1997 - #4 (WINTER)

DIY boat owner

the MARINE MAINTENANCE MAGAZINE

Features

REPLACING A RUB RAIL

Damaged or badly worn rub rails are easy to replace with universal parts. Here's how.

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INSULATING CABIN INTERIORS

Tired of clammy interiors? Install a cabin ceiling and cure the condensation blues.

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For additional information on working with StarBoard and other StarBoard projects, refer to DIY 1996-#4, 1998-#4, and 1999-#4.

TALKBACK Q&A

A Slipping Cobra

Q: I have a '88 Bayliner Bow Rider 5.7m (19') with a 3L OMC stern drive. The outdrive slips slightly under load in forward under acceleration. The clutch and gears then "settle" into a position and run normally. The clutch is a $350 part and before I sign up for a lower unit rebuild ($1,000 plus), I want to make sure it will fix the problem. Was this a common problem with OMC outdrives of this era and is the price of this part legit or is this an inflated cost? It's the single most expensive part in the whole lower-unit gear case.
Greg Foster, Elkins Park, Penn.

A: There was a recall of the shift cable on the '88 Cobra outdrive. If the cable was never replaced, then this is probably the root of your problem. Cost for a new shift cable is CDN$130. If the shift cable was updated, then it's possible the lower unit is out of adjustment or the forward unit and the dog are worn. If the engine has been operated for many hours with the gears not engaging properly, it's likely the gears are damaged. The clutch is now sold as a gear kit (CDN$589, depending on the model). You may be able to purchase a clutch from an aftermarket parts supplier, but it won't match the gear set as the original set was discontinued. You'll also need a $75 seal kit. OMC's book rate specifies one hour to replace the shift cable and five hours for the complete rebuild. Total cost is CDN$794 plus labor. U.S. parts prices are about 30% less.
— RF

Fiberglass Crazing

Q: Our '75 Grampian 30 sailboat has a lot of crazing in the gelcoat. Is there a paint or coating that will cover this? Grinding out each crack with a little grinder is not practical because there are too many. Some people have suggested that we just leave these cracks alone as the boat will outlive us anyway. However, we have heard horror stories about balsa core rotting if the crazing is left unchecked.
Frank de Vries, Stella Maris, *Spragge, Ont.*

A: Presumably your whole boat, including the topsides, hull and deck, are suffering from crazing, which is also known as spider cracking, star cracking or stress cracking. The cause is usually the same for all types: Thin laminates (to save weight and increase performance) and flex. The gelcoat is not as flexible as the underlying fiber-reinforced resin and over-bending results in hairline cracks. There is no elastic paint or coating that will prevent the reccurrence of this crazing. The usual solution is to grind off all the offending gelcoat, reinforce the laminate and then reapply gelcoat. Some people reinforce on the inside of the hull, instead of the outside. Regardless of the method, if the reinforcement is not completed, the gelcoat will craze the minute the laminate flexes again. Gelcoat is the primary barrier against water entry into the laminate. Water will migrate through the laminate into the core. Your boat should be surveyed to determine if there is balsa core damage from water saturation. This is a far worse consequence of crazing than the cosmetic aspect. *DIY* is hosting the MRT Workshops, a series of maintenance, repair and troubleshooting workshops, including two on Fiberglass Cosmetic Repairs, at the Toronto Boat Show, January 17-25. These 3-1/2 hour courses cover everything you need to know to effectively repair fiberglass crazing and cracking. For Workshop information, call (888) 658-BOAT.
— WR

Hot-Engine Starting Problems

Q: I have a '87 6m (20') Marathon powered by a four-cylinder, 165hp MerCruiser. The engine has trouble starting when hot. Cold start is fast and effortless, but after it's warmed up, it takes at least 15 seconds of cranking to get it going again. The battery is new and charged correctly. I have a friend with the same engine and boat combination and the same trouble.
Bill Stenger, Cupid's ORA, *Mystic Island, NJ*

A: In-line, four-cylinder engines are particularly susceptible to vapor locking, which creates hot engine starting problems. The solution is to install water-cooled fuel lines, MerCruiser part number 32-17870A2. Some engines may also require a high-volume fuel pump. As well, have your dealer reset engine timing to the current specs: your engine is set at 8° and MerCruiser now recommends retarding the timing to 4°.
— RF

Engine Winterizing

Q: I recently bought a used '90 2651 Bayliner Ciera Sunbridge with a MerCruiser 5.0L Alpha One stern drive. Unfortunately, the operations and maintenance manuals are missing. I need instructions on

TALKBACK Q&A

draining the water from the cooling system and engine block for winter lay-up. Also what type of lower-unit gear oil should I use, SAE 90 EP or Type C?
Kevin Hamelin, No Worries, *North Bay, Ont.*

A: First, you need to drain the water out of the engine. Remove the petcocks or plugs located on each side of the engine block, just above the oil pan, halfway down the engine. Also remove the petcock or plug on the bottom of each manifold. On the port side of the engine, you may have a power-steering pump intercooler. This looks like a torpedo-shaped tube and it's connected to a hose on each end. Disconnect the hose on one end. On the top of the engine behind the fan belt on the thermostat cover are two hoses, one going to each manifold, and one large hose connected to the water recirculating pump. Disconnect the two hoses going to each manifold and the larger hose at the top recirculating pump.

Now you've drained all the water into the bilge. Reconnect the hose to the intercooler and tighten clamps, put all four plugs back into the engine (two in the block and one in each manifold). Pour non-toxic (plumbing) antifreeze into each hose that you've disconnected from the thermostat cover, one at a time, until you hear fluid exiting at the outdrive. It runs out at the propeller. Now, fill up the larger hose with antifreeze until you fill the block. It takes about 2 gal and is full when fluid runs out the hoses you've disconnected from the manifold. Reconnect all hoses, tighten the clamps and your engine is now ready for winter storage. Remember to change the lower-unit oil (use SAE 90) and add stabilizer to the fuel.
—RF

Fuel Gauge Troubleshooting

Q: I have just purchased a '90 Sunbird 226 Sportfisher with a faulty fuel gauge. The gauge reads 1/8, regardless of the actual fuel level. Is there an easy way to isolate the actual offender?
Tom Evans, Miss Conduct, *Quantico, Va.*

A: The float arm may just be stuck, a common problem with gauges and one that's easily fixed with a light tap. Otherwise, check the gauge with your multimeter to ensure power is getting to it. If all is well, the problem is most likely with the sending unit. The only way to check if it's working is to remove it from the tank. Do this carefully — make sure there is no open flame and don't use any electric tools that could cause a spark. Remember, you're working with a bomb! Now, use your multimeter to check the resistance of the unit. Most senders have two wires, although some have three. Set the dial to the ohmmeter function. Hold the two leads (probes) together and check that the meter reads "zero." Place a probe on each wire and turn the unit on. If it indicates resistance, the sender is okay.
— JM

Saildrive Upgrades

Q: I have a '79 Hughes Columbia 31 and I intend to do some coastal cruising. Please advise what improvements I should do to my boat. Also, will a diesel saildrive replace the existing OMC saildrive without too much trouble?
Garth Woodward, Washago, Ont.

A: Most production boats survive quite well in a salty environment, requiring only minor modifications. Corrosion is your biggest enemy. It attacks poor-quality wiring, navigation lights and other electrical systems, and parts made of non-stainless steel. Considering the vintage of your boat, I suggest you carefully inspect all systems and upgrade as necessary. Yanmar and Volvo both offer diesel saildrives. Replacing your OMC unit with either a 18hp Yanmar (model 2GM20FCXSD20) or 19hp Volvo (model 20/20) will likely require fiberglassing the hull to resize the hole for the outdrive, a new fiberglass engine bed, an upgraded exhaust system and hoses (Yanmar and Volvo use 2" hoses), changing the fuel tank and lines, and new control cables. You can probably retain the existing throttle/shift controls and water intake. Either engine will cost around CDN$10,500 plus a propeller, $400 to $600 for the bed (or you can make your own) and 20 hours labor to have it professionally installed, if you opt not to do it yourself.

TECH TIPS

NO SEIZE: Use a heat gun on a seized bronze seacock or frozen turnbuckles (on a calm day) to soften hard grease or grime. You can also use a hair dryer, but it takes a lot longer. Don't use a torch or you'll overheat the bronze.

NOODLE GUARDS: Cut a slice out of a pool noodle and put it over top window frames to shield heads, faces and hands or place them along the edges of boarding ladders and swim platforms.These inexpensive, brightly colored noodles last about two season and have many uses.

SILICONE TIDBITS: A little silicone sealant dabbed on the ends of cotter pins will protect bodies and gear from snagging and prevent cotter pins from backing out. To stop electrical tape from curling up, dab some silicone sealant on the end.

RETURN POLICY: If you loan out tools, make sure they are returned — paint your initials on them.

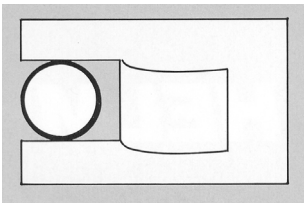
CUSHION RESTRAINER: Sew or glue one part of Velcro to the bottom of seat or berth cushions and the other part to the seat top to keep cushions in place in rough seas.

ELECTRIC SHORTS: For a positive electrical connection, install new shakeproof (star) washers between the terminal and the component, not between the terminal and the nut. *Robert Hess,* Water Music, *Delta, B.C.*

COLOR-CODING: Color-code your cleaning cloths to avoid grimy surprises. Use only white cloths for cleaning and colored cloths when servicing mechanical gear.

BILGE VACUUM: A wet/dry shop vacuum makes a quick and effective bilge pump, removing water from all the nooks and crannies.
Nick Bailey, Looney Tunes, *Toronto, Ont.*

TUBE GAUGE: Here's an easy way to determine the size of your engine shaft, deck rail or any round tubing: Place a 7.6cm- (3") square piece of lightweight cardboard against the tubing, take a straight edge and extend a line from the top and bottom edges of the tubing onto the cardboard, cut slits following your marks, fold back and slip it over your rail.



Courtesy of Helm Products, Addison, Ill.

OPTIC EYE: A hand-held dental mirror makes a great tool to inspect out-of-sight hoses and wiring.

CIRCLIP REMOVAL: When you need to remove circlips (the retaining clips that always spring off into the drink), chuck the screwdriver and pliers and buy inexpensive circlip pliers. They come with a variety of interchangeable tips and can open either inside or outside clips.

ADHESIVE REMOVER: Use a moisture-displacing lubricant to remove tar and adhesive residue from hard surfaces. Spray on liberally, let it sit for a minute or so, then wipe off. Some scrubbing may be necessary. (Do a compatibility test first.)

PLASTIC PROTECTOR: To protect plastic windows when storing for extended periods, place a towel or piece of soft fabric between each layer as it's being rolled.

Tech Tips welcomes contributions from readers. If you have a boat-tested tip you'd like to share, send complete information along with your name, boat name and home port to: **DIY Tech Tips, P.O. Box 22473, Alexandria, VA, 22304 or E-mail to info@diy-boat.com.**

ShopTalk

TO RESTORE OR NOT

Before plunging into a restoration, prepare an action plan to determine if the value of the finished project justifies the time and expense.

By Wayne Redditt

When deciding to restore a wooden boat there are some important questions you should ask yourself at the outset. First determine the market value of the boat after restoration. This may take some research if the boat is a custom one-off or home-built. Find boats of similar quality and finish to compare with your boat. Displacement, propulsion, rig, accessories, materials and reputation (if any) are things that should be considered. Some antique and classic boats are of historic significance (primarily race boats) and some are simply rare examples of a manufacturer's product line. If it's a commonly seen example (i.e. certain Chris-Craft models) then be particularly careful about determining value. You could quite easily spend more money restoring a boat that is missing important components (engines, rudder, gauges, steering wheel) than you would have buying one that is complete.

Is there an emotional attachment that overrides your sense of pragmatism in this restoration? Many people restore boats and automobiles at great expense to create a sense of connection with their past. Weigh this point seriously, as it will keep your mind at ease when the investment exceeds any hope of financial return if the boat is later sold. It's a critical error to let emotion stand in the way of reason when it comes time to plunge into a restoration.

How much time do you have to devote to the project? Without the burden of time constraints, project finances

The allure of owning and driving an antique boat justifies, for some, the time and expense required to restore the boat to original condition.

ELECTRONICS

STORING ELECTRICAL POWER — PART II

In the last issue, we reviewed the various types of batteries and how they are rated. In this second part, we'll focus on selecting and sizing batteries for your house loads on board.

By Kevin Jeffrey

The first thing to do is determine your total house battery capacity, which relates to two things: your total electrical load drawn from the house batteries, excluding those supplied by direct AC power sources; and the reserve battery capacity you'd like to have — the amount of time you can live solely off battery power before needing to recharge. The reserve capacity you choose determines the time between regular engine-charging cycles. If your contribution from renewable chargers (solar, wind or water-powered generators) is small or nonexistent, you'll have to adhere to this regular engine charging schedule. If renewables are making a significant contribution, you can extend the length of time between regular engine charging or eliminate the need for it altogether.

Sizing Battery Capacity

When sizing batteries, there are certain rules to follow. First, your usable battery capacity is the amount of energy available when the batteries are between 50% and 90% of full charge. This means that your usable capacity is about 40% of the total capacity. Battery life is extended if you don't discharge below the 50% level on a regular basis, and topping up the last 10 percent of charge usually takes too long with an engine-driven charging source since charging current drops significantly during the latter stages of charging. Not all of the charging power that reaches the batteries actually gets stored as electrical energy; some is lost in the process. It's a good idea to make provisions for battery losses of about 15%.

In addition to these rules, I usually recommend sizing total battery capacity as if no renewable chargers were present. That way the more power renewables produce, the less you'll need to be concerned with a regular engine-charging routine. For example, assuming an electrical load of 110 amp-hours per day and a one-day reserve capacity, requires roughly 320 amp-hours of battery capacity **(Figure 1)**.

Increasing your electrical load or the length of your reserve capacity increases the total battery capacity required. For instance, if you wanted two days between regular engine-charging cycles, you would need to roughly double your total battery capacity.

Before proceeding, check to see if the total battery capacity you've calculated is suitable for your charging sources.

To make the most efficient use of your alternator, total battery capacity should be at least four times the amperage delivered during bulk charging (when your alternator is producing the most current). With 320 amp-hours of total capacity, you could have a 100-amp high-output alternator producing about 80 amps or so when it's warmed up; larger amperage alternators should have more battery capacity to keep their amperage levels from dropping prematurely, although the only harm done if you don't have more capacity is a loss in alternator efficiency.

Now check to see if you have enough storage capability for your renewable chargers. You should be able to store all the charging current produced during a full day of maximum output. This is usually not a problem with solar panels, but a wind or water generator could produce upwards of 200 amp-hours

Figure 1

BATTERY CAPACITY

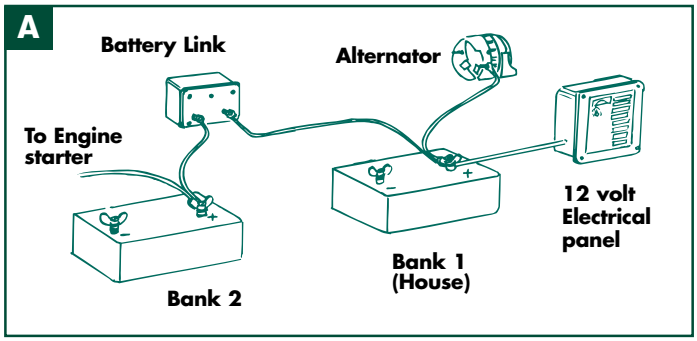
Assuming an electrical load of 110 amp-hours per day and a one-day reserve capacity, sizing total battery capacity would be as follows:

110 amp-hours per day load x 1 day of reserve capacity
= 110 amp-hours of usable battery capacity needed

110 amp-hours of usable capacity
= 40% of total battery capacity

110 amp-hours divided by 0.4
= 275 amp-hours of total battery capacity before losses

275 amp-hours of total capacity x 1.15 (accounts for 15% battery losses)
= roughly 320 amp-hours of battery capacity required.

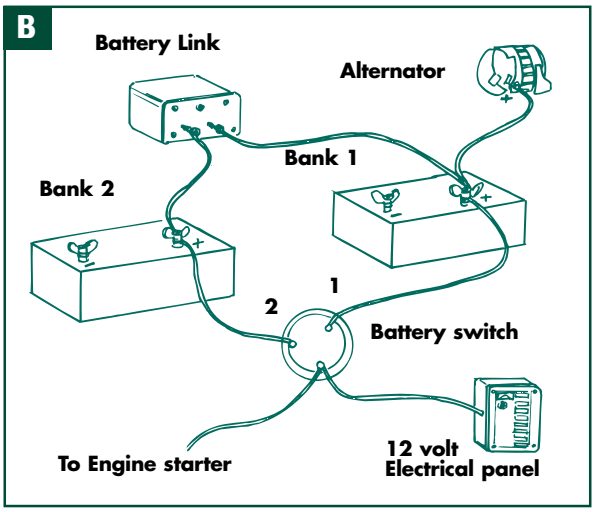


ANNEMARIE HENDRY

Figure 2

A battery link joins battery banks together during charging then disconnects them when the charging source is off so that all battery banks automatically receive the charge they need. When the alternator is on, separate banks are "linked" together temporarily.

A) Loads supplied separately from each bank.
B) Loads supplied through battery switch.



per day. With a 320 amp-hour battery bank you could only store 200 amp-hours if the bank was discharged to 50% at the beginning of the day (with 160 amp-hours to reach full charge) and you used the remaining 40 amp-hours to supply loads. If the batteries were more fully charged to begin with, or you used less power during that time, or you had optimal charging conditions for several days, some of that hard-won electrical power would go to waste. In this case, it might be a good idea to add a bit more battery capacity if you can.

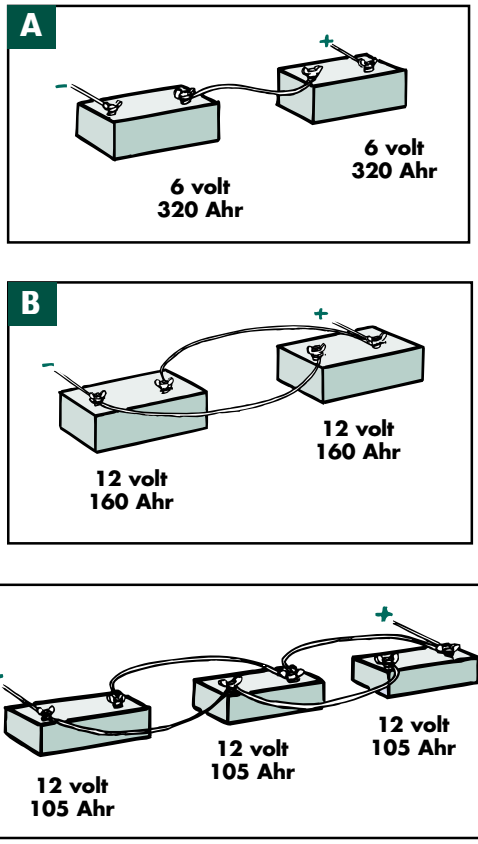
Number of Banks

For most marine applications a single house bank of batteries with a designated engine-charging battery makes the most sense and is the easiest to control and

monitor. With this arrangement, you can track charging performance, load draw and battery condition with a low-cost system monitor, and there's no need for switching banks to supply your loads. With the addition of a battery link or combiner, even the charge distribution to the house and engine-starting banks will be automatic **(Figure 2)**.

Sometimes it's useful to keep certain house loads, such as an anchor windlass, separate from the main bank to simplify wire runs. Two-bank systems are also popular on wide catamarans with an engine in each hull.

Figure 3



ANNE-MARIE HENDRY

Three different battery configurations to achieve 320 ampere-hours (Ahr) total capacity in a 12-volt system:

A) Two 6-volt, 320 Ahr batteries connected in series to make a 12-volt, 320 Ahr bank.

B) Two 12-volt, 160 Ahr batteries connected in parallel to make one 12-volt, 320 Ahr bank.

C) Three 12-volt, 105 Ahr batteries connected in parallel to make one 12-volt, 315 Ahr bank.

Battery Terminology: House vs Starting

House batteries are used to supply normal daily operating loads — everything except engine starting. They are either deep-cycle or hybrid deep-cycle batteries that can be discharged to 50% of capacity repeatedly without harm.

Starting batteries are used for starting engines, both main auxiliaries and gen-sets. They have a high Marine Cranking Amps rating due to large plate surface area inside the battery. These batteries get their surface area by having lots of thin plates, as opposed to deep-cycle batteries, which have fewer, thicker plates.

Battery Type Versus Performance

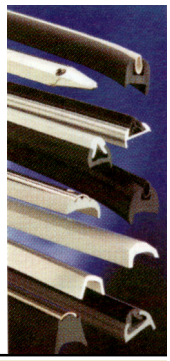
As we discussed in the last issue (1997-#3), you'll need to choose between deep-cycle, hybrid deep-cycle or starting batteries, between gel or liquid electrolyte, and between batteries that are inexpensive but with modest life expectancy or more expensive models with increased life and performance. Batteries strictly for house loads should be true deep-cycle or hybrid deep-cycle, and batteries strictly for engine starting should be starting or hybrid deep-cycle. It's important that you don't mix batteries of different size, type, or age in one bank — this can lower the life expectancy of the bank.

Total battery capacity can be achieved in various ways. In a 12-volt system, the 320 amp-hours of total capacity calculated in Figure 1 can be supplied by two 6-volt batteries of 320 amp-hours wired in series, by two 12-volt batteries of 160 amp-hours (4D) wired in parallel, or by three 12-volt batteries of 105-110 amp-hours (Group 27) wired in parallel (**Figure 3**). With two 6-volt batteries, there are only 6 battery cells; with two 12-volt batteries, there are 12 cells; and with three 12-volt batteries, there are 18 cells. The more cells in a bank, the more potential for problems. On the other hand, Group 27 batteries are much easier to handle and accommodate than larger batteries.

Once you've sized and selected your house and engine-starting batteries, make provisions in the way you install them for simple charging and discharging sequences and proper monitoring so you can visually track battery performance. A discussion of the proper charging techniques and the various charging controls appears in an upcoming issue.

Kevin Jeffrey is an independent energy designer and consultant, author and publisher of The Independent Energy Guide, *and co-author and publisher of* The Sailor's Multihull Guide *and* Adventuring With Children.

REPLACING A RUB RAIL



Damaged or badly worn rub rails are easy to replace with universal parts. Here's how.

Equipment

Rub rail kit
Measuring tape
Drill
Cordless screwdriver
Putty knife
Caulking gun
Silicone sealant
Polyurethane sealant
Goggles
Garden shears (vinyl only)
Hacksaw (metal and rigid vinyl rails only)
Metal file (metal rails only)
Heat gun (rigid & semi-rigid vinyl rails only)
Rubber mallet (stainless-steel rails only)

After many years of dock thrashings, chafing from spring lines and fender lines, and everyday wear and tear, rub rails may depreciate in form and function. A new rub rail enhances protection and can greatly alter and improve your boat's appearance, particularly when replaced with a different style or color.

Rub rails are constructed of vinyl, aluminum or stainless steel. Taco The Aftermarket Co. (98 Northeast 179th St., Miami, FL 33162; tel: (800) 653-8567, fax: (800) 653-8569) offers a broad range of universal replacement rub rails and rail kits that include a choice of rail and insert (where applicable) in 15m (50'), 21m (70') and 30m (100') precut lengths, fasteners and an installation guide **(Figure 1)**. Kit prices

TACO AFTERMARKET

Figure 1

Rub rail replacement kits include the rail and insert (where applicable), fasteners and installation guide.

range from US$100 for small runabouts to US$400 for large cruisers. For easier installation when purchasing rub rails and inserts separately, Taco also offers installation kits that include screws, end caps and instructions.

To calculate the length of your replacement rub rail, multiply your boat's length by two, add the beam and a foot or two for good measure. Take a small piece of the rail or a paper pattern of the rail shape to your nearest dealer. If you can't find a perfect match, you might want to upgrade to a different shape or style. For added protection, consider replacing a flimsy rub rail with a heavier one or add a long-lasting stainless-steel insert. If you prefer a metallic look, consider an aluminum rub rail or one with a black vinyl insert, or a white or black vinyl rub rail with a stainless-steel overlap. You might want to dress up your boat with some color: semi-rigid rails come in nine basic colors; inserts for rigid vinyl and aluminum rails are available in 10 vibrant colors to match the more popular gelcoat finishes. When selecting a rail, choose one that is at least the same width as the original or you'll have a noticeable color difference in the gelcoat or paint where the exposed hull surface has faded.

Rub rails are easy to install if you have all the parts and the proper tools. Before starting, unpack the rail kit, check that you have all the pieces and carefully read the instructions. A cordless screwdriver is indispensable for this job; borrow or rent one if you're without. Be sure to wear safety goggles when using power tools.

For help with rub rail selection or installation, or for the name of your nearest dealer, call Taco's toll-free hotline at (800) 653-8567.

Removal

First remove the end caps, then the insert — lift up the end with a slot screwdriver and pull it out of the rub rail. Remove the aluminum stiffening strip behind the insert found

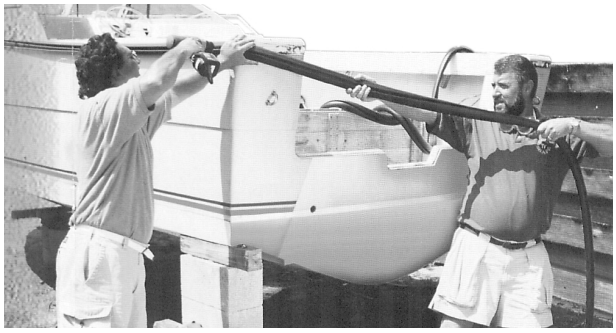
on some rails. Now pry off the rub rail which is usually held on with screws or pop rivets. Removing the screws is easy, provided they aren't corroded or the heads aren't stripped. When fastened with pop rivets, drill through the rivet head only using a bit of the same or slightly smaller diameter as the shaft, then push the shaft through the hull (remember to gather these later). Some rails are bedded in silicone sealant, so they should lift off without much persuasion.

Figure 2

Use a putty knife to remove the excess sealant, being careful not to scratch the gelcoat.

Hull Preparation

Use a putty knife to scrape off the old sealant, being careful not to scratch the gelcoat (**Figure 2**). It's not necessary to remove all the sealant, just the excess. Fill all fastener holes with a polyurethane sealant, such as 3M 5200. You'll be drilling new holes for the replacement rail.



TACO AFTERMARKET

Figure 3

Stand at the stern and pull the flexible rub rail, stretching it until taut.

Installation

The follow installation directions are numbered according to the type of rail you're installing: flexible (**1**); aluminum (**2**); rigid vinyl (**3**); semi-rigid vinyl (**4**); stainless steel (**5**); and sailboat (**6**).

1 To make the flexible rub rail easier to work with, soak it in a tub of hot water (maximum 37°C/120°F) for about 20 minutes or use solar heat, placing the rail on hot pavement. Place a mark on the rub rail at the

REPLACING A RUB RAIL

midpoint and align this mark with the bow. Hold the rail in position and drill three holes, about 3.8cm (1-1/2") apart, and insert the screws. Be careful that the drill chuck doesn't mar the rail when drilling.

Stretching the rail is the next step and you'll need a helper. Stand at the stern and pull one side of the rail, stretching it until taut. While one person keeps tension on the rail, drill three holes close together **(Figure 3)**, about 3.8cm (1-1/2") apart, and fasten with screws. Beginning at the stern, pull back the rail, apply a narrow bead of silicone sealant to the hull, then drill and fasten the rail, spacing the screw holes every 15cm (6"). Work in .9m (3') increments, caulking, drilling and screwing **(Figure 4)**.

Figure 4

After applying silicone sealant to the hull, flexible rub rails are fastened with truss-head screws.

To prevent screws from pulling through the rail when tightened, use truss-head screws (included in Taco rail kits) or a round-head screw and a flat washer. Repeat this process for the other side. Don't overtighten the screws or the rail will pucker.

After both sides are fastened, cut the rub rail to the correct length with pruning shears. Smooth the cut edge with a file. The insert goes on next. For a friction-less fit, soak it in a bucket with warm water and a little liquid dish detergent for a few minutes. Beginning at one end, squeeze the insert and slide it into the rub rail **(Figure 5)**, keeping the excess material warming in the bucket. To finish, cut the ends with the shears, then drill and mount the end caps. Replacement end caps are supplied with the kit, but you might want to use the original caps, if in good condition.

Figure 5

Soak the insert in soapy water then slide it into the rail.

2 Aluminum rub rails are sold in 3.6m (12') and 6m (20') sections and have predrilled holes spaced every 15cm (6"). Find the midpoint of one aluminum section, then place a mark on the wrong side, 7.6cm (3") off center. Position the rail over the bow, lining up your mark with the bow stem. Be sure the screw holes fall on either side of the stem. Walk down one side, holding the rail against the hull. At the end, mark the placement of the last hole. Drill with a 5/32" bit and install a screw. Continue drilling holes and installing screws up to the bend at the bow. Spread a light coating of silicone sealant on screw threads to seal the holes.

For aluminum rub rails with an insert, follow the directions below.

TACO AFTERMARKET

Figure 6

Predrilled aluminum rub rails are fastened with Phillips screws.

Otherwise, continue drilling, applying sealant to the screw threads and fastening **(Figure 6)**. Position the joining rail section on the hull, butting the ends. If this is the final piece, check that a screw hole doesn't lie on the transom corner. If it does, slide the rail forward so the screw holes straddle the corner, then mark where this piece overlaps the forward section. Cut it in a mitre box with a hacksaw and file the edge smooth. Drill and fasten the rail from the join to the transom. Finish drilling the remaining holes and attaching screws. Cut off the excess rail, smooth the edge with a file, and install the end caps.

For aluminum rub rails with an insert: To obtain a smooth, even curve at the bow and transom corners and prevent the rail from collapsing, install a short length of the insert, about 15cm (6") or so, into the rail so it overlaps the bow. Press the rail over the bend, drill and fasten. Complete the rub rail installation as instructed above. To install the insert, follow the instructions for flexible rub rails in Step 1. To finish, cut the insert to size with the shears and slide ends into the end caps.

3 Carefully unpack the rigid vinyl rail as it's coiled tightly in the carton and unwinds quickly. Like aluminum rub rails, it is predrilled every 15cm (6"). Follow the instructions for

aluminum rub rails to mark, drill and fasten the first rail section. Stop when you get to the bow. To bend rigid vinyl, use a heat gun **(Figure 7)** to soften the rail where it bends around the bow and transom corners. Move the gun quickly back and forth to prevent overheating, which can damage the rail or blister the gelcoat. You can also heat the rail with a hair dryer, but it takes a lot longer. You'll need a helper: Have one person heat the rail as the other slowly bends it over the corner, then drill and screw to hold it in place. Don't force the rail or you'll get white stress cracks on the outside.

TACO AFTERMARKET

Figure 7

Heating rigid and semi-rigid rub rails with a heat gun makes it easier to bend them around corners.

To join rail sections, overlap one piece by 3mm (1/8") **(Figure 8)**. Don't fasten the last two screws in each section. Pull out the ends until they meet, then push in until they snap into place. Install the remaining screws and the insert (where applicable), following the instructions for flexible vinyl rub rails, and you're done.

Figure 8

To join rail sections, overlap one piece by 3mm (1/8"), pull out the ends until they meet, then push in until they snap into place.

4 Remove the semi-rigid vinyl rub rail from the carton and stretch it out. Warming it in the sun helps to flatten it more quickly. When it's fairly straight, place it on the deck, near the edge. Semi-rigid rub rails are not predrilled. Kits include a combination drill and countersink bit, and stop. Rails are 15cm (6") longer than specified so you can practice drilling and countersinking before installing on the boat. Drill the sample rub rail until the stop just touches the rail. Insert the screw. The screw head should be recessed just below the surface of the rail. If necessary, adjust the stop and drill again. Be sure the stop is adjusted correctly before installing the rail.

If the rub rail doesn't wrap around the transom, match the end of the rail with the corner and drill a hole, about 2.54cm (1") from the end. Have a helper hold the rail in position, while you continue to drill and fasten. Space the holes every 15cm (6") or closer, if needed. After drilling each hole, clean the countersink to remove the vinyl shavings. Remember to coat screw threads with silicone sealant before inserting and be careful not to overtighten the screws or the rail will pucker. To bend this rail around the bow, follow the instructions for rigid rails in Step 3. For rub rails that extend around the transom, begin installing the rail in the middle of the transom, drilling a hole 30.4cm (12") from the end of one rail section. Use a heat gun to bend the rail around the transom corner (just as you did at the bow). Continue drilling, sealing threads and fastening, stopping a foot from where the ends meet at the transom. Cut the joining section to length, then make a snap-in-place splice (see Step 3). Install a screw 2.54cm (1") from each spliced end and another 14cm (5-1/2") away.

5 To install stainless-steel rub rails, follow the instructions for aluminum rails in Step 2. Remember to seal screw threads with sealant. You'll need some percussive force to bend stainless-steel rails around bow and transom corners: Place the rail over the corner and lightly tap with a rubber mallet until it conforms to the shape of the corner. When installing a stainless-steel rail over a vinyl one, be sure to stagger the screw holes and splices.

6 Many sailboats have a horizontal flange where the deck edge meets the hull. Taco offers a two-piece replacement system for sailboats — a rigid vinyl inner piece caps the flange and an outer rub rail snaps over the insert. To install the inner piece, drill holes vertically through the insert and flange and fasten with screws. Coat the screw threads with sealant. Use a heat gun to bend the vinyl around corners as described in Step 3. Snap the outer rail over the insert.

TIPS — A Picture's Worth a Thousand Words

Taco Aftermarket's Do-it-Yourself Rub Rail Installation video (US$19.95) makes an excellent companion "tool" to this article. In this 30-minute video, the hosts of Ship Shape TV show you the proper techniques to remove an old rail, prepare the hull and install a new one.

ENGINE TROUBLESHOOTING

REBUILDING AN INBOARD ENGINE

Most small horsepower gasoline or diesel inboard marine engines can be rebuilt by anyone with some automotive engine experience, a good set of tools and a decent shop manual.

Story and photos by Robert Hess

Inboard engines under 30 hp are fairly simple designs that are easily rebuilt in about 50 hours. Before you begin rebuilding your inboard engine, purchase shop and parts manuals. Ask your dealer for a copy of all factory service updates. Talk to a mechanic who has experience with your engine to discuss any common problems with that model, and to ask him for his recommendation on parts that usually need replacing during a rebuild. Don't ask to borrow tools or manuals. Most specialty tools are available from rental outlets, if you're without.

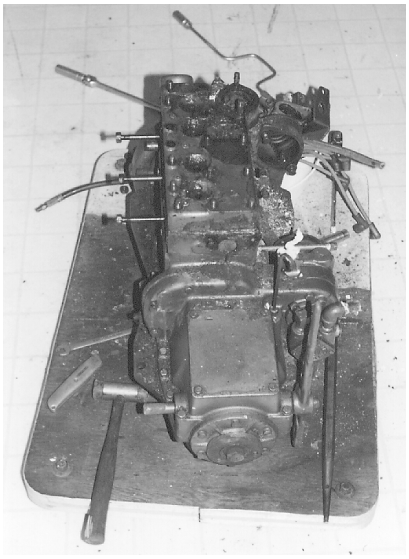
The rebuilding work can only begin once salt and sludge are cleaned from the block, head and manifold internal water jackets. Unless salt and corrosion are removed from water jackets the engine may run hot even after rebuilding. Any rust, gasket material and paint must be cleaned from the external surfaces of all engine components. The paint applied during the rebuild will not adhere properly causing parts to rust again soon after the engine is put back into service.

It's common practice to flush the water jackets of raw-water-cooled engines with an acid mixture when they become plugged with salt and overheating occurs under full load. I don't recommend this procedure because the acid may damage gaskets and hoses and make it necessary to remove and disassemble the engine to stop leaks anyway. As well, working with acid solutions is dangerous, and can cause serious personal injury from burns and fumes. A better solution is an automotive radiator flush available at auto parts stores.

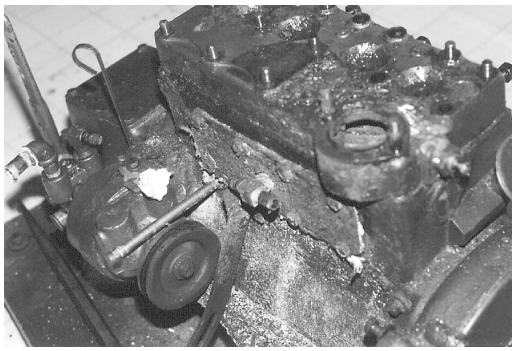
Disassembly

Disassemble the engine completely, removing all studs and pipe fittings. It's easier to get the cylinder head off if you remove the head studs first. Drill a 6mm (1/4") hole in each frost plug and pry them out with a small pry bar. Grind or cut off any seized cap screws or nuts. Ideally, all fasteners should be replaced with new ones. When they are not available, be careful not to remove all of the original coating when cleaning with a wire wheel; the fasteners will quickly rust, making removal difficult. Any broken studs or cap screws (a bolt screwed directly into a component) can be drilled out by the machine shop when the parts are sent out for crack checking (see below).

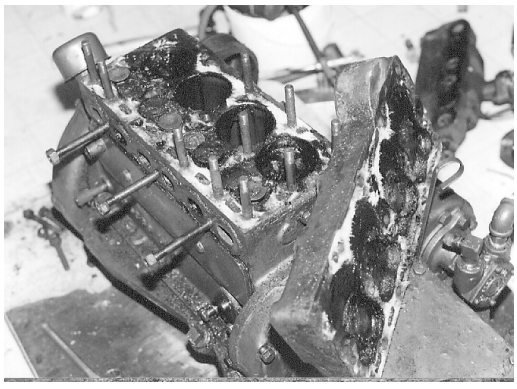
Once the engine is apart you can clean the components yourself, but it's far more effective and much less messy to have them cleaned professionally in a hot tank (hot caustic solution) to remove dirt and



Disassembly beginning.



Corrosion and salt buildup on the engine.



Head off, showing gaskets that need to be removed. Note carbon on pistons and valves.

sludge, and then a pickling tank (acid solution) to remove corrosion. If you can find a shop that also does electrolytic derusting, have that done as well to remove every trace of rust.

If you decide to clean the components you'll need wire brushes and scrapers, a couple of jugs of Gunk (an automotive rust remover), a large washtub, a bench grinder with a wire brush, a garden hose and lots of clean rags. First soak the parts in Gunk for several days. Use a wire brush and scraper to remove dirt, salt and loose rust, then using a garden hose (a steam cleaner or pressure washer would be even better), remove the Gunk along with dirt and rust. Once all the baked-on crud has been removed, repeat the process several more times using your rust-removing chemical. A light sanding with very fine paper helps in cleaning gasket surfaces. Be careful not to gouge them with chisels or scrapers. You can also use the garden hose to flush water jackets.

Machining

An old engine can have a myriad of problems and damage even though it continues to run — problems that may not show up until the engine is running at the correct temperature and producing full power. The most serious (and hardest to detect) is a cracked oil gallery or water jacket, which quite often won't show up until after the rebuild when the engine has been working hard for several hours. A cracked piston, crankshaft or connecting rod may not show up until the engine is tested after rebuilding and makes full power and rpm for the first time in years, at which time the failure may destroy the block beyond repair. For this reason, it's important when rebuilding a used engine that the cylinder head, block, crankshaft, pistons and connecting rods are sent out for crack checking (usually with the zyglo or magnaflux method) by an automotive machine shop.

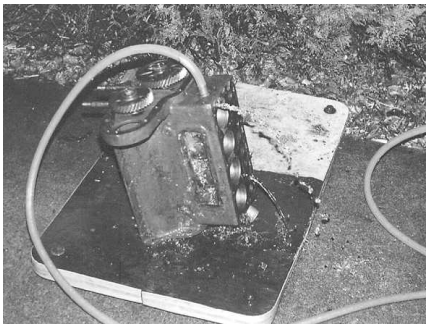
After the engine components have been completely cleaned and checked for cracks, they should be carefully measured to determine the machining required before reassembly. You can have a machine shop do the measuring and then have them do any machining required. Of, if you have a set of external micrometers and feeler gauges, you can measure the components and plastic gauges to check the clearance on bearings. It's important to check all dimensions, such as bearing clearance, fore and aft clearance on ends of crankshaft, etc., against what is specified for your engine. Keep a record of all dimensions.

Necessary machining may include: ridge reaming and cylinder deglazing if you are going to use the old pistons; boring or honing the cylinders oversize for new pistons; valve and seat grinding; valve guide replacement; connecting rod resizing and straightening; crankshaft grinding; cylinder head resurfacing; drilling out bro-

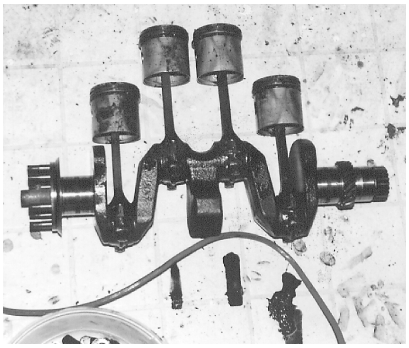
ENGINE TROUBLESHOOTING

ken studs and screws; checking valve spring tension; and replacing camshaft bearings (camshaft bearings require a special tool for removal and installation). If you are having the valve seats ground, make sure you specify the manufacturer's recommended seat width. When sending parts out to a machine shop always mark each one with a metal name tag fastened to the part with a piece of wire. Small parts should be joined together in a wire necklace as well as having a name tag attached.

Usually the parts order is divided into two: an order to the authorized dealer for parts that are only available from the manufacturer, and an order to the machine shop for everything else. When parts are ordered at one time, the cost is usually less (always ask for a discount no matter how many parts you order). Ordering the parts from the machine shop along with the cleaning, measuring and machining may also reduce the price. Some machine shops will pick the parts up and return them if you request it. Include the required number of brand-name Grade 5 plated cap screws, nuts and washers of the proper sizes with your order to the machine shop. Grade 5 bolts are marked with three hash marks on the head. Buying by the box helps to ensure a standard grade and quality. Some special fasteners, such as connecting rod nuts and cylinder head nuts or bolts, should be obtained from the manufacturer to ensure the correct grade is used.



Flushing the block water jackets (this was done after the engine was apart).



Crankshaft, connecting rods and pistons ready for measuring.

Assembly

When the engine parts arrive back from the machine shop and you have all the new parts, begin the rebuild by washing the cylinder walls with hot water and soap, then squirt clean oil on them and wipe with clean rags until the rags are dirt-free. This is very important — it's the only way to remove the residue from the grinding stones used in cylinder honing or deglazing which will shorten the life of the piston rings. Next, wash the block with varsol, blow out all the oil galleries with compressed air, wipe it down with clean rags, then coat the machined surfaces with oil to prevent rusting. Now screw the engine together, torquing all fasteners after oiling the threads and the contact surface between the washer and the underside of the head of the bolt or nut. Component fasteners (except studs protruding into water jackets) should be coated with Never-Seize, Loctite Blue or a similar product as specified by the manufacturer. Studs protruding into water jackets should have their threads coated with non-hardening gasket cement.

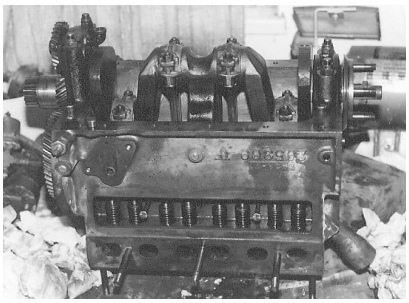
TIPS — BOLT ID

Hash marks are short dashes cast in a radial pattern on the bolt head to designate the grade. Most cheap bolts of Grade 3 and lower have no marks. Standard Grade 5 bolts have three marks, Standard Grade 7 bolts have five marks, Standard Grade 8 bolts have six marks. The higher the grade, the better the quality; however, higher grades are more expensive. Factory fasteners sometimes do not have grade markings. Some special fasteners, such as connecting rod nuts and cylinder head nuts or bolts, should be obtained from the manufacturer to ensure the correct grade is used. Because of excess vibration with diesel engines, always choose Grade 5 fasteners when repairing or rebuilding accessory brackets and mounting hardware, unless stainless steel is specified by the manufacturer.

Torque fasteners in three stages. Working from the center of large castings (i.e. cylinder heads and oil pans), gradually tighten the bolts to make sure the casting is tightened down flat without inducing any stress (which can create a crack). Most engine shop manuals show the tightening sequence for the cylinder head in this type of pattern. When installing gaskets spread a very thin coat of non-hardening gasket cement on one side of the gasket only, or don't use any at all. Check the manufacturer's specs as many head gaskets don't require cementing. Never use grease to hold a

gasket in place. The grease creates a path for oil or antifreeze, causing the gasket to leak.

When the engine is assembled, mask off any pipe threads or machined surfaces and paint it, first with two coats of rust preventative primer, followed with three coats of engine enamel. I use white engine paint; it makes the engine easier to work on in a dark bilge and it's easier to spot leaks.



Assembly in progress.

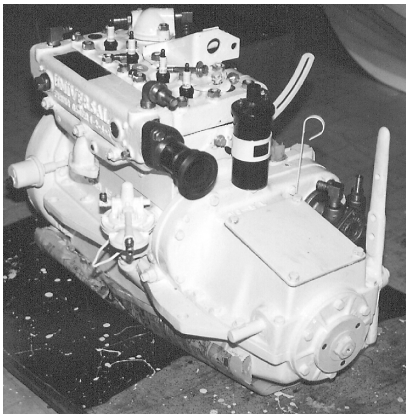
Now, install the wiring harness, replacing all corroded terminals or damaged wires. Use only marine tinned-copper fine-stranded wire. To waterproof connections and protect against accidental shorting, use heat-shrink terminals or fit heat-shrink tubing over the wire where it joins the terminal. (For complete step-by-step instructions on wiring and crimping refer to the WINTER '95 issue.) To give a good electrical connection, install new shakeproof (star) washers between the terminal and the component not between the terminal and the nut.

Bench Test

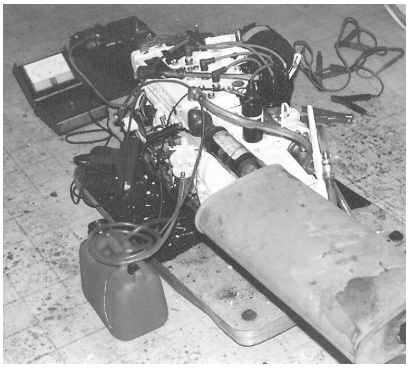
Rig a test stand for the engine, attaching a fuel line, water hose and muffler. Have a fire extinguisher ready and make sure you have adequate ventilation to avoid carbon-monoxide poisoning. You can start the engine without motor mounts (i.e. resting on the floor of the shop) if you don't attach the drive shaft flange to a load.

Manufacturer's recommend using

ENGINE TROUBLESHOOTING



Engine assembled, the exterior primed and painted, and all fittings installed.



Engine testing: Attach a fuel line, water hose, muffler, battery, mechanical oil pressure gauge and tachometer.

non-synthetic oil until the engine is broken in, then adding synthetic oil after the first oil change. A gasoline engine should have the carburetor idle mixture screws adjusted to their former settings (normally very close to one turn out), and the ignition timing should be set as closely as possible. A diesel engine without a self-bleeding fuel system will need to be bled by loosening all the fuel injector lines, activating the starter motor and tightening each injector line when it stops pumping air bubbles. (Refer to your shop manual for proper bleeding procedures.)

The engine should start instantly once it has fuel. If it doesn't, it either wasn't rebuilt properly, or in the case of a gasoline engine, the carburetor or ignition wasn't adjusted correctly. Set the ignition timing and run the engine for several hours at medium rpm. Don't idle the engine for more than two minutes at a time. At higher speeds, there is much more oil thrown up on the cylinder bores while the new rings are seating, and the oil pressure will be higher while the new bearings are bedding in. Check the oil pressure by attaching a mechanical oil pressure gauge to the oil pressure sender port. Most modern gaskets do not require retorquing after initial installation; however, check with the dealer or gasket manufacturer. Aluminum heads are usually retorqued cold, and cast-iron heads are usually retorqued hot.

When the engine is thoroughly tested, prepare it for installation by removing the major accessories that might be damaged while it's hoisted down into the boat. Cover any holes with duct tape to keep out dirt and stray parts. Before installing the engine, carefully check the drive shaft, packing nut, cutlass bearing and propeller, and service as necessary. Clean out the engine cooling water seacock and strainer, and inspect the exhaust system carefully. Install new coolant and fuel hoses, and install a new fuel filter.

DIY Repair Bill

Average prices to rebuilt a small two-, three- or four-cylinder inboard engine includes machining and cleaning, miscellaneous fasteners, cleaners, oils, lubricants, etc.

Cleaning and crack checking	**$250**
Fasteners, cleaners, miscellaneous supplies	**$100**
Gasket set and oil seals	**$200**
Rebuilt fuel injectors (for diesel engines)	**$200**
Valve job	**$100**
Piston rings	**$150**
Main and rod bearing shells	**$200**
Crankshaft grind	**$150**
Total Average Cost	**$1,350**

Robert Hess has a background in automotive and marine mechanics and in 1994 he restored Water Music, *a 7.5m (25') Hughes that he cruises on the coastal waters of Canada's West Coast.*

DIY PROJECTS

BOAT IMPROVEMENT PROJECTS & UPGRADES

Many boaters wanting to personalize their boats have undoubtedly suffered apprehensions of the project quickly getting out of control. My experience has proven to me that after measuring endlessly and drawing view after view one must eventually cut, assemble and mount the item in place. If you have serious doubts about your mechanical skills but feel compelled to make substantive changes to your boat, I say, "Just do it!" Usually the more intimidating projects are made up of a series of simple steps that you can master with an organized approach. Just be sure you clearly understand each step before you start and measure everything, just one more time.

The DIY projects detailed in this section provide solutions to gear storage, interior renovations, safety afoot and fabricating add-on comforts. We've given the most common method for doing these projects, but just like opinions, our ways are not the only ones.

Illustrations by Anne-Marie Hendry

INSULATING CABIN INTERIORS

Tired of clammy interiors? Install a cabin ceiling and cure the condensation blues.

By Ryc Rienks

If there is an area in your boat with exposed hull creating condensation, there is an easy solution: Install an interior liner, or in nauticalese, a ceiling. While there are simple options, others involve more work or expense or skill than you may have.

One solution is to carpet the exposed hull, a method used by many boatbuilders. While the current trend is towards using foam-backed vinyl, this material works best on flat areas and its shiny surface shows all the imperfections in the hull, so you'll need to first prep the hull. Vinyls are very difficult to work with and must be cut exactly to size. Carpet, however, is an inexpensive, easily handled material. Don't use "bunny fur," the short-napped fuzzy material installed in many powerboats. Such material acts as a magnet for mildew, leaving traces of nasty black fungus that seem impervious to cleaners.

Another option is a wood ceiling made of ash, birch, maple or mahogany. It adds warmth and ambiance to any cabin, but it is more expensive and demands some woodworking skills.

Both carpet and wood ceiling options are outlined below.

Installing a Wood Ceiling

A ceiling made of wood strips, 9mm (3/8") thick and 5cm (2") wide attaches to a framework that is glued to the hull **(Figure 1)**. The frame is made of 2.54cm (1") ribs (usually fir) laid vertically on 40cm (16") centers. The thickness of the ribs and spacing depends on the insulation type (see below). Ribs are bonded to the hull with fiberglass tape and epoxy or vinylester resin. To support the ribs before the resin cures, brace the ribs to the hull using beams cut to size, expandable curtain rods or whatever.

To prevent condensation and keep the boat cool in summer and warm in winter, attach foam insulation to the hull between the ribs. The typical blue-colored polyurethane foam is commonly use

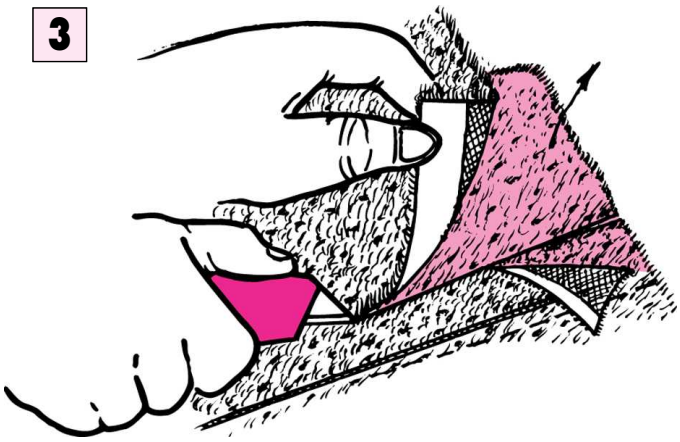
A wood ceiling adds warmth and ambiance to any cabin, but it's more expensive and demands some woodworking skills. To prevent condensation and keep the boat cool in summer and warm in winter, attach foam insulation to the hull between the ribs.

and is available at hardware stores. It's sold in 1.2m x 2.4m (4' x 8') sheets, 2.54cm (1") thick, and costs about $30. An option is to use foil-backed refrigerator foam, which has almost double the insulation qualities but it's double the price. Panels are cut to size to fit between ribs and glued to the hull (use a glue compatible with foam) or polysulfide sealant, which allows easy removal of the panels. You also can use a spray polyurethane foam, but you won't be able to access the hull.

MELITED FABRICS

The lining of this Corsair catamaran is Front Runner, a soft and pliable unbacked marine hull liner applied using a contact adhesive.

Finish the wood strips by slightly rounding the outside edges and applying an oil or varnish. Lay the strips over the ribs, leaving a 1.5mm (1/16") or so air space. Fasten the ceiling to the frames with #6 brass or stainless-steel pan-head screws. Make sure the screw heads in each strip line up vertically.



The pros use this tape-and-glue technique to get an invisible seam where carpet sections join.

Carpeting the V-berth

To gain some experience installing a liner, I decided to cover the smaller area in the V-berth first. I selected an unbacked Ozitex indoor/ outdoor household carpet purchased from a carpet remnant store. The disadvantage of using indoor/outdoor carpet is its rubber backing that may never dry if it gets wet. It's also stiff and bulky, making it difficult to conform to curves.

A better choice is to use a material designed for boats, such as Australian-made Front Runner **(Figure 2)**. Marketed in Canada by Velcro Canada (tel: 905/791-1630, fax: 905/791-5329) and in the U.S. by Melded Fabrics (tel: 888/635-3337, fax: 562/802-3227), and available from many upholstery shops, it sells for about CDN$24 per metre or US$15 per yard. A tightly woven nylon-polyester blended fabric, it comes in 30 solid colors and some tweeds. It's extremely soft and pliable, easily shaped to fit around fittings, corners and curves. It's rot- and mildew-resistant and compatible with hook and loop tape (Velcro), so you can mount storage bags, organizers and other stuff that has a hook fastener.

Carpet is fairly simple to install. Measure both sides of the area to be carpeted. Select a piece of carpet sized to your needs with a bit of allowance for trimming to final fit. To fit my V-berth area, I needed two pieces 1.3m x 1.8m (4-1/2' x 6'), so a piece 1.8m x 2.7m (6' x 9') was perfect. Now, rough-cut the carpet to a dimension that will allow you to lay the carpet piece against the hull. With one piece against the hull, you can establish a base reference line, probably the V-berth platform. Using a utility knife, rough-trim to an allowance of 2.54cm to 5cm (1" to 2") on all edges. Be careful of surfaces behind the carpet. To check the symmetry of the two sides, lay the cut section face down on the opposite side. It should fit well enough to allow moving on to the next step.

If the fit is close enough for both sides, you can use the trimmed piece as a cutting pattern for the second carpet section. Be sure to place the two carpet pieces right sides together or back to back, to produce the mirror image necessary to fit both sides.

You can now take the second piece and dry-fit in place. A felt-tip marker pen will allow you to mark

Share a boat-tested project with other DIY readers. If we publish it, we'll send you $25 to $150 depending on the published length.

TIPS

Larger areas require using more than one piece of carpet. To obtain a perfectly matched edge where carpet sections meet, add an extra 7.6cm (3") or so to your measurements on all joining edges. Lay a strip of 10cm-(4") wide masking tape along the joining edge on the wrong side of each carpet section. This prevents gluing the edge. Now spray glue on the cabin ceiling and to the wrong side of carpet.

either piece for additional trimming, but be sure to allow overhang until the carpet is glued in place as it may shift around a bit.

Now, to make it permanent. Use a spray contact adhesive, such as 3M 76 Spray Adhesive or a brush-on latex wallcovering adhesive. The spray glue is easy to apply: simply spray on both the hull and the fabric, let it dry until not tacky, which takes one to five minutes depending on the glue. Open all hatches, use fans for extra ventilation and only do one side at a time to allow the fumes to clear. Also, don't smoke during this operation as the fumes may be explosive.

I glued and placed one side, then the other. Use lots of glue in the corners, and press down the carpet so it lies flat. The more pliable the carpet, the better the final finish. To minimize the bubbles and get uniform adhesion I needed to roll out each side using a fairly rigid fender. This step isn't necessary when using Front Runner. It likely won't buckle or bubble, and if it does, work out the excess with your fingers.

Carpet on the cabin ceiling is more difficult to install. Cut a piece that overlaps 15cm (6") on all edges. To place, match the ends up to two edges, so you get a square edge. Remember, once the carpet sticks down, it's permanent.

Remove masking tape so everything except the joining edges is glued. Let glue dry until tack-free, then lay the carpet in place, overlapping the edges. Take a sharp utility knife and cut through both layers of carpet **(Figure 3)**. Peel back the carpet edges, spray the edges, let dry, stick down and you have an invisible seam. Another plus for Front Runner: the edges don't fray.

Cleanup is simple if you've been careful with the glue as all you need to do is finish trim around the edges with your utility knife. Wood trim can be used to cover the edges if you have wooden bulkheads to attach to. I trimmed the edges with mahogany molding strip and the result looked as tidy as any factory job I've seen. I've improved the livability of the boat and I now feel better about covering the other exposed parts of the hull.

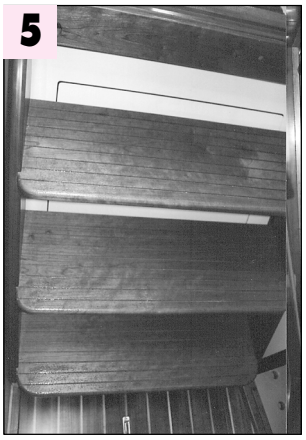
NON-SKID FOR STEPS

Often it's the little details that separate a well-appointed production boat from a prefab. Take companionway steps, for example. Many are beautifully finished with multiple coats of varnish, like a piece of fine furniture. But navigate these steps when they're wet and it's like walking on ice with rubber-soled boots.

There are two easy ways to prevent a potentially lethal descent. For a quick fix, purchase some self-adhesive, heavy-duty non-skid tape and depending on the width, cover each step with two or more strips **(Figure 4**). The only drawback to using tape is it tends to attract dirt and will need replacing after a few seasons of use.

Adhesive-backed non-skid tape applied to companionway steps.

An alternative to tape is to recoat the steps adding a non-skid compound to paint or varnish. **Figure 5** shows varnished steps with non-skid sand (in this example) laid in a narrow strip on the ends only. It's a more permanent remedy that should last until the steps need refinishing again. Simply mask off the area to be recoated with tape, prep the surface and paint or varnish. Over the wet coating, sprinkle a non-skid additive such as silica sand, pumice or polymer beads. When the steps have cured, vacuum to remove the excess grit. If you're painting the steps, an option is to use a premixed paint containing non-skid particles.



Sand sprinkled over wet varnish gives a permanent non-skid finish.

WOODWORKING

COMPANIONWAY STEP BIN

By Ryc Rienks

Materials

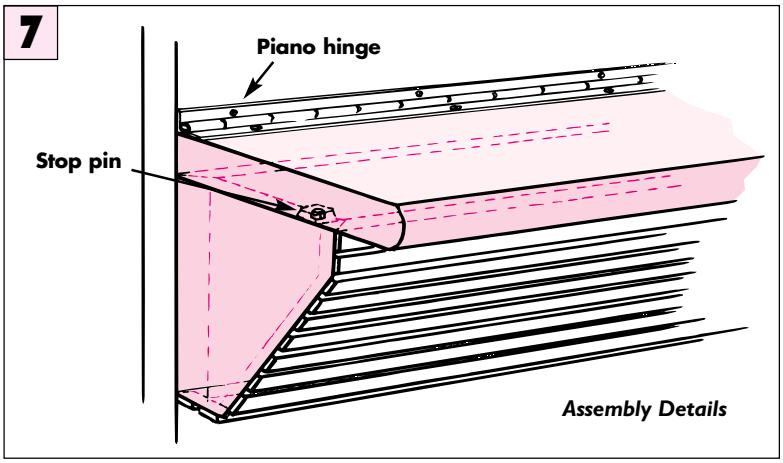
2 1.8m (6') teak batten strips
22 #6 x 3/4" pan-head screws
1 38cm (15") piano hinge
14 flat-head screws

For some owners, it's easy to step aboard a production boat and live happily ever after, never wanting or needing to add anything more than fuel and supplies. Then there are others, like myself, who see their boats as a vast expanse of potential awaiting development.

The first thing most boats need is a little more stowage space with easy access for small odds and ends. In my search for more usable space I decided that the companionway step had possibilities. In its original form it was a horizontal step supported by two upright braces. The whole thing was mounted to a marine plywood panel. The conversion doesn't cost much and is easily accomplished in just a few hours using basic hand tools.

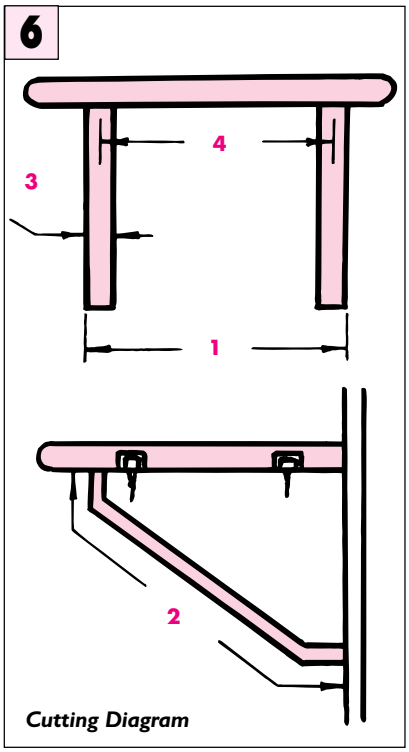
Referring to **Figure 6**, measure and record the following dimensions: (1) The distance between the step supports, outside edge to outside edge (mine was 32.7cm/12-7/8"). Check at several points to be sure the supports are parallel; (2) Measure down the length of the support to find the length of the bin (mine was 28cm/11"); (3) Measure the thickness of the support pieces (19mm/3/4" in my case); (4) Measure the distance from center to center of the two supports (mine measured 30.4cm/12").

Measurements 1 and 2 will allow you to calculate the amount of batten stock needed to cover the area between the two side supports. If your steps have open sides, make a cardboard template so it fits between the tread and the bulkhead then transfer the template onto 6mm (1/4") mahogany plywood and cut two sides. To reinforce the plywood, glue 12mm (1/2") triangular cleat stock to all inside edges. Some companionway steps have an open back and this requires closing off the back of the step with plywood that is glued or screwed onto the sides.



The battens that form the bin front (shown in **Figure 7)** are cut from 19mm x 6mm (3/4" x 1/4") teak, mahogany, maple or other hardwood stock. Teak battens are available from some marine stores and make a nice facing for your bin. Cut the battens to length using a miter saw or a small square for an accurate 90° cut. Allowing 6mm (1/4") between the battens, I needed 11 pieces 30.4cm (12") long, or two 1.8m (6') battens.

Since the battens are screwed in place, mark the center-to-center measurement (4) on each piece. If you have cut carefully, each piece should be close to the same length. Make a jig by marking the drill holes on one piece and drilling it. Lay this piece back-to-back on each piece and mark through the existing holes. Use #6 x 3/4" screws and drill a 3/32"



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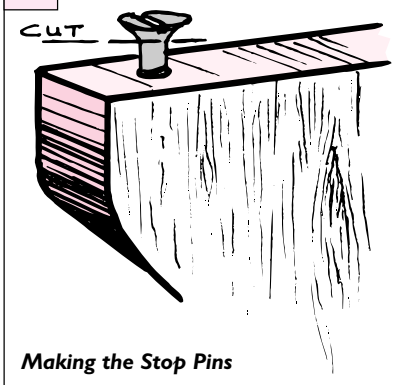


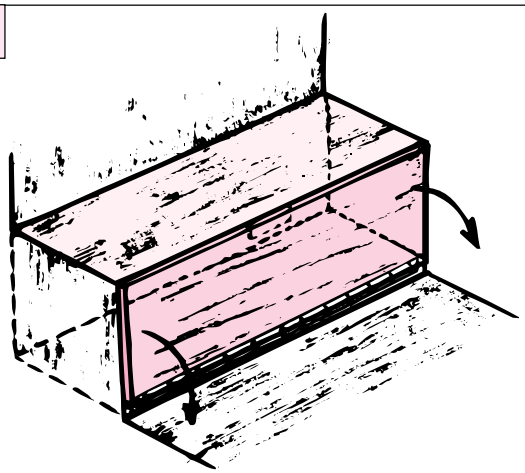
Making the Stop Pins

pilot hole. When drilling, you'll get the best results by placing the piece face down on a clean scrap of wood and drilling from the back of the piece. This will minimize splintering of the facing side. Don't apply too much pressure.

Since my step was mounted on a hinged panel, I removed the whole assembly. This allowed for easier assembly. Starting at the bottom and using a 6mm (1/4") piece of scrap as a spacer, I drilled and mounted each piece to the side supports until the area was enclosed. If you are using #6 screws, drill a starter hole into the side supports with a 3/32" bit to prevent splitting the wood. A bit of beeswax or soap on the screw threads makes a good lubricant when screwing the pieces in place.

Now that the supports are rigid, the tread can be removed. Locate and drill out the plugs covering the screws that hold the tread plate to the uprights. (Follow the instructions in "Easy Removal Of Wood Plugs" on page 28 .) Also check for screws coming from the back of the mounting plate. Remove the screws and tap gently around the bottom edge. If the tread is reluctant to move, it may be glued in place, or you may have missed a screw. Once you are sure you have removed all the screws, use a wooden mallet or a wood block and a hammer to tap the tread free.

9



Alternative design: Front face folds down to access storage compartment under step.

DIY PROJECTS

To help stabilize the step, screw the front two tread screws into each side support, saw off the screw heads leaving about a 6mm (1/4") stub and round the edges with a file to form a stop pin (**Figure 8**). Where these pins touch the tread, drill a hole the depth of the pin and slightly larger than the diameter in the underside so the tread sits flush on the side supports.

With the tread held in place by the pins you can now mount the piano hinge. Screw it to the tread and the backing piece **(Figure 7)**. Once you've put in an upper and lower screw at each end, swing the step up to be sure you like the way it moves. If the tread seems reluctant to move, the stop pins may be jamming and you'll have to drill larger holes in the tread. Finish installing the hinge screws, varnish or oil the battens (and sides if added) and you're done.

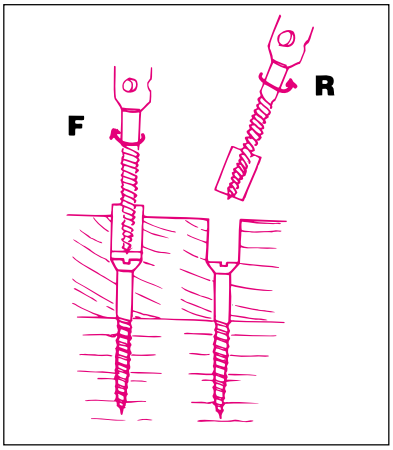
Alternative designs of stowage compartments on boats with steps, as shown in **Figure 9**, is to hinge the front panel, installing a piano hinge and magnetic clasp, or hinge the top tread following the instructions given above.

A former musician, custom knife-maker, teacher and writer, Ryc Rienks lives with his wife aboard a Cascade 36, currently berthed in San Francisco.

EASY REMOVAL OF WOOD PLUGS

Renovations often require the removal of wood plugs that have been glued in place or seated in varnish to hide the heads of countersunk screws.

To remove plugs without damaging the sides of the original drilled hole, cut the head off a #8, 38mm-long (1") wood screw with a hacksaw. Insert the headless end of the screw into the chuck of an electric drill. Carefully drill into the center of the wood plug until the tip strikes the head of the screw underneath the plug. Providing the plug wasn't seated in epoxy glue, the corkscrew-like force applied on the plug causes a clean break away from the sides of the plug hole and the plug will begin to win up the screw towards the drill chuck. Stop drilling and pull the plug out with a sharp tug on the drill or run the drill in reverse. Remove the plug from the screw and go on to the next one.



SPACE-SAVING SETTEE

By George Van Nostrand

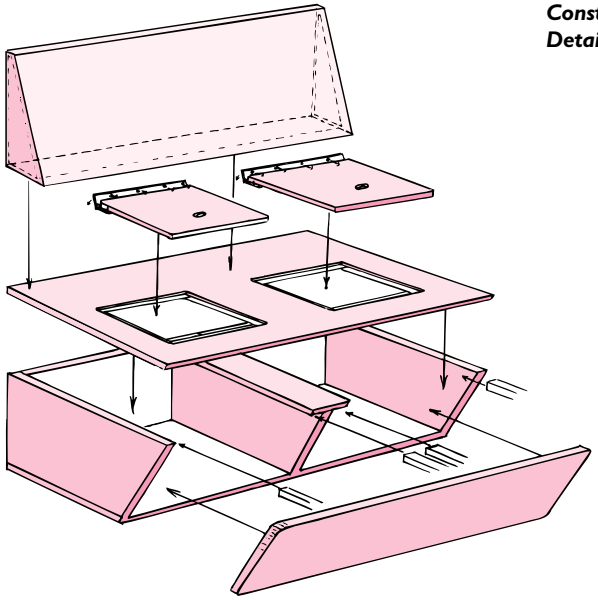
Much floor space was rescued after removing the bulky, free-standing hide-a-bed from the combination main salon and galley in our 22-year-old Tollycraft 34 Tri Cabin. The bed, which had been mounted athwartships against the aft bulkhead, was replaced with a two-cushion settee **(Figure 10)** installed longitudinally, along the starboard side.

GEORGE VAN NOSTRAND

Two-cushion settee replaces a bulky, hide-a-bed in this 22-year-old Tollycraft 34 Tri Cabin.

First the original interior wall panel on the starboard side, between the sliding side door and the aft bulkhead, was removed revealing hoses, wires and, of course, the inside surface of the hull. To support the settee and provide two underseat storage lockers, three identical upright supports were cut from 19mm (3/4") marine-grade fir plywood. These supports measured 31cm (12-1/4") high, 66 cm (26") wide at the top edge and 58cm (23") at the bottom edge, squared on the inboard end and angled on the outboard (front) end for heel space. These were then secured to the floor with 19mm (3/4") cleat stock glued to the inside surfaces, one support at each end with the third in the middle to make a seat of 1.5m (5') in length and two compartments of equal size. For added support, cleat stock was glued to the inside of the two end supports and both sides of the middle one, flush with the top edge. Refer to **Figure 11** for construction details.

11



Construction Details

Next, the removed wall panel was cut to form the angled front section. A piece of 12mm (1/2") plywood formed the seat, the angled back, which measured 55cm (22"), and the exposed end near the companionway door. This wedge-shaped piece has a 7.6cm (3") offset, providing a comfortable angle for the backrest. All panels were installed with #8 flat-head countersunk screws.

For access to the storage lockers, two large holes with radius corners were cut in the seat, positioned centrally between the two ends and middle supports. If cut carefully, the cutouts become the locker lids. Strips of hardwood, 6mm (1/4") thick and 3.8cm (1-1/2") wide, were glued to the underside of the seat so the strips overlap the edge, giving a 19mm (3/4") ledge to support the lids. Mortised door hinges were mounted at the back of the lids and large 2.54cm (1") finger holes drilled near the front and center.

Cleat stock was glued to the inside edge of the back section then the wedge was attached. The whole assembly was then taken to a local upholsterer to construct a permanently-mounted cover backed with 7.6cm (3") medium-density foam. The wedge too was lightly padded and covered. Because the settee is located in front of a large window, the top edge was fitted with a snug-fitting cap to protect the backrest from soiling and fading from the sun. Two 10cm (4") cushions were fashioned to fit over each of the two seat lids and under the lip of the back cushion.

MAKING WOOD PLUGS

Plugs of mahogany, teak or oak are available from many marine and hardware suppliers or you can make your own. You'll need a 3/8" or 1/2" plug cutter and a drill press (preferred, but I cut them with a hand drill) and wood (or StarBoard) scraps.

Holes for screws and plugs are drilled in one pass with a combination counterbore and plug drill bit. The depth of cut for the counterbore should be about one-third of the plank thickness. Dip the plug in wood glue or varnish (easier to remove), seat it in the hole with the grain parallel to the wood piece. Then lightly tap the plug with a wood mallet. Do not "hammer" the plug or it may split. Let the glue cure, then shave the plug with a sharp chisel until it's slightly proud of the surface. Your first cut should be with the grain so you don't chip the edge and have to start again. Use a sanding block to sand the plug flush with the wood piece.

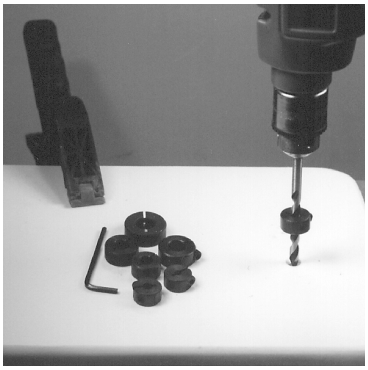
DIY PROJECTS

Final finishing involved staining the plywood seat top and exposed wood at the end of the settee to match the front panel, then varnished. As the upholstery material chosen grips well to the hook side of Velcro tape, a length of it was stapled near the front edge of the seat to discourage movement of the cushions.

A retired mechanic, part-time instructor of the Canadian Power and Sail Squadrons and delivery skipper, George Van Nostrand has owned and skippered power cruisers for more than 30 years. He and his wife Sheilah are currently restoring their '75 10.2m (34') Tollycraft for long-distance cruising.

DRILL STOPS

An accurate and easy way to set depths when drilling is with a depth collar. Just slip the collar over the bit and tighten the set screw with an Allen wrench. Now you can drill holes to the exact depth without guessing. Available in standard drill sizes from 1/8" to 1/2", depth collars are sold at many hardware stores. A set of seven sells for under $15, or about $3 each.



MAKING A DOUBLE BERTH

By Sandra Turney

Materials

Bunk pieces: 17 each 22cm (7/8") mahogany, maple or ash. Use cedar or fir, if added weight is a concern
Fiddle: 19mm x 5cm (3/4" x 2") mahogany or teak
Framework (optional): 2.54cm x 2.54cm (1" x 1") cleat stock
Screws: 36 each #10 1-1/4" flat-head wood screws
16 brass #10 1-1/4" flat-head wood screws
Plugs (optional): 16 1/2" diameter plugs
Fasteners: 2 brass barrel bolts
Spacers: pennies

While skimming through "The Finely Fitted Yacht" by Ferenc Mate, I found the pull-out double bunk I've been wanting to install on my Contessa 26. It's easy to install over an existing bunk. If you convert a former seat or locker, you'll have to build a framework of 2.54cm (1") cleat stock to support the sliding bunk pieces as shown as dotted lines in **Figure 12**.

Template

First, cut a template out of scrap plywood or cardboard that fits the length of the bunk, the curve of the hull, and is flush with the edge of the bunk in the main cabin. Label the top side of the template and draw a line 19mm (3/4") from the straight edge down the length of the template. The template is used to fit and trim the pieces of the bunk and framework without having to go in and out of the boat a hundred times. The 19mm (3/4") space is for the fiddle that holds the cushion in place and mounts flush to the bunk edge.

Bunk Pieces

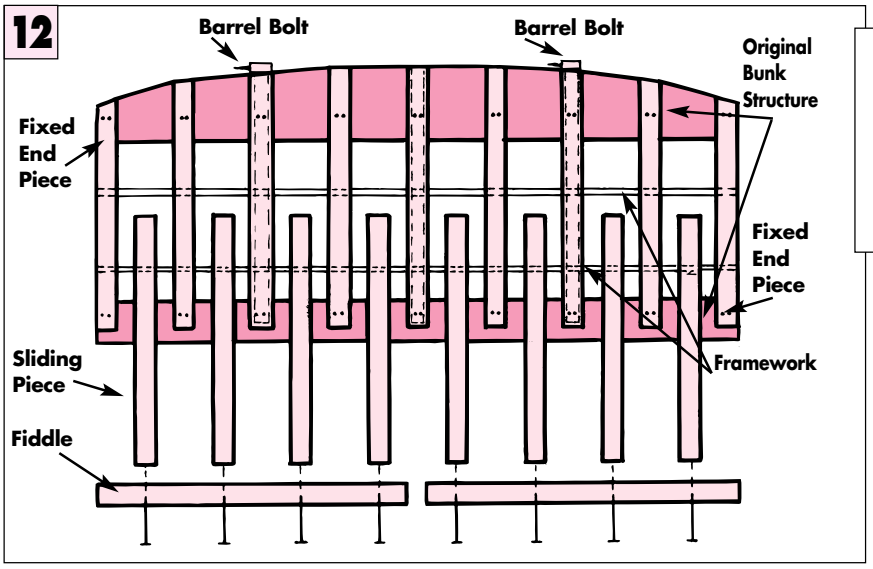
To calculate the width of each bunk piece, measure the length of the template in inches, subtract 2.54cm (1"), and divide by 17. The 2.54cm (1") you subtract is the total of the 1.5mm (1/16") gap needed between each piece for sliding.

Figure 13 compares approximate bunk lengths with the widths of the pieces. Cut your 22mm (7/8") wood to the proper width (which for me was 10cm/4"). I had a professional carpenter cut the pieces for me because I don't have a table saw, planer, joiner or router.

Dado the pieces using a dado saw blade or router, according to the measurements in **Figure 14**, removing half the thickness plus 1.5mm (1/16") to a width of 9mm (3/8"). Remember to only dado the inside of the two fixed end pieces. Using your template as a guide, position a bunk piece over the template, lining up one end, and cut it to length, less 19mm (3/4") for the fiddle. As you lay the pieces on the template, insert pennies between

13 Chart of Bunk Length Versus Width

Length of Bunk Less 1"	*Width of Bunk Pieces*
63-3/4"	*3-3/4"*
68"	*4"*
72-1/4"	*4-1/4"*
76-1/2"	*4-1/2"*
80-3/4"	*4-3/4"*
85"	*5"*



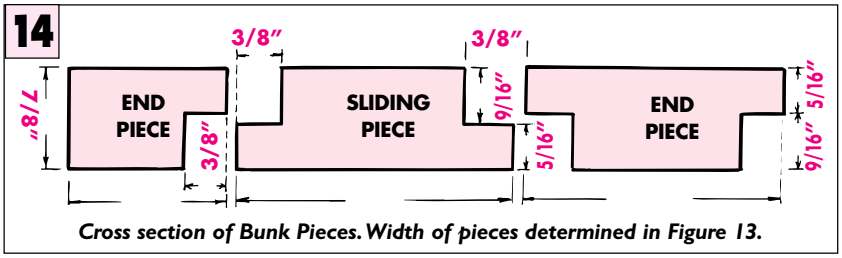
Exploded View (not to scale) Inset: Detail of framework joinery uses a cross lap, glued or screwed, where longitudinal and cross members intersect.

each piece and along the back (hull) edge. Use additional pennies along the sides of longer boards. These act as spacers to ensure an equal gap between each piece. Once all pieces are cut and fitted, they should exactly layover the length and width of the template.

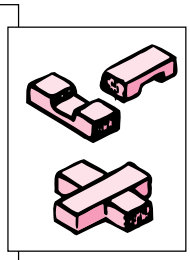
Number the bottom of the pieces to ensure you keep the same order as you fit the pieces to the template. Sand smooth all rough edges.

Fiddles

Cut the fiddle of 19mm (3/4") hardwood, 5cm (2") high for a 10cm/4" cushion, and the length of the bunk less 3mm (1/8") for clearance. For easier handling, I cut the fiddle into two pieces of equal length. Round the edges with a router, block plane or cornering tool (see "Rounding Edges" on page 33), then sand smooth.



Cross section of Bunk Pieces. Width of pieces determined in Figure 13.



Support Legs

Instead of using legs to prop up the pulled-out bed, I supported the sliding portions of the bunk on a ledge attached to the port galley bulkhead with a barrel bolt to keep them locked in place. If this is not appropriate, fashion four legs (two legs if using a one-piece fiddle), about 5cm (2") square and of a length appropriate to the bunk height. Attach them to the sliding portions with removal table leg fasteners (Perko 719 or similar). You'll need to recess the part that mounts on the underside of the bunk piece so it lays flush with the bottom.

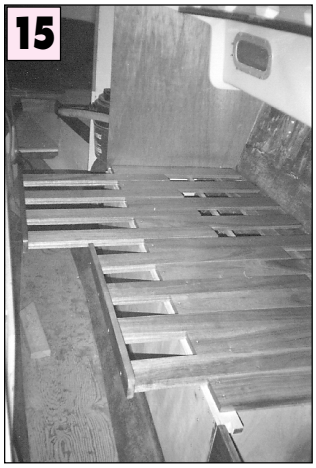
Assembly

Take all the pieces into the boat and place them, along with the pennies for spacers, onto your bunk structure. Dry-fit and trim the pieces (on the curved hull side) if necessary to ensure you have room for the fiddle(s).

To assemble, first mount a fixed end piece, dado side down. Drill four 3/16" holes (if using #10 screws) and countersink for a flush finish. (Tip: Use a combination bit that drills and countersinks in one operation.) Fasten with stainless-steel screws. Place the next piece,

DIY PROJECTS

dado up, against the fixed piece. Insert spacers (pennies) between the pieces and on the back edge. Continue with the same steps for each fixed and sliding piece until the rest of the bunk pieces are screwed in place. Note that every



Double berth assembled with two-piece fiddle for easier handling.

second piece of the bunk slides.

Place the fiddle(s) on the 19mm (3/4") ledge, using a penny spacer at each end. Drill and countersink a 3/16" hole (if using #10 screws) and mount the fiddle with a brass screw to one of the sliding pieces. Continue until all sliding bunk pieces are screwed to the fiddle(s) **(Figure 15)**. For a professional finish, counterbore the screw holes for wood plugs, using a 1/2" plug cutter and drill to a depth of about 6mm (1/4").

Once assembled, the screw heads are plugged with plugs made of the same wood as the fiddle(s).

When you are satisfied that everything slides according to plan, remove all the screws and disassemble your bed. Make sure you have numbered the pieces.

Finishing

Coat all pieces with three or more coats of oil, varnish or paint. Once all pieces are dry, reassemble your bunk using the numbers to fit them into place again. Attach the fiddle(s). If using plugs, set them in paint or varnish with the grain parallel to that of the fiddle(s). Attach barrel bolts to the hull, about 45cm (18") in from each end, so that they lock into two sliding pieces of the bunk. This is so your bunk doesn't slide out in rough weather or when heeled.

Sandra Turney is a technical writer for a software company in Ottawa, Ont. She's currently retrofitting her '79 Contessa 26, Sandy's Beach, *for long-range cruising to the Caribbean.*

A REFASHIONED DISH CUPBOARD

Story and photos by Sheilah Van Nostrand

All boats are a compromise and our 10.2m (34') Tollycraft was no exception. The dish cupboard was an attractive wooden piece but not very functional **(Figure 16)**. I decided to redesign this cabinet, adding pegs, partitioned compartments, hinged doors and a microwave supported by the lower shelf.

Moving the cabinet to the shop, the fiddles were removed, old Mac-Tac on the shelves was peeled off with a hair dryer. The exterior was stripped with Dad's Easy Spray, scraped down to bare wood, sanded, stained and finished with polyurethane varnish.

Utilizing the lower shelf of a discarded teak coffee table, I cut two doors the size of half the outside dimension of the cupboard less 12mm (1/2") on all sides. Teak strips of the same thickness were glued to the edges, mitering the corners, and rounding the outside edge on a router with a standard round overbit. The doors were then sanded, stained, varnished, hung with brass piano hinges and fitted with roller catches and copper handles to match those in the galley.

Dish cupboard before remodeling.

New dish cupboard with microwave mounted to lower shelf.

The next step was to drill the two 12mm (1/2") holes in the top shelf for dowel supports. There wasn't enough clearance for the drill inside the cabinet so rather than remove the glued-in shelves and risk ruining the interior, these holes were drilled through the top of the unit into the shelf using an extra-

Details of cupboard interior showing doweling, non-skid matting and roller catches.

ROUNDING EDGES

A simple and quick method to shape a fixed radius edge in wood or StarBoard is with the Veritas Cornering Tool (CDN$19.95). The kit consists of two cornering tools with a different radius cutter at each end. One tool cuts a 1/16" and a 1/8" radius; the other cuts a 3/8" and 1/4" radius. Easy to use, these tools cut on either the push or pull stroke and fences prevent cutting past the fixed radius. A sharpener comes with the kit.

long drill bit. As this cabinet mounts very near the headliner, the holes would be unseen. Short lengths of 12mm (1/2") dowels were cut to allow sufficient height to secure a stack of plates while leaving enough space to easily insert and remove them. Dowels were sanded, the tops rounded, stained and varnished, then installed with wood glue. Wood plugs covered the holes in the top of the cupboard.

To complete the project, a new microwave oven was mounted under the unit (**Figure 17)**. Rather than spend up to $40 on a manufactured bracket, most microwaves can be easily rigged with a homemade bracket. You'll need two strips of heavy-gauge stainless steel, hardwood spacers, four 1/4" bolts, four large flat washers and lock washers, and eight nuts.

To reinforce the microwave casing, cut two 3.8cm (1-1/2") strips of heavy-gauge stainless steel and drill two holes for 1/4" bolts in each. Remove the outer shell and position these brackets on the inside of the casing — whether they are mounted along the front, rear or near the sides will depend on the location of the oven's interior components — and drill through the casing. Be sure the brackets do not interfere with the oven's inner workings. The microwave casing must have a sufficient number of screws to support it to the main frame of the oven. If not, add some.

Using the four drilled holes in the oven casing as a guide, mark and drill four corresponding holes through the bottom shelf. Countersink four 1/4" nuts on the top of the bottom shelf.

To ensure there is adequate ventilation between the oven and the shelf, place a spacer between the two. (Check the manufacturer's specifications.) I made a spacer of 6mm (1/4") teak, but any hardwood or metal would suffice. Mark and drill the two bolt holes in each spacer. To determine the exact length of your bolts, carefully measure the distance from the oven casing to the top of the lower shelf. Cut the bolts to size with a hacksaw and file the ends smooth if necessary. TIP: Before cutting, thread a nut on the bolt past the cut point, then back it off after filing the end.

To mount the microwave, insert bolts through the stainless-steel brackets and the oven casing and secure with nuts. Reattach the casing to the microwave. Slide the spacers over the bolts, then insert each bolt into the corresponding hole in the cabinet and add a large washer, lock washer and nut. Fill in the gap around the nuts with wood putty, if desired. Line the shelves with non-skid rubber matting to prevent dishes from sliding **(Figure 18)**.

Sheilah Van Nostrand is a retired registered nurse, free-lance writer, Jane-of-all-trades and part-time boating instructor. She and her husband George (also a DIY contributor) do seasonal yacht deliveries in Canada and to the U.S. and are currently upgrading their '75 Tollycraft 34 Tri Cabin for long-range cruising.

Share a boat-tested project with other DIY readers. If we publish it, we'll send you $25 to $150 depending on the published length.

BUILDING WITH STARBOARD

In just a few hours, you can make accessories out of maintenance-free King StarBoard, a strong and durable UV-stabilized polymer. This material is easily cut, routed, shaped and drilled with standard woodworking tools. (See the WINTER '96 issue for complete step-by-step instructions for building with StarBoard.) Available in standard colors that match most gelcoats, it requires no painting. Following are instructions for making an outboard bracket, chopping board, tool rack, pulpit seat and boarding step. (Instructions to build a tool organizer, fishing rod racks, hatch board seat, folding jump seat and swim platform appear in the WINTER '96 issue.)

OUTBOARD BRACKET

Materials:

- 19mm (3/4") King StarBoard, 68.6cm x 20cm (27" x 8")
- 2 3.8cm (1-1/2") 1/4" flat-head bolts and nuts
- 4 U-bolts to fit rail and locknuts
- 2 eye straps and fasteners (lower wire rail only)

If you tow a dinghy, it's good practice to remove the outboard but where to stow it can pose a problem. On one trip, we lashed our outboard to the foredeck, on another occasion to the sidedeck, but both locations created an obstacle course every time one needed to go forward.

Simple to build, this outboard bracket safely supports engines up to 9.9hp. It bolts to 61cm- (24") high stern pulpits with 2.54cm- (1") or 3.1cm- (1-1/4") diameter rails. A recess routered on the inside of the bracket confines the engine's clamp screws. Two 2.54cm- (1") diameter holes cut out in the center of the bracket allows attachment of a security chain to lock the engine or a restraining line tied to the lower unit.

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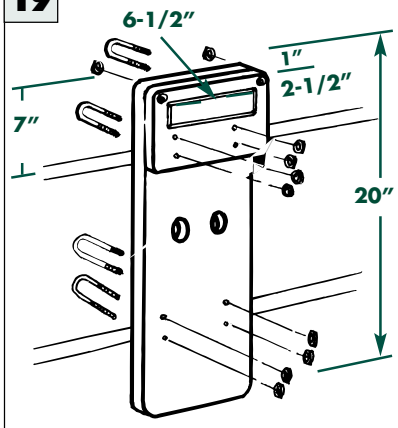


Cutting & Assembly Details

All fasteners are stainless steel and mount with locknuts to deter theft of the bracket or engine.

To begin, cut the StarBoard into two pieces, one 50.8cm (20") long for the bracket, leaving the remainder, measuring 17.7cm (7"), for the reinforcing pad. Refer to **Figure 19** for measurements and assembly details. (For higher rails, cut longer so the bottom extends 5cm (2") below the lower rail.) Radius all corners. Sand with 50- or 80-grit paper depending on the roughness of the cut edge, and round all outside edges. On the outside edge of the pad, router a 6mm- (1/4") deep groove, 16.5cm (6-1/2") wide and 6.3cm (2-1/2") high, 2.54cm (1") down from the top edge using a straight bit. This recess stops the clamp screws from accidentally sliding off the bracket. The height and width of the recess should fit the placement of the clamp screws on most engines, but check your engine before cutting.

Match up the top edges and sides of the bracket and pad, then drill a 1/4" bolt hole in each corner. For a professional finish, countersink the bolt heads and counterbore all nuts. Assemble the two pieces with two 1/4" flat-head screws, 3.8cm (1-1/2") long or cut to size with a hacksaw.

On the outside of the reinforcing pad, draw a line 12.7cm (5") down from the top and 3.8cm (1-1/2") from each side. This marks the centerline of the top rail. To mark the centerline of the lower rail, measure down from this line a distance of 29cm (11-1/2") for 61cm- (24") high pulpits. Draw a line on the inside of the bracket piece, again 3.8cm (1-1/2") in from each side. Center a U-bolt vertically over each mark and drill mounting holes. On the outside of the bracket, counterbore the holes for locknuts. When the lower rail is wire, replace the two U-bolts with eye straps. Use a hacksaw to cut the two upper U-bolts to a shaft length of 3.8cm (1-1/2"), and the two lower bolts to 19mm (3/4"). Drill two 2.54cm- (1") diameter horizontal holes in the center of the bracket and radius the edges.

Attach the bracket to the pulpit with the four U-bolts (or eye straps) and locknuts. StarBoard is slippery, so affix non-skid tape to the recess in the reinforcing pad.

CHOPPING BOARD

A proper chopping board is an item few boats have but an essential tool for preparing meals onboard. On smaller boats with limited counter space a kitchen-type board is impractical and, besides, there's probably no place to stow one when underway.

A sink-mounted chopping board (**Figure 20**) is self-stowing, increases your work space and doubles as a

StarBoard chopping board.

trivet for hot pots or pans. You could laminate a board from narrow strips of oak or maple, but making one of StarBoard saves fabrication time, it won't warp, crack or mildew and it's readily disinfected with a water-and-bleach or -vinegar solution.

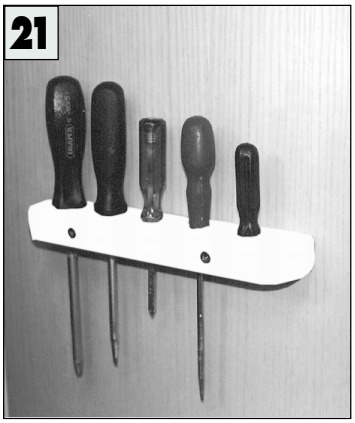
For sinks that are recessed, make your board to fit the cutout, less a gap of 3mm (1/8") or so for a loose fit. Ideally, the board should be the same thickness as the cutout so it sits flush with the countertop. If the sink is mounted over the countertop, use 2.54cm (1") thick StarBoard and add an extra 2.54cm (1") or as needed on all sides so the board overlaps the sink flange. To prevent the board from sliding around, you'll need to recess the board. Make a template of the inside shape of the sink, center the pattern on the wrong side of your board and mark a line around the edge. Router a 12mm (1/2") rabbet around the outside edge of the board to your scribed line. Cut a finger hole in the board or make a larger opening that doubles as a drain. To finish, round all edges and lightly sand smooth with 120-grit paper. StarBoard floats, so when not needed in the galley, it makes a perfect floater board for the kids when swimming.

TOOL RACK

It seems that I can never find the correct tools when working on the boat or engine. An easy remedy to this is a tool rack **(Figure 21**). Gather all your must-have tools — screwdrivers, adjustable pliers, vise grips, wrenches. Cut your rack of 19mm (3/4") King StarBoard (or hardwood), 25cm (10") long and 5cm (2") wide. Radius the corners and outside edges. Position your tools on the rack, mark the cutouts for the shafts and handles and drill it. Drill two 3/16" holes (if using #10 screws) and countersink. Use bolts if you have access to the back of the panel. Mount the rack in the engine room or on a nearby bulkhead.

PULPIT SEAT

A bow-side seat gives the perfect platform for resting one's derriere when tending the anchor, navigating



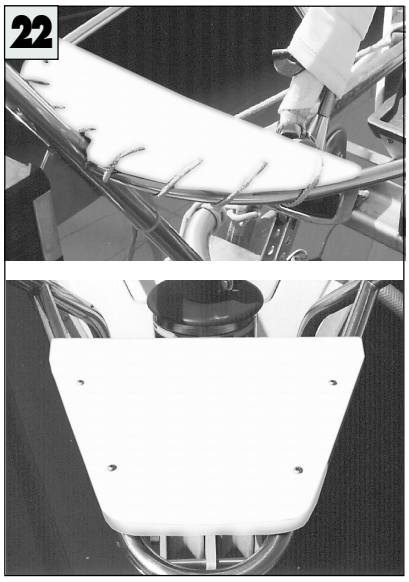
Tool rack made of King StarBoard.

through the shallows or spending some quiet time alone.

Two styles are shown in **Figure 22**. Designed to fit over the top or lower rail, these fasten to the pulpit with rope lacing, machine screws or bolts.

Make a template of cardboard, lay it over the rail and scribe the outer edge onto the pattern. Transfer the finished shape onto 19mm (3/4")

DIY PROJECTS



Bow-side derriere rest.

StarBoard (or hardwood such as teak or mahogany), cut and radius all edges. Dry-fit the seat and mark the drill holes. Drill four 3/16" holes for #10 machine screws or bolts. Lay the seat on the pulpit and drill the rail. For fastening with rope, drill a series of 6mm (1/4") holes, evenly spaced, and bevel the edges. Lace the seat on with 4.7mm (3/16") polyester cord.

BOARDING STEP

By Janis Priedkalns

Many boats, including ours, have rather high freeboards which can make for difficult boarding and disembarking. Dock boxes and overturned milk cartons are often tried but are cumbersome and impractical to store onboard for use at other marinas. We also considered a boarding ladder but after examining the various methods of attachment, the idea was dropped.

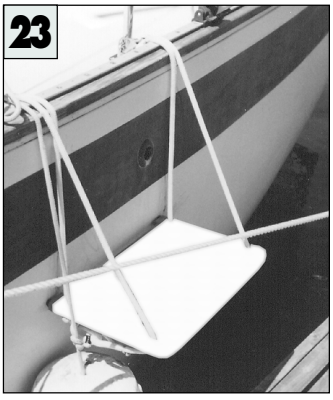
We finally came up with an alternative that has served us well. This boarding step can be made out of solid hardwood, plywood or a maintenance-free polymer such as King StarBoard. The latter material requires little finishing and you can make a step from it in just a few hours (see the WINTER '96 issue for complete instructions for working with StarBoard).

The step here measures 40.6cm (15") in length. You can make it any width, but no narrower than 14cm (5-1/2"). I made ours of 22mm (7/8") teak, assembled in a grate pattern.

To make a StarBoard step **(Figure 23)**, simply cut 19mm (3/4") of material with a jigsaw, round the edges with a router, drill holes for the attachment lines, attach a protective bumper (see below) and, *voila*, an instant boarding step. Lay strips of adhesive-backed non-skid tape on the top side for better traction. No other finishing is necessary. And it floats!

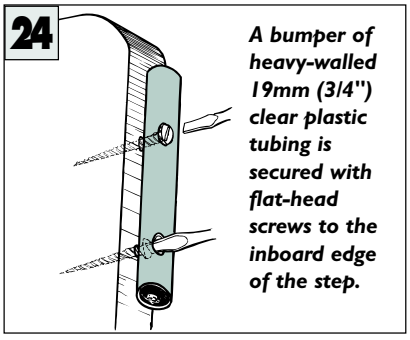
If you've chosen plywood, use 19mm (3/4") or two layers of 12mm (1/2") laminated with epoxy or vinylester glue. You'll have to waterproof all surfaces with a minimum of three coats of epoxy covered with an enamel or polyurethane marine paint. Better yet, wrap the entire step in 6 oz. fiberglass cloth cured in resin. On the top side, sprinkle sand over the last coat of paint before it cures or finish with strips of non-skid tape.

Protection is required for the topsides where the step rests against the hull. The only suitable material we found was a 5cm (2") piece of heavy-walled clear plastic tubing screwed to both ends **(Figure 24)**. We tried various rubber and plastic bumpers but all left marks or scuffs.



A boarding step provides an easy solution to boarding or disembarking from a dock or dinghy.

Position the step on the hull and measure the inboard and outboard height from the gunwale to the step. Add 50cm (20") or so to each measurement and cut four attachment lines of 12mm (1/2") nylon. Splice (or tie) these lines to heavy-duty snap hooks. Secure the line under the step at each corner with a figure of eight



A bumper of heavy-walled 19mm (3/4") clear plastic tubing is secured with flat-head screws to the inboard edge of the step.

knot. Don't cut off the excess line as you may need it to lower the step. The excess ties neatly on the underside of the step. To adjust the step height, reposition the knots. On our boat, the snap hooks clip to the stanchion base at the gate area and can be used on either side.

After a few seasons of use, we've discovered that this step doubles as a valuable docking aid. On boats with high freeboard, it's very difficult and dangerous to jump off the boat onto a dock during docking maneuvers (or getting aboard when leaving the dock), especially where the dock is low, narrow or wobbly. My crew now stand on the step and step ashore to attend the lines without any dangerous acrobatics. The step is also useful for boarding a dinghy. Periodically check the attachment lines and replace any that show signs of wear.

Janis Priedkalns manages an electronics service business based in Markham, Ont., and spends his summers cruising the Great Lakes in Simmerdim, *a Corbin 39 he built from a kit.*

FIBERGLASS

HOME FOR THE HOOK

By Ryc Rienks

Materials

12mm or 19mm (1/2" or 3/4") mahagony plywood
Scrap wood for pattern making
Cleat stock
Fiberglass stripper
Epoxy or vinylester resin
10cm- (4") wide fiberglass tape
5cm (2") disposable brushes, mixing pots, gloves
Compass
Scissors
Masking Tape
6mm (1/4") ID copper pipe

A chain locker places your anchor on the bow, ready to serve when you need it in a hurry, whether it be to stave off disaster or to give you time to think. If your boat is without a locker, this design **(Figure 25**) is simple to build, but requires unrestricted access to the bow. On my boat, the interior was glassed to the hull so the locker was glassed directly to the hull without cutting anything away. Direct attachment makes for a rigid structure and will also stiffen the hull.

The measurements given are those I used and may be modified to suit your boat. I suggest that you do the layout on paper following the guidelines below and shown in **Figure 26**.

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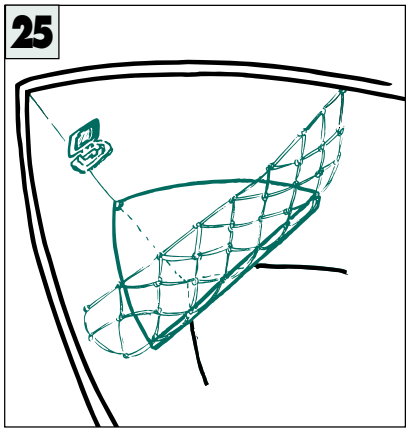


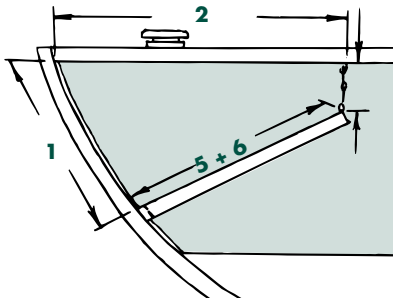
Crawling into the forepeak, measure down the inside of the stem from the hull-deck joint at the bow a distance of 61cm (2') and mark it **#1**. From the bow, measure aft along the hull-deck joint on both the port and starboard sides a distance of 71cm (28") and mark it **#2**. From your #2 marks, measure down vertically 30cm (1') on port and starboard and mark it as **#3**. Now, measure and record the distance between the port and starboard #3 marks. Mark this as **#4** on your layout. Measure forward from #3 on the portside to your lower mark at the bow, marked #1, and record this measurement as **#5**. Repeat this step on the starboard side, noting the measurement as **#6**.

The last three measurements you recorded, #4, #5 and #6, provide the rough dimensions for the floor of your new chain locker. You can now lay out the basic floor design on a piece of 12mm to 19mm (1/2" to 3/4") marine-grade mahogany plywood or exterior plywood.

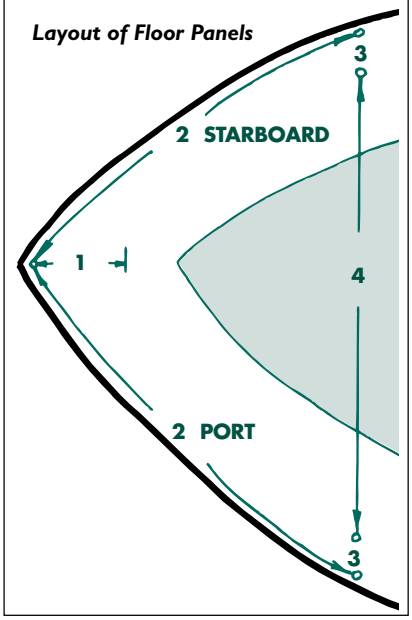
To complete the locker floor, the sides need to match the curvature of the hull. To make a pattern, scribe a compass line onto a piece of scrap wood as follows. First, cut a piece of scrap wood the length of #5, shaped as shown in **Figure 27**. Lay it against the hull from mark #3 on the portside to mark #1 at the bow. Set a compass to just bridge the gap between the hull and your board at the point where the gap is the widest. Holding the compass perpendicular to the hull, scribe a line the length of the board. Mark this side "port." Using a bevel gauge, measure the angle of the hull at three or four points. Record the angles on your pattern. Turn the board over and repeat the above steps for the starboard side. Mark this side as "starboard."

Now lay your pattern board on the plywood and transfer the above lines with your compass. Follow your reference line carefully and you will have a tight fitting floor. Remember that gaps of up 4.7mm (3/16") are considered acceptable.

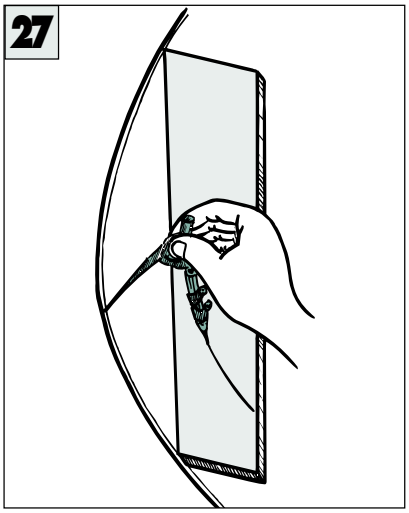
26



Layout of Floor Panels



DIY PROJECTS



Transferring a Cutting Line

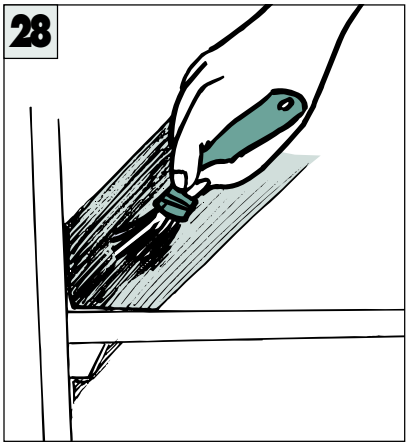
You should avoid a tight fit that might change the shape of the hull. Mark cutting angles on the plywood. Cut the floor panel with a jigsaw, adjusting the blade angle as necessary. As this location will see a lot of moisture, coat all sides and edges with a minimum of three coats of epoxy resin before glassing in place.

Dry-fit the panel in position. You may find as I did that the piece will sit in place without additional support. This is all to the good as it will allow for a tidy installation. If you wish or need additional support install short sections of wood affixed to the hull with a five-minute epoxy. These blocks should be shaped as right triangles viewed end on as they can then be left in place and the fiberglass tape will lay fair when put over them.

The next step is the hull preparation. Any paint must be removed to allow a true bond to the glass underneath. There are two methods of paint removal to consider — sanding and chemical stripping. I tried sanding through the paint to achieve a reasonably clean surface. This is one approach I'll never try again. Ah, the horrors of fiberglass dust! The chemical strip has been proven as workable as long as the stripper will be kind to your hull. When purchasing, specify a fiberglass stripper (i.e. Pintoff 299) and follow the directions carefully. These are powerful solvents, so wear a respirator and open the hatches. To improve ventilation, run fans to circulate the air.

I approached the actual fiberglassing with some trepidation but, as it turns out, the actual process is simple and straightforward. Of particular advantage are those epoxies that come as a kit, such as 3M Marine's new vinylester resin, or Interlux's Epiglass or West System epoxy with the resin and hardener and two metering pumps to assure accuracy in the mix. This accuracy is essential to get proper performance from the resin and avoid having it kick off too soon. I mixed mine in one pint batches and the job went well. Wipe all surfaces with acetone or lacquer thinner with white paper towels to remove any contaminants.

Setting the floor in place, I precut six pieces of 10cm- (4") wide fiberglass tape, the length of each



Multiple layers of fiberglass tape set in epoxy or vinylester resin form a flange that bonds the locker floor to the hull.

side plus a little extra. The six pieces allowed two layers on top, port and starboard, and one per side underneath.

Now mix up your first batch of resin, according to the directions for the type you're using. (Wear gloves and protective clothing when working with resins.) With the resin ready, move quickly to apply it before it sets up. Wet the areas on the hull and the floor panel with the resin and lay in the first layer of

solution, there wasn't much foaming, but what was there lasted a long time. A few drops placed on varnished and gelcoat surfaces didn't affect the finish. Recommended volume is 29.5ml (1oz.) per foot of boat length, so a 946ml (32fl.oz) bottle will treat a 9.6m (32') boat.

Captain Phab Bilge Cleaner (CDN$9.95) has a refreshing lemon smell. The suggested dosage is a half-bottle (500ml/17.5fl.oz) for a 7.5m (25') boat. It foamed more than the other products and lasted longer. Although marked "Corrosive" on the container, the product didn't harm the varnish or gelcoat.

There is no discernible smell to the Natural Marine Bilge Cleaner (CDN$10.95). Recommended usage is a half-bottle (450ml / 15fl.oz) for a 10.5m (35') boat. There was very little foaming, which dissipated quickly. If it spills, it won't harm gelcoat or varnish.

Star brite Sea Safe Bilge Cleaner (CDN$12.95/US$9.40) is an attractive sea-blue color with eye-catching graphics on the label. At full strength, the smell is somewhat overpowering, but this is subdued once the cleaner foams. Foaming was minimal but it lasted long after mixing. There was no damage to gelcoat or varnish. It's recommended you use the entire 946ml (32fl.oz) bottle for a 7.5m (25') boat.

Dosages are based on the suggested volume as specified on the container label. These are approximate and usage depends on the condition and configuration of your bilge. Manufacturers recommend treating the bilge at the beginning of the season then once a month or as necessary.

Aurora Bilge Bath is the most economical product to use; however, if your boat has a varnished cabin sole we don't recommend using this product because of it's potential to damage the finish if spilled. Four of the products were similar in foaming action, with Aurora and Natural Marine bilge cleaners dissipating faster than the others. The exception is Captain Phab Bilge Cleaner, which contained the most detergent, producing lots of long-lasting foam. Products from BoatLife and Star brite produced minimal foam but the foaming action also lasted a long time.

CAUTION: All these products claim to be biodegradable (will not harm the environment) but when poured into a bilge containing fuel or oil, the dispersed scum isn't. Pumping this bilge brew overboard pollutes the waterways and, in some areas, is illegal. Bilge water containing hydrocarbons must never be pumped overboard but pumped into a container for safe disposal ashore. An absorbent bilge sock (i.e. Bio-Sok) placed in the bilge removes toxic pollutants, leaving a solution that is safe to pump overboard.

Since doing this test, some new biotech products have appeared, such as Captain Phab's One-Shot Bilge Treatment, which organically decomposes fuels and other contaminants (except oil) into odorless carbon dioxide and water, leaving a bilge water that's safe to pump overboard, provided it doesn't contain oil.

Tim Melville and his wife Vicki operate Bosun's Charters in Sidney, B.C. The company offers bareboat and skippered charters, learn-to-sail vacations, flotilla cruises and yacht management on power and sailing yachts ranging in length from 8.1m to 12.6m (27' to 42').

Good Boatkeeping

REDOING A WATERLINE

Story by Zora Aiken
Illustrations by David Aiken

Many boats have boot tops — the painted line separating the topsides from the bottom paint — that are wrongly located. Some of these wrong-lines curve up at the bow and stern, creating a saucer look. If the line is mismatched port to starboard, the boat appears to list. A bow-down waterline prompts neighbors to ask if you're sinking. Repainting an accurate line may not be on the quick-and-easy project list, but it is possible.

The one sure way to find out where the boat floats is to put it in the water, leave it in long enough to get a dirty "scumline" on the hull, then haul it out and mark the line. This works for all hulls, but is practical only for small trailerable boats unless you or a friend own a Travelift.

Instead, try this method. Estimate where the bottom edge of the boot top should be at the bow and at the stern and mark these points. If there are no clues on the hull as to the location of these points, refer to boat plans or designer's specs, check other boats in the yard and copy from a same or similar design or guess, but err on the high side.

To establish a straight line, you need to construct a transit. Use a carpenter's level on deck to determine if the boat is sitting level fore and aft. Get two stepladders or construct tall sawhorses to support two "sighting" planks. At the bow and stern, place a .9m- or 1.2m- (3' or 4') long plank at the level of the boot top, extending it outboard to visually "move" the bow and stern points to a place where you can see both from a position behind the stern plank.

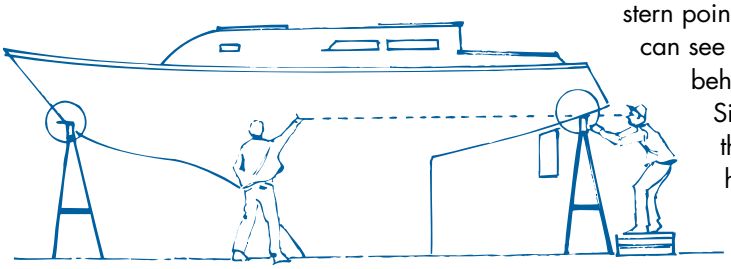


Figure A

Sight the two planks until they are on the same horizontal plane. Have a helper walk along the side of the hull with a pencil, following instructions as you call out "up", "down" or "mark" **(Figure A)**.

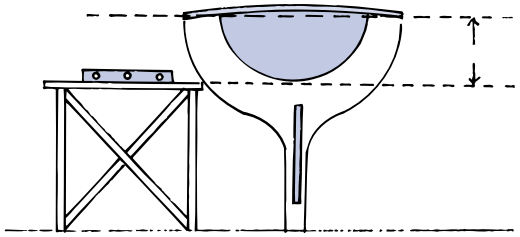


Figure B

After the line is marked on one side, measure down from the deck to check placement of sighting board on opposite side **(Figure B)**. Use the level to determine if the boat is sitting evenly side-to-side. If not, tilt the sighting boards to match the deck angle so the waterline will be in the same place on both sides.

The pencil marks give you a general guide for taping the boot top. Use 3M Fine Line tape, which gives a crisp edge, or Long Mask, which can be left on for up to seven days. Don't try to move along taping a few inches at a time. Instead, hold the tape at one end, extending a 1.2m (4') section or longer out from the hull, then move the tape towards the hull while holding it level to the pencil marks. Have your

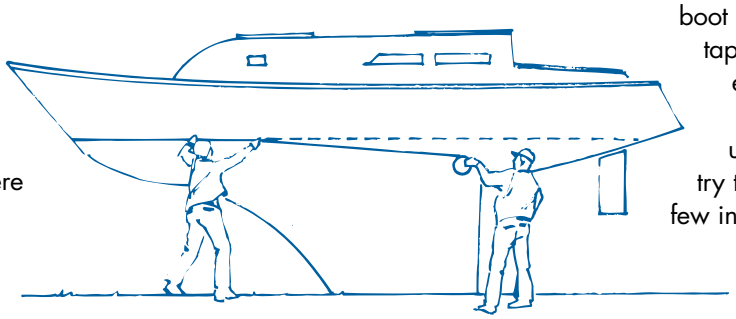


Figure C

helper gently press the tape down **(Figure C)**. Burnish well only after you're sure of placement. If the line isn't taped correctly the first time, you'll have to repeat the taping process, beginning at one end. It's very hard to shift a section up or down without getting a noticeable bulge or dip.

When you're happy with the placement of the line, move the two planks up to establish the top of the painted boot top. This averages 5cm to 7.6cm (2" to 3") above the bottom line at the center. You cannot simply measure up from the first line. As hull shape varies — in some places it's nearly vertical, in others horizontal — the painted expanse must also be different to achieve the visual effect of a boot top that is the same width bow to stern.

Once both lines are taped, it's helpful to check the taping from a good distance away — lines should appear to be parallel. Unfortunately, this is often not possible in a busy yard as boats are too close together to get a clear view.

Repeat the sighting procedure to mark the top and bottom of the boot top on the other side. Some people use the first designed waterline as a guide and try to match it by measuring down from the deck at certain intervals. However, the sighting planks are still the best way to determine the top of the painted boot top, especially near the transom where the hull turns under the actual painted line will be much wider **(Figure D)**. When the boat is floating, the line will appear to be the same width.

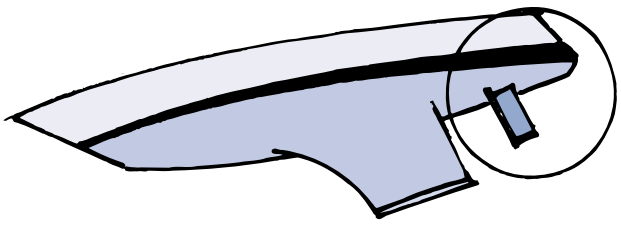


Figure D

It's common to raise the top of the painted line forward, which gives a slight turn-up at the bow. This is better than an accidental bow-down line. For boats with unusually high freeboard, cut down the wide expanse by using double or triple strips, rather than a single wide swatch of color.

David and Zora Aiken are the authors of Good Boatkeeping *and* Good Cruising *published by International Marine. The books are compilations of hundreds of practical boating tips acquired from nearly 22 years living afloat. The Aikens currently live aboard a 1963 10.5m (35') Chris-Craft sloop,* Atelier, *berthed in Mathews, Virginia.*