2001-#2

DIY boat owner

the MARINE MAINTENANCE MAGAZINE

Currents

E-Edition Queries

I have been buying your magazine off the newsstands, and, since I move around a lot, will continue to do so. Can I get an online only subscription? I don't want the magazine sent to an address.
Bob Ulland via email

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I have a subscription to DIY. Does this automatically make me a member of DIY EZINE? If so, how do I log in?
David L. Snyder, Chapmansboro, Tennessee

You need to subscribe to the EZINE, but as you're a subscriber to the print edition, the cost for the E-version is 1/2 price (US$7.50/ CDN$11). This offer is not online, so to order and receive your user ID and password, call us toll-free at 1-888-658-BOAT (2628). With DIY EZINE you can read, print or download the current issue plus the three most recent back issues. To preview the EZINE, go to DIY ONLINE at www.diy-boat.com and click on "Free Preview."

How do I download the whole issue at once to make printing easier?
Glenn Noonan, Rochester, New York

Currently you can only download a page at a time. Since each issue averages a 5mg file size, this was done to facilitate downloading. For high-speed users, we'll be adding a link to download an entire issue.

Reefer Troubleshooting

I had a problem with my boat's 12-volt refrigeration compressor. It would power up, cycle briefly, then shut down. This would go on continuously, and after a few minutes I'd give up, shut off the compressor, and head out to buy more ice. I decided to call the repair people. Later, while rewiring the autopilot I came across an unrelated wiring connection that was poorly spliced using a pigtail-style household connector. I traced the circuit and discovered that it powered the fridge compressor. After crimping and insulating the connection heat shrink tubing, the fridge cycled properly. The prior connection was adequate to deliver the full 13.5 volts to the compressor when it was idle, but when it powered up, the load and resistance from the faulty connector increased. This caused the voltage to drop to a level where the compressor's battery saver circuit kicked in to shut down the compressor. (DC refrigeration systems have a feature that saves the batteries from being discharged and permanently damaged.) My new motto? Check your wiring and connections before you call the repair shop.
Bruce Colman, "Solaro," Ottawa, Ont.

Customer Service Wanting

I clicked into your site when looking for information to resolve a problem with my Suzuki outboard. The greatest statement I discovered in one of your articles was something to the effect of, "An engine will last forever, as long as it is maintained properly." The connotation was that it doesn't necessarily have to die and be buried. I had just spent an afternoon talking to three Suzuki dealer technical reps between Miami, Florida, and Marathon in the Florida Keys. Two reps said my engine problem was "old age." (That's what they said, honest!) The

IS IT AC OR DC?

Q. What is the best way to check if a circuit on board is AC or DC powered?

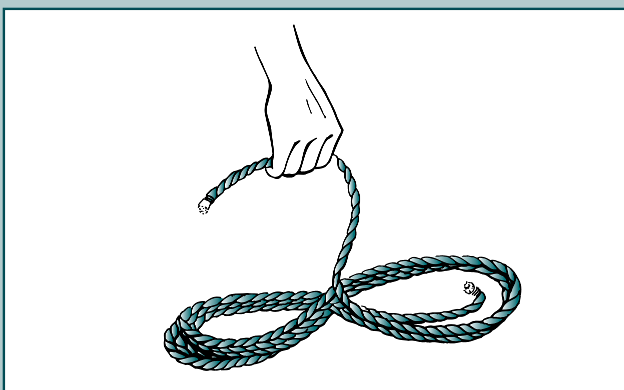
A: Trace the wiring back to its power source or to the electrical appliance it's feeding. If the wires terminate at the DC electrical panel or a DC appliance, it's a DC circuit, and likewise for a 110V AC circuit. Be extremely careful in tracking wires to loads and supply circuits, especially when you see aftermarket wiring and equipment installations. AC circuits are dangerous, so I don't recommend anyone attempt to take a reading with a multimeter across a set of wires without knowing if they are part of an AC or DC circuit.
— Kevin Jeffrey

KNOTTY KNOW HOW

Flaking Down

It's better to flake an anchor, dock, tow or any long line rather than coil it to prevent it becoming a tangled mass. A loop of coiled line often picks up another loop as it's running out. Flaking involves laying the line in a series of figure eights so it pays out freely.

To flake a line, follow the lay of the rope and make a large loop by twisting the line counterclockwise, then twist the end of the loop clockwise to form the eight. Repeat, forming as many figure eights as desired or to the end of the line. Take care to keep all turns the same length.



third gave a more rational explanation. He said it was either from water in the fuel or clogged carburetor jets. I've suspected for many years that some marine engine "experts" are not technically qualified to service an outboard engine or diagnose symptoms. I think it's because they either work for a dealership that believes in solving problems by selling new engines, or they don't understand engine diagnostics, or maybe it's a combination of the two. Unfortunately, for me, competent marine mechanics in the Keys are as rare as….

A past issue had a letter from a boat owner in Puerto Rico that was stranded at sea for four hours because a mechanic said his problem was corrected. I am beginning to suspect that there are many boat owners experiencing the same level of service. After all, if all were honkey-dory, why would people read your magazine?
Louis Orosz, Hollywood, Florida

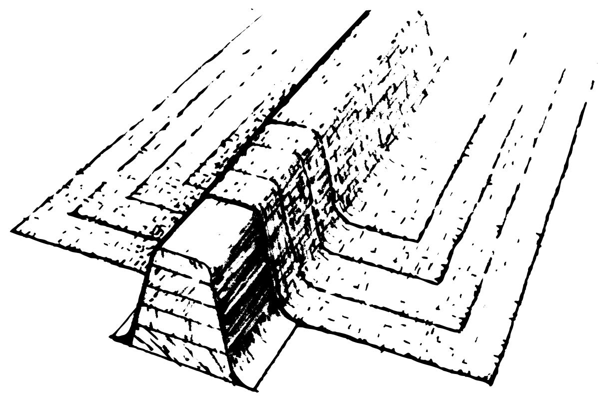
A Fuel Miss

I have been a subscriber since DIY was launched (1995) and enjoy reading your articles and making use of the hints and information. The article in your 2000-#3 book titled, "A User's Guide To Outboard Maintenance," page 27 under the heading "Troubleshooting: Fuel," states in the last paragraph: "As a final check on boats with inboard fuel tanks, attach a portable tank directly to the engine. If the engine doesn't stall, this eliminates the fuel system failure." It would appear to me that if you have an engine that is stalling and you change the method supplying the fuel (different tank and direct hookup to the engine), and this change results in the engine not stalling, the problem is somewhere in the original fuel supply system. If the stalling continued, then the fuel system is eliminated as the problem.
Jim Adams, Executive Officer, Georgian Trent District, Canadian Power and Sail Squadrons, Orillia, Ontario

You're absolutely correct.

Floor Repair: Another Way

I enjoyed the article "Floor Saver" in Shop Talk, DIY



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2000-#4 issue, about a runabout's plywood floor and support replacement. A local shop suggested I fiberglass in an upside-down, U-shape with ears over the top of the stringers to "clamp" them to the hull in case the wood-to-fiberglass bond separated. It was the second replacement for my 28-year-old Reinell hull. The first time I installed treated wood stringers. This was a mistake because treated wood is harder to bond and the stringers separated. Be sure to seal out all moisture with complete fiberglass encapsulation of the wooden stringers.

Allen Hansen, Decatur, Illinois

Winners of DIY Draw

Winners of DIY's Product Information Card Giveaway who received a Clymer Engine Maintenance and Repair Manual from the 2000-#4 issue are: Ron D'Agostino, L'Anse, Michigan; Andy Mead, St. Catharines, Ontario; and William Zbaeren, Alpine, California.

Wanted

DIY reader Christopher Harcourt-Vernon needs a solution to keep birds from landing on his mast's horizontal support for the anemometer wind cups at the masthead. He has considered a household product called Tanglefoot, but it's apparently not intended for smaller birds and is much too sticky. Email your findings to c2hv@sympatico.ca.

Recall Notice Now Online

Automobile recalls are highly publicized by the media. This is not the case with boats, engines and marine equipment. Without a national database of boat serial numbers, when a boat sells the manufacturer's first owner records are not updated with new owner information. Buyers sometimes fail to return equipment warranty cards, and safety defects often go unreported.

There are two online marine recall sources for owners. In one site you do the searching; the other, manufacturers search for you. The U.S. Coast Guard (www.uscgboating.org/dbpub/recall) maintains a database of recalls for non-compliance and safety detects in boats and equipment. Viewers can search by hull identification number (HIN), company, problem, model or model year.

The Boat U.S. National Alert Registry at www.boatus.com/recall allows boat owners to register their boats and engines online, recording the make, model and HIN or serial number, in a secure database. This information is made available to manufacturers in the event of a recall.

Manufacturer's Identification Code CDR Details for Recall Number 970124T

Number: 970124T
MIC: CDR
Company: CARVER BOAT CORPORATION
Model Name: 350 MARINER
Model Year: ALL
Other Company:
Problem 1: CARBON MONOXIDE
Problem 2:
HIN:
Case Open Date: 11/19/97
Disposition: CLOSED
Case Close Date: 1/5/99
Units: 149
Campaign Open Date: 11/19/97
Boat Type: 12
Campaign Close Date: 1/5/99
Severity: H
Comments: THE MANUFACTURER HAS DETERMINED THAT UNDER CERTAIN CONDITIONS THE CANVAS CAMPER TOP PREVENTS ADEQUATE VENTILATION AND RESULTS IN AN ACCUMULATION OF CARBON MONOXIDE CREATING A HAZARDOUS SITUATION. 1/13/98 DNR RCVD 149 UNITS IDENTIFIED THAT MAY HAVE THIS PROBLEM. 9/3/98 UPDATE REPORT #2 RECVD 110 FIRST PURCHASERS NOTIFIED 34 DEALERS NOTIFIED 4 CORRECTED 108 DO NOT HAVE PROBLEM 5 OWNERS REFUSED REPAIR. 9/17/98 CUR#3 RECVD 149 UNITS 110 NOTIFIED 34 DEALERS NOTIFIED 8 UNITS CORRECTED 107 UNITS INSPECTED NO PROBLEM 1/5/99 CUR #4 CLOSE

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Talkback Q+A

Search past Q&As for answers ro hundreds of boat, engine and gear problems @ www.diy-boat.com

Used Boat Blister Beware

Q: A pre-purchase survey detected small blisters, about the size of a dime, under the waterline of a 1994 Passport 456. The surveyor's moisture meter didn't register much around the small blisters, and he suggested a hull profile be performed. I like the boat, but we don't want to buy a headache.
Andy McKnight, "Hallelujah," Newport, Rhode Island

A: It's not unusual for a six-year-old boat to have 12mm (1/2") diameter blisters, so based on the information given, there are a couple of things you need to address. The meter readings on the hull topsides should serve as a baseline for other meter readings over the hull. Using whatever "baseline" reading you get, readings on the hull bottom would be relatively higher. That's normal. If the boat had been dry docked for a long time the bottom would have had a chance to dry out. The blisters would still be there, but the readings would be inconclusive. If the boat was recently hauled, meter readings become even more difficult to interpret. Some meters are sensitive to surface moisture, but not depth. Some will scream "wet," and read relatively high on the scale, and there will be no visual evidence of blistering or other moisture intrusion. Using a moisture meter is an art that is subject to expertise in taking readings and in interpreting them. The moisture meter should never be relied upon as the sole method of determining the condition of the fiberglass laminate. What were the readings taken from other locations on the hull? Did you pierce a blister to sample the fluid? Fluid in an osmotic blister is released under pressure and smells of styrene (that familiar acidic fiberglass odor). If not, the condition may just be benign paint blisters. The blisters could also be the remnants of a condition where the fluids within have already been released during a period of dry storage, and the laminate had dried passively. There are too many variables to factor into a conclusion without the testing recommended.

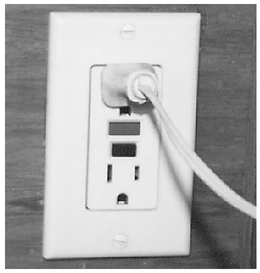
Sue Canfield, a SAMS-certified surveyor and contributor to DIY, confirms that you should have a hull profile test to ascertain the integrity of the hull. You will have to get the boat owner's permission to conduct the test. The cost of the testing is yours, as is restoring the condition of the surface tested. Most owners are reluctant to have this test as it involves grinding a 15cm (6") hole and leaves a noticeable patch. The results will either give you peace of mind, or they'll give you the evidence you'll need to renegotiate the price of the boat if you proceed with the purchase. The profiling is done by a qualified fiberglass repairer who grinds an area on the hull in a location where there are blisters to determine the condition of the laminate substrate at various intervals during the grinding process. First, the tester grinds away the bottom paint. Then, with digital calipers, he measures the thickness of the paint and takes the Barcol test (hardness) and moisture readings at the surface. The repairer then continues grinding through each layer, measuring the depth and taking hardness and moisture readings. When the moisture reading drops and hardness rises, the substrate is sound. Normally, grinding removes the paint, skin coat and one or two layers of mat, and on some, but not always, the first layer of woven roving. It takes about 1/2 hour and costs US$100 to US$200, including a temporary patch.

If you are serious about buying this boat, discuss the test with the owner, and, if the results indicate the need for repairs, you can offer to renegotiate the sale price to reflect some or all of the anticipated costs related to the job. If the boat is sound, the contracted price stands. You owe it to yourself, the boat and its current owner to become knowledgeable about blistering and repair. There is a lot of misinformation on this subject. There are four excellent articles in past issues of DIY on this subject

that cover surveying the damage, barrier coating with Interprotect and epoxy, doing a litmus test to check the pH of the blisters and step-by-step repair. Canfield also added that surveyors, as a rule, do not normally provide job estimates unless the surveyor is well experienced in that field. Rather, Canfield recommends that you confer with boatyards and marina operators, retailers and other boat owners to seek out the fiberglass repairer with the best reputation in your area to do the profile test and provide a repair estimate, if needed.
— Jan Mundy

Outdoor-Proof AC Outlets

Q: I am installing a 1,000-watt inverter and would like to know what kind of weatherproof receptacle (it rains a lot here) I should mount on the bridge. Also, recommend the wire size needed to plug in my laptop.
Ross Woodhouse, "Antiquity," North Vancouver, British Columbia



A: A regular outdoor weatherproof ground fault circuit interrupter (GFCI) outlet would be suitable for use on the command bridge, and 12/3 marine-grade wire is more than sufficient for the small load of a laptop.
— Kevin Jeffrey.

Bonding Bronze

Q: My 7.3m (24') Sea Sport has one bronze thru-hull water pickup fitting for the washdown pump. Should it connect to the engine block via a small jumper wire to electrically tie it in, or should it be isolated? There is no common bonding strap in the boat.
Ernie Holt, "Carol Ann," Ephrata, Washington

A: I'm not familiar with the Sea Sport, but I'm going to presume it's equipped with a gasoline-powered stern drive with aluminum outdrive. I'm also going to presume that your boat doesn't have an AC electrical system. With the addition of the bronze thru-hull, the potential for galvanic corrosion damage to the outdrive increases. Galvanic corrosion, however, is a slow process and I'll presume that the outdrive is normally raised when your boat is not in use. Check the condition of the zincs on the sterndrive regularly and replace them when half wasted. To minimize the risk of galvanic corrosion, replace the bronze thru-hull fitting with one made of nylon-reinforced plastic (e.g., Marelon). Alternatively, bond the bronze thru-hull to the engine negative terminal using at least #8AWG marine-grade wire, one that is multi-stranded and tinned to resist vibration and corrosion.
—Sue Canfield

Outboard Trim Refilling

Q: I need to refill the trim pump on my Mercury 200 EFI. It has a screw on the side of the trim but nothing on the top. Can you tell me where the refill hole is? Do I need a special hose or tool?
Ronald Orosz, Hollywood, Florida

A: To refill, tilt the outboard to full-up position and engage the tilt lock lever. The system is pressurized, so raise the engine to the top trim position to depressurize. The screw on the side of the reservoir is where you fill it. If you remove the wrong screw while the engine is jacked up, you'll disengage the manual release valve and the engine will come crashing down. Remove the fill plug and O-ring. Fill with automatic transmission fluid until the oil level is visible at the bottom threads on the fill hole. Reinstall the fill plug with a new O-ring and tighten. It's a self-bleeding system, so just power up and down a few times to bleed. This procedure will remove fingers if done incorrectly. You should obtain the proper engine owner's manual, and follow the service precautions.

A Hole in One

Q: When removing the old floor to replace with a new one, I put a 10cm (4") saw cut through the fiberglass hull. Any suggestions for repair?
Mike Greene, "11 Born Free," Toronto, Ontario

A: You don't mention whether or not the hull is cored or solid glass, so I will presume it's solid, and that you

cut through with a circular saw, and that the cut is straight and even. You have two options. Do the repair primarily from the inside, or from the outside, whichever is most convenient. Either method requires beveling the laminate about 5cm (2") away on both sides of the slice. Begin by laying out the repair area with a felt pen. The width is dependant upon the thickness of the laminate. If the hull thickness is a 6mm (1/4"), for example, draw an oval 5cm (2") away from the 10mm (4") cut. Grind the laminate on either side of the slice, beveling the surface so the material is even with the cut edge, and decreases to zero at the pen line (similar to scarfing plywood). With extreme care and a very neat job, you should see concentric lines created by the laminations. Your repair area is now 10cm wide (4") 20cm (8") long. On the inside of the boat, lay plastic or a piece cut from a bleach jug over the slice. Brace it securely in place using a thin plywood backing and weights or whatever you can devise to hold it against the hull and provide a secure backing for the new lamination you create on the outside. The huge crater you created by grinding is now filled with epoxy and cloth, either 6oz, 8oz or 10oz. I recommend epoxy resins for fiberglass repair, unless you prefer and are really familiar with polyester resins. Cut the cloth into layers, starting with the smallest diameter to fit into the bottom of the hole, and all subsequent layers incrementally larger until you have reached the laminate thickness. It may take 5 to 10 layers depending upon the weight of cloth you use. The overlapping edges are important in creating a good solid bond to the existing boat hull. Before you begin laminating, mask the area around the repair, then wipe clean with lacquer thinner or acetone. Repeat the solvent wash with a clean cloth, and repeat once more. Clean just the ground portions of the laminate, not the gelcoat or you risk contaminating the laminate with wax or bottom paint. Stack the cloth in the proper orientation on a piece of wax paper or plastic on a flat surface, then prewet with mixed, unthickened epoxy resin. Lift and position the stack onto the repair, then use a squeegee to squeeze out excess resin and force out air bubbles. A material known as "peel-ply" laid on top of the stack makes this process easier, or just cover with Mylar or plastic, and use the squeegee right over the plastic. Make sure you remove any excess resin that runs under the plastic. Let the resin cure, usually overnight, then sand flush and paint. If you are gelcoating, first wash the epoxy thoroughly with water. The amine that sometimes blushes onto the surface will inhibit polyester curing.
— *Wayne Redditt*

Q+A 1(888) 658-2628

Soak It Up, Y'all!

Q: Oil has collected under the starboard engine in my 1977 10.6m (35') Chris-Craft double cabin, either from past oil changes or some other service as it's not leaking per my mechanic's inspection. It's difficult to reach under the engine and I have pumped out most of the standing liquid. Is there a mat that will soak up oil better than rags or paper towels and/or a cleaner that will dissolve it or a microbe-based one that will eat it? I want to clean this myself if possible since my mechanic charges $65 per hour.
Dan Ellard, "Jawja," Davenport, Iowa

A: There's an easy and inexpensive fix. Purchase some bilge "socks" or pads from your local marine store. Made of a highly absorbent material, they are specially designed to collect oil and fuel in the bilge. When they no longer can absorb any more fluid, you dispose of them in the same manner as oil and engine filters. They do a great job and we highly recommend one be placed in the engine pan under every engine. It's also a good idea to use a bilge cleaner. There are plenty available. I suggest you use one with an appealing scent. Using a bilge cleaner or one with oil "eaters" does not allow you to legally pump the oily residue overboard, unless you install a filteration system similar to the unit described on page 48.
— Jan Mundy

Formula for Deck Cracking

Q: I need to redo the deck on my 11.2m (37') Irwin ketch but there are just to many cracks to patch them one at a time. I have considered using Gluvit or similar product, overlaying a new teak deck over the fiberglass, or applying a synthetic non-skid.
Peter Harrison, "Rainbow 11," Beachwood, New Jersey

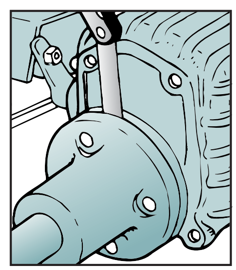
A: The general consensus on cracking gelcoat in topsides and decks is that the underlying reinforcement laminate is flexing beyond the ability of the unreinforced gelcoat to withstand the strain. Consequently, the only true fix is to reinforce the structure to prevent flex. Any attempt to cover the cracks results in the eventual reappearance once deck flexing reoccurs.

Some causes of flexing are thin (light and performance-oriented) laminate, a highly tuned rig (lots of stress on the deck) or the result of a collision or other overload. If the laminate is thin, then simply walking over the deck can cause sufficient flex to crack the gelcoat. To test for deck springiness, simply bounce up and down on your toes in different places. If the deck gives somewhat, then you have flexing in the deck structure. A teak or cork (i.e. Marinedeck 2000) overlay is actually a good idea. The stiffness gained adding a layer of wood is far greater than an equivalent weight of fiberglass reinforcement. Carefully bed the wood to prevent leaks, the primary complaint of those that have gone this route. Other alternatives are to apply reinforcing from the inside, then refinishing the deck, or strip the deck of gelcoat, reinforce the laminate from the outside, regelcoat the deck, and apply a non-skid surface. A third option after reinforcing the laminate is to glue down a synthetic non-skid then paint the non-skid areas with Interthane paint or Epifanes or other quality marine paint.
— Wayne Redditt

Grounding Effects

Q: After grounding my 12.5m (41') Silverton, I had only the props reconditioned, as the shafts seemed to be okay. When running at 3,200 rpm I now get a vibration out of the shaft that actually ran aground. There is also a noticeable vibration when in reverse. Can you tell me what might be the problem?
Jim Kirk, "Emotional Rescue," East Islip, New York

A: Based on your comments I suspect that either the prop is not "true" or you have a slightly bent shaft. This would cause the above-normal vibration in reverse, due to inherent prop cavitation when backing up, that would only be present in forward at higher speeds. Even a minor shaft misalignment increases vibration. I would first return the prop (the vibrating one) to whoever reconditioned it to recheck for balance. Naval architect Dave Geer recommends a simple way to check if the shaft is bent. Back off the coupling from the transmission just enough to insert a feeler gauge, realign the shaft, then rotate the shaft in 90° increments. A noticeable change in feeler clearances suggests either a bent shaft or that the coupling is skewed.

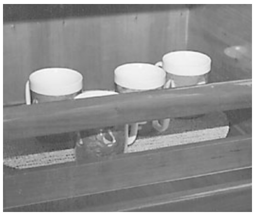

DAVID AIKEN

Tech Tips ✓

#1 HAND CLEANER: When you need to clean your hands of grease, grime, oil or other tough dirt, omit the abrasive, pumice-type cleaners. Just rub your hands with a little olive oil, wipe with a paper towel, scrub nails with a nailbrush, and then wash with soap and water if desired.

HOSE FLUSH: As a temporary remedy to remove sewage odors flush sanitation hoses with a solution of 30% water and 70% vinegar.

SLIDE-FREE: Plastic non-skid fabric, sold in sheets or on a roll at marine and discount stores, grips gear stored in cabinets, cupboards, pigeonholes and shelves.



TEAK WRAP: To prevent premature evaporation of teak cleaner when cleaning teak in direct sunlight, lay plastic food wrap over the applied solution.

BEST CUTTING TOOL: A rod blade mounted in a hacksaw cuts through stainless steel, aluminum, even brass or bronze like soft butter.

READY TO THROW: Install a stainless steel or teak handrail within reach of the helm and secure the life ring (or horseshoe buoy) with quick-release Velcro ties.

CONDUIT HORNS: I don't know if these were custom made or purchased off-the-shelf, but they certainly provide a shipshape and waterproof routing for mast and deck cables and wires.

POWER CLEANING: Many liquid boat cleaners have ordinary pump-action spray applicators and hand pumping these products during the annual boat cleaning, in my case pontoons, is incredibly tiring. For faster and easier application, use a Wagner Power spray gun fitted with the spray nozzle normally used for applying thin stains. Mix the cleaner, I use Toon-Brite for pontoons, according to the directions, pour it into the sprayer reservoir, set the control to the maximum spray setting, and spray. The directional and accurate spray pattern puts the cleaner where you need it with a minimum of over spray. Since it's a very fine spray, you get better coverage with using much less cleaner. Be sure to first do a spot test, wear protective clothing and eye wear in keeping with the manufacturer's safety recommendations on the product label, and don a respirator to prevent inhaling the vaporized solution. *Bob Hamme, Elizabethtown, Kansas*

CRACK TEST: A very cheap and effective dye test method for hairline cracks in stainless steel or rod rigging (see "Rod Rigging Repairs," DIY 2001-#1, page 5), uses food coloring dye (blue works best) dissolved in WD40. Clean the metal to remove any surface staining, then using an artist's brush paint on the mixture and let it "cure" for a few minutes. Rub the surface with a dry cloth and examine with a magnifying glass. After the liquid evaporates, the dye is visible in any cracks. *Alan Porte, "Te Tiaroa," Victoria, British Columbia*

SEND YOUR TIPS

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

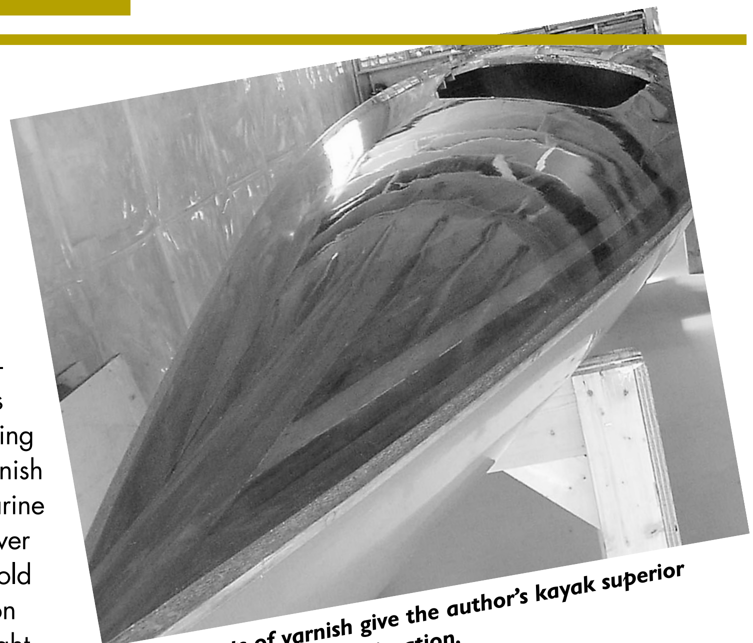
ShopTalk

FINISHING TOUCHES

Here's how to repair varnish dings and scratches to produce a perfect finish.

Story and photos by Wayne Redditt

Repairer's tools and materials.



10-plus coats of varnish give the author's kayak superior protection from UV deterioration.

If your boat has varnished surfaces it is likely to suffer the inevitable scratch and ding with regular use. For many, perfection is always in the next can of varnish, and keeping things protected is the real order of business.

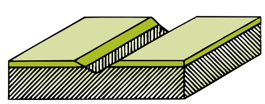
There are many different philosophies and approaches to this maintenance issue. Since protection of the wood is the function of the varnish, let's begin by outlining the important qualities of the finish. It must be fully intact, and it must be shiny for total protection. It goes without saying that the varnish must be marine quality. Never use household urethanes on exterior brightwork, as it cannot withstand the extreme UV exposure and moisture contact in a marine environment.

Keeping varnish surfaces intact demands diligence in repairing scratches and dings as they occur. It's a mistake to forgo this maintenance until your seasonal routine refinishing schedule rolls around. Moisture entering the wood through a break in the finish may turn the wood a particularly unattractive color, due to staining. More critical is that water vapor compromising the adhesion of the varnish film may cause it to lift and peel around the perimeter of the break. Neglecting this condition now will result in a more extensive repair later. Repairing a minor scratch or gouge is relatively simple.

Start Here!

Step #1

Begin by gently scraping away the damaged edges with a sharp paint scraper. The object is to taper the edges back toward undamaged varnish. Don't overly enlarge the repair zone. Generally, 120 grit non-loading type sandpaper will do the trick.



Step #2

If the wood doesn't require filling, hand sand until a smooth transition is achieved. Sand along the grain to avoid cross-scratches. You may refine the edge with 240 grit, but don't sand any finer. Use masking tape to delineate the repair zone, and protect the surrounding area from accidental damage.

Thin your initial application of varnish to 50% with the recommended solvent and apply. This generally dries very quickly, so it may be possible to apply a second coat the same day. Mix this second coat

-Tip- Coloring Epoxy

When filling deep gouges in varnished surfaces, it may be desirable to tint the epoxy to match the wood or a stain. After thickening the epoxy with colloidal silica, mix in a small quantity, about 5% by weight, of artist's acrylic paste pigments. Available in myriad colors from art or craft supply stores, paste pigments slightly weaken the epoxy but are frequently used on minor repairs where strength is not an issue. Be sure to overcoat with varnish to protect the epoxy from UV.

in a ratio of 70% varnish, 30% thinner. Apply the varnish with the intention of filling the shallow depression that you created by sanding. Don't overlap the unsanded area yet. The next day, hand sand the varnish gently with 240-grit paper. The object is to scratch the surface of the repair in preparation for the next coat. Use your varnish unthinned from this point on. For small repairs, a disposable foam brush works very well. If throwing these away after using them for only a minute bothers you, consider putting them in a freezer bag, and popping them into the freezer. They will be quite usable the next day. [Ed: On very minute repair surfaces, use a Q-Tip to apply varnish.]

Since you are trying to achieve a film thickness comparable to the original, it may take anywhere from 5 to 10 coats to build up the finish. Obviously, this takes considerable time in terms of days, although not in actual work time. Perhaps you can complete this over a number of weeks if you only get to your boat on weekends. The important part is the initial sealing of the wood from the environment. Plan to apply at least 3 coats on the first weekend.

Once the film thickness starts to come close to level with the surrounding varnish, switch to a sanding block for sanding. The overlapping material must be brought down to level if the repair is to disappear. At this stage, remove the masking tape and extend the repair area slightly. Try not to overdue it. After all, the routine seasonal recoating will diminish any remaining unevenness.

Step #3

Once surfaces are level, apply the last coat of varnish. Extend it out to a 3mm (1/8") overlap into the unsanded surface slightly.

Step #4

I suggest using epoxy as a filler. This may be adulterated with colorants or left clear. If you decide to color the filler, try to match the color with a mixture of wood dust. I have found that very seldom will the actual wood species make a good color match for filler, as it's almost always too dark when mixed with epoxy. For that reason, I prefer to just fill the ding with clear epoxy. When brought level and varnished it's usually less noticeable than poorly color matched putty.

The general knock against epoxy is the long cure time. Since this is not a structural repair or a lamination, it is not necessary to use the high strength stuff. A quick-cure epoxy works well for this particular application. I particularly

like the Gougeon Brothers G/5 epoxy, since it has good clarity and is of usable viscosity, or MAS Rapid Cure.

Step #5

Mask the area well, as you don't want to extend the sanding area by getting epoxy on the adjacent varnish. Apply the epoxy putty mixture with a putty knife.One word of caution, the solvents that are usually used to clean up epoxies may be deadly to varnish. Acetone, for example, will strip many varnishes immediately upon contact. So be careful not to get epoxy anywhere except in the repair zone.

Step #6

Sand with a block and varnish as in the scratch repair.

Your repair should be barely noticeable to you and invisible to the watchful eye of your fellow boaters.

About the author: Wayne Redditt has 20-years experience in design, construction and repair of small craft built of wood, composite and metals. He intentionally damaged his cherished self-built strip-planked kayak to obtain photos for this article.

Electrical

POWER RECKONING

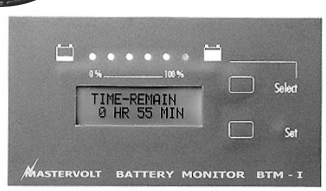
Install a system monitor to effectively make and manage your boat's onboard electrical power supply.

By Kevin Jeffrey

SALT TM-500

Link 20

Link 10



Mastervolt BTM-1

Having good instrumentation aboard helps you use your boat more safely and efficiently. Knowing that you have an accurate assessment of functions such as boat speed, water depth, wind speed and direction, engine rpm and hours of operation can make the difference between peace of mind and high anxiety. This is why digital electrical power system monitors are becoming so popular on workboats and pleasureboats worldwide.

Onboard monitoring of electricity is produced and consumed is an accepted and essential practice to protect your boat's batteries and ensure enough electrical power to meet your usual needs. Electrical system monitors were introduced to the marine market about 10 years ago to keep track of these vital functions. The early electrical system monitors worked well enough, but they were quite expensive and weren't intuitively easy to install or operate.

System monitors are often the last component considered when designing and installing an electrical power system on a boat. Selecting battery capacity, choosing charging sources and appliances, and determining the need for onboard AC power are all important details of a power system typically assessed initially in designing a system. Such details are based on how much electricity you use, so it's logical to address them immediately after establishing an average daily electrical power demand. [Ed: Refer to DIY 2001-#1 for a power consumption worksheet.] Conversely, electrical power system monitor selection is based more on the type of system you have, such as the number of battery banks that require monitoring. Instead of the last piece of equipment, I strongly recommend installing a system monitor before other components, regardless of whether you are upgrading an existing electrical system or laying out a new system. Here's why. An electrical power system monitor selected and installed at the beginning of the project gives you all the necessary information you need to establish that all important average daily electrical power demand and to know the capability of your present charging sources.

Many owners don't know important basic information about their boat's electrical power system, such as the current draw of individual components, or how much current the auxiliary engine's alternator is actually producing at varying rpm and time elapsed from starting the engine. A system monitor makes this information crystal clear, and lays the groundwork for creating an electrical power system where the amount of electricity produced is in balance with the amount of electricity consumed.

Defined Selection

There are several good, reasonably priced electrical power system monitors on the market that are relatively easy to install and operate. Cruising Equipment's E-Meter, a single system monitor for a single house bank, was one of the first monitors to be widely available. When Heart Interface and Cruising Equipment became part of the same business group, Heart released a virtually identical unit called the Link 10 (US$275; includes shunt). They subsequently released the Link 20 (US$380), a two-house bank monitor, as well as the Link 1000 (US$330), a remote unit with one bank monitor, and Link 2000 (US$500 to US$850) with integrated inverter controls and monitoring functions for one and two house banks respectively.

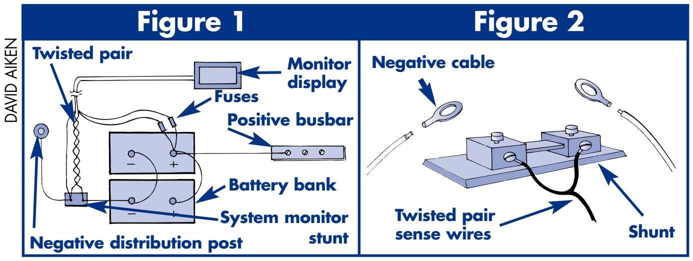
Mastervolt, a Dutch electrical power company that is beginning to establish a strong presence in the North American market, has recently released an interesting model called the BTM-1 (US$350; includes shunt). Like most system monitors, it displays four primary functions: battery bank voltage in volts; current in amperes going in from charging sources or out to loads of the battery bank; total amp-hours remaining in the bank; and a digital readout of percent of charge. This device also has several other features. It monitors the voltage of a starting battery, gives an accurate at-a-glance visual representation of state of charge with a row of LEDs, and displays all four of the major functions simultaneously. This means you can assess electrical power system conditions without having to scroll through a menu.

Sea, Air and Land Technologies (SALT) also has a good system monitor. Its TM-500 (US$615; includes one current loop and a 40-amp charge control for solar panels) is capable of tracking the performance of four individual power system devices, such as multiple battery banks, separate charging sources, or some combination thereof. A typical set-up using a SALT monitor would have Channel 1 monitoring a house bank of batteries, Channel 2 monitoring a starting battery, and Channels 3 and 4 monitoring charging sources, such as an alternator and solar panels or a wind generator. In addition, the SALT monitor uses current loops instead of shunts (the industry standard). The advantage of current loops is discussed below under installation.

Once you choose the monitor that makes sense for your application and budget, I recommend purchasing it through an electrical supplier that can assist you with the installation and service should a problem arise later.

Wiring Basics

Installation is straightforward, and a DIY enthusiast can easily do the job. As shown in Figure 1, first install a current shunt (or loop for the SALT monitor) near the negative post of the battery bank to be monitored. This usually involves cutting the existing negative battery cable, installing wire connection lugs on the two raw ends created by the cut, and reconnecting the negative cables as shown in Figure 2. All other negative wire connections from charging sources and loads (including inverters) should occur on the system side of the shunt, away from the batteries. This ensures that all current going into or out of the battery bank will pass through the shunt and be measured by the monitor. Shunts typically have two large studs for connecting the system side and battery side cables. On smaller boats, the system side stud often also serves as the negative distribution post. On larger boats, a separate distribution post or busbar is needed. Current loops for the SALT monitor don't require cable cuts or the installation of new cable lug connections. The current loop simply slides over the existing negative cable. Of



course, the loop can't serve as a distribution post for smaller systems.

System monitors typically have five low current wires to install: two sense wires from the center of the shunt, two wires leading to the positive terminal of the battery bank (one for powering the monitor display and one to read bank voltage), and one from the negative side of the shunt. The two shunt sense wires are configured as a twisted pair to reduce electrical noise interference. Most system monitor suppliers offer five conductor wire cable that is ideal for the job, in precut lengths or by the meter (foot). Small amperage fuses usually need to be installed in the wires leading from the monitor to the battery positive terminal. (Hamilton Ferris Company offers a preassembled dual fuse Y-connector for the Link 10 monitor.)

Most system monitors are mounted so the outer face is flush with the mounting surface. This requires cutting only a small circular or rectangular hole through a convenient bulkhead or navigation station wall panel. Display location can be up to 9.1m (30') from the shunt. Try to locate the display in a convenient spot with easy access.

Fine Tuning

Although all electrical power system monitors operate similarly, individual models have their own method of displaying and retrieving information. There are typically two control buttons on the front face of the display. One is used to scroll through the display menu; the other to set changes to the values in the menu. For example, when setting up the system, the user typically programs the size of their battery bank (in amp-hours) and a rough estimate of battery performance level (from new battery to older battery) into the monitor. Other than that, the user has only to check the monitor regularly to assess battery condition and manage their supply of electricity.

Having the right information when and where you need it is a key to successful boating. Since so many onboard systems rely on a steady supply of electricity, it only makes sense to be well informed about the condition of your batteries.

About the author: Kevin Jeffrey works as an independent electrical power consultant and is the author of the "Independent Energy Guide" and publisher of "Sailor's Multihull Guide," now in its second edition.

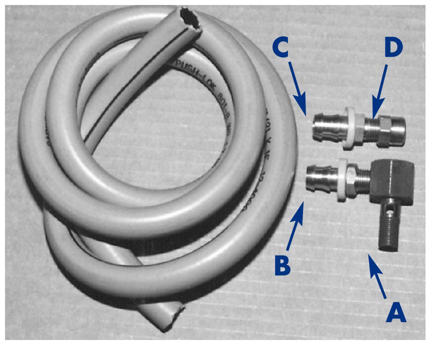
Projects

OIL QUICK CHANGE HOSE

Changing engine oil is a vital part of keeping an engine running efficiently and reliably but it can also be a messy job. Pumping oil out through the dipstick tube works well on some engines, poorly or not at all on others. Oil should be drained only after running the engine under load for at least 30 minutes and, by this time; the oil is hot enough to burn.

Fortunately, it's possible to permanently install an oil change hose on many engines to withdraw the hot oil without burning your hands or spilling a drop in the bilge. Mastry Engine Center (St. Petersburg, Florida, Tel: 727/522-9471) offers a kit (US$64) primarily used with various Yanmar diesel engines, though it fits any engine that uses a banjo-type fitting on the side of the oil pan for connection to the normal dipstick. The threaded end of the custom connector with a drilled hole (A) screws into the oil pan hole, and the top of this fitting reconnects the existing dipstick fitting. A hole in the side of this fitting allows insertion of a hose barb (B) to attach an oil drain hose. The other end of this hose attaches to a hose barb (C) with a screw-on cap (D).

Installation is easy. First, warm the engine and drain the oil, enjoying the fact that it will be the last time you make a mess doing it. Remove the banjo fitting where the dipstick attaches to the side of the oil pan. Install the new fitting (A), reinstall the dipstick and attach the hose. Attach the other hose barb (C) with cap (D) to the open hose end and securely fasten it at some elevated point so that even if the cap where loose, no oil would be lost. When it's time to change oil, uncap and lower the hose enough for gravity to drain engine oil into a container or attach a small hand or



powered pump and transfer the oil to the collection container.

Some engines may need adapting from the standard Yanmar setup, but with a bit of planning it won't be difficult to devise a workable solution. If you have access to machine tools you can likely make the appropriate parts needed for the hose connection.

— Charles Husick, Tierra Verde, Florida

SMALL BOAT STORAGE

You'll need:

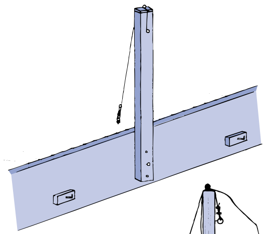
- 1, 2x4, about 10' long
- 1 turnbuckle
- 3/16" diameter plastic-coated stranded cable, about 8' long
- 4 cable clamps
- 2, 3/8" x 3-1/2" galvanized lag bolts and washers
- 4, 6mm (1/4") eyebolts with lag screw threads
- 1 galvanized cleat
- 2 L-bolts with lag screw threads
- Tie-up line for dinghy
- 1 sheet metal end cap

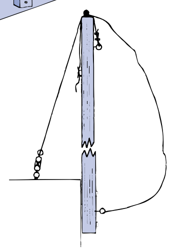
Lacking adequate room on the main dock walkway, I used to stow my hard dinghy on the boat's foredeck until winter winds tossed it back in the water when I wasn't aboard. The damage was minimal, but could have been disastrous.

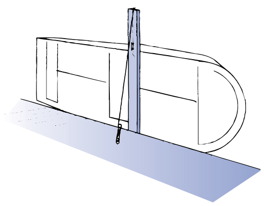
I needed someplace handy to store the dink, ready for use at any time. Floating it in the water was not an option as winter rains would fill it to the gunwales quickly, and there was always the chance of hitting it when coming in to the slip on windy days. I devised a support for my dink at the head of the slip that safely dry stows the dinghy and keeps the bottom clean. Purchase galvanized fittings available for US$20 or less from a hardware store and plan to spend a couple of hours for the completed assembly.

Depending on the beam of your dinghy, and the distance off the edge of the main dock needed for a walkway, cut two pieces, about 23cm (9") long off a 2x4. These pieces form the bottom dinghy supports. The remainder of the 2x4 forms the main upright support. Fasten this to the dock using two galvanized lag bolts and washers. At the bottom of the support install one eyebolt. Predrill all holes to reduce the chance of splitting the wood. I mounted a metal cap (the kind made for fence posts) on the the support top to protect it from the abuse of cable and line.

Once you decide where the bottom of your dinghy will rest against the dock, screw the two short pieces to it with wood screws or lag bolts. Then screw an L-shaped lag screw into the center of each one of these supports. These screws support the bottom edge of







the dinghy and lock it in place. Force one of the turnbuckle eyes open and slip it through an eyebolt, and close it. If this is not easy task, link the two parts together with a shackle. Screw the eyebolt into the dock at the support base, and about 15cm (6") out from its base. In this location the eyebolt shouldn't be in anyone's way, and will still supply ample leverage. Install one eyebolt to the support top. Another eyebolt installs on the back of the upright support, its location determined by where the top edge of the dinghy rests against the support. This eyebolt mounts above the edge of the dinghy, a few inches below the top of the support.

Insert one end of the wire cable through the eye of the turnbuckle mounted to the dock, forming a loop. Fasten the loop closed with two cable clamps. Feed the other end of the wire cable through the top eyebolt on the support, down to and through the lower eyebolt on the back of the support. Once again, form a loop and fasten with the two remaining cable clamps. Now turn the turnbuckle on the dock until all slack is taken up, putting some tension on the upright support. Perhaps, even putting a slight bow in it. Fasten a cleat at almost any point on the dock side of the upright support. To mount the dinghy, run a line from the support lower eyebolt, around the hull, and through the eyebolt located at the support top, then down to the cleat.
— Donald Boone, Sequim, Washington

PORTHOLE HANGER

If your boat's portholes won't stay up when opened, here's a cheap and easy-to-make solution. Fashion 5cm (2") square hardwood blocks, two per porthole. Drill and countersink for required fasteners to hold blocks to the deckhead (or cabin side). Drill a 3mm (1/8") hole in the center of each block and countersink this hole on the wrong side to allow space for the knotted cord end. Cut 3mm (1/8") cord in 15cm (6") lengths or so, allowing extra for knots on both ends. Thread a line through each block and finish with a stopper knot.

Mount blocks to the deckhead at an angle to the porthole hold-downs (see photo on page 20). Hold the porthole open and mark the cord for placement of a 1/2-round plastic drawstring ball, the kind typically placed on jackets and available at fabric stores. Thread

the cord through the holder and tie a stopper knot. Provided blocks are mounted so the angle of the cord puts tension on the portholes, these hangers should hold in all but the roughest of waterways.
— Jan Mundy

UNIVERSAL LPG TANK HOLDER

We use petroleum gas (LPG) to fuel our stove and barbecue onboard our boat. It's a good choice as it stores compactly, burns cleanly with a high heat output and is readily available. [Ed: Refer to "A Boater's Guide to Propane," in DIY 2000-#4 issue for detailed information on LPG installations, standards and operating procedures.]

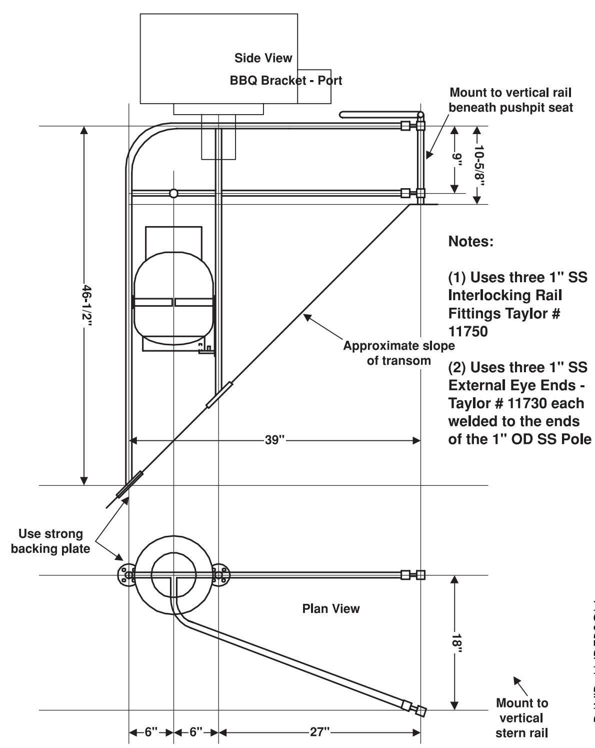
Tank storage is limited on many production boats, often consisting of only a single 4.5kg (10lb) tank housed in a vapor-tight and vented compartment. Adding a LPG heater for our six-month cruise of the East Coast created a need for more fuel and our planned ports of call suggested limited access to tank refills.

There were three viable solutions to our problem: find a location to install an additional enclosed and vented LPG storage compartment; modify the anchor locker; or store an extra tank in an exterior location. We rejected the first solution due to lack of a suitable location, while the second choice impeded access to the windlass and our dual anchoring system. That left the third alternative.

LPG tanks need to be well secured. Vibration is inherent on boats and tanks that are not well secured can tip, become damaged and possibly leak. To provide safe secure storage for the spare tank, I designed a holder made of 2.5cm (1") OD 316 stainless-steel tubing. It mounts to the transom and stern rail, and holds a 4.5kg (10lb) cylinder and accommodates the barbecue as well. A local metal shop fabricated the holder, the tank-retaining band and foot lip. Pigtails allow fueling the barbecue either from the spare tank or, using a special tee, from the main tank.

While specific to our boat, the design is readily adapted for use on most power or sailboats. Should you not want or need a transom-mounted holder, an existing or additional stanchion is easily modified to accommodate a tank. It's surely a better and safer solution than lashing a tank to something onboard — the ocean has a habit of claiming such items!

— David Anderson, "Stand Sure," Toronto, Ontario



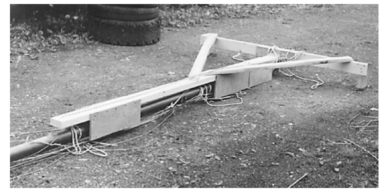
EASY MAST HOIST

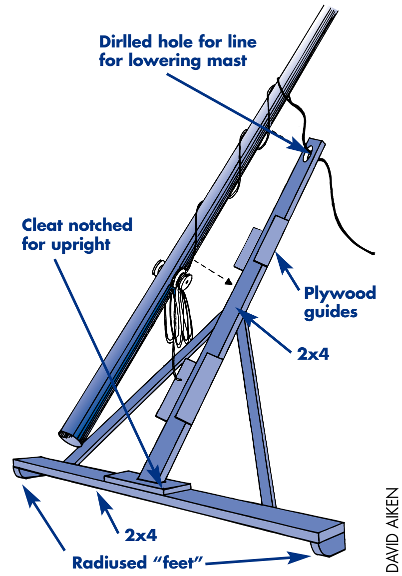
One aspect of the annual commissioning of small cruising sailboats and one-design dinghies that consumes a substantial amount of energy and effort is stepping the spar. Although most fiberglass trailer sailors have hinged masts stepped on deck, a number of older one-design and some smaller cruisers feature masts stepped through the deck. The usual procedure with such a yacht is to muscle the mast up by brute force, then drop it down through the partners onto the step. With a light but still unwieldy 8.2m (27') Lightning spar, this can get a little hairy. I've seen it done solo, but prudent sailors and women likely require two or even three people for the job.

I experimented with a number of semi-successful (and in one case spectacularly unsuccessful) versions of gin poles using my 7m (23') cruiser and 5.8m (19') Lighting as experimental platforms. Then I crossed tacks with a sailor whose grasp of geometry exceeded my own. Thanks to his mathematical intuition, I perfected my mast lifter for small sloops and catboats up to 6.7m (22') with keel-stepped spars. It can be rigged easily afloat or with the boat on land. This design is almost certainly not original, but I've never seen it used before.

This mast lifter consists of a 2.4m (8') long, 2x4 attached to an approximately 1.2m (4') base to form a tee. The base has a small base foot on each end made of 3.8cm (1-1/2") scrap and cut in a radius to allow it to roll through 90°. The longer vertical piece attaches to the center of the base with its wider face in line with the length of the base. To reinforce this joint, lay a piece of plywood over the base and notched to accommodate the vertical support. Two pieces of 9mm (3/8") plywood, about 15cm (6") wide and 30cm (12") or so long, attach to the sides of the vertical support at its top and bottom. These serve as guides to help hold the spar in place against the lifter. Drill a hole in the top of the lifter to fit the spar lowering line. In designing your lifter watch for cleats or protrusions on the mast that could get hung up on the side guides as the mast slides
down into place.

The routine described here for





putting the mast up assumes two people, though on a Lightning-sized boat given a little finesse, a solo act seems feasible. Having created your mast lifter, lay your spar on deck with the butt slightly aft of the step. Place the lifter on the spar's bottom end, lining up the butt with the base of the lifter. Lash the butt loosely here so it can slide. Securely tie a line on the spar near the top of the lifter, and then run this line through the drilled hole at the top of the lifter and down to a secure attachment point and tie off. When you raise the mast to vertical, you'll use this line to lower it through the deck down onto the step.

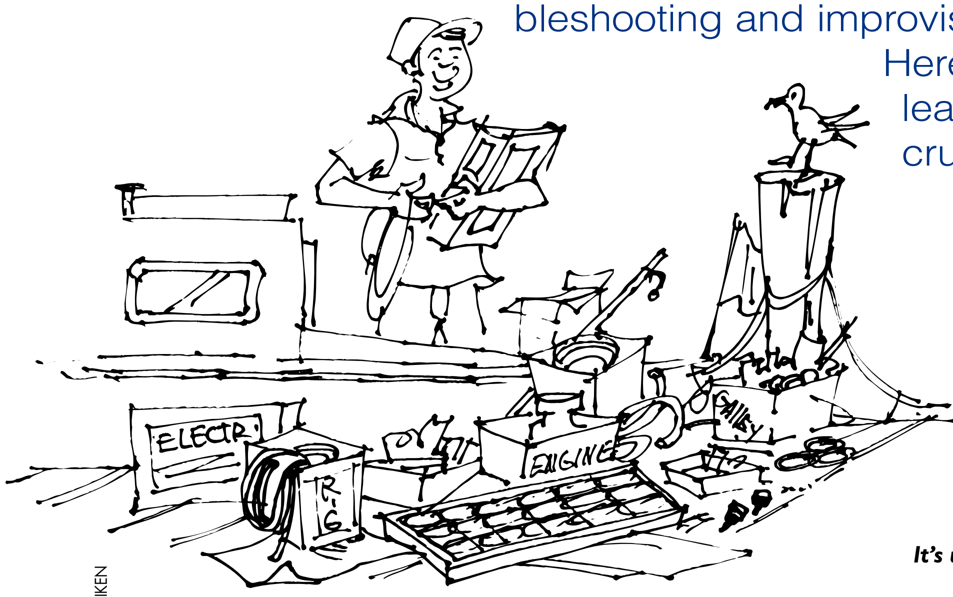
If the boat and spar are light and small, you can get away without securing the outboard ends of the lifter base, but lashing them to the chain plates is probably prudent. Remember to tie them loosely enough so the base can rotate through 90° on its footings. Now have one crew stand in front of the base with it tight against the ankles. This keeps it from sliding forward during the lift. Crew two starts walking the spar up as usual. As the mast goes up, the lifter base will roll on its radiused footings moving slightly forward. The mast lifter with its wide base eliminates that nasty tendency for side to side action during the raising that otherwise can so easily lead to things going really out of control. The person doing the muscling has a far easier time keeping things where they belong and in alignment. And the crew person whose legs are keeping the lifter base in place can also rig a line to the lifter top and run it forward through a fairlead or bow eye and then pull on it. Running the line through a block forward gives more leverage. Once the spar is up, simply uncleat the lowering line and lower away down onto the keel.

With a bigger heavier spar, it might be possible to add a gin pole for greater lifting leverage, and you could rig a backstay of sorts to the lifter to help keep it from tipping past vertical. That with a line also running forward would increase control even more than the set up described. For aging boomers, singlehanders, and short people this lifter makes a heck of a lot of sense!
— *Susan Peterson Gateley, Wolcott, New York*

Upgrade

SPARE PARTS HARMONY

Doing-it-yourself demands that you plan for the inevitable by securing the parts, learning about installation and troubleshooting and improvising when necessary. Here are some lessons learned from two veteran cruisers.



DAVID AIKEN

It's useful to have backups to everything and backups for your back up. Spare parts and tools for every job are necessities for the self-contained boater and limited only to available space onboard.

By David and Zora Aiken

On our first extended cruise, we traveled from Michigan City, Indiana, to the Florida Keys aboard a 8m (27') sailboat. In the two months it took to complete the trip, we lost an anchor, broke the prop and cracked the transom. The steaming light burned out, the halyard winch fell off the mast, and in general, we scared ourselves more often that we care to recall. The boat was new to us, as were we to the cruising lifestyle.

Perhaps we were not personally responsible for all the incidents. Things happen, and we learned how little we knew and how poorly prepared we were. We found out the hard way that, even along the Intracoastal, there are many stretches of waterway where help is not readily available and parts are scarce. A malfunctioning alternator led us right off the chart and up a side creek to a tiny marina whose owner was only too willing to offer expensive assistance. If we'd thought ahead and packed a spare alternator, assuming we also packed the how-to-install instructions, we'd have saved our nerves, many hours and money. All of which was the inspiration for our Plan "B," as in "Backup," mentality.

Backup describes many things. It can be a supply of spare parts, a list of possible alternatives or a different way to achieve a desired result. It can mean built-in redundancy or it can suggest preventive measures. Without wanting to recommend that anyone worry too much about worst-case scenarios, it's unfortunately true that the idea of preparation inevitably forces thoughts about the what-ifs.

Murphy On Board

The tech world keeps giving us smaller and more reliable gadgets that can do more, do it better, and do it faster whether "it" is a location-finder, a motor-maintainer or a power-generator. If something should go awry, the handy pocket cell phone assures instant connection to the friendly neighborhood boat-tow captain, and since that's included in Cover-Your-Transom Insurance, there's no need for a second thought. Make the call, have a coffee.

There's nothing wrong with this, or maybe there's a lot wrong, depending, of course, on your self-image and your conception of "smart." The ability to help yourself out of a jam makes you feel clever, provides a measure of pride and gives you a sense of independence and confidence.

There's no universal problem list for boats. Such must be considered in the restricted context of your boat and the way you use it. Recognize that Murphy (of Murphy's Law where anything that can go wrong, will) loves boats, and the only way to deal with this uninvited crewmember is to try to stay one step ahead, starting with the first rule, Caution: "When the gas tank's half empty, turn around;" and working up to the Oh-No Rule: "What do I do when the rudder falls off?"

Pick Your Spares

The most obvious backup is the inventory of spare parts. When deciding what to carry, consider the kind of boating you do. What do you need to get home or to get help? If your boating style consists mainly of day trips around a small lake, your main concern may be getting back to the ramp or dock before dark. A few spare spark plugs, an extra gas can, or even a little kicker engine, may be the extent of your list. If, however, you're on an extended coastal or offshore cruise, where particular engine parts may be very hard to find, or take a very long time to receive, then your list of spares will be as inclusive as your lockers are huge.

How many things can you stow? Engine filters in food lockers, hose clamps in the first-aid kit — the amount of storage space onboard certainly limits your choices. If you are lucky to have ample space, there is the temptation to carry too much stuff. This is the overkill factor. Don't carry something around so long that it gets rusty, mildewed, or otherwise destroyed before you have occasion to use it. Most boat owners fit at the opposite end of the space spectrum, and items are chosen on a priority basis. For help in establishing priorities talk with others who own the same or similar boat, engine or gear as yours. Common problems are often discovered, giving you at least a hint of what to expect.

Stow your spares according to a general plan of what you'll probably need first. Naturally there's no guarantee that you'll guess right, but most likely you'll need a water pump before injectors, as the case with a diesel engine, so keep the sooners on top of the laters in the seat locker.

Sources

Once you've established a probable list of spares, consider how you'll acquire them. Ordering from manufacturers or catalogs is surely the most convenient way, but it may also be the most expensive. Often, there are alternatives. Many boating communities have at least one source for used gear of all types. When looking for some engine parts, especially if yours is an older model, locate dealers in the area that sell new engines. Contact each dealer and ask if they are scheduled to replace an engine like yours anytime soon. It they are, you may be able to salvage components such as a starter, water pump, perhaps a transmission from the old engine. This strategy worked for us a few years ago, thanks to a lucky meeting with the owner of an outgoing Volvo.

Information Aides

While carrying lots of parts is always good practice (you won't have to wait for delivery), it's only part of the solution if you don't have the know-how, skills or tools to install them. Some people have a natural ability to fix almost everything onboard. Those who are not so blessed need help.

If you plan to cruise extensively, you must learn about the workings of all your boat's systems. Skilled help is not always available, and even when it is, there is the dollar factor. An unexpected engine overhaul or refrigeration recharge can put a huge dent in a cruising budget. In the more popular boating areas, community colleges often offer classes in marine engine repair, local mechanics give seminars or a maritime museum has courses. Some engine manufacturers or distributors offer concentrated weeklong courses on specific models, and/or they may have a video available showing maintenance procedures and simple repairs.

If no such organized classes are convenient, a boat owner can hire a marine mechanic and pay the hourly rate for some hands-on instruction on the peculiarities of your engine or other mechanical systems onboard. Regardless of what instruction you acquire, you should carry owner's manuals for every piece of electrical and mechanical gear onboard, and other reference books. Don't forget your back issues or CDs of DIY!

Record Keeping

No matter how many spares you carry, you should maintain a list or a diagram showing where things are stowed. Put the information on a laptop if you like, but put a hard copy with the boat's papers, too. Keep a current inventory so you won't forget that spare you used four months ago needs to be replaced. You don't need special software. A simple item listing will do. Set up columns to note the model and/or serial numbers, purchase date, when last used, when (if) replaced and possible parts' substitution if the manufacturer's product is not available.

If you are efficient about recording the replacement dates, you'll eventually see some general maintenance patterns emerge, and you'll be more able to predict the approximate time for the next service.

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.

Rigging

DRIVING FORCE

Hydraulic steering systems are easy to maintain provided you heed the warning signs. Read on for details about how hydraulic systems are configured, and how to troubleshoot and maintain them.

By Nick Bailey

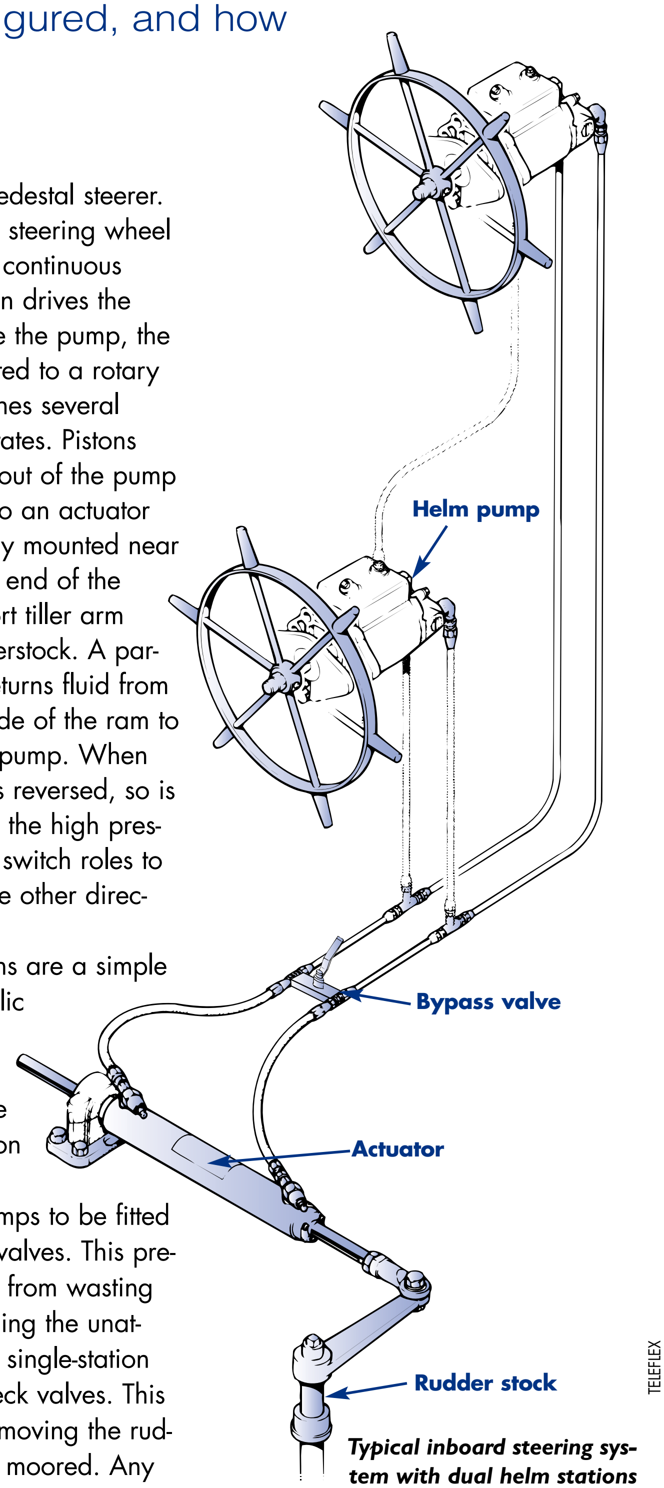
Hydraulic wheel steering is very much the norm in large powerboats. Well-known makes are SeaStar and Capilano by Teleflex, Hynautic by Morse and although Wagner is out of business, Jastram has picked up where they left off. This type of steering also makes sense on a center cockpit sailboat where the helm is a few cabins away from the rudder head. A motor sailor with both a pilothouse and cockpit helm station is also a good candidate for hydraulics.

One big advantage of hydraulic steering on a powerboat is a disadvantage on a sailboat; namely that there is no rudder feedback or "feel." Another disadvantage is that you cannot mark a king spoke on the wheel to serve as a rudder angle indicator. Because there is no direct mechanical connection to the rudder and hydraulics always slip a little, the straight-ahead wheel position varies. This is where installing a separate rudder angle indicator is handy, particularly when maneuvering a boat in close quarters.

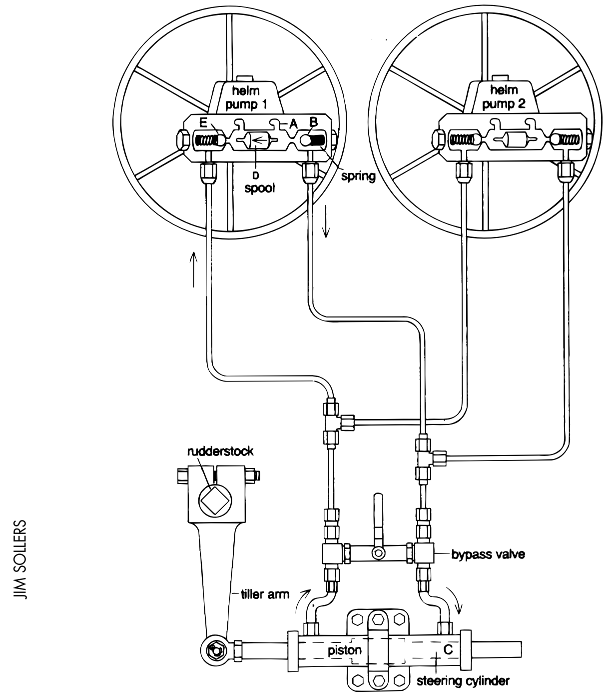
Single and Dual Mechanics

A single-station hydraulic steering system may have the steering wheel mounted directly on the helm pump or mounted on the pedestal steerer. In the latter case, the steering wheel turns a sprocket and continuous chain loop that in turn drives the steering pump. Inside the pump, the drive shaft is connected to a rotary swash plate that pushes several small pistons as it rotates. Pistons force hydraulic fluid out of the pump and through piping to an actuator piston or ram securely mounted near the rudder shaft. The end of the ram pushes on a short tiller arm attached to the rudderstock. A parallel hydraulic line returns fluid from the lower pressure side of the ram to the other side of the pump. When the wheel direction is reversed, so is the pump action and the high pressure and return lines switch roles to actuate the ram in the other direction.

Dual helm stations are a simple addition with hydraulic steering. Plumbing for the pump is teed into the lines from the first pump. Dual-station hydraulic steering requires the helm pumps to be fitted with one-way check valves. This prevents the helm in use from wasting its effort simply spinning the unattended wheel. Many single-station pumps also have check valves. This prevents water from moving the rudder and wheel while moored. Any hydraulic steering with check valves



Typical inboard steering system with dual helm stations and optional bypass valve.



When hydraulic steering fails, a manual bypass valve diverts oil and allows attachment of an emergency tiller to the rudder-post for hand steering the boat.

should also incorporate a manual or solenoid bypass valve to allow the ram to be short-circuited and freed from the system. This allows an emergency tiller to be used in the event of a helm pump failure. Otherwise the check valves and hydraulically locked ram prevent the rudder from manual operation. The bypass valve also allows combinations of mechanical and hydraulic steering. A motor sailor might use a mechanical cable system for the cockpit steering pedestal, but have a second helm station inside the pilot house that uses hydraulic steering on a separate tiller arm attached to the rudder stock. The bypass is opened (usually with a switch or a solenoid) when using the mechanical steering.

Troubleshooting

The basics of isolating a problem follow the same logic as with a cable steering system. [Ed: Discussed in "Steering Tune-up," DIY 2001-#1 for how to troubleshoot, maintain and service cable wheel steering systems.] If the wheel is stiff or difficult to turn, unhook the steering ram at the rudder head, and see if it makes a difference. If the wheel now moves easily, there is a problem with the rudder, possibly a bent shaft or a seized bearing. If the wheel is still difficult to turn (make sure the brake is off), a hydraulic line might be damaged and crimped. If the oil was just changed, incorrect, heavy weight oil may have been added to the system.

If the wheel turns easily but the boat doesn't turn, it's usually due to a loss of hydraulic fluid or air in the system. If a bypass valve is fitted, make sure it isn't open. If there is a second station, and the other wheel is turning, it would indicate that the check valves are bad in the other helm pump. Also check that any wheel driving a remote pump via a chain drive is actually connected to the pump. Some Hynautic dual helm systems on large motor yachts are pressurized. It's often necessary at spring commissioning to pressurize the reservoir with a bicycle tire pump. Loss of air pressure results in no steering at the upper station first. If the ram is moving okay, check that the tiller arm is fixed to the rudder shaft. If so, it could be that the rudder is gone. Time to exercise your jury rig skills.

Tired or wonky hydraulic steering systems are notorious for grossly imprecise steering due to two problems: slip or creep, and sponginess. Slip is caused by a worn ram that allows fluid to leak from the high pressure to the low-pressure side of the ram. Test for this by putting the wheel hard over. It should not slowly continue to turn. The cure for this is to have the ram rebuilt or replaced. Sponginess is caused by air in the system due to residual leftovers from incomplete bleeding or low fluid due to a leak. This can be confirmed by putting the helm hard over then releasing it. If it springs back, this indicates that there is air in the system. Obviously, too much air will lead to a complete loss of steering. Small amounts of air left after bleeding will usually make their way out (see more on bleeding below). Leaks must be found and fixed before using. A leaking pump or ram must be rebuilt professionally or replaced. Failure to correct may result in a loss of steering.

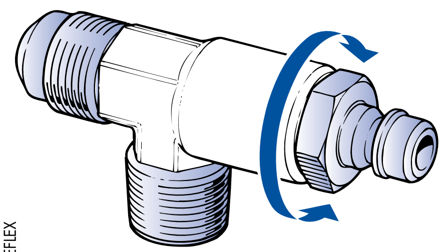
Fill and Purge

If so equipped, the pedestal chain drive and wheel shaft bearings will need periodic lubrication. For details, see the maintenance section in "Cable Steering" in DIY 2001-#1 issue.

Check the oil level in the reservoir occasionally and top up the fluid if needed. Be very careful not to introduce any dirt into the system while doing this. Dirt is what wears out pumps and rams. Be careful to use only the correct oil to top up. Never use brake fluid or engine oil. If the fluid looks dirty or shows signs of water contamination, the whole system should be drained, refilled and bled.

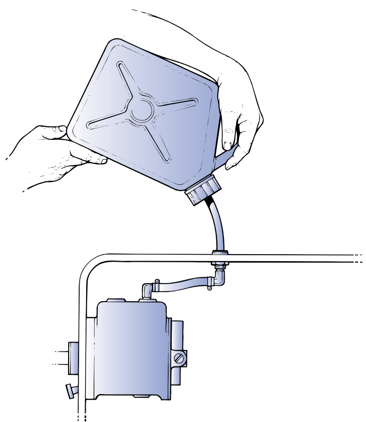
To do this, you will need two lengths of clear plastic hose sized to fit snugly over the bleed nipples on the ram cylinder. These are the bleed hoses and they should be led to a 1-gallon bucket or larger with enough oil in it to keep the ends immersed. This is to avoid sucking air back into the system at the ram. To fill the system, you will need the correct oil and a clean funnel attached to a piece of hose (or oil bottle assembly kit). The hose should fit snugly into the pump reservoir fill fitting.

If there is a reservoir separate from the pump, fill it first with hydraulic oil starting at the lowest pump reser-



TELEFLEX

Common cylinder bleed fitting.



TELEFLEX

Filling and bleeding is simplified with a refill kit that consists of an oil filled bottle with hose that screws onto the helm filler hole, available from some manufacturers.

voir if there is more than one in the system. (Some dual station systems may have the lower pump vent connected by hose to the upper pump's drain. This simplifies filling, as you only need to fill at the top pump). Insert the funnel and hose at the helm pump and have an assistant stand by at the helm with an adequate supply of proper hydraulic oil. Check owner's manual for oil specifications and capacity.

Make sure cylinder bypass valve is closed. Open the bleed screw on the pressure side of the pump for the particular wheel direction with which you wish to begin (i.e. turn to starboard). Make sure your cylinder bleed lines are in position, and have your assistant begin to slowly turn the wheel while, at the same time, keeping the fill funnel topped up with fluid. Meanwhile, down at the ram, air and fluid will be expelled through the bleed line. Keep turning the wheel until the bubbles stop coming. Close that bleed screw, open the one on the other end of the cylinder, and turn the wheel in the reverse direction. Continue until the bubbles stop and close the bleed screw. Finish topping up the helm pump, and reinstall the pump fill cap.

Bleeding hydraulic steering can be frustrating. The steering may still feel spongy, which indicates trapped air. This residual air can be difficult to purge, but usually works its way out over time. You can help the process along by turning the wheel from hard over starboard to hard over port, holding in each position for one minute, and repeating up to 10 times. Top up the fluid if necessary. A noticeable drop and rise in oil level indicates that air is still in the system. If all else fails, you may have to bleed the system again. ⚓

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

OF SEALANTS, THREAD LOCKERS & ADHESIVES

Select the right gasket sealant, thread locker and adhesive for your marine engine.

By Robert Hess

Choosing the correct gasket sealant, thread lockers and adhesives for your marine engine can be complicated. Industry leader Loctite has a catalog that lists at least 17 liquid gasket sealers alone.

These products fall into three main groups: aerobic, anaerobic or room temperature vulcanizing (RTV). The designation depends on the chemical reaction that makes them congeal (curing, drying or setting) after application. Most products remain at least slightly pliable to allow for movement of components.

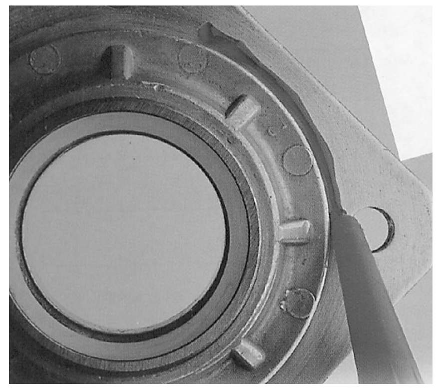
Aerobic products congeal in the presence of air. Traditional paints and sealers are solvent-based aerobic products, and until recently, were the only types of engine sealers and adhesives available. Because aerobic materials don't cure quickly and effectively where there is little or no air, such as with a sealed joint between two castings or between fastener threads, cut paper, cork and other materials are used for engine gasketing. In order to create an effective seal, sealant often remains soft and pliable, a bonus only when sealing low pressures. Hardenable aerobic sealant is usually used solely on semi-permanent rigid joints, such as plugs and internal threads, where there is no movement and a long congealing time is acceptable.

Modern anaerobic products congeal in the absence of oxygen. Their low viscosity effectively seals components with very small clearances. Such products "wick" into tiny spaces, such as pre-assembled threaded fasteners, and tightly sealed joints. They are capable of sealing higher pressures (and in many cases higher heat) than aerobic products.

Liquid RTV products made from silicone compounds are increasingly replacing paper and cork gaskets in low-pressure applications in the engine manufacturing and repair industry, especially when there is a requirement to seal large gaps between components. They congeal when the acetic acid (one of their components) boils off in the presence of air. RTV sealants cannot seal high pressures when filling large gaps in an assembly and generally, cannot withstand temperatures higher than 315°C (572°F). If the acid is released while the sealant is congealing, it can corrode internal engine components, especially those made of aluminum. Some types of RTV sealants release silicone that can contaminate emission control oxygen sensor elements. There are, however, non-corrosive and sensor-safe RTV silicones available.

In most cases, sealants and adhesives are designed to be applied to a clean, oil-free surface. Manufacturers often sell a primer specifically made to prepare the surface to enhance the performance of their product. Many mechanics use brake cleaner spray as a substitute generic primer to clean parts before applying sealants.

Gasket Sealants



LOCTITE

Gaskets installed between components quickly bring the finish tolerances up to the required specification, as calculated to prevent leakage, without using expensive machine tools.

For marine engine applications, the perfect gasket material must be oil, glycol, seawater and fuel resistant, free of ozone-depleting substances, and resist surface contamination by oil and shop chemicals. It should be a low viscosity gap filler, flexible enough to withstand major joint and flange movement and/or vibration and impact. It must be slow congealing to allow time for part placement and torquing, but fast tacking to allow for vertical use and to reduce the cure and wait time before equipment is operation ready. The material needs to withstand high torque, crush and clamp load applications, and be resistant to high heat (exhaust manifolds can reach temperatures of 815°C/ 1,500°F). Materials should last longer than cut gaskets before cracking or blowing out, and be brightly colored to facilitate visual inspection during and after assembly. Finally, it should be non-corrosive and sensor-safe.

Aerobic liquid gasket sealer material, commonly called "gasket shellac," was once used to seal cut paper gaskets to resist oil, fuel and other chemicals, as well as to hold both paper and cork gaskets in place to prevent "blow-out" (cork gaskets absorb some of the sealing liquid so they swell and create a firm seal). The term "Permatex" became synomanous with gasket cement as a result of the popularity of the Permatex company's popular Aviation Form-a-Gasket, a semi-hardening aerobic liquid gasket cement. Before installing a cut paper or cork gasket, this liquid is applied to only one side of the assembly casting (usually the cover or removable section). This allows easy removal for inspection and/or adjustment without ripping the gasket. Sometimes gasket shellac is applied to both sides of critical inner gaskets. Often this material is used to seal threads of cylinder head studs, pipe fittings and other internal engine fasteners that protrude into components which contain liquids, such as engine coolant water jackets, oil galleries, compressed air system components, etc. Despite the fact that Permatex (now allied with Loctite) and other manufacturers offer a wide range of more effective sealers, Aviation Form-a-Gasket continues to be used by many veteran mechanics.

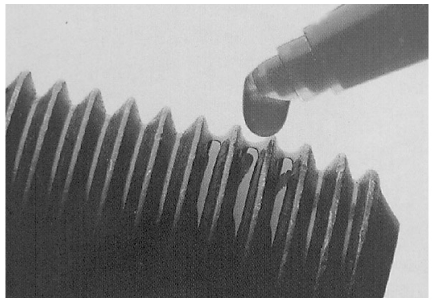
Precut paper, cork, copper, steel sheet, asbestos and other traditional gasket materials have, in the past 20 years, been replaced or augmented with new anaerobic and RTV silicone liquid gasket sealers. This reduces manufacturing and aftermarket inventory costs, and in many cases, has increased the equipment reliability. In severe duty applications, liquid gasket sealant is capable of compensating for different expansion rates between cast iron and aluminum engine components much better than cut gasket material. Robotic application of RTV silicone and anaerobic sealant during manufacturing (called "form-in-place gasketing") is a common procedure. Eventually, this technology must be duplicated during repair and rebuild, since cut gaskets will not be available from the manufacturer.

Pipe Sealants

Besides sealing pipe threads, the real use of pipe sealant is to prevent galling or seizing of the pipe joint, since the tapered feature of pipe threads means threads in good condition are self-sealing. Most pipe thread sealants contain Teflon or similar anti-galling lubricants. Similar to traditional non-hardening aerobic gasket sealants, pipe sealant seals rough or damaged threads, yet allows the joint to be tightened when required to stop leaks.

Thread Lockers

Thread lockers prevent loosening of threaded fasteners and are also used as a gasket material to stop leakage at threaded fastener threads, and in some cases, to allow for future disassembly by sealing threads against intrusion by foreign



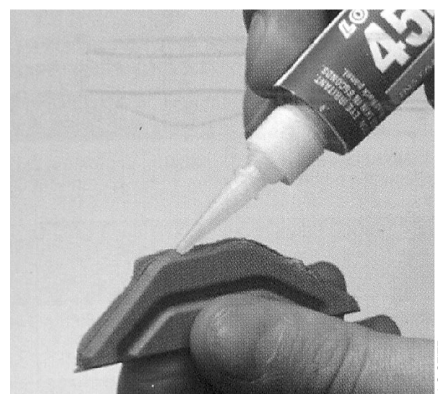
liquids that could cause corrosion and/or seizure. For example, saltwater could migrate into the threaded joint, and corrode the metal until it seizes. Gasket sealer, grease, and Never-Seize or Tef-Gel lubricant is also used for this purpose.

Although many fastener failures could be prevented by correct lubrication and torquing during assembly, a high proportion of equipment failures are caused by loose nuts and bolts, even when they are torqued correctly.

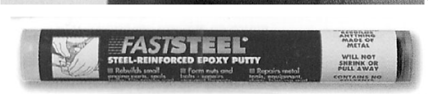
Before the invention of liquid sealant products designed specifically to lock threaded fasteners, it was common in industry to “stake” semi-permanent cap screws and nuts after final tightening by using a sharp punch to cut the threads and lock them together in order to prevent them from loosening. The aviation industry pioneered thread locking by drilling a hole in the head of each fastener and using thin, multi-strand, stainless-steel lock wire to prevent it from turning. [Ed: It’s still common practice to lock wire transmission coupling nuts on inboard engines.] In the ’70s, Loctite’s invention of liquid anaerobic thread locker led to the development of a wide range of products for specific applications. The latest developments are surface-insensitive materials that work on inactive, plated and oily surfaces without primer.

There are four main classes of thread lockers packaged in industry standard colors: red for permanent, large fasteners; blue for removable, medium fasteners; green for pre-assembled fittings; and purple for small adjustment screws. Thread lockers are also available with different heat ratings, based on the four classes. Many engine manufacturers now use Loctite #266 (red, high heat) to ensure the reliability of critical internal fasteners.

Adhesives



LOCTITE



Steel-reinforced epoxy putty sets in minutes.

Traditional aerobic acrylic and rubber-based adhesives are still used to fill inner voids, strengthen loose press fits, bond metal assemblies, and join dissimilar materials (i.e. rubber and metal). New anaerobic sleeve-retaining adhesives, including high-heat compounds developed from anaerobic thread lockers, are increasingly used to improve locking and seal and fit when assembling press-fit sleeves, seats, flanges, casings and shafts. Most Loctite sleeve retaining materials are colored light green.

Epoxy technology has led to the development of epoxy mixed with carbon steel, stainless steel, aluminum, and bronze or titanium powder called metal-filled epoxy adhesive. Epoxy compounds are created by the combination of two components that, when mixed together, form a very hard material that can withstand high heat and vibration. Metal-filled epoxy is used in equipment repair as both an adhesive and filler, since it's easily machined, much like light metal. It can be filed, drilled, and painted, as well as manipulated to create complicated molds, but in most cases, cannot replace original metal because it cannot be tapped with reliable threads.

About the author: Robert Hess operates Atomic Four Engine Service in Vancouver, British Columbia, and specializes in rebuilding Universal gas and diesel engines.

Recommended Usage

Locking large fasteners (over 3/4") that are only removed during major overhaul	Loctite #262, red
Locking small fasteners (1/4" to 3/4") and fasteners that are regularly removed during servicing	Loctite 242, blue
Locking very small fasteners and setscrews	Loctite #222, purple
Gasket sealant for stamped assemblies with large gaps	Loctite RTV Ultra Black
Gasket sealant for rigid castings and flanges	Loctite #510
Gasket sealant for cylinder head and manifold studs	Loctite #262 or Loctite #510
Gasket sealant for holding cut paper and cork gaskets in place	Aviation Form-a-Gasket
Joint retaining fluids for locking shaft drive flanges, valve guides, pressed joints	Loctite #609
Gasket sealant for sealing steel pipe threads	Loctite PST
Gasket sealant for sealing stainless steel pipe threads	Loctite 567
Gasket sealant for sealing hydraulic pipe threads	Loctite 545
Primer	Loctite N7649

COMPASS POINTS

A professional compass adjuster pilots you on a course of compass selection, installation, calibration and adjustment, including readability, compass performance and care, and how to avoid magnetic compass errors.

By Robert Hempstead

Until the mid-50s, commercial fishermen navigated in all weather conditions with little more than a magnetic compass, a sounding device or a lead line, and an alarm clock. Radar or loran A units were found aboard only the largest trawlers. These seamen knew what to expect from the currents on the familiar runs to and from their fishing grounds. In those times, they might adjust the compass every time the trawler changed from one mode of fishing to another, as this could involve a change of gear with a different magnetic field that could cause new errors in the compass.

Today, we have GPS, radar, electronic chart plotters and autopilots. Why then is a magnetic compass so important? The answer is quite simple. Electronic navigation instruments are only aids to navigation, not substitutes for it. When they fail, you must rely on traditional dead reckoning like the fishermen of the past. Because of its simplicity, the most important navigation equipment you have is the magnetic compass.

This discussion is limited to non-ferrous vessels and the spherical-type liquid filled compass (with a globe shaped dome) that features a gimbaled card suspended inside.

Select Readability

When selecting a compass, you need to consider card size, mounting location, visibility and your voyaging intentions.

The larger the compass, the easier it is to read and the steadier the card. This is true because a larger compass has a longer period of oscillation than a compass with a smaller card. This translates into selecting the largest compass that space and your wallet can handle. I installed a high quality 15cm (6") spherical unit on my 10.3m (34') boat. The advertised size on a compass usually refers to the apparent diameter of the card. Larger compasses are generally manufactured to a higher standard of precision, are capable of higher accuracy, and their higher cost reflects these characteristics.

Terminology

Adjustment: the process of eliminating compass error.

Card: the compass part imprinted with the heading graduations, commonly referred to as the dial.

Built-in correctors (BIC): an assembly, in the base of the compass, of two brass or aluminum rods with magnets that can be rotated to create a magnetic field, equal in strength but opposite in polarity to the boat's disturbing magnetic field, thereby eliminating compass deviation.

Cardinal points: N000°, S180°, E 90° and W270°

Course over ground (COG): the track over ground of the vessel's course vector combined with leeway and drift vectors.

Dead Reckoning: Determining the position of a vessel by adding to the last fix the vessel's surface course and speed for a given time.

Deviation: the angle between the compass heading and the corresponding magnetic direction. The differences caused by the magnetic influences onboard the boat, and that change with the boat's heading.

Intercardinal points: NE45°, SE135°, SW225° and NW315°

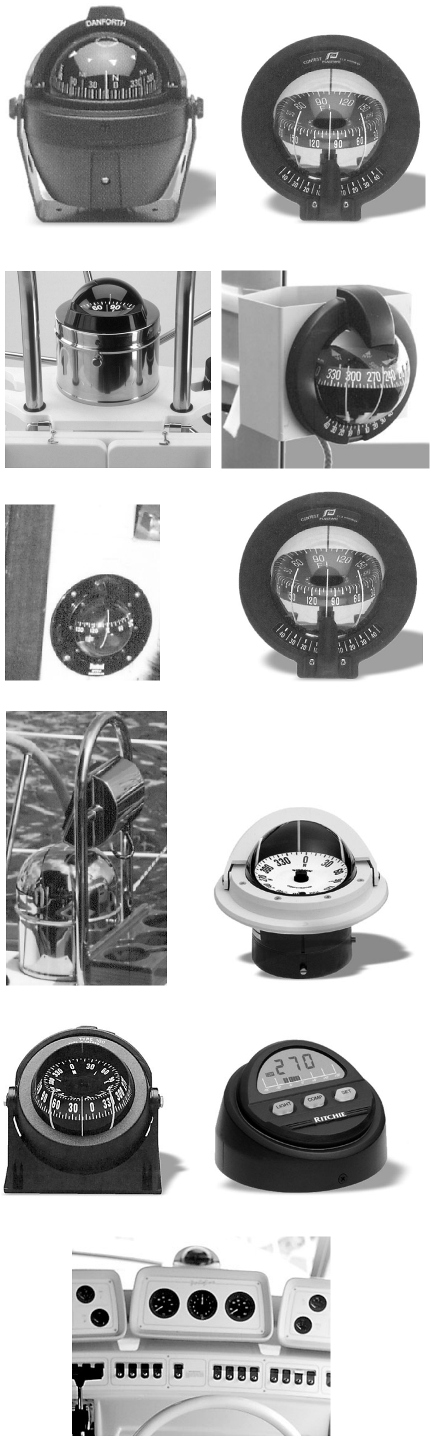
Lubber line: the vertical white reference line on the forward edge of the compass bowl where the user reads the heading.

Magnetic dip: the angle between the horizontal and the lines of force of the earth's magnetic field at any point.

Pelorus: a device with a compass-like card and rotatable pointing and sighting vanes used to take bearings.

Swinging Ship: the process of placing a vessel on various headings and comparing magnetic compass readings with the corresponding magnetic directions to determine deviation.

Transient Deviation: changes in deviation resulting from variance in the magnetic potential of a disturbing field source or its change in position in relation to the magnetic compass.

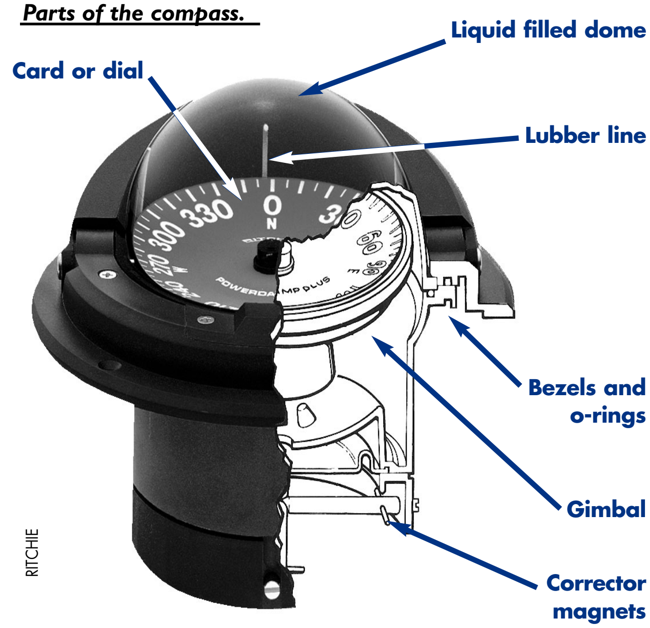


Compass mounts: (top left to right) removable compass on a fixed bracket; dual reading compass allows both flat or direct reading so one can steer when sitting or standing; binnacle compass mounted on steering pedestal; dual compass flush mounted on mast bracket; bulkhead compass enables reading from the cockpit or cabin; binnacle mount with protective cover; tactical sailboat compass with 45° lubber lines and sun shield; no-spin card powerboat compass with solid bracket permits various mounting options, even on the headliner; electronic compass; surface mount with direct reading dial.

If your boat has dual steering stations, and you have two compasses of different sizes, install the larger compass at the principal operating station. If both stations are used equally, install the larger compass at the flybridge helm station, as this compass has better resistance to the more severe motion.

The ever-increasing crowd of electronic equipment has invaded the compass' rightful space directly ahead of the helm. This has challenged compass manufacturers to develop models that deliver a readily visible heading indication and fit within the available space. One such model is a "direct reading dial" compass. This compass card has graduations on the card skirt (the vertical outer face of the card with the heading graduations), and is read on the aft face of the skirt (the side nearest the observer), where the lubber line is also located (similar to an automobile or small airplane compass). This model is often selected when the mounting surface is such that a conventional flat card compass would be impossible to read due to its height. The direct reading feature, however, causes a sacrifice of two of the primary advantages of a conventional spherical compass. Magnification of the graduations that occurs when viewing the heading on the far (forward) side of the card is lost, possibly reducing the precision of heading indication. The card skirt is closer to the inside surface of the compass dome, which detracts from the card's ability to settle if the vessel is yawing in a seaway. Where possible, select a conventional, flat-card spherical compass with card graduations read against a lubber line at the forward face of the dome.

Parts of the compass.



Most stock boats are outfitted with a builder-supplied compass. In many instances, a purchasing agent selects the compass, and a carpenter or similar craftsman installs it. Neither of these well-intentioned people is likely to possess the specific knowledge to make the best selection or exercise the necessary precautions in installation. Most builders will gladly accommodate your specific request, or allow a credit if you provide your own compass for expert installation.

Southern Balancing

Magnetic dip is seldom considered or even understood when selecting a compass. An undisturbed magnetic compass indicates magnetic heading by way of the directive magnets attached to the compass card. These magnets align themselves with the earth's magnetic lines of force. Only on the magnetic equator — an imaginary line on the surface of the earth, generally within about +/-10° of the geographic equator, connecting all points at which the magnetic dip is zero — are these lines of magnetic force horizontal. At any other latitude, these lines of magnetic force dip towards the nearer magnetic pole. The closer one approaches these poles, the greater the angle of magnetic dip. Unless otherwise specified when a compass is manufactured, the card is balanced by attaching a counter weight so that it rests level at the manufacturer's latitude. This compass will operate without excessive dip in an approximate latitude range of +/-15° to 25° of its location of manufacture. If the compass is of U.S., European or UK manufacture, no difficulties should be experienced sailing in the northern hemisphere to about 10° north of the equator. A compass balanced for northern latitudes will dip excessively, and not perform satisfactorily, when used on a voyage into the South Pacific or below the equator.

If planning a voyage into the southern hemisphere, select a quality compass directly from the manufacturer and specify the cruising region and latitude range so that the manufacturer can balance the compass card for the mid range of latitudes. The card will dip approaching either extreme of this magnetic range, but it won't hang up from excessive dip.

Another option for covering a wide latitude range with less dip problem is to purchase two compass capsules for one binnacle housing. Each capsule would have its card balanced for the mid hemisphere of its use. As long as the compass corrector system is housed in the binnacle, and not attached to the compass capsule, there would be no change in deviation, since the swapped compass capsules are acted upon by the corrector system identically.

-Tip- Refillability

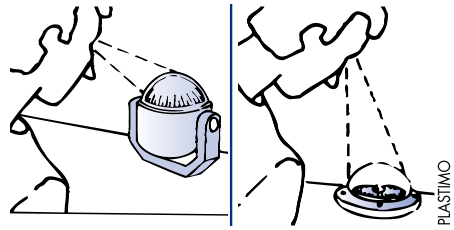
Refilling a compass is a simple matter of adding fluid as long as the compass is not hermetically sealed. It's imperative to add the correct fluid, and that it be done under immaculate conditions. A bubble will likely reappear if the reason for the loss of fluid is not corrected and the compass is not pumped in a vacuum chamber for 15 to 20 minutes at up to about 24" hg of vacuum. This should be done by an approved repair facility.

Pre-Use Inspection Steps

Before purchasing a new compass or relying on an existing one, it's very important to assess the condition. To evaluate its condition, you can perform the following tests.

1 Check for stickiness.

Position the compass on a non-magnetic surface like a wooden table or a similar magnetically hospitable environment. Allow the compass card to come completely to rest. Turn the compass very slowly to bring one of the heading graduation marks on the card into precise alignment with the lubber line. If rotated slowly enough, the card should remain absolutely stationary with no visible drag. With the card graduation mark at rest in precise alignment with the lubber line, introduce a mildly magnetic device, such as a knife or screwdriver, close enough to the compass so it deflects the card only about 1° from the lubber line. Now, remove the device and observe carefully to see that the card returns precisely to its original position relative to the lubber line. Do this test deflecting the card in both directions, clockwise and counterclockwise, either by placing the magnetic device on the opposite side of the compass or inverting it. You are checking for sensitivity on the card's jewel movement suspension. Reject this compass and try another if the card sticks even slightly. If the sticking is severe enough, not only will an accurate adjustment be impossible, it will also be difficult to keep a course. If this condition occurs in an existing better-grade compass, it's cost efficient to overhaul it rather than purchase a new one.



Types of compass cards: (left) flat card allows heading observation at the forward edge of the card against the lubberline when below eye level ; (right) Heading on a direct reading card is observed when above eye level on the aft skirt surface.

2 Check for a bubble in the top of the dome.

Loosing compass oil is caused by: an aged or badly seated O-ring between the dome and compass bowl; a crazed dome that has developed a crack completely through to its inner surface; a failed diaphragm; or a leak at the filler plug (where oil is injected into the compass). A compass with a bubble should be serviced promptly to prevent condensation from forming in the air space and corroding the card.

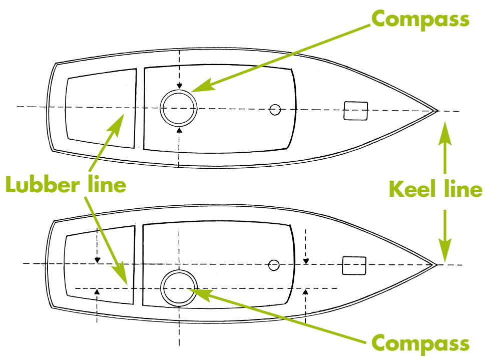
3 Check the dome for crazing.

With few exceptions, the domes of modern spherical compasses are Lexan. Because of this material's large coefficient of expansion with temperature changes, domes fatigue over time, crazing and eventually cracking. The deepest cracks generally develop near the bezel ring at the base of the dome. Crazing can also develop from locked up stress in the injection molding process used in forming the compass dome. This commonly causes cracks across the top of the dome. You can prolong dome life by covering your compass to protect it from UV when not in use (see "Compass Coveralls" on page 39).

Better quality compasses are repairable at a manufacturer's authorized service station. Check the owner's manual for locations. The repair of such a compass is usually much less costly than replacement.

Installation Basics

If the compass is a binnacle (compass in a raised cylinder) or flush-mount (recessed into a console) model, it must be installed on a horizontal surface. If the location of choice is slanted, such as on a flybridge, a wedge (fabricated base of wood or epoxy) under the compass must be fashioned beneath the compass to create a level surface. If the compass is a bulkhead mount model, it must



DAVID AIKEN

When mounting the compass off center, be sure the compass lubber line is aligned exactly parallel to the boat's centerline (or keel).

have a vertical mounting surface that is also at right angles to the fore and aft line. The purpose in either case is to ensure that the built-in corrector system (BIC) is positioned squarely under the center of the compass. Without this precaution, it will be difficult to adjust the compass with the BIC.

There are a few basic and essential steps to take when installing a compass. The wire provided for the compass lighting should be made long enough to allow the compass to be lifted clear of its mounted position by at least 46cm (18") without cutting the wire. An alternative is to use quick-disconnect fittings (i.e. Ancor Products Posi-Loc Connectors) on the wires. Use stainless-steel (nonmagnetic) mounting screws or bolts. When attaching the compass base to an aluminum steering pedestal, grease the stainless bolts with an anti-seize lubricant (i.e. No-Seize, Tef-gel) to reduce corrosion from dissimilar metals. Be sure the compass is aligned parallel to the boat's keel.

A leveling block is often required on a slanted bulkhead to provide a vertical surface for installing a bulkhead mount compass. Further shaping of the leveling block may be required if the mounting surface is not at right angles to the keel.

Twisting the two leads of DC wiring that pass close to a compass will greatly reduce the DC current-caused magnetic field affecting the compass.

If mounted on the centerline, simply sight the lubber line at the boat's stem or forestay. If mounted off to one side, transfer this distance from the centerline to a position well forward. Mark that location with a strip of masking tape or similar object visible from the compass, sight the lubber line on it, then secure the compass in that alignment.

Magnetic Detraction

Whether you are installing a shelf-mount binnacle compass, flush-mount compass or bulkhead compass, the rules are the same. You must select or create a stable magnetic environment within sensing distance of the compass. True, you or a qualified compass adjuster can adjust the compass to cope with the deviation (see "Preparing a Deviation Table" on page 39) caused by the boat's magnetism and the equipment onboard, but you will never be able to correct those items that vary their magnetic potential and polarity. Better to observe the following precautions.

Equipment whose magnetic field is prone to vary should be kept away from the compass. Radios generally have magnets in both their speakers and in their hand microphones. These should be kept at least 61cm (24") away from the compass. Avoid installing stereo speakers within 1.5m (5') of the compass, even if on the inside of a bulkhead or deck. Unless the bulkhead and deck are steel, the magnetic field from the powerful speaker magnets will not be stopped by non-ferrous surfaces. Keep all non-compass DC wiring at least 61cm (24") away from the compass. A greater distance is preferred if the wiring is carrying over 5 amps. Navigation instruments that have analog displays of the voltmeter type and recording depth sounders (old-fashioned paper type) should be kept at least 46cm (18") away. Most equipment with digital displays have small, if any, detectable magnetic fields and may be mounted closer to the compass. Radar's effect on the compass varies with the model. The display unit typically will have negligible effect on the compass if kept further than 61cm (24") away. However the transceiver generally houses the magnetron, a very powerful magnet, and must be kept more than 1.8m (6') away from the compass. Avoid installing sheet steel furnishings like refrigerators, microwaves, etc. within 1.2m (4') of the compass to avoid frequent changes in compass deviation caused by the transient nature of the magnetism in sheet steel. If you have a helmsman's chair installed, make sure that it's made of nonmagnetic materials.

Transient Deviation

Sometimes it's impossible to keep all equipment, whose magnetic fields might vary, at a sufficient distance from the compass to avoid transient error.

Electric windshield wipers, for example, if closer than .9m (3'), have two magnetic fields that affect the compass, the natural field from the components of the electric motors when stopped and the electro-magnetic field when operating. Because the compass corrector magnets are set for a fixed condition of deviation, a compass adjuster can only correct for a stationary field. Consequently, the initial adjustment is made with the wipers turned off and the deviation resulting when the wipers are turned on recorded on a second deviation card. This error, like all deviation, varies with heading.

Radar or recording sounding units cause compass error due to their magnetic components and, if installed

SHORT ON FLUXGATE

Increasingly popular, fluxgate compasses, in addition to providing a digital (and in some cases analog) presentation of the boat's heading, can at the same time input heading into the radar, autopilot and chart plotter using the NMEA 0183 (or newer NMEA 2000) protocol. If properly installed in a magnetically hospitable environment, the heading information may be less prone to developing the transient deviation so commonly found in a poorly located conventional steering compass. If the magnetic environment is suitable, the fluxgate compass performs best if installed as near as possible to the longitudinal centre of flotation. Its displayed headings are least disturbed by vessel motion in that position. Because the fluxgate sensor is located in a magnetically hospitable environment, the heading display unit can provide heading information at the helm station unaffected by the array of other electronic instruments adjacent to it. However, as an electronic instrument it can be crippled from a number of causes, and should never be considered a stand-alone or replacement for the conventional, simple, reliable magnetic compass. A fluxgate is fine for all the previous reasons and as a telltale check on your steering compass, but it's imperative that it be correctly situated.

closer than 61cm (24") to the compass, could be a source of transient magnetism between on and off conditions. When turned on an additional electro-magnetic field causes another error, which varies with the heading. A radiotelephone mounted within several feet of the compass also causes a temporary transient field each time the microphone is keyed, since the radio draws a substantial amount of DC current when transmitting.

On a sailboat with the engine only 1.5m (5') or so below a steering pedestal-mounted compass, the engine alternator can cause a variable deviation. First, there is the field due to the energizing of the alternator exciter when the engine is turned on. Superimposed on this field is a magnetic field whose intensity varies with the magnitude of the charging rate. At 1.8m (6'), with the alternator cut back to only a trickle charge (the usual underway condition), the deviation would seldom exceed +/-2° for a 35-amp alternator. Start a DC electric refrigerator or air-conditioner compressor, thus increasing the load and therefore the alternator's charging rate, and deviation value increases. Again, this transient field causes deviation that varies with the DC current load and compass heading.

Another common cause of transient deviation in sailboats is the outboard motor clamped to the stern rail 1.2m to 1.8m (4' to 6') aft of a pedestal-mounted compass. The outboard flywheel incorporates a very powerful magnet (its magneto) to facilitate the ignition spark. At such a short distance from the compass, this magneto will not only cause deviation, but also the deviation will vary if the outboard is returned after use with the flywheel magneto stopped in a different position than the previous. The change in magneto orientation not only changes the headings on which deviation is caused but the magnitude as well. Prior to adjusting or calibrating the compass, clamp the outboard to the rail mount in its normal alignment position. Remove the flywheel cover and mark the position of the flywheel relative to the housing. Whenever an accurate compass (in agreement with the deviation table) is required, reposition the outboard to its normal alignment, remove the flywheel cover and return the flywheel to the marked position. This repositions the magnetic field to the orientation set for adjustment or calibration.

It's not possible in this discussion to list all the likely sources of transient magnetism, however, the examples given should logically lead you to other likely sources that may exist on your boat.

Preparing a Deviation Table

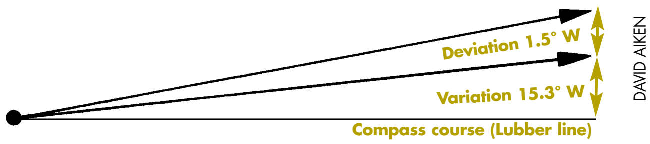
After you've created a hospitable magnetic environment for your compass, checked DC electrical circuits, movable magnetic material for transient deviation, and compass condition and alignment, you're ready for the calibration or adjustment.

You will generally be well served by engaging a professional compass adjuster to adjust your compass. Because he (or she) has all the necessary equipment and experience, there will likely be few problems that he has not already encountered and learned to overcome. If the deviation is small, you may feel comfortable with simply "swinging ship" (calibrating compass) to determine a table or graph of deviation without attempting to adjust the corrector magnets to cancel out the deviation.

To prepare for swinging ship, select the "magnetic" heading instead of "true" heading from the setup menu on a differential GPS (DGPS). There is normally a toggle between the two options, provided it's preprogrammed with the world variation model (most are). To create a table for recording your deviation, draw three columns on a sheet of lined paper. You will record the compass heading in the left column, the corresponding DGPS magnetic course over ground (COG) in the middle column, and the difference (deviation) in degrees between the two in the right column. The following describes two ways to develop a deviation table, one using a DGPS, the other by transiting a range.

Method 1: Although not the system employed by a compass adjuster, the following procedure, if done carefully under the right conditions while allowing time for both the DGPS and compass readings to settle, will provide a table of deviations generally within +/-2° of accuracy.

Pick a day and time with little wind, and no surface current or wave action. Choose a location in a protected body of water large enough and relatively free of boat traffic. You will need to maintain the various compass headings at about 6 knots for close to 5 minutes on each of eight equally spaced compass headings (N, NE, E, SE, S, SW, W and NW). The length of time on each heading run should be long enough to allow



Compass deviation caused by the boat's magnetic field is determined by observing the difference between the compass heading and the boat's corresponding magnetic direction. Deviation is labeled W'ly if the compass heading is greater and E'ly if less than the magnetic direction.

the DGPS COG to settle on a steady value. Be certain that none of these heading legs bring you near the magnetic field of a steel bridge, moored ship, cargo handling terminal or similar. A run no less than 0.3 miles from such sources is generally safe from their local magnetic influence.

To reduce the risk of changing deviation from transient magnetism, position all gear with a likely magnetic component in its normal seagoing position. Turn on your usual navigating instruments, radios, radar, running lights and any other equipment with wiring near the compass that are likely to be on when you most need compass accuracy. Record these conditions of calibration on your deviation table.

In your chosen area of operation, maintain a steady compass course on a cardinal (N, S, E or W) heading for about 4 to 6 minutes. For example: begin on a compass heading of 000°(N) and observe the course made good over ground (COG) on the DGPS while holding the selected compass heading steady. On your deviation table, record the difference in degrees between the average COG on the DGPS display and the course held by the compass. If the magnetic DGPS COG is greater than that held by the compass, label that deviation value "East." If you were to then plot this magnetic course on the chart, it would be necessary to steer a compass heading this number of degrees less to maintain the charted course direction. If the DGPS magnetic course is less than the compass heading, label that deviation value "West." This would require steering a compass heading the recorded number of degrees greater in order to proceed in the charted direction. If the DGPS and the compass are in agreement, you have no deviation on that heading. Repeat this procedure for each cardinal (N, S, E and W) and intercardinal (NE, SE, SW and NW) compass heading, recording the deviation and labeling East if the DGPS COG is greater, and West if less than the compass heading.

The deviation on headings between those observed will be an interpolation between the observed deviation on either side.

For a tighter deviation table, observe errors at every 30°, 20° or even every 15° of the compass. Remember that the DGPS course displayed is the COG and is the result of the heading of your boat combined with any leeway from wind or drift from current. Do this in only ideal conditions and be sure to allow time for the DGPS COG to stabilize to a steady value.

Method 2: A deviation table may also be constructed by transiting, on the various compass headings, a range line drawn through two accurately surveyed positions, such as a harbor entrance range, and observing the bearing of the range by sighting over the compass card at the moment of coincidence of the two targets. The headings taken by the compass are the same as described in Method 1. The deviation is the difference between the charted magnetic bearing of the range and that observed by sighting over the compass card. To allow the compass to settle after turning to a new heading, the approach to transiting the range line should be long enough, at least 300m (984') before the two targets come into range.

Calibrating Polarity

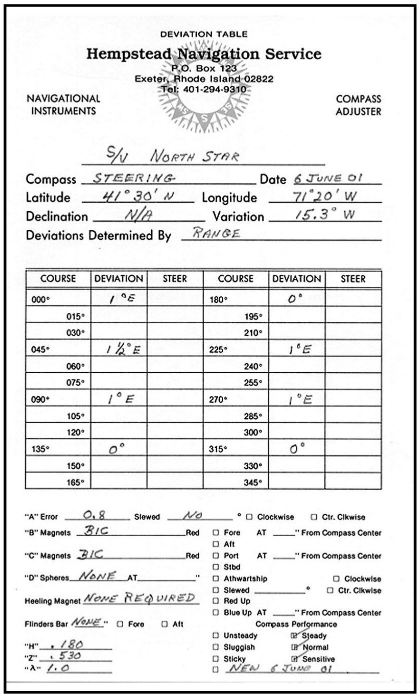
If you feel comfortable with the previous discussion and have the patience with the systematic, detailed procedure that follows, you may accomplish a quite satisfactory compass adjustment provided the magnetic environment of the compass is acceptable and the deviation is not too great. By this I mean a deviation of less than 22° near the cardinal headings (N, S, E and W). The reason for this restriction is that most built-in correctors (BIC) are limited to correcting error not much in excess of 22°. For deviation greater than this amount, adjusting the compass requires additional magnets, a condition beyond the scope of this discussion. As I assume that you don't have a bearing taking instrument aboard, such as a pelorus (US$700) or surveyor's transit, the DGPS or range transiting method for determining deviation will be the system described.

-Tip-

Caution: Repair, or Replace and Readjust

If your compass needs repair and you are uncertain whether to replace it, repair may be your best option. If it has had its corrector magnets adjusted to your boat's magnetic field, a repair can usually be accomplished without disturbing the BIC magnets. The cost of repair is generally less than half the cost of replacement. However, it is best to request the repair facility to take care to avoid disturbing the BICs. Replacement means you'll have to adjust the new compass yourself, or absorb the cost of a professional adjustment.

Typical deviation card for a 10.6m (35') sailboat.



DEVIATION TABLE

Hempstead Navigation Service
P.O. Box 123
Exeter, Rhode Island 02822
Tel: 401-294-9310

NAVIGATIONAL INSTRUMENTS — COMPASS ADJUSTER

S/V NORTH STAR

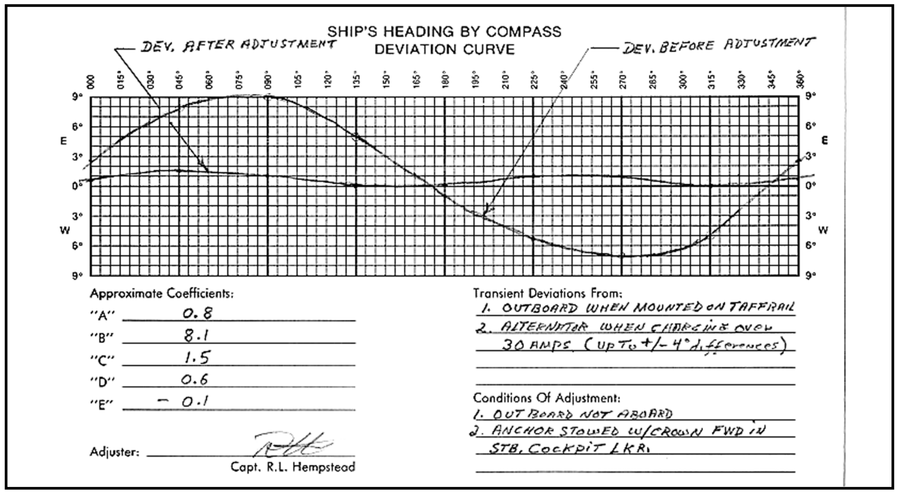
Compass STEERING Date 6 JUNE 01
Latitude 41° 30' N Longitude 71° 20' W
Declination N/A Variation 15.3° W
Deviations Determined By RANGE

COURSE	DEVIATION	STEER	COURSE	DEVIATION	STEER
000°	1°E		180°	0°	
015°			195°		
030°			210°		
045°	1½°E		225°	1°E	
060°			240°		
075°			255°		
090°	1°E		270°	1°E	
105°			285°		
120°			300°		
135°	0°		315°	0°	
150°			330°		
165°			345°		

"A" Error 0.8 Slewed NO ° ☐ Clockwise ☐ Ctr. Clkwise
"B" Magnets BIC Red ☐ Fore ☐ Aft AT ____" From Compass Center
"C" Magnets BIC Red ☐ Port ☐ Stbd AT ____" From Compass Center
"D" Spheres NONE AT ____" ☐ Athwartship ☐ Slewed ____° ☐ Clockwise ☐ Ctr. Clkwise
Heeling Magnet NONE REQUIRED ☐ Red Up ☐ Blue Up AT ____" From Compass Center
Flinders Bar NONE" ☐ Fore ☐ Aft

Compass Performance
☐ Unsteady ☒ Steady
☐ Sluggish ☒ Normal
☐ Sticky ☒ Sensitive
☐ NEW 6 JUNE 01

"H" .180
"Z" .530
"λ" 1.0



Approximate Coefficients:
"A" 0.8
"B" 8.1
"C" 1.5
"D" 0.6
"E" − 0.1

Adjuster: Capt. R.L. Hempstead

Transient Deviations From:
1. OUTBOARD WHEN MOUNTED ON TAFFRAIL
2. ALTERNATOR WHEN CHARGING OVER 30 AMPS (UP TO +/- 4° differences)

Conditions Of Adjustment:
1. OUT BOARD NOT ABOARD
2. ANCHOR STOWED W/CROWN FWD IN STB. COCKPIT LKR.

Front (left): The adjuster records the location, date, particular compass, variation and method of adjustment. The table documents the deviation corresponding to the compass heading after adjustment. On the bottom of the card the corrector settings are entered and notes on compass condition and the earth's magnetic values for the location. **Back** (right): Numbers across the top of graph are the boat's compass heading. Numbers at the sides label the magnitude of deviation. The graph with the large amplitude is the boat's deviation before adjustment, the nearly flat graph is after adjustment. The deviation curve plotted after adjustment is characteristic of a sailboat compass installed on a steering pedestal with the engine 1.8m to 2.4m (6' to 8') away. **"Approximate Coefficients"** is for entering the five primary coefficient values. This is done by a professional compass adjuster who wishes to break down the deviation curve into the components comprising it. This is not for the amateur. **"Transient Deviations From"** lists the equipment that can produce changes in deviation when turned on, such as windshield wipers, an alternator charging at a high rate, and outboard or other portable equipment mounted close to the compass. **"Conditions of Adjustment"** defines the parameters existing at the time of adjustment. If the navigation lights, for example, produce a change in deviation when turned on (transient deviation), the adjuster may elect to adjust the compass with the lights turned on and enter that condition under this heading to remind the navigator that this is a necessary parameter for the deviation card to be valid.

BIC systems almost universally consist of an assembly of two brass or aluminum rods positioned near the base of the compass with one rod aligned fore and aft and the other athwartship (both horizontal). Short magnets are inserted parallel through holes near the rod ends. These ends are slotted and sometimes covered with plastic caps that are pried off to access the BIC rods. Adjustment is achieved by turning the rods using a nonmagnetic (brass) screwdriver (normally supplied with a new compass). Rotating these rods raises one set or the other of opposing magnetic poles depending on the direction in which the rods are turned. The purpose of BIC is to set up a magnetic force acting on the compass card directive magnets equal in intensity but opposite in polarity to the boat's disturbing magnetic field causing the deviation, thereby balancing it. Compasses are generally shipped from the factory with the rods set with the correcting magnets lying horizontal and thereby creating no deflecting force. In most brands of compasses this may be verified by observing if the screwdriver slots in the rod ends are positioned horizontally.

Make the adjustment while steady on a compass cardinal heading and set the appropriate rod magnets to achieve minimum deviation (agreement between compass heading and DGPS COG). The fore and aft compensating rod is rotated to correct error on the east (90°) and west (270°) headings, while the athwartship rod is set to correct error on the north (000°) and south (180°) headings. Most instructions shipped with the compass detail an adjustment procedure different from the one discussed. This method works satisfactorily, if the preceding checks are observed.

The following method requires no equipment other than your DGPS receiver and a brass screwdriver, is reasonably quick and may be accomplished with acceptable accuracy. Check your compass to see if it's fitted with a locking system for the BIC. If so, back off the screw so there is only light tension on the corrector rods. Carefully rotate each rod 1/4 turn to the right and to the left to confirm freedom of movement but with enough friction to offer a slight resistance. Then return both rods with their slots horizontal to neutralize the stored magnetic field. Follow all the procedures described above for swinging ship. Steady up on the east heading (90°) by compass. After holding course for a few minutes and after the DGPS COG readings have stabilized, carefully rotate the fore and aft corrector rod until compass and DGPS are in agreement. Rotating one way increases the error, rotating the opposite way reduces the error. (Do not rotate either direction beyond 1/2 turn.) Determine the correct direction by trial and error.

Now reverse course and steady up on west (270°). Observe the deviation, if any, and then adjust the fore and aft BIC rod again to reduce this error by 1/2 the amount observed. Record the remaining deviation in the deviation column of your table, noting whether it is East or West deviation. You should now also have the same amount and sign (E or W) of deviation on your previous 090° heading, because you have split the error between the two opposite headings (assuming your compass has been properly aligned).

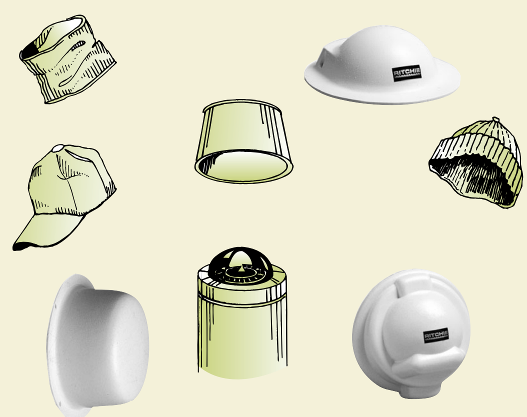
Now come to a compass heading of south (180°) and as described above, to remove all error, rotate the athwartship corrector rod until DGPS and compass readings match. Be sure to allow time to permit the compass to steady and the DGPS to settle on a constant display of the same heading.

Reverse heading to north (000°), again allowing time for displays to settle. As above, correct for 1/2 the error observed, if any, by again rotating the athwartship correc tor rod. Record this remaining deviation. The same deviation value and sign should now exist on 180°.

Following the same procedure described above for

Tip: Compass Coveralls

The goal is to prevent the compass from large temperature variations. Some manufacturers offer white plastic covers with ventilation channels around the base. If you create your own cover, be sure it's a light color, has a means of ventilation and there is an air space between it and the dome. One fabricated from a white Turkish towel makes a good nonabrasive cover, and may be slipped over the compass like a sock.



DAVID AIKEN

swinging ship, observe and record any remaining deviation on the intercardinal headings (NE, SE, SW and NW). Also check the east (090°) and south (180°) headings for any remaining deviation, as these headings were the first to be corrected before halving any error on the reciprocal headings.

Error Check

Now that you have finished the adjustment and constructed a table of any remaining deviations, confirm the accuracy of your work by running several ranges. Sets of accurately surveyed targets on your chart, where the magnetic bearings of any two range lines are near 90° different, will yield the best check.

To do this, carefully head the boat on one selected range heading at slow speed for at least 1 minute to allow the compass to settle after heading changes. Compare the compass bearing of the range with the magnetic bearing you have determined. They should be the same, or differ only by the deviation value you have determined for that heading if you have been careful in your adjustment.

Repeat this procedure with the second range. If running both ranges has yielded compass bearings the same as the plotted magnetic bearing, then the compass will have negligible deviation on all headings.

This adjustment system will not render as good results as may be expected from engaging a professional compass adjuster. Never theless, your compass accuracy will have been improved and you will have gained an understanding of the factors influencing compass performance.

RITCHIE

To balance onboard deviation, most compasses have built in correctors that are adjusted by turning a slotted rod; the East-West (fore & aft) adjusting rod shows at the aft side, the North-South (athwartship rod)on the right side on most compasses.

Compass Care

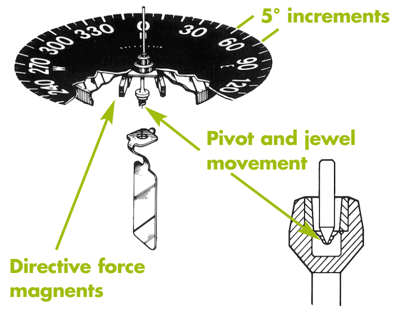
Although magnetic compasses are mostly maintenance-free, there are a few things you can do to extend the life of your compass and the time between overhauls.

When mounting a binnacle compass on a steering pedestal, grease the mounting bolts with an anti-seize lubricant (i.e. Tef-Gel). You (or the compass adjuster) will appreciate this when unfastening bolts to realign the compass or remove it for repair. A drop of oil or similar moisture-displacing lubricant on the corrector rod locking system reduces the likelihood of this system freezing up.

Lighting systems in compasses

mounted out in the weather succumb to corrosion quite rapidly. Unless you have a new compass with shrinkwrap-protected LED lighting, frequent inspection of the lighting system is necessary to assess its condition.

Avoid exposing the compass to shock or vibration. A compass installed on a pedestal steering column in a sailboat, for example, may be exposed to excessive vibration at certain engine rpm. Vibration sources include an engine mounted directly below the steering column, a bent or out of balance propeller, a bent shaft, or structural weakness in the engine bed or cockpit deck. The steering pedestal acts like a tuning fork and amplifies this vibration. Compasses have delicate jeweled movements and vibration causes the pivot in the compass card assembly to pound against the jewel bearing, thus blunting the highly polished pivot radius and scratching or even cracking the jewel. The compass card assembly then loses its sensitivity to indicate small changes in boat heading. If you feel vibration when placing your hand on the compass dome while the engine is running, excessive wear may be taking place. If the compass card appears to periodically chatter, excessive wear is definitely occurring. Try



Vibration damages the pivot and jewel movement, creating stickiness.

to avoid vibration-causing rpm.

With very few exceptions, modern spherical compasses use domes formed of Lexan. These scratch very easily, so never wipe them with anything abrasive. Never wipe with a paint solvent or paint remover to remove paint spatter. Never wipe with a dry cloth unless polishing with an anti-static wax made for acrylic surfaces. Not only will a dry cloth risk scratching by dragging grit or salt crystals across the dome, but a static electric charge build up on the dome surface causes the dial assembly to tip up in attraction and lock in position. Though the static charge discharges in a short time, releasing the dial, you can accelerate discharging by shorting the dome to ground. To discharge a statically alive dome, wet your hand and touch the dome and the mounting base surface simultaneously, maintaining the contact for 10 to 15 seconds until you observe the compass card return to a level condition. Rinse off salt crystals with freshwater. Lengthen dome life by protecting it from direct sunlight when the compass is not being used (see "Compass Coveralls" on page 39).

About the author: Captain Robert L. Hempstead is a licensed shipmaster and pilot of unlimited grade, and a UK-trained and BOT-certified adjuster of ships' compasses. He is also a consultant to, and authorized service station for a compass manufacturer, and has been a professional compass adjuster since 1952 whenever he was not at sea.

-Tip- Pro Fees

Some compass adjusters charge by the size of the boat, some by the number of compasses to be adjusted, some on the basis of time and travel, and most by some combination of these. The average yacht owner should expect to pay between US$200 and US$250, plus the cost of any additional magnets and related travel time. A second onboard compass typically costs an additional US$100. A competent, conscientious compass adjuster may take several hours for the adjustment, in addition to the adjuster's travel time.

GO BARE

A well-built scrubbed teak deck can be maintained with a minimum of elbow grease. Here's how from two veteran circumnavigators.

Liquid dish soap, plastic scrubbers and salt water are almost all you need to maintain bare teak decks.

By Lin and Larry Pardey

Varnished handrails and cabin trim can be serious time consumers and are extremely hard to keep well finished because moisture is always creeping in beneath the varnish at the joint of wood trim to cabin structure. If these parts are teak, we would definitely leave them bare. Vertical surfaces hold varnish better than horizontal surfaces, which get less chafe or direct sunlight.

The maintenance of scrubbed (bare) teak requires no special materials. Liquid dish soap, plastic pot scrubbers and saltwater will be almost all you need to maintain your wood [Ed: Except where the teak has turned black.]. The one piece of gear you don't need is a stiff bristle brush. A brush scratches out the softer summer grain found in most wood, and leaves the harder annual rings standing proud. These ridges aren't attractive, and they can reduce the slip resistant qualities of the wood. The valleys between them trap dirt so you have to scrub them more often, and only a brush will get that dirt out. This reduces wood thickness at an astounding rate. It's possible to loose 6mm (1/4") of wood in three or four years of regular cycles of brushing, sanding, brushing.

The all-around most satisfactory way of maintaining bare teak is a scrubbing with warm saltwater, some dish soap and a pot scrubber. Scrub in a circular or across the grain motion. Try to minimize scrubbing with the grain as the pot scrubber can also press into the softer grain and scratch it out a little. With this method, you should be able to go five years with only slight grooves developing in your edge grain deck or trim. When these grooves get deep, the deck and bare wood parts should be sanded almost flat. Use a belt sander, or do it by hand with 100-grit wet sandpaper. Sand only until the gray in the little grooves becomes visible. This way you remove as little wood as possible. If this lower grain is still black from pollutants instead of light gray, a light bleaching with oxalic acid should return the wood to an even light tan color. We avoid the use of oxalic acid or harsh cleaners on our bare wood. We feel the cleaners pull out the natural oils that protect most good decking woods.

The regular use of saltwater is critical to the maintenance of scrubbed decks. The salt left on the wood attracts moisture and holds it there. Wet or damp wood resists checking and cracking because it doesn't shrink and swell as much. The salt soaks into the soft summer grain. This salt dries and toughens the wood so that the regular wear is kept to an absolute minimum. And finally, salt is a preservative that minimizes wood rot.

The best time to wash down with saltwater is just before dark so the decks and bare wood can absorb moisture all night long. We try to wash the boat with saltwater at least once a week. In hot dry climates, we try for every night.

To clean common deck stains, oil spots, food spots, drips of varnish or paint, we use acetone and a pot scrubber as soon as possible. We rub with the grain only if necessary. We don't try to get every last bit of oil stain out because we find that a few weeks of sun and saltwater does the work for us. The black stains caused by iron tools or tin cans can be removed by soaking the wood with a 5% solution of oxalic acid crystals and water. (If oxalic acid is not available, look for one of the solutions recommended for removing rust stains from sinks.) Repeat the soaking until the stain bleaches out.

About the authors: The gurus of the "Go simple, Go now" cruising philosophy, Lin and Larry Pardey have sailed to more than 66 countries in nearly 30 years of cruising. This article is an excerpt from "The Capable Cruiser," available from Paradise Cay Publications (800/736-4509).

Maintenance

MID-SEASON CHECKUP

Canvas

❐ Examine all seams for broken or worn stitching.
❐ Pour water onto the canvas. If it leaks, it needs recoating (use 303 Fabric Guard or 3M Scotch-gard) or replace.

Electrical

❐ Examine all wiring connections for corrosion and all wire runs for support.
❐ Check condition of battery.
❐ Check operation of electrical equipment (i.e. windlass, water heater, head, etc.)

-Tip- When to Reseam a Deck

When old sealant splits or tears, or separates from the seam edge (bond line), it's time to replace it. Completely remove the old sealant using a reefing hook, router or circular saw, and then vacuum the seams to remove any residue. You must apply a sealant specially formulated for teak. Some products, like 3M Teak Seam Sealant, require application of a primer followed by the sealant. Rabbetted seams require inserting a bond breaker (i.e. 3M Fine Line Paint Striping tape No. 218 or cotton caulking) in the bottom of the seam. This creates two-way adhesion, allowing movement of the joint as the wood contracts and expands. Carefully follow the manufacturer's instructions.

❐ Unscrew incandescent bulbs and check sockets for rust. Apply petroleum jelly or a corrosion inhibitor to protect from corrosion.

Engines

❐ Check for leaks. Place a finger under all hoses and fuel connections. Squeeze all coolant hoses and replace if hard, brittle, soft and spongy or cracked.
❐ Inspect hoses and fuel lines for chafe.
❐ Inspect and/or replace fuel filter and fuel-water separator filter.
❐ Check engine zinc.
❐ Check the exhaust system. Install a carbon monoxide detector system.
❐ Check V-belt tension. Using moderate finger pressure, depress the center of the longest span of each belt. Black rubber fragments below a belt indicate excessive wear.
❐ Examine all wiring connections for corrosion and all wire runs for support.
❐ Check the engine mounts are fastened securely and engine bearers for splits, cracks and, if wood, rot.
❐ Put a wrench on every nut and bolt to make sure they are tight.
❐ Check lubrication chart for mid-season service requirements.

Hatches

❐ Check gaskets and replace if no longer supple. Inspect hinges, supports and latches for corrosion.
❐ Check notches or rabbets that retain the sliding companionway hatch.

Insurance

❐ Read your boat insurance policy. Make sure your boat's coverage hasn't lapsed and is what you think it is. Be sure you have a copy of the insurance papers onboard.
❐ Make sure the insurance coverage evaluation reflects the boat's actual value.
❐ Video tape or photograph your boat with all its equipment, inside and out for the record. Take exterior shots from all points of view.

Plumbing

❐ Squeeze or flex all hoses connected to seacocks and replace if necessary.
❐ Open and close each seacock.
❐ Check all hose clamps for tightness and corrosion.
❐ Clean bilge and inspect limber holes for blockages.
❐ Do a water check. Fill watertight compartments and lockers with water and check for leaks.
❐ Pour water into the bilge and see how long it takes to pump out. Check operation of float switch.
❐ Test cockpit water tightness by placing corks in cockpit scuppers, filling with water, then watching where water exits. Pull plugs and time how long it takes for the cockpit to empty.

Propane Systems

❐ Check all fittings for leaks using a brush dipped in a leak detector solution or ammonia-free soap mixed with water.

Rigging (Sail)

❐ Examine all dock and anchor lines, and running rigging for chafe.
❐ Check mast tuning.
❐ Inspect cotter and clevis pins, threads on turnbuckles.

Safety

❐ Remove lifejackets from lockers and have each crewmember put on one, then go for a swim.
❐ Practice man-overboard drill and rough-weather management.
❐ Check tightness of all lifeline fittings, gate hooks, pulpit attachments, etc.
❐ Find out if your boat or engine has been subject to any safety recalls.
❐ Determine what you should/would do if you knew there was a hurricane predicted in your area.
❐ Make sure your charts are current.

Service

❐ Make a complete list of your boat's equipment; locate all the manuals, and set up a file or a "know it all" reference for your boat gear.
❐ Consider having a marine surveyor do a maintenance inspection.

Steering

❐ Move the tiller or turn the wheel to check for binding or play.

Tanks

❐ Check for corrosion in steel and aluminum tanks around fuel pick up, sending device, inspection hatch.

Dockside

Here's a look at some new products, some old favorites and some solutions to a few maintenance matters.

By Jan Mundy

TAKE A LOAD OFF YOUR BACK

If you're an ardent diver, or you would like to perform underwater maintenance or hull cleaning, take a look at the Australian-built SurfaceDive diving systems (Tel: 800/513-3950, Email: jbellinder@surfacedive.com, Web: www.surfacedive.com). These lightweight, compact systems are sold complete with all the equipment needed for one or two divers to dive to depths of 7m (23') or 12m (40'),

The toolbox size DeckSnorkel weighs just 6.3kg (14lb).

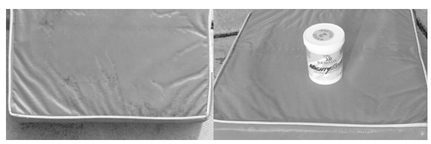
depending on the model. A 12-volt oil less diaphragm pump that is powered by the boat battery supplies air to the diver's demand regulator eliminating the heavy scuba tank. Three models are available. The DeckSnorkel (US$969) and Double DeckSnorkel (US$1,405) for two divers both operate from a deck-mounted container. The PowerSnorkel (US$1,934) is a portable, floating unit with a self-contained 12-volt battery.

Visit DIY ONLINE at www.diy-boat.com

TOP RATED MILDEW REMOVER

Shop Tested

We're always on the lookout for cleaners that remove mildew effectively. Iosso Mold and Mildew Remover (reviewed in DIY 1995-#2 issue) was our favorite, but now drops to second place with Armada MightyBrite (Tel: 800/336-9320) taking top honors as the best product we've tested so far to clean vinyl and laminated cloth. Both are a non-toxic dry powder formula that



Before ***After***

dissolves in water, and then applied and left to "cure" for up to 45 minutes before rinsing off. MightyBrite successfully cleaned a moldy vinyl cushion (see photos), moldy sailcloth and bimini top, though it had no effect on a mildew-stained nylon lifejacket.

WASH WATER ON DEMAND

The Washdown Quick Connect (US$90) from New Found Metals (Tel: 360/385-3315, Email: nfm@olypen.com, Web: www.newfoundmetals.com) provides a simple and inexpensive washdown system. A 316 stainless-steel deck plate fitting mounts flush on the deck. One end of a positive lock bayonet type plastic connector attaches to a garden hose. The other end inserts into the deck fitting for free-flowing water. Double O-rings provide a watertight seal. Connect to a pressure pump with the 12mm (1/2") NPT threaded fitting on the stem end of the deck fitting.

STREAK REMOVER IN DISGUISE

Before

After

You're cleaning the hull and don't have any specialty cleaner to remove black streaks. What to do? Reach for StarBrite Inflatable Boat & Fender Cleaner/ Protector. These photos illustrate the amazing results. Just spray on, wipe off and rinse. (I always rinse thoroughly after cleaning and before the cleaner dries to prevent surface damage.) I'm sure StarBrite would prefer to sell you its Instant Black Streak Remover for this task, but this is one job-specific cleaner that does double duty. Besides, one less cleaner means more room in the locker for other goodies.

HASSLE-FREE MASKING

Shop Tested

Peel and stick this Handrail Masking Tape and you're finished with trying to fit little pieces of tape around

Dockside

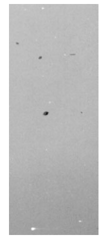
handrail bases to protect surfaces against spills and runs when oiling or varnishing. This pre-cut masking tape fits most handrail bases. Its adhesive allows for repositioning and it reportedly can remain for up to six days without any adhesive transfer. Sold in packages of 12 bases (US$2.98), Handrail Masking Tape is available at BOAT/U.S. and other marine chandleries, or contact Nelson & Niemen Manufacturing at 562/596-0104.

REMOVING TEAK OIL STAINS, GAS-OUT MILDEW

Shop Tested

Three of the most oft asked questions our Technical Helpline receives from owners of fiberglass boats concern rust stains, removing cured teak oil and mildew. I still haven't found a solution to the first problem, though I've applied various solvents, rust removers, paint thinners, detergents and compounds including a hot mustard plaster, toothpaste, tub and tile cleanser, shaving cream and oven cleaner to extract rust stains deposited by a cast iron navy anchor stored for many years in a cockpit locker. I have found a solution to removing cured teak oil from gelcoat and a product that limits mildew effectively.

Teak oils permeate porous gelcoat. What's needed is a product that draws out and absorbs the oil. Solvents, paint removers and fiberglass cleaners actually drive the oil further into the gelcoat. I've questioned various manufacturers of oils and cleaners, but none had a cure. I've tested most of the available marine and household chemicals and cleaners, but all failed. At a



boat show last year a 3M Marine rep handed me a bottle of Sharpshooter with the verbal guarantee that it would readily remove cured oil. Typically used by boat manufacturers to clean molds, because of its chemical makeup, this product is not available to consumers.

Our test boat was spotted with various brands of teak oils spilled on the side decks and transom during 10 years of routine refinishing. As promised, Sharpshooter effortlessly removed the teak oil. Just spray on, scrub lightly, and rinse off. A pity it's not consumer friendly. Prior to this test, I cleaned an old greasy chain saw and its oily plastic case with a new degreaser, Captain Phab Citrus Cleaner/Degreaser (Captain Phab, Tel: 905/706-0583, Web: www.captphab.com). This product beats all degreasers we've tested. Just spray on, let stand for a few minutes, then rinse off. As this product was within reach, I grabbed the can, sprayed it on some teak stains and scrubbed lightly. Much to my surprise, it lifted off the oil (see photos). Best of all, it's available at select marine retailers (only in Canada), though it's possible other automotive degreasers or a bug and tar remover will do the job. As with any cleaning product, it's wise to sample test on an inconspicuous area first, and rinse with fresh or saltwater after using and before it dries.

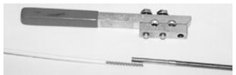
Once mildew takes root, it's very difficult to eradicate. Introduce humidity and the then-dormant spores regenerate to flourish and multiply. DIY has tested various treatments, including vinegar, TSP and bleach solutions, and microbe-based cleaners and preventatives but all failed, likely because we didn't reapply within the recommended intervals. For the first time in 10 years, the gray "bunny fur" headliner in the cuddy cabin of our test boat wasn't dotted black with mildew after a six month lay-up. The antidote was not an ozone generator but StarBrite's MDG Mildew Control Bag (reviewed in DIY 2000-#1, page 34). Hung in the small cabin, this $4 bag contains Aseptrol, a chlorine gas that's toxic to mildew. To ensure success, install one bag for every 37 cu.m (400 cu. ft) of cabin space and replace about every 3 months.

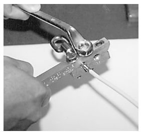
"GREEN" BILGE DISCHARGE

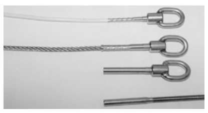
Dumping oil and other petroleum-based chemicals into the sea is illegal and violators are subject to hefty fines. BilgeKleen (US$129) removes oil, gas and diesel fuel, other hydrocarbons and hazardous chemicals from bilge water, allowing the treated bilgewater to be legally pumped overboard. The two-component system consists of a Mycelx filter and filter housing, hose adapters for easy installation inline in the bilge hose between the pump and the outlet thru-hull, and a SmartPad to be placed in the bilge sump to precapture contaminants. The 25cm (10") filter removes pollutants from the water stream to below detectable limits in a single pass and can hold up to a quart before being replaced (US$34). Available from Mycelx Technologies, Tel: 770/534-3118, Email: mycelx @mycelx.com, Web: www.mycelx. com.

DO-IT-YOURSELF LIFELINE INSTALL

Lifeline ends and gates are normally machine swaged by a rigger, and for good reason, as a person being hurled into a lifeline develops a very high impact force. Provided you follow the instructions carefully, you can assemble lifelines or replace broken terminals yourself with the Johnson Marine (Tel: 860/873-8697, Web: www. csjohnson.com) Hand Crimp (US$40, part 53-210). Made of zinc-plated, heat-treated steel, with some effort this handy tool compresses stainless-steel hand-crimp fittings. You'll also need a cable cutter, 12mm (1/2") open end wrench or socket, sharp knife or cable stripper, marking pencil, and 3.1mm or 4.7mm (1/8" or 3/16") lifeline turnbuckles and pelican hooks for gates. To use the tool, loosen clamping bolts, open the die then insert the terminal. Tighten bolts alternately until die blocks are fully closed and you cannot see any light (space) between them. Continue to tighten about five more turns. It's not necessary to apply any extra torque. Loosen bolts and reposition terminal for the next crimp. A total of five crimps are needed, equally spaced about 3.9mm (5/32") apart. It's not a speedy tool, so if you need to press a few, consider purchasing the more expensive, lever-type tool, Johnson part 53-215 (US$192). Hand crimp terminals, when properly applied, have a maximum breaking strength of 70% of 7x7 wire strength, compared to a swage fitting which develops the breaking strength of the wire. When done correctly, hand crimping is adequate for lifelines, but not for standing rigging.





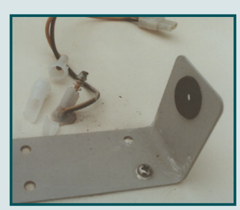


FLARE COMPLEMENT

Due to the high cost of pyrotechnic devices most boaters carry only the legal minimum number of day and night use flares onboard. But in an emergency when you need to be located at night, three night flares (the minimum) may not be enough. ACR's DistresS.O.S. (US$44) is an affordable alternative and one that has no expiration date. It automatically flashes the S.O.S. distress signal and complies with the USCG's non-pyrotechnic visual distress night signal for use on coastal and inland waters. Its more than 50,000 candela of light is visible for 22 nautical miles at sea level. Four D-cell alkaline batteries supply power for six hours of continuous use, and it floats. With a discounted price of around US$30, you can afford to stow one in your ditch kit and one in a handy cockpit locker.

-Tip- Solar Decay

Solar UV rays are extremely damaging to exposed components, especially plastic parts. This plastic fuse holder, attached to an upscale VHF radio mounted on a dash, fractured after a seven-year exposure.



A SMARTER WAY TO BETTER HANDLING

Shop Tested

This simple device improves boat-operating efficiency and handling safety. Plane earlier and more consistently, gain stability in cornering, and enjoy the enhanced ride. There's also the promise of fuel savings.

Story and photos by Jan Mundy

One of our test boats is a 6.7m (22') walkaround cuddy with 16° modified-V hull. Its 1,371kg (4,500lb) hull was somewhat underpowered by a 150hp outboard. A hydrofoil greatly enhanced the boat's performance. The foil improved planing speeds considerably but the boat still ran bow high causing poor forward visibility. Loading the boat with extra cruising gear or crew diminished performance again, especially when cornering, as the boat would dig (list) and engine rpm dropped to where the boat came off plane. Coming out of the corner, the boat gradually gained speed and came on plane again. At wide-open throttle (WOT) it was necessary to trim out the engine to a position where the boat "danced" to achieve top performance. Throttle down too fast and the stern dug in, burying the exhaust outlet on the engine, sometimes stalling it. Trim tabs would obviously improve performance. Albeit small runabouts and nearly all inflatables would benefit greatly from the addition of trim tabs, electric and hydraulic trim tabs are typically designed for larger boats, are considered overkill for small powerboats, and definitely not a necessity for our mini-cruiser.

Smart Tabs from Nauticus appear to be a performance solution for runabouts. Affordably priced and easily installed with standard tools, the operation of these tabs is fully automatic and self-adjusting. Just three models fit boats from 3m to 6m (10' to 20') in length and engines from 8hp to 175hp. Our test boat was beyond the load rating of the largest model (ST1290-80), but within the horsepower limits. Considering the possible performance rewards, we decided to install a set.

These tabs operate much like shock absorbers. Trim plates are installed at a downward angle to the transom and attach to a gas actuator. Throttle up and the plates remain in the "down" position, providing lift at the stern while lowering the bow angle. As speed increases so does water pressure and when the pressure exceeds the actuator load rating, the trim plates raise up to a horizontal position. This "lift" period is determined by each model's load rating and trim plate adjustment when installed.

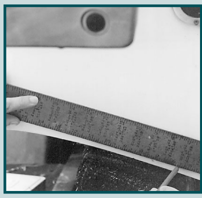
Installation

Installation is simple. These mechanical tabs require no complex wiring or routing of cables. The only tools needed are a drill, two bits (1/8" and 3/16"), a Phillips screwdriver and two wrenches or a socket set. The boxed kit includes two stainless-steel trim plates, (ours measured 30cm x 22cm/11-3/4" x 8-3/4") all fasteners and hardware, two 30.4cm (12") nitrogen gas actuators, a makeshift trim indicator, installation and operation manuals, and sealing tape, though we opted to substitute 3M 4200, a fast cure polyurethane sealant. Allow at least one hour to plan and layout the proper tab placement, 20 minutes to assemble the components and 45 minutes to install both tabs. With cockpit, baitwell and fishwell scuppers, a speed transducer, kicker motor mount and half-swim platform brackets to avoid, positioning the plates and transom brackets on our test boat took longer than on a lesser equipped boat.

Test Drive

Before relaunching, read the operation instructions carefully. Setup varies with the boat's transom angle and power-to-weight ratio. Too much pressure and the tabs behave as brakes, affecting steering and handling. Be sure to temporarily mount the string-band trim indicator to confirm the tab placement when running. When the boat planes, the plates should be fully up. If they rise before the boat is on plane, or remain down at cruising speed, you'll need to adjust the lift pressure by moving the actuators in the slotted brackets.

Since tabs will change the way your boat handles, approach the initial test run with caution. Begin by throt-

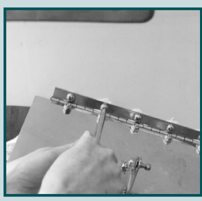


Draw a line 12mm (1/2") up from the hull bottom. Solvent wipe the mounting surface to remove wax and contaminants.

Position the lower edge of the trim plate on the line and mark the screw holes.

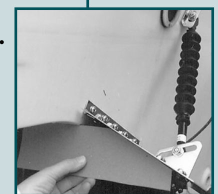
Drill holes for machine screws. Use a drill depth guide or masking tape wrapped around the bit at the appropriate depth.

Use supplied sealing tape or liberally apply sealant.



Mount and securely fasten the trim plate. Remove excess sealant. Be sure no sealant remains on the hinge.

Place a square along the top edge of the trim plate and inline with the plate actuator bracket, then draw a vertical line. Position the actuator along this line and mark the mounting holes for the transom bracket. Drill fastening holes, degrease with solvent, apply sealant and mount the bracket. Snap on the actuator. Repeat steps to install the other tab.



Attach the actuator to the trim plate bracket. Use the supplied template to mark the position for the transom bracket. This mounts the trim plate at a 25° angle downward angle to the keel.

Completed installation. Transom and plate brackets are slotted to allow fine-tuning of actuator positioning. Mid-point placement is recommended for the initial test run. As our boat was stern heavy, actuator ends were moved higher in the slot to increase the lift.

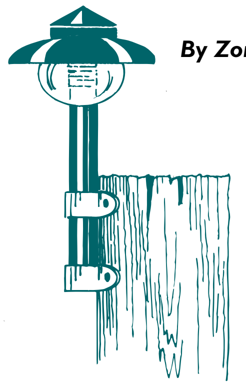
Install the supplied string and rubber band trim indicator to confirm proper up-down tab position during the test ride.

tling up slowly to test the handling. A boat with faulty tabs can be dangerously unstable. Once you have the feel of the boat throttle up and enjoy the ride. The differences detected in our boat's performance and handling were remarkable.

In timed runs, with two people onboard and running in a slight chop, the boat averaged 0 mph to plane in 9 seconds with barely noticeable bow rise. As the boat slowed, the tabs lowered automatically to maintain a level ride. Even at 1/4 throttle, bow rise was eliminated. (It was actually amusing watching the string indicator.) A smooth transition from idle to on plane and back, and level flat turns all enhanced the ride. Top-end speed gained 5 mph without trimming out the engine excessively. Minimum cruising speed while maintaining plane was a scant 15 mph, compared to 26 mph in calm seas without the tabs. Cornering at full speed resulted in a loss of 4 mph only, and the boat remained on plane! There was a slight noticeable loss in directional control when backing up due to drag. We had no tools to determine the fuel economy but the manufacturer claims a savings of up to 20%.

If you own an inflatable or runabout that could benefit from better handling, Smart Tab kits retail for US$130 to US$200 and are available from marine stores or call Nauticus toll-free at 1-800/233-0194.

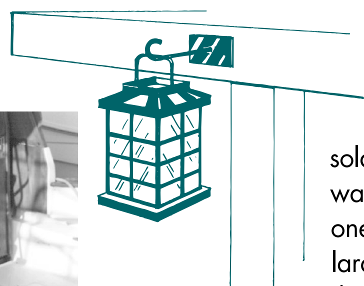
Good Boatkeeping

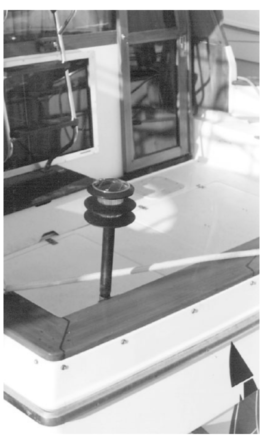


By Zora Aiken, illustrations by David Aiken

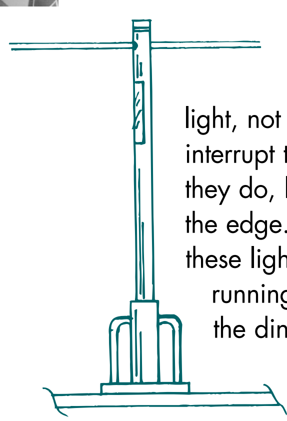
LET THERE BE LIGHT

When the dock lights quit, and there's no moonlight, the simple act of boarding your boat can be dangerous, especially if the dock is wet or worse, icy. You should leave repairs to the marina's wiring to the experts, but you can probably find a spot to install a small solar light, the kind sold for house walkways. Put one atop a bollard and it provides enough light to illuminate the edges of the dock and the boat's deck. Mount one in each corner of the cockpit to easily see where it's safe to step. On a houseboat, use one as a "porch" light.





Small solar lights radiate a yellow-orangish light, not bright enough to interrupt the night sky, but they do, literally, show you the edge. Never substitute these lights for anchor or running lights, even for the dinghy.



Another lighting aid doesn't actually glow, but it will capture and amplify a flashlight's beam. Reflective tape is practical for many applications. Put a few strips on the hull sides and transom of the dinghy so you can locate it easily after an evening ashore. Create an original design so you can distinguish your dinghy. Put a strip on the lifeline stanchion closest to the place where you normally board your boat. Of course, you already have some tape on PFDs and foul-weather jackets. Then there's the mooring buoy. Use is limited only by your imagination.

WALK A PLANK

If the dock doesn't float, the tide's really low, and you're toting groceries, boarding becomes a challenging balancing act. Remedy the situation with a boarding step. This is not a permanent gangplank. Use it only for those occasions when an extreme low tide may have placed the boat too low for comfortable reach, or docked it too far out for a safe leap.

Start with a piece of 12mm (1/2") exterior plywood, at least 30.4cm (12") wide and long enough to accommodate a worst-case low tide, allowing extra length for a safe overlap at the dock end. Glue and screw three strips of pressure-treated 2x2s lengthwise to the underside of the plywood, then add some 1x2s crosswise on the top of the plank to function as foot-stoppers when the plank is on a steep incline. Drill a couple of holes in the boat end of the plank. Tie a loop of line through each one and slip the lines over a cleat, winch or whatever is convenient to secure the plank to the boat and extends onto the dock. Add some substantial padding to the boat end, such as a small fender or some dense foam rubber to protect the deck finish.

For a fancier touch, use teak or mahogany for the board. In any case, don't leave the board in place when it's not needed, since it doesn't have the required wheels or fixed attachments that allows it to shift position safely like a real gangplank. Paint your boat's name on the board, just so no one can assume it's marina property.

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.