be required to stop plug carbon fouling. This option is not recommended, although it might be useful for engines with very lean carburetor settings. Alternatively, you can pump the highest octane rated gasoline available to reduce the heat and pressure caused by any intermittent detonation/pre-ignition under heavy loads, although high-octane gasoline is not always available at marine fuel depots. Retard the ignition timing several degrees to reduce the high heat and pressure caused by detonation/pre-ignition under heavy loads. This will reduce maximum power output and increase fuel consumption. Another method is to install an extra head gasket or head spacer to reduce compression ratio and reduce the heat and pressure under heavy loads. This will reduce maximum power output and increase fuel consumption. Lastly, install the coolest thermostat available from the manufacturer (usually 60°C/

6 Conversions to Unlead Fuel

Service Description & Cost (estimated)

- Do nothing. *$0*
- Perform a valve job and to reduce maximum combustion chamber temperature install a cooler thermostat. *$100*
- Perform a valve job and to reduce maximum combustion chamber temperature install 2 head gaskets, or head gasket and shim to lower compression. *$US20 per head*
- Protect exhaust valve faces and valve seats with a lead substitute additive. *$4.50 per fill up*
- Check propping for maximum rpm, retard ignition timing. *$700 new prop*
- Perform a valve job and maximize exhaust valve stem-valve guide heat transfer by replacing exhaust valve guides and ream to minimum valve stem clearance. *$10 per valve*
- Perform a valve job and maximize exhaust valve face-valve seat heat transfer by grinding valves to maximum seat width specification. *$8.50 per valve*
- Perform a valve job and install hardened exhaust valve seat inserts. *$23 per valve*



(left) Example of valve recession where high exhaust valve temperatures damages the exhaust valve seat damage, causing it to sink into the casting. (right) Installing hardened exhaust valve seat inserts checks valve seat wear.

140°F) to reduce engine coolant temperature and help reduce the combustion chamber temperature under heavy loads. This may increase fuel consumption and engine wear slightly. Don't remove the thermostat as it may result in stuck valves and a cracked head, as well as increased engine wear and oil sludge.

Most engines will benefit from a lead substitute added to the gas tank every time it's filled. There are many types, and applications vary, therefore always follow the manufacturer's instructions carefully and do not mix brands. Although most well-known brands may work as advertised, some users report the build-up of deposits on spark plug insulators that cause ignition problems. Other items to consider are the propeller and timing. Be sure the prop allows the engine to reach the correct rpm at wide open throttle (check owner's manual for specs), and reduce total ignition timing.

There are three modifications you can perform when servicing the valves, each designed to avoid valve seat damage. Installing new guides with the minimum valve guide-valve stem clearance, usually about .002" to .003" (refer to your engine service manual for specifications), maximizes valve guide heat transfer. Normally about 25% of the heat is transferred from the valve to the guide. Reducing the clearance below the minimum specification may lead to stuck valves. Machining the valve seats to the widest specification exhaust valve seat width also maximizes valve face-valve seat heat transfer. Normally about 75% of the valve heat is transferred from the valve to the seat. Marine inboards normally use narrower seat widths than automobile engines, usually about 1/32" to 3/32" (refer to engine service manual for actual specs). Increasing the width above the maximum specification can cause the valve seat to run cold enough to gradually collect carbon deposits that can hold the valve face off the seat and cause the valve to overheat and burn. The last option and the most expensive is to install hardened exhaust valve seat inserts. Most machine shops recommend high nickel content inserts for standard gasoline engines, and stellite inserts for diesel and turbo-charged gasoline engines.

About the author: Robert Hess operates Atomic Four Engine Service in Vancouver. He is an authorized dealer for Universal Diesel Marine Engines, and specializes in rebuilding both Universal gas and diesel engines.

Project Boat

Restoring a Mac V222

The energy to restore an abandoned 22-footer is fueled with energy, vision, optimism and the passion to sail. Here's how one determined sailor rebuilt a bargain boat on a budget.

Story and photos by Brian Gilbert

At one time I owned and lived aboard a Catalina 27. I loved that boat, but reality beckoned me to move on, complete my education and marry.

Eight years later, my ship, a 1972 MacGregor Venture 222, came in. It was a sad sight as found abandoned to the elements in the woods. Stagnant rainwater covered the cabin sole, and the interior essence was fouled with the scents of wet, rotting wood and mildew. The boat was little more than a giant fiberglass petri dish.

MacGregors probably aren't the best candidates for restoration, but they do have some strong points. New boats were inexpensive. Lots of them were sold, resulting in a strong network of owners. They are easy to trailer, launch and rig, and are reported to have redeeming sailing qualities.

Scraping two coats of paint off the hull was a time consuming and tedious job.

I wanted to sail again, and this boat would be an affordable way to do it. I wanted to introduce my wife and son to sailing and all its attendant joys. If I didn't rescue this boat, the next stop for it was definitely the dump. I was being lured to the challenge of bringing the boat back to the sailing life, and besides, I really enjoy boat work. I paid $500 for the boat and its original trailer. The price even included delivery to my house.

Demolition Begins

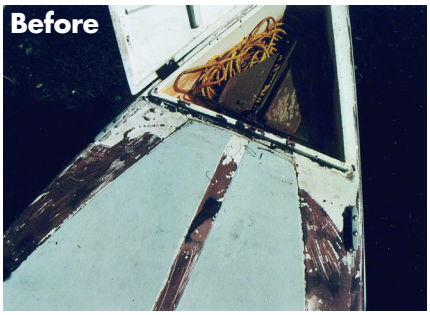
I went to work, and for a long time, the project looked more like a demolition, not a restoration. Everything that was rotted, rusted or mildewed had to go. The deeper I dug, the more damage I found, and any thoughts of sailing that season faded quickly. There were mild steel fasteners that had dissolved into rusty barbs, hopelessly delaminated plywood, and a pair of pine grubs happily munching their way through a winch support post built by a former owner.

The interior hadn't been cleaned of years' of accumulated toilet paper rolls, toiletries, propane cylinders, swimming floats — it all had to go. All the carpet on the cabin sole and fabric glued to the hull was mildewed. The galley cabinet was falling apart due to water damage.

Many of the rotten pieces were photographed before removal, measured, and saved for patterns. This model didn't have a molded fiberglass liner. Major sections of the interior were pieced together from plywood bonded directly to the hull. Under the icebox and in a few areas, this plywood was rotted. The boat needed a complete paint job, both inside and out. To do it right, involved removing nearly every fit-

Tip — Filling Small Holes

The easiest fix to fill holes drilled by previous owners in an aluminum mast is to fill them with a metalized epoxy compound. For large holes that tend to sag and run out, put a good-sized dot of epoxy filler onto the sticky side of some masking tape, then tape it to the hole. The tape holds the epoxy in place until it sets up.
— BG



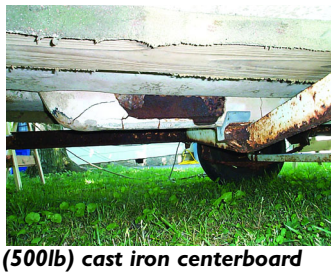
Another "improvement" that needed repair, the plywood anchor well had delaminated from the deck. Once dried, the entire well was laminated with two layers of fiberglass saturated in epoxy resin, a drain was installed, and wood cleats (right) epoxy-glued to the sides to support a new flush-deck hatch. Personally, I wouldn't put an anchor well on a V222, and this one is too small for a primary anchor.

ting. Cutting corners by painting around fittings always shows. Anyway, all the hardware needed rebedding. I cleaned and re-used some of the fittings, and replaced others. All mild steel fasteners were replaced with stainless steel.

As cleanup progressed, I formulated my restoration plan. I would return the boat to its stock condition to the extent possible. After some sailing, I had a better idea of what the boat really needed. It would be pointless to build custom cabinetry now, only to discover later that it was a low priority. Money was earmarked for materials needed for labor-intensive jobs, like painting and structural repairs, and I deferred purchases of rigging and hardware. I decided to finish the exterior work first, and work on the interior during the winter.

Sourcing Parts

The BUC value for this boat in its best possible condition ranges from $1,700 to $2,050, not including motor or trailer. Spending more than $1,500 in the restoration would be money lost. I took my time finding the best deals on used and new equipment through eBay.com (a web auction site), including a VHF radio and antenna,



Fairing material on the 226.8kg (500lb) cast iron centerboard keel was badly cracked and the keel rusted. It was removed, sandblasted, primed with zinc rich primer, filled and faired, then laminated with epoxy and S-glass purchased for a bargain price on eBay.com, new pivot hole drilled, then reinstalled.

PROJECT BOAT

jib sheet lead blocks, fiberglass cloth, new Harken traveler car, 5-hp Tohatsu longshaft outboard and more. BoatUS offered the lowest catalog prices using my member's discount for other parts and supplies.

Painting the Exterior

Yellow over a chalky pale blue paint covered the hull, and neither coating was adhering well. I'd work on scraping a section for an hour or two, until my arms got sore, then switched to a different project, one of which was removing, restoring and reinstalling the centerboard.

After two months of on-again, off-again scraping, the hull was smooth and ready for a new paint job. Two coats of deep forest green Pettit Easypoxy were rolled on using the "roll and tip" method. I rolled about .9m (3') hull section with a solvent-resistant foam roller cover, then went over the painted area with a fine, dry brush to smooth out the air bubbles. The result isn't as glossy as a professional spray job, but it's amazingly close.

One of my biggest mistakes and a constant source of frustration was not having a shelter for the boat. A great deal of time was lost cleaning up. In the end, I bought a portable carport, an item I should have purchased from the start.

Tip — Painting Views

When you buy your paint, stick with one brand for everything — thinner, primer and color. Interlux for example, makes a special brushing thinner which works great with its paint formulations, but who knows how well it works with another manufacturer's products. It's a good idea to gain experience by painting something small, like a hatch. If the results are less than what you want, you can adjust your preparation or technique accordingly. A good brush will help with the finished paint job, but it isn't as critical as you would think. I even got away with using a disposable chip brush in places with excellent results, but I had to be more careful.
— BG



To roll and tip, first roll on the polyurethane paint, then with a dry brush lightly smooth out the bubbles, working in small sections. While the finished result isn't as glossy as a spray job, it's amazingly close. Had I applied a thin coat of primer then sanded before painting, I'm sure the hull would look even better.

The cockpit trim color applied and nonskid areas brushed on with paint mixed with polymeric nonskid compound, then dusted with a little more compound to fill any bare spots.

Deck finished with two coats of paint mixed with nonskid. Original deadlight still in place.

I didn't remove the rubrail, but I did recaulk above and below with polyurethane sealant.

Deck Repairs

Where fittings passed through the deck, water intrusion rotted the wood deck core. All old mounting holes were filled with epoxy. Before reinstalling fittings into a cored deck section, I drilled an oversize hole through the top laminate and core, but not through the inner laminate. This "well" was filled with acetone and allowed to dry, then filled with epoxy mixed with colodial silica and microballoons to a ketchup consistency. After it cured, the mounting hole was redrilled to the correct size. This provides a stronger mount-


My plan: completely strip the interior to the basic fiberglass and plywood structure, make the necessary repairs, paint, and reassemble, using new equipment where needed, used or original equipment, if possible.

ing base and isolates fittings to prevent water from entering the core.

Interior Blast

While the outside was fairly straightforward, the inside was a jumble of old carpet adhesive and paint, and cracking gelcoat, all on very irregular surfaces. The smoother and more accessible surfaces cleaned up well with disc sanding. For this task, I use two inexpensive 11.4cm (4-1/2") sidegrinders costing less than $15 each and modified to attach a soft-backed sanding pad.

Sanding the compound curves of the overhead and under the cockpit to remove layers of paint was slow work and not very effective. Sandblasting did the job in short order!

Sanding didn't fix everything, though. The sidegrinder was too big to sand the compound curves of the overhead and under the cockpit corners, and there was too much to remove by hand. I finally bought an inexpensive pressurized sandblaster. Blasting removed most of the peeling paint, but I spent too much time waiting for the pressure to rise. I also had to sift the sand through a screen as the small unit clogged easily. All told, I made the right choice, but I'll definitely find a bigger compressor before I blast the trailer.

Restoring with Epoxy

With the interior laminate now visible, several structural repairs and improvements could begin. Repairs by previous owners using polyester resin were a problem in several places. There are some situations where polyester is a good choice, but not to bond to cured fiberglass as it doesn't have the adhesive strength. Though more expensive than polyester, repairs made with fiberglass and epoxy resin can be as strong as the original laminate. Like polyester, it's toxic, so I wore an organic vapor mask when working inside the hull. A full-face mask in addition to safety glasses isn't overkill in my opinion to prevent eye damage from spills. Old coveralls, rubber gloves and a rag tied around my head completed my protective clothing ensemble.

Though the foredeck leaked and the plywood core

was wet, it was still reasonably solid. I dug out the cracked areas on deck, well into the core, and poured acetone into the groove. This along with warmth from a lamp dried the core somewhat. (Don't apply heat, as acetone is highly flammable.) These trenches were filled with a mixture of thickened epoxy resin and fiberglass. After sanding the underside of the foredeck, epoxy fillets (epoxy thickened with glass microballoons) applied along stringer edges helped reinforced the underside. Relaminating this area turned out to be impossible, as I had to work upside down, and the

I applied fillets of epoxy resin mixed with colodial silica and microballons, smoothed with a radiused paddle, and covered in fiberglass tape saturated in epoxy to increase strength, give a nicer painted finish and make cleaning easier.

Original berth locker top had poor access and sharp corners weakened the rotted plywood openings. The easiest fix was to expand the berth locker openings, thereby cut out the rotten areas, and make new locker covers.

PROJECT BOAT

New dinette top was pieced together from two discarded dresser tops purchased at a furniture store and trimmed with hardwood pieces salvaged from a packing crate, but you have to overlook the nail holes.

fiberglass wouldn't hold in the sharp corners. Instead, the stringers received a coat of unthickened epoxy brushed on, which penetrated into the wood and old glass. A padded panel would eventually enclose stringers, adding insulation and easing the impact of those cracks to the head as one moved about the vee berth.

A previous owner had "improved" the original design by raising the foredeck several inches, supporting the underside with a web of wooden stringers attached with polyester resin. The result was a cracked and leaking deck, rotten deck ply and stringers. Holes were epoxy filled, epoxy fillets reinforced the stringers and the entire overhead was coated with unthickened epoxy.

Any old boat can be strengthened with the addition of epoxy fillets. Armed with a 5.8l (1-1/2gal) kit of Epiglass, 3.8l (1gal) of microballoons, and 9.1m (10 yards) of fiberglass, I found all sorts of places that needed attention. Several joints ended in sharp corners, most notably, where the centerboard case met the bottom of the hull. While the strength was probably adequate, the layup in these areas was quite rough and would be difficult to clean. After sanding to remove most of the old and flaking paint, I applied the mixed epoxy filler, then smoothed with stiff cardboard (plastic paddles would work better) cut into a 25mm (1") radius. A strip of glass pressed into the fillet reinforced the joint. Once cured, I brushed on a coat of unthickened epoxy resin. The damaged keel winch mount, once repaired with polyester resin and some 2x4s, was ground to the original cracked laminate and relaminated with a few pieces of glass cloth saturated in epoxy resin. Redrilled and painted over, the strength of the repair is probably stronger than the original laminate. I also rebuilt the keel lockdown hole with epoxy filler and fiberglass, and reinforced the keel pivot hole. I added three extra layers of glass at the chainplate mounts and four layers at the centerboard mounting holes.

After cleaning the outboard and anchor wells, it became obvious that drains were badly needed to prevent the pooling of water. A simple job, just drill a hole, slightly screw in a brass hose barb, and seal the whole area with a generous fillet of epoxy mixed with a little silica. I used 9mm (3/8") barbs, but larger would be better.

Once reinforcing and repairs were complete, the interior was primed with household-grade Kilz primer rolled on, and then brushed onto the areas the roller missed. It worked well, even helping to bond areas of loose paint that I missed with the sander or sandblaster. For the interior paint, I used a commonly available oil-based polyurethane paint by Red Devil. I found three dented cans for $2 apiece. Plywood berth tops were coated with a low VOC latex enamel, reasoning that the more flexible latex would work better over the wood. In retrospect, I wish I'd used polyurethane paint throughout for it gives a much tougher finish.

-Tip- Solvent Treatment

Don't use an expensive brushing thinner to clean your brushes. Instead, clean brushes using mineral spirits and a settling jar. Using a small amount of thinner, about 125ml (1/4 cup), rinse the brush. Pour the spent thinner in the settling jar, which is any glass container with a tight-fitting lid. Repeat the rinsing process three more times. By the fourth rinse, your brush will be fairly clean, and you'll have dirty thinner in the jar. Seal the jar with the lid. After four or five days, nearly all the paint solids will have settled out, leaving clear thinner that can be re-used. The only loss of thinner is by evaporation. If you need to clean brushes more frequently, simply start a second settling jar. When the paint job is finished, open up the jars and let the excess thinner evaporate. The resulting solid can be disposed in the regular trash system. If it's still liquid, then it's classified as hazardous waste (at least in Tennessee), and requires special handling for disposal.
— BG

Interior Finishing

Now that the interior was painted, I could finally start reassembling. The many photographs taken before ripping out the interior were really

(top) Original "panel" was buried behind the winch, circuits had been added using lamp cord and wire nuts, all protected with a single fuse. (bottom) New master battery switch, VHF and Sea-Dog panel wired to ABYC standards mounted on the aft bulkhead. The panel mounts onto a hinged plywood board that drops down to a horizontal position to easier servicing.

handy for jogging my memory as to just how things went back together.

Several rotten plywood bulkheads were replaced with DuraPly ($35 per sheet), a product used by sign painters that lasts outdoors for many years. Resorcinol-glued plywood has a phenolic paper surface on one side that takes paint really well. The laminates are a touch softer and have more voids than true marine ply, but it's considerably cheaper. Since I had saved the original panels, reproducing them went quickly. Stainless steel screws and waterproof glue were used to assemble them, and they were primed and painted on all sides (especially the end grain) before installation.

A very basic electrical system, providing 12V power for nav lights, interior lighting and a VHF radio, was built from scratch to ABYC standards. This included a separate bonding system, and a new switch panel mounted on plywood hinged to make servicing easier. I'll add a solar panel and depth sounder next year.

Rigging

Sanding, filling and painting of the poptop companionway hatch, laminating new hatch sliders and grabrails and installing new cockpit drains completed the deck refinishing. The rudder had been fiberglassed with polyester resin and a large section in the middle had separated from the solid wood core, and there was a chunk of solid mahogany missing from the forward edge. Adding

Interior nearing completion with cushions installed. I still need to paint the vee berth overhead and install a padded panel. Wood bullnose molding, stained and varnished, hides the hull-deck joint and wires. It cost about $30 to trim the interior.

new sheets and halyards, a Harken traveler, and genoa sheet lead tracks with dual sheet blocks were a considerable upgrade over the original. The extra expense slowed my progress, since I paid for this project as I went, but investing money on rigging should pay off by making the boat much more enjoyable to sail.

"Just in need of a good cleaning," as described by the seller, has taken over a year and a half of part-time work, much longer than I originally estimated. There's plenty more to do — restore the trailer and add lights, repair the mast, new sails, recover the cushions and replace the missing ones, build a small galley to hold a stove and some dishes — but at some time you have to call it "restored." As I write this, we still haven't sailed the boat, which we renamed "Fluke," but I think we can call it a success.

About the author: With launch planed for next spring, Brian Gilbert is looking forward to sailing the lakes around his hometown of Chattanooga, Tennessee, and possibly trailering the boat to the Carolinas or Florida Keys. A bigger boat to cruise the Bahamas is on his wish list. You can follow his progress at www.macgregorboats.com/gilbert/gilbert.html

DIY RESTORATION BILL

As the boat isn't finished and still not launched, this is not a complete list. Work remaining includes: make new interior cushions, build a small cabinet, some miscellaneous interior finishing, and restore the trailer. There's always more to do and to buy!

LABOR (hours)	
Interior preparation	12
Interior painting	16
Exterior preparation	66
Exterior painting	30
Interior repairs (includes rewiring)	68
Exterior repairs (includes re-rigging)	69
Keel repairs	22
Other miscellaneous work	14
TOTAL HOURS	297 hours

EXPENSES	
Boat and trailer (includes delivery)	$500
Motor	$450
VHF radio & antenna (purchased used, but should have bought the radio new)	$86
Tools & Consumables (includes $205 for a cover and $140 for a sandblaster)	$749
Fiberglass & epoxy	$155
Duraply (2 sheets)	$56
Stainless fasteners	$190
Rigging	$285
Electrical	$324
Miscellaneous	$252
TOTAL INVESTMENT	**$3,047**

Electronics

TUNING IN VHF

Often all it takes to maximize the range of your VHF radio and minimize power loss is to install the proper antenna and coax. Here's what you need to know to diagnose your radio's performance.

RADIO-OLOGY

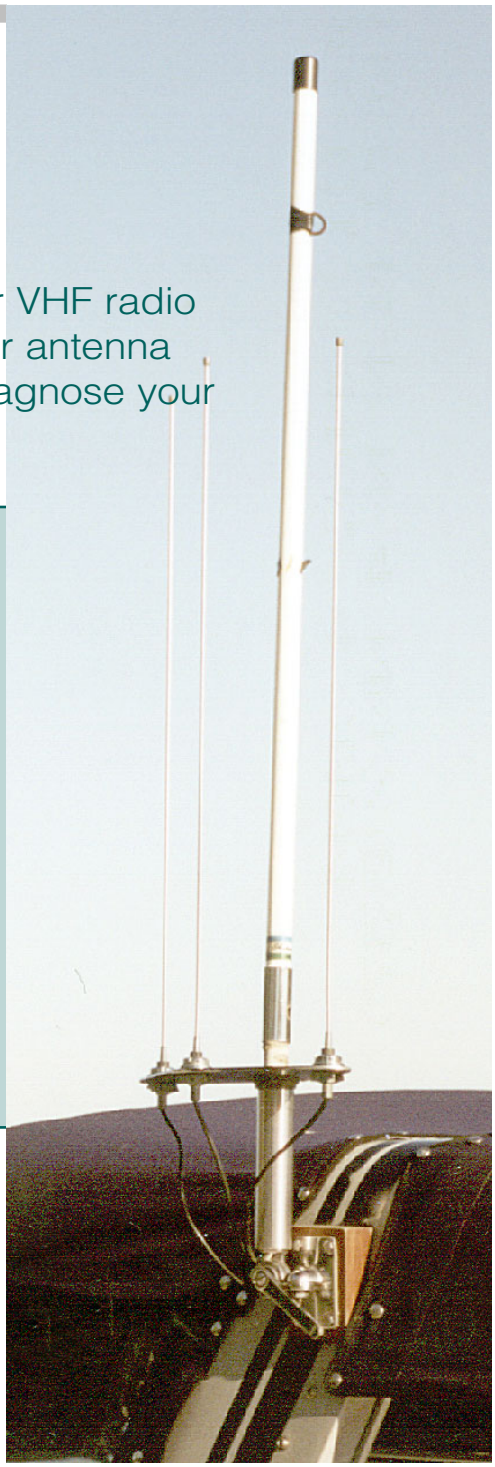
Bandwidth: the range of frequencies required to transmit a signal; measured in megahertz (MHz)
Gain: the measurement of the effective radiated power, or signal; measured in decibels (dB)
Impedance: the combination of resistance and reactance; measured in ohms
Frequency: the number of radio waves, or cycles; measured in hertz
Radome: fiberglass shaft that houses the metal components inside the antenna
Out-of-Band Interference: strange noises emitted from even a squelched VHF radio caused from pagers and other commercial transmitters operating near the VHF band signal
Wave length: distance between radio waves; measured in meters

By Jan Mundy

It's possible to improve the reception and range output from most VHF radios. The two key components are the antenna, which captures the electro-magnetic radio waves traveling through the atmosphere, and a cable to transmit these waves to and from the receiver. Matching both of these to the type of boat and the installation determines the power and quality of the signal. As most antennas and cable are sold with standard equipment, it's important to select the right package.

Tuned Elements

The common VHF antenna is much more than just a fiberglass whip. Inside the radome are various elements, joined together to form a collinear (vertically stacked) array, all designed to maximize the transmitted and incoming received signals. Some antennas have brass elements soldered end to end with coax cable, all held in place with foam spacers. Others have a solid brass core or copper wire. The ferrule on some units is brass.



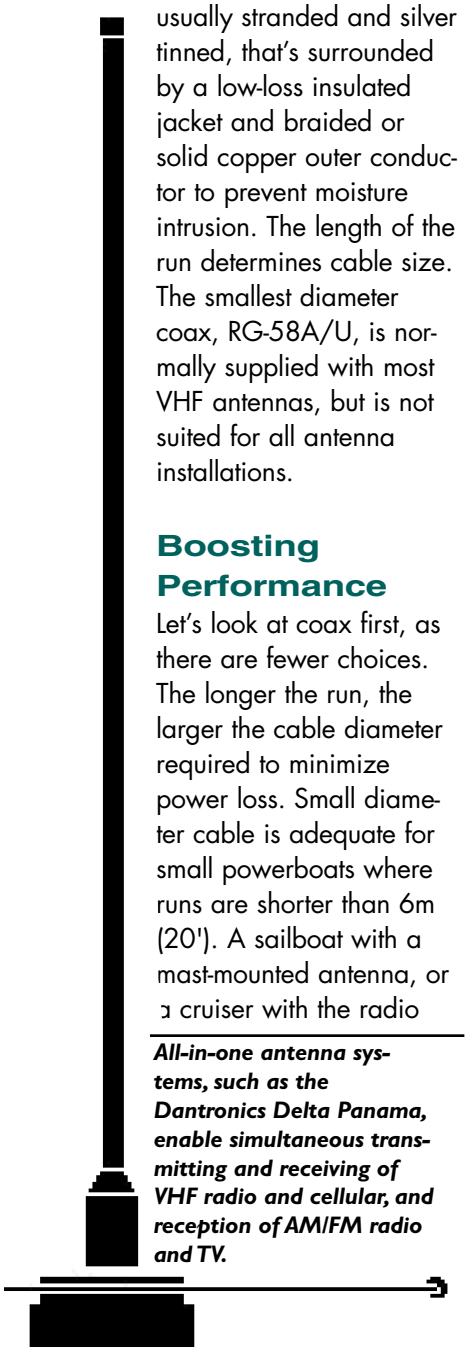
Sometimes, stainless steel is used for better corrosion resistance. The more expensive the antenna, the better the internal elements, and as a rule, the better the reception.

VHF radios operate on a bandwidth of 156MHz to 162MHz with a wavelength of 2 meters. (To determine the frequency in MHz to wavelength, divide either by 300.) VHF antennas range from 1/4 to 5/8 wave, depending on the

Electronics

antenna length and style. The receiving zone is omnidirectional, meaning you can turn the boat in any direction without signal fade. Antenna length determines the gain, or power output measured in decibels (dB), and its height equals the range. VHF antennas are commonly classified as 3dB, 6dB and 9dB.

Coaxial cable (a.k.a. coax) consists of a center conductor, usually stranded and silver tinned, that's surrounded by a low-loss insulated jacket and braided or solid copper outer conductor to prevent moisture intrusion. The length of the run determines cable size. The smallest diameter coax, RG-58A/U, is normally supplied with most VHF antennas, but is not suited for all antenna installations.



All-in-one antenna systems, such as the Dantronics Delta Panama, enable simultaneous transmitting and receiving of VHF radio and cellular, and reception of AM/FM radio and TV.

Boosting Performance

Let's look at coax first, as there are fewer choices. The longer the run, the larger the cable diameter required to minimize power loss. Small diameter cable is adequate for small powerboats where runs are shorter than 6m (20'). A sailboat with a mast-mounted antenna, or a cruiser with the radio mounted a distance from the antenna, requires a larger coax, such as an RG-8X. For lengths reaching 15m (50'), a better choice is RG-8U or RG213 to ensure against excessive transmitter energy loss between the radio and the antenna.

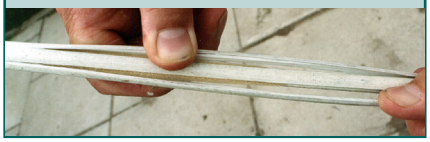
A typical mast-mounted antenna on a sailboat is a 91cm (36") stainless-steel whip with a gain of 3 dB. Small powerboats are usually supplied with a 2.3m (8'), 6dB antenna and very large cruisers or commercial boats have a very heavy 9dB, 6m (20') radome. Since length equals gain, then to achieve maximum power all that's needed is a big antenna, mounted as high as practical, and a powerful radio (25 watts preferred) to transmit and receive a good quality signal.

Unfortunately, because of the path taken by radio waves, it's more complicated. In fact, a small gain antenna mounted up high provides better reception, provided it's using the proper coax (i.e. RG-8X), than a taller, larger gain antenna mounted low. This is due to the direction of radio waves. VHF antennas radiate waves perpendicular to the antenna. When a boat is stationary, the high-gain antenna has a greater range. As a powerboat rolls or pitches, or sailboat heels, the high-gain antenna results in a decrease in the transmission beamwidth, causing the signal to fade. Powerboats could mount a 5.5m (18') 9dB antenna on the stern, but a better option would be a 2.4m (8') 6dB mounted on the flybridge or above the wheelhouse.

Increasing Life Span

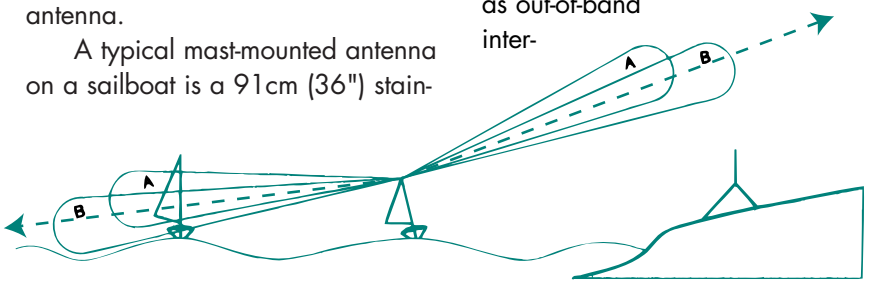
When properly cared for, an uncoated fiberglass antenna should last for 10 years or more. Totally ignore it, and you'll be replacing it in five, as we did. Like all things made of fiberglass, UV reacts with the resin causing the radome to become brittle and eventually, crack. Water enters through the tiniest fracture, and corrodes the inside metal components. If it's not too far-gone, a patch of epoxy resin and fiberglass mat should hold for a time. Or epoxy glue on a PVC sleeve, the kind used as chafe gear on sailboat rigging.

Next time you're cleaning and waxing your boat, give the antenna the same treatment. Many newer antennas have a high-gloss polyurethane paint finish. Routinely apply wax to protect the finish, and when it becomes dull and faded, apply two protective coats of paint, sanding between coats. Use a latex paint or any other kind provided it doesn't contain lead or metallic chips.



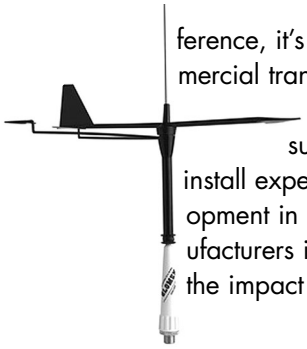
Filtering Option

Around metropolitan areas, busy harbors or shipping channels, it's common to hear high-pitched chatter, chirps, squeaks, whistles and other strange noises emitted from even a squelched VHF radio. Known as out-of-band inter-



JOHN PAYNE, "THE MARINE ELECTRICAL AND ELECTRONICS BIBLE."

When a powerboat rolls or a sailboat heels, this motion narrows the radiated signal, and if aimed at the surrounding water or upward toward the sky, causes fadeout and intermittent reception. When this happens, a high-gain antenna (B) has greater range but also a greater decrease in the transmission beamwidth than a lower gain antenna (A).



Combo windvane and stainless steel VHF whip for mast mounting.

ference, it's caused from pagers and other commercial transmitters operating near the VHF band. In the past, the only means to suppress these annoying sounds was to install expensive external filters. A recent development in antenna design offered by some manufacturers is a built-in filter that helps to reduce the impact on the radio receiver without affecting the transmitting range. It's a good option but expensive. You can pay as little as US$60 for a short, 3dB stainless-steel whip, or more than US$500 for a 7m (23') 9dB fiberglass antenna with a built-in filter and all stainless-steel components.

-Tip-

FINE TUNING

Mount Once

Antenna bases come in various mounting configurations in stainless steel (most expensive), chrome-plated Zamak or nylon (cheapest). A ratchet mount provides a quick and easy way to raise and lower a powerboat antenna when passing under bridges or for storage. Not all mounts are created equal. On our powerboat, vibration and rough seas would pop the gears on the nylon ratchet mount. Replacing it meant drilling new holes, rebedding, and a lot of extra effort for hardware that we assumed would do the job. All mounts accept a standard thread so buy a good one. If your existing one is of poor quality, replace it.

Split Reception

Turn your VHF antenna into an AM/FM radio antenna with the Shakespeare 4357 marine band splitter. It allows the VHF antenna to operate on the FM band as well, with only a nominal power loss in VHF reception.

Best Radio Check

Though it's standard practice to test VHF radio performance by calling for an on-air radio check, it's bad protocol to tie up the radio waves. Instead, purchase a radio-testing meter that measures a radio's output power and the power being received by the antenna. Definitely, a much better option.

Determining Antenna Range

Here is the formula to calculate the range of your antenna:

Square root of height (in feet) above water x 1.42 = range in miles

Courtesy Shakespeare

Good Boatkeeping

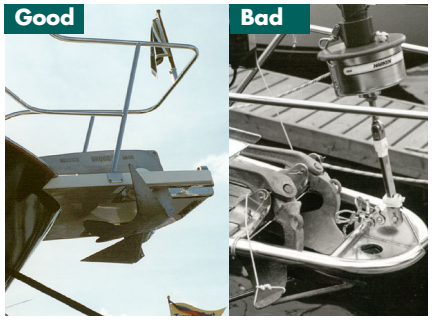
GETTING HOOKED: A LOOK AT ANCHORING OPTIONS

By Zora and David Aiken
Photos by Jan Mundy

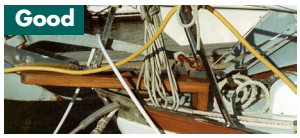
Many nights "on the hook" are calm and serene, and, if the anchorage isn't buzzing with other boats, it's peaceful and solitary. Having the proper equipment and backup plans ready for emergency maneuvers, builds confidence in the gear, the boat and in your own skills.

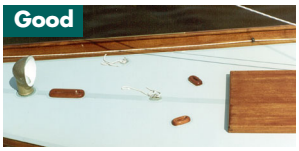
Need more reasons to carry more than one anchor? It's not uncommon to loose an anchor when the deck crew neglects to attach the all-important bitter end of the anchor rode to the cleat. An anchor can get stuck on a mysterious snare, and you may have to cut the line and leave it, at least till you can return with a diver to retrieve it.

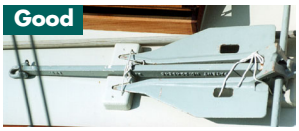
Mix, don't match, your anchors. If all your boating time is spent in a place were you will anchor in either mud, sand or kelp, you'll naturally plan your anchoring gear around only one type of anchor. Twin matching anchors may look nice on the bow, but if you plan to travel to places that might bring variations in the sea, lake or river bottom, you'll need a variation in anchor design.

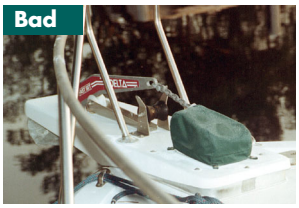


Carry two anchors on the bow, but make sure your carrying arrangement is secure. Give an anchor too much freedom, and it might pitch on the bow or bounce on deck, doing a lot of damage in the process. Use a bowsprit with a built-in anchor-roller, or stow a Danforth on deck in chocks or attached to a stanchion with the help of some PVC pipe and line.

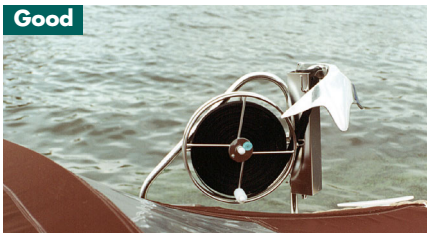








Whichever anchor you choose for the primary one, it should be ready to release in a split second. For example, the engine quits as you're navigating a busy channel, or quits just as the tide is carrying you toward a bridge that requires opening for your vertical clearance.

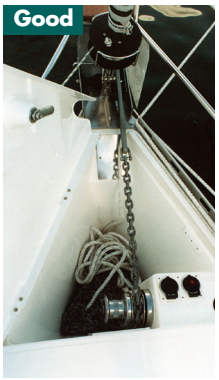


If the bow does not have the proper hardware, add some. Our boat had only one cleat at the center of the bow. That was fine if we used only one anchor; not so fine when we used two. It was impossible to adjust the bottom line without risking a slip, or worse, with the top line. We moved the center cleat to port and bought a matching one for starboard. We built up fiberglass pads for each by cutting

pieces of mat and layering them in a series of slightly smaller rectangles so the overall finished shape could be sanded at an angle to look as though it was part of the original mold. We added a piece of 12mm (1/2") plywood under the deck beneath each cleat, so they could be thru-bolted securely with substantial backing plates.

Don't forget to carry and use some kind of chafing gear for anchor line. You can use leather, pieces of rubber or vinyl hose, even rags secured to the line where it passes through the chock.

Save your back and equip your boat with an anchor windlass. No doubt you once retrieved your anchors manually with help from the boat's engine. Just power up slowly, pulling in rode as you go. But pulling up 30.5m (100') of chain and line attached to a 13.6kg (30lb) anchor…well, it's not really much fun. Don't forget to rig a lifting device on the stern!



Available space on board dictates how much of anything can be carried. Finding places to stow chain and at least two extra anchor rodes of the length practical for the average depth of water where you anchor as well as in consideration of the space available

Tip — Set, Don't Drag

Many times I've witnessed a boat enter an anchorage, drop its anchor, and immediately turn off the engine, while the deck crew attempts to set the anchor by hand — but it doesn't hold! The trick to not dragging is to properly set your anchor. To do this, put the engine in reverse, run at high rpm for about a minute. Then sight three objects on land to see if the anchor drags. If your position doesn't move in a minute or two, your anchor is likely well set.
— JM

for anchoring gear, may take some creativity. On the bow, a deep anchor well can contain the rode for the primary anchors. You'll also need to find a home for the stern anchor rode as well.

More Reasons to Carry Many Anchors

For many years, our two primary anchors onboard "Atelier" were a 15.8kg (35lb) CQR (a.k.a. plow) and 10kg (22lb) Danforth, and a lunch hook, a 5.4kg (12lg) Danforth. In the Bahamas one winter, we were riding out a nor'easter in a place with a hard sand bottom. We'd found a nook with a water depth of about 2m (7'), partially sheltered from the full force of the wind by a low island. But when sustained wind speeds reached 50 knots, gusting to 70, there was no opportunity to increase scope because there was no place to go but onto a rocky bar.

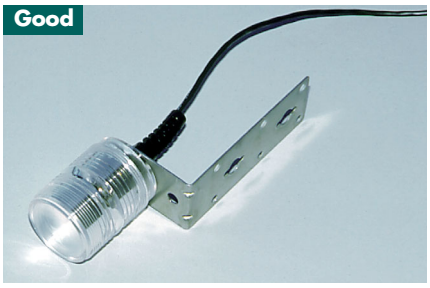
Our CQR and Danforth, both on 16mm (5/8") line, were positioned in a wide vee off the bow, and the lunch hook with 9mm (3/8") line was dropped straight ahead.

During the blow, the larger Danforth had to be reset often, an interesting exercise given the conditions. Occasionally, the plow pulled out, probably as a result of the abrupt jerk on the line that occurred each time the boat "sailed" to the end of the its line. The anchor did reset, but shifted position a bit each time. The little Danforth apparently had found the one place where an anchor actually could dig in, and it did, holding us in almost the same place for the storm's 36-hour duration.

After the Bahamian venture, we added to our collection a big, 20kg (44lb) Bruce storm anchor that occupied the lazarette for three years until one not-so-fine day when Hurricane Bob came to call. Good Bruce! Bad Bob!

A different kind of Bahamian adventure prompted the purchase of a grapnel. While anchored on the banks one very calm night, we calmly drifted about 1 mile from our wide-open anchorage, not because the anchor pulled out but because the bitter end of the anchor line had not been attached securely, if at all. The happy ending was that, thanks to clear water and friends with both a GPS and a grapnel, the anchor was retrieved. A grapnel now shares the lazarette with Bruce.

— Zora Aiken



anchor in designated anchorage areas and always run your anchor light at night. An ideal low-power anchor light, the Davis Meta-Light mounts on the masthead with a supplied stainless-steel bracket, draws only .074 amps, and a light sensor automatically switches the light on at night and off at dawn.

Before buying a new anchor, do some research. Manufacturers continue to offer variations on familiar styles and occasionally, a new design. Check out anchors carried on other boats in your harbor, and talk to other boaters about their experience. Fortunately, independent testing is often done, and the results of these may inspire enough confidence to try a new anchor.

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

-Tip- Anchoring Tricks

Counterbalance
A true backup is a sentinel. If you must anchor in unusually deep water or in a crowded anchorage where you don't have the option of increasing scope, you must improvise. The idea is to reduce the lifting angle, forcing the anchor rode to pull from a more horizontal direction. Attach a sentinel — some kind of weight, perhaps the dinghy mushroom anchor — to a separate line that is looped around and slips down the rode. This decreases the pulling angle to keep the anchor set and the boat in place.

Upwind is Better
Always anchor upwind of the crowd. That way, should another boat drag anchor in the middle of the night, you won't be a target.

Reuse, then Recycle
Turn anchor line end-for-end occasionally to change the area of most use. When the ends of the line become unreliably stretched or worn, cut them off. When the line is finally too short to be of practical use for anchor line, use it for mooring lines.
— ZA