SUMMER 1996

DIY boat owner

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For instruction on repairing a delaminated deck, see DIY 1998-#2.

TALKBACK

CHANGING NAMES

Q: I recently purchased a boat with its name painted across the transom. The boat was built in 1993, so I 'm assuming the name has been there for three seasons. I want to rename the boat using vinyl graphics. How do I remove the painted name without damaging the gelcoat?
Paul Travis, Undecided, *Fifty Point, Ont.*

A: There are several ways to remove sign paint from gelcoat. Oven cleaner (Easy-Off is one brand) does a good job of removing some but not all paints. Apply the cleaner, then use a wide-blade putty knife (plastic is best) to lightly scrape off the paint, being careful not to scratch the surface. Interlux Pintoff 299 will also remove the paint, but use a metal putty knife because the product can dissolve plastic ones. After removing all the paint, rinse thoroughly and apply your new vinyl graphics. (See SPRING '95 issue for step-by-step instructions.) Some people use oven cleaner followed by a heat gun, but you must be extremely careful not to heat up the surface. We recommend that you try Pintoff before resorting to a heat gun.

REMOVING A GORI

Q: My boat is S2 9.2A and is fitted with a Gori folding propeller. I would appreciate some information on how to remove the prop from the shaft.
Brian Lee, St. Catharines, Ont.

A: For a solution, we contacted Ole Jensen of Jensen Marine in Oakville, Ont., who for many years distributed Gori propellers and now handles the Danish-made Flex-O-Fold prop. In order to remove a Gori propeller, you must first take off the blades. At the end of the hub you will see two small holes that hold two Allen screws that secure the pivot pin. Remove the screws and knock the pins out of the hub. Now, undo the Allen screw on the side of the hub with a 7/8" socket wrench, and unscrew the nut inside the hub. To remove the hub from the shaft, you will need to borrow or rent a prop puller with two long prongs. If the prop has been on for a long time, it may take a lot of pressure to get it off. However, persistence will pay off in the end. When you go to reinstall the prop, grease the shaft to facilitate removal next time.

CAUKLING A WOOD HULL

Q: I enjoy your magazine and subscribed to only yours after looking at no less than eight other boating publications. I recently purchased a 9m (30') 1966 Chris-Craft Crusader. As I consider myself to be an accomplished woodworker, topside issues do not concern me but I could use some advice on the bottom, which is double-planked, 22mm (7/8") Philippine mahogany. In two places the antifouling has peeled off and one spot shows a gap in the planking. The question arises: When should a gap be caulked, and when can it be left alone? Which caulking should I use? I gather from your advice and that of other sources, that 3M 5200 would be appropriate. Also, how dry should the hull be before caulking? Finally, how far into the joints, both running and end, should the caulking penetrate?
John Griffiths, M.I.S. Directed, *N.E. Massachusetts*

A: Shipwright Duarte Picanco of Noahs in Toronto, Ont., offers these recommendations: "We tend to leave gaps that are smaller than 2mm (3/32") alone, since it is difficult to inject enough caulking material in and the gap will seal up when the wood swells anyway. Caulking should penetrate a minimum of 12mm (1/2") into the joints. The wood surfaces must be dry to the touch; excess moisture can cause a chemical reaction which could create a weak bond. Depending on your situation and conditions, the caulking process could take anywhere from a few days to a couple of weeks. We have used both 5200 and Sikaflex 240 in the shop with excellent results, but prefer the quicker tack-up and curing time of the Sika products. Regardless of the product you use, remember that the wood must be dry, cleaned of any loose, flaking paint or old caulking, and degreased before you start."

TECHNICAL HELPLINE

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

DIY TALKBACK is a special reader service that makes available to you the resources of marine industry experts on topics such as boat repair, engines, trailers, electricity, plumbing, electronics, sails, maintenance and more.

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E-MAIL: info@diy-boat.com

TECH TIPS

SHAKE IT UP: The power in dry chemical fire extinguishers tends to pack or "cake" over time. Periodically shake the cylinder vigorously, then invert the cylinder and strike it soundly two or three times with a rubber mallet to loosen the powder.
Sheilah van Nostrand, Dream Catcher, *Keswick, Ont.*

WHEN YOU NEED MORE JUICE: If you inadvertently run your batteries down at anchor so much that they won't turn your engine starter over, and there is no help nearby, try using jumper cables that you keep aboard (you do keep them aboard, don't you?). Connect the ship's service battery in series to the starting battery (negative post to positive post, and positive post to negative). This might produce enough voltage to turn the starter over, but if so, use the starter only in short bursts and allow time for it to cool between starting tries.
Phil Friedman, Port Royal Marine, Pompano Beach, FL.

MAKING CONTACT: Next time your flashlight fails to shine, the fault may be with the contacts and not the batteries. Surface oxidation on internal switches where two pieces of metal touch can prevent electrical contact. Periodically open the flashlight and clean all the contact points with a standard pencil eraser.

TAPELESS COTTER PINS: Using needle-nose pliers, curl the ends of cotter pins so they form a tight coil. You'll save on rigging tape that otherwise would be wrapped around the pin ends to keep them from puncturing fingers, ankles and sails. It will also prevent your from reusing the pins, which is not a good practice.

TEAK OIL RAGS: Spontaneous combustion may cause rags which have been used to apply teak oil to catch fire. To prevent this from happening, soak rags in water immediately after you use them.

FAULTLESS CONNECTIONS: If you didn't do it this spring, now is the time to go around your boat with a screwdriver and tighten all the electrical connections. A loose connection can result in voltage drops, overheating and even electrical failure. Check and retighten wire connections regularly.

PLEASE GRAB BAGS: Plastic bags discarded in marina slips and waterways are a leading cause of failed water-pump impellers. If you see bags floating on or under the surface, use your boat hook to remove them. You could save yourself and others from pump failure and possible engine damage.
George van Nostrand,
Dream Catcher, *Keswick, ON*

SCRATCHLESS CLOTH: Use a terry towel when you apply polish to smooth surfaces such as gelcoat. Any dirt remaining on the surface ends up in the loops of the towel. A chamois, cloth diaper or similar smooth rag can drag sand or grit residue and scratch the finish.

CHARCOAL UDPATE: In the TechTips column of our FALL '95 issue we suggested you use charcoal to absorb odors and moisture when you're not using the boat. A reader from Montreal, Que., called to tell us that on a boat the charcoal should be stored in a metal container, such as a cookie tin, rather than a plastic one. Charcoal is highly susceptible to spontaneous combustion.

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.

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PROJECT BOAT

REPAIRING A DELAMINATED HULL

Faulty construction causes the fiberglass laminate to separate and peel off the hull in sheets.

Story and Photos by Paul and Sheryl Shard

We watched with trepidation as the haul-out crew positioned the slings under our home-built Classic 37 sailboat, *Two-Step*. Lifting the boat with a crane always made us nervous, but we were worried about the condition of our fiberglass hull following a 20,000-nautical-mile voyage to countries around the Atlantic Ocean. Three years in warm tropical seas can take their toll.

Fiberglass hulls are renowned for their high strength and durability; however, fiberglass is susceptible to osmosis blistering and, if left unchecked, can cause structural damage and hull delamination. To prevent osmosis from happening to our boat, we had coated the bottom with six protective layers of Interprotect 2000, an epoxy barrier coating.

Now back in our home port of Port Credit, Ont., the foreman gave the hand signal and *Two-Step* began to rise out of the water. We had hauled out briefly in Gibraltar the previous year — to redo the bottom paint after our transatlantic passage to Europe — and had been pleased with the condition of the hull at that time.

When we decided to build a boat in 1985, we both agreed to start from a bare hull rather than build the hull ourselves. We knew the limitations of our skills (and enthusiasm) and felt it prudent to trust this job to a professional. We found a small independent builder with the molds for the Sparkman & Stevens' designed Classic 37 and, with good references, had him and his crew set to work. We took delivery of the hull in the summer of 1986.

It was the only part of the boat we did not build ourselves. We did everything else though, right from smelting the lead for the internal keel to doing the interior and exterior woodwork, electricity and plumbing, rigging and countless other jobs required in building a boat. When we finished, we had accumulated more than 6,000 hours of labor between the two of us during the three-year process.

As *Two-Step* was lifted out of the water we saw, with relief, only a few barnacles clinging to the prop and a few bare spots on the bottom of the keel where the 1.8m (6') draft had found unmarked shoals. Otherwise, the boat was in great condition — or so we first thought.

The outer layer of fiberglass peeled off the hull in huge sheets — like peeling a banana!

Mistaken Identity

Then something very strange happened. During the next few days, as we cleaned and unloaded the boat in the yard, we noticed a few deep blisters in the gelcoat, about the size of a quarter, so we marked them and drilled them out to dry. But as the days went by, more blisters began to appear. The blisters actually seemed to be growing and spreading!

We continued to mark and drill out new blisters daily. They were all the same size and discharged a sour-smelling ooze about the consistency of honey. Within a week, our beloved boat had a serious case of the "pox." Mystified, we sadly left the boat to dry out over the winter.

After pressure washing the hull with fresh water, blister cavities were filled with a mixture of microballoons, Cabosil and polyester resin.

In the spring, things got worse. We were back at the boatyard and Paul was preparing to fill *Two-Step*'s blisters while I did some refinishing in the galley. I could hear him tapping at the hull as I worked. Then I heard a noise that I will never forget. A sound like fingernails on a blackboard. A scraping, withering "rrrrrrrrrrip" of fiberglass. I raced down the ladder and found Paul leaning against the cradle with a piece of our hull in his hand.

"Our boat's falling apart," he said.

He had dug the edge of a chisel into a large blister and discovered that the outer layer of fiberglass would peel right off. We were stumped. Our problem did not have the symptoms of a typical osmosis or delamination problem. We needed expert advice.

We called our friend Wally Dzuryk, former project manager of CS Yachts. He took one look at our peeling hull, checked the substrate and tapped the hull all over. He knew immediately what the problem was.

"Your hull isn't delaminating," he said. "It was never correctly laminated in the first place."

Wally explained that it is common practice for builders to prepare hull molds for the next boat by coating them with gelcoat, then spraying on a thin layer of

PROJECT BOAT

chopped fiberglass strands mixed with resin. Although this saves time for the builder, when the hull is left for more than two or three days the surface must be cleaned and ground to remove the wax that was added to the resin to promote curing, or subsequent layers of glass will not bond properly to the outer layer.

Boats with blisters under the gelcoat or blisters caused by voids deeper in the laminate are easily repaired by grinding the blisters out and filling them with an epoxy coating. Where blisters are caused by inferior laminating techniques, however, repairing the visible blisters still leaves voids between the outer layer and the hull, causing new blisters to appear every year. As the hull layers were never correctly bonded, we suspect it was the Interprotect coating that blocked the water from getting into the void sooner.

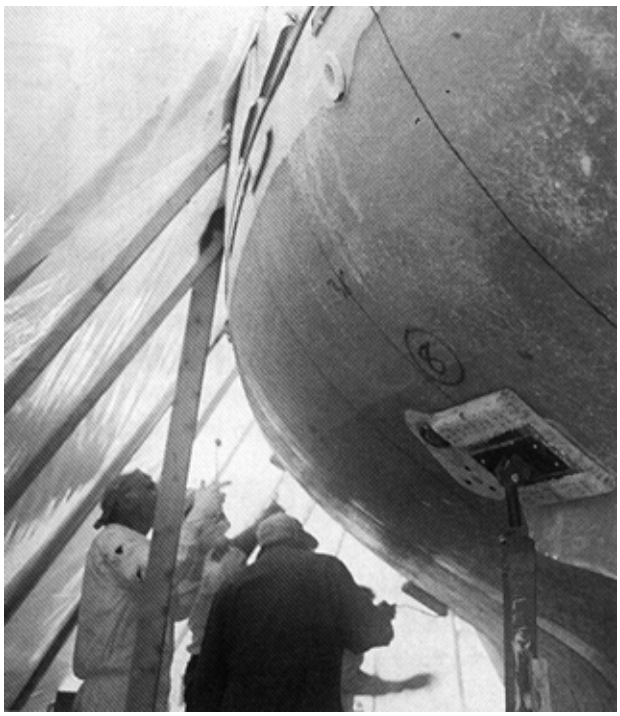
After a thorough survey, Wally assured us that the underlying hull was strong and sound. There were only a few voids in the topsides and we could inject those with epoxy to re-bond. We were relieved; we knew that if we had to strip and relaminate the topsides, we could never fair them to our satisfaction.

Under Wally's direction, we stripped away the fiberglass laminate from the waterline down to the keel and laid in four new layers of fiberglass mat and roving. Next we faired the bottom and reapplied Interprotect epoxy barrier coat and antifouling.

Make-Ready

The first job was to build a shelter around the boat to keep the hull dry. We made a simple structure of 2x2s covered with a clear plastic tarp. For added protection, we ran a rain gutter made of folded electrical tape around the hull above the waterline to prevent any water running down the topsides from traveling down the exposed hull below the waterline. We supported the boat with 4x4 wood beams bolted to the toe rail and various other props at the stern and bow, so the entire bottom would be accessible without having the cradle pads in the way.

Mat and roving were precut and labeled so they could be applied without stopping.



The hull was divided into sections and labeled with a waterproof marker in preparation for applying the new laminate. The lighter area below the waterline is the Airex core which remained intact.

Then we began stripping away the old laminate. This was much easier than we thought it would be, which demonstrated how poorly this layer was originally laminated. With a sanding disk on a grinder, Paul carefully ground to the depth of the outer layer of laminate all around the waterline. Then we peeled away the outer layer of fiberglass down to the keel. Sometimes it tore away in 1.8m-long (6') strips. The hull was surprisingly smooth underneath. The Airex closed-cell foam core, visible through the next few layers of fiberglass, was well sealed. Airex is impermeable to water and adds strength, stiffness, impact strength and sound and thermal insulation that prevents condensation in the boat's interior and kept us cool in the tropics.

Dark gooey patches showed where moisture had collected in the voids, mixed with resin and left glycol, a by-product of polyester resins that, unlike water, does not evaporate. We pressure washed with clean water before attempting to sand and fair the hull and left it to dry.

To prepare the exposed hull for reglassing, we used a small grinder and 36-grit disks to smooth the hull and create a "tooth" for the new laminate. A light touch is important here to avoid cutting crescents in the

glass. Then we washed with acetone and clean rags to remove any last traces of wax. Finally, we filled any dips and crevices with a putty of resin, microballoons and just enough Cabosil to thicken the mixture — too much Cabosil and it would be too hard and impossible to sand. When we were satisfied with the fairing job, we measured the hull into sections the width of a piece of fiberglass mat and labeled and marked each with a waterproof marker. Then we premeasured and cut the mat and roving into lengths.

Six-Layer Wrapper

On Wally's recommendation we had decided to use polyester resin instead of epoxy. It's less toxic to handle, much cheaper than epoxy and forms a reasonable mechanical bond to the existing fiberglass. Epoxy would have provided a stronger bond but would have added more than $1,000 to the bill. Of course, we would still apply an epoxy barrier coat over the new fiberglass.

Now we had to wait for good weather; we needed two consecutive dry days. We taped the waterline to give a clean edge. The new laminate would stand proud by 15mm (1/16"), but would be masked by the boot stripe.

The first day, we applied a layer of 1.5-oz chopped strand mat as a base. It took five of us to do the job — two to position and hold the mat, one to hold the mat against the hull, one to mix the resin and another to wet-out the glass with rollers. We had to work quickly before the resin hardened, keeping less than a gallon in the paint tray while being careful not to mix more than we could use in 15 minutes or less. We used a paint-mixer attachment on a drill to stir the mixture. Soon we worked out an assembly line system of pre-wetting the hull, positioning the mat, wetting the mat, mixing more resin, and on and on.

The next day, we hand-sanded the bottom and washed it with acetone. Then we applied another 1.5-oz mat followed by 18-oz roving and a final 1.5-oz mat. Adding one layer to the entire hull took about one and a half hours. We waited nearly another hour for each layer to partially cure before applying the next layer. Applying consecutive layers "green on green" forms one chemical bond between the layers that is much stronger than four individual layers.

When the final layer had fully cured, we sanded high spots and began fairing using a similar mix of microballoons, Cabosil and resin, and an old saw blade as a putty knife, to follow the contours of the hull. We enlisted Wally's help again with the final fairing around the waterline and his professional eye gave us an arrow-straight boot stripe. Finally, we washed the bottom with acetone one more time and applied the Interprotect 1000 and 2000 epoxy barrier coating as per the instructions, followed by antifouling. With the help of friends and family, it had taken 11 days to complete the job.

The hull repair was a massive job but, as all do-it-yourselfers know, the satisfaction and feeling of control you get from tackling a big problem can make even such a large job well worth the effort. Now we know our own hull and feel more confident than ever as *Two-Step* cuts through the waves. She has been back to the Bahamas twice since we made this repair and remains blister-free.

Paul and Sheryl Shard spent three years sailing to 23 countries around the Atlantic Ocean in a Classic 37 sailboat that they built from a bare hull. Their book, Sail Away! A Guide to Outfitting and Provisioning for Cruising *(CDN$24.95) and video documentary of their voyage,* Call of the Ocean

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(CDN$29.95) is available in bookstores and chandleries or from Pelagic Press, Tel: (705) 484-0061.
web site: http://www.searoom.com/shard

Laminating the four layers was arduous overhead work and it took five crew to do the job.

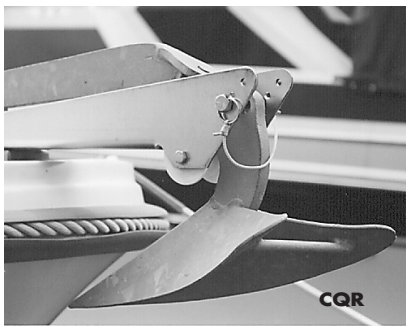
DIY REPAIR BILL

The following is the approximate cost for repairing a 11m (37′) sailboat from the waterline down to the keel. Prices vary depending on the products used and amount of paid labor. It's a good idea to enlist someone with professional boatbuilding experience as supervisor of your team. If you haven't done much fiberglass work, check with a professional yard for an estimate. We got rough estimates around $10,000. This works out to almost $300 per foot (LOA). Estimates for DIYers run from $50 to $100 per foot depending on how much help you enlist.

Temporary shelter (lumber, plastic, staples)	$100
4x4 legs to support hull	$50
Acetone	$50
Cabosil, microballoons	$50
Polyester resin (20 gallons)	$360
Fiberglass mat and roving	$380
Interprotect 1000 and 2000 (6 coats)	$420
Antifouling paint (2 coats)	$400
Rollers, sandpaper, grinding discs, brushes, solvent$	100
TOTAL:	$1910

CAST OFF

ANCHORS AND ANCHORING



The first of a two-part series looks at anchor design, holding power, load requirements and components.

By Sheilah van Nostrand

No craft, be it a rowboat or a yacht, should be without ground tackle. Anchors hold the boat in position when lunching, fishing, or overnighting away from the dock. In an emergency, such as an engine failure or dismasting, an anchor doubles as a safety device, securing the boat until help arrives.

The ideal anchor sets quickly and resets itself when the wind and/or current shifts. It should hold well in all bottom types: sand, mud, stones, weeds, coral, rock and mixed bottoms. It should withstand high load stress, hold well with a short scope, release easily from the bottom and store compactly on deck or in a locker. Unfortunately, no one anchor possesses all of these qualities for all boats in all situations. Making informed choices on what to use on your boat and how to use it is as personal as your hair style.

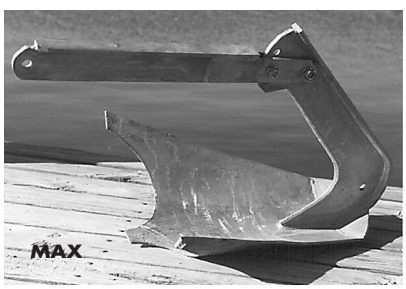
GETTING HOOKED

There are essentially four types of anchors: fluke; plows; kedges or hooks; and mushrooms. Among the most popular of these is the fluke-style, lightweight burying anchor developed by Richard Danforth. There are a variety of Danforth-type anchors marketed under the Fortress, Kingston, Performance (West Marine) and other brand names. This style holds exceptionally well in sand, mud or clay bottoms. In weeds or rocky bottoms, however, the flukes of all Danforth types tend to skate rather than dig in. The pivoting flukes also collect mud and weeds on retrieval. A recent adaptation, the American-made SRS self-releasing anchor, is a fluke-type with feet. Made of stainless steel, it was designed primarily for holding in rocks.

The plow-type anchor comes in several styles. The CQR's unique design resembles no other anchor type. Its deep-burying flukes are connected to the hinged shank that pivots somewhat parallel to the bottom as the vessel changes its direction of pull. Similarly designed plow-type anchors are the Kingston, Max, Bruce and Delta. The latter two are one-piece anchors with no welds. The Bruce anchor is designed so the anchor always rests on the bottom on one of its three flukes. The Delta, made by Simpson-Lawrence, is weighted so that the flukes dig in as soon as it reaches the bottom. Furthermore, it is balanced so that it can fall unaided from the bow roller and, on recovery, it is self-stowing — an advantage for singlehanders and when the anchor is used with a windlass. In tests conducted by the British publication *Motor Boat and Yachting*, Delta anchors rated best in setting and holding in sand and clay bottoms.

The Max anchor made by Creative Marine has a unique three-position shank (fixed models are also available) which can be pinned at different angles to improve holding power in a variety of seabeds. The anchor is easy to set as its wide flukes quickly dig into mud, sand, weeds and rocks. Independent testing in the U.S. gives this anchor top marks for deployment and holding. Because of their large flukes, all plow anchors tell you a lot about the bottom when retrieved.

The kedge or hook type anchors, such as the Yachtsman, Herreshoff and Fisherman, are somewhat reminiscent of the huge, traditional Navy type. Such anchors are more dependent on weight for holding power than fluke or plow anchors. While this design is an excellent choice for hooking rocks and coral heads or penetrating through grass and weeds, its bulkiness and excessive weight makes the anchor difficult to stow. Other hook types are the stockless Navy which, pound for pound, is prohibitive on modern pleasure craft. The grapnel, a stockless, five-pronged anchor is sometimes used by anglers but works better for retrieving lost equipment on the bottom by dragging it back and forth. Northill-type anchors look a little like modified grapnels. These anchors are best used during daytime rather than for overnight security unless they are trapped in a rock ledge or coral.



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The fourth anchor type, mushroom anchors, are used primarily for permanent moorings in muddy bottoms because of their unmanageable weight. Their efficiency as an anchor is otherwise at the lowest end of the scale.

When it comes to choosing ground tackle, you don't want to minimize or economize. Consider anchors not for the calm conditions you hope to use them in but rather for the worst conditions. Buy name-brand quality, examine overall construction

and welds (where applicable), and study the features of each type in an effort to match your style of cruising to the security needs of your boat. Serious cruisers often carry two or more types of anchors in readiness for a variety of seabeds.

Table 1 — MINIMUM HOLDING REQUIREMENTS (in lb/kg)

Use this chart to determine the minimum load requirements on an anchoring system in varying wind conditions.

LOA '/m	BEAM Sail	BEAM Power	Storm Anchor (42 knots)	Working Anchor (30 knots)	Lunch Hook (15 knots)
15 4.5m	5 1.5m	6 1.8m	500 225	250 112.5	60 27
20 6m	7 2.1m	8 2.4m	720 324	360 162	90 40.5
25 7.6m	8 2.4m	9 2.7m	980 441	490 220.5	125 56
30 9.1m	9 2.7m	11 3.3m	1400 630	700 315	175 78.7
35 10.6m	10 3m	13 3.9m	1800 810	900 405	225 101.2
40 12.1m	11 3.3m	14 4.2m	2400 1080	1200 540	300 135

Note: Holding power will vary depending on the type of bottom and anchor, the style of the boat and the wind conditions. These values do not consider any additional load factors (see Holding Power).
Courtesy American Boat & Yacht Council.

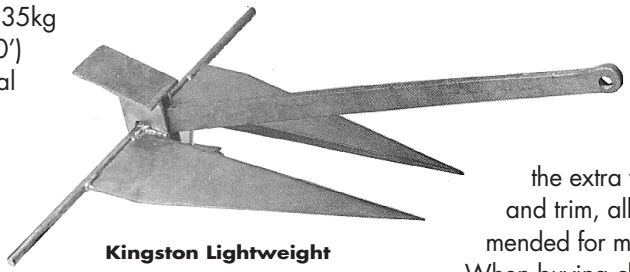
HOLDING POWER

The sizing of ground tackle is determined by a boat's length, beam, weight, the owner's boating habits and the type of seabed that is expected.

The best way to select working and storm anchors (you should have both) is to consult the boat's designer, builder or an experienced owner of a sistership. Where this is not possible, the minimum load requirements on an anchoring system, provided by the American Boat & Yacht Council, are listed in **Table 1**. Manufacturers also provide suggested anchor sizes according to a boat's overall length or gross weight. Use these values as a general guide. When buying an anchor, you must also factor in hull

form, displacement and superstructure, and the usual prevailing wind and sea conditions.

Rough seas, strong currents and wind all increase the loads on your ground tackle. In 15 knots, for example, wind exerts about 135kg (300lb) of force on a 12m (40') boat. Mass also plays a crucial part. A heavy-displacement boat has more "yanking" power than a lighter one. Boats with lots of windage — such as tall masts, flybridges or canvas enclosures — produce more load as the wind increases. The wetted surface of all underwater fittings, even the propeller, increases drag. Where any of these load conditions exist, you should always select the next size larger. When buying an anchor, remember bigger is better.



Kingston Lightweight

TWO'S BETTER

Delta

How many anchors do you need? One anchor is never considered sufficient. Despite the risk of fouling one anchor beyond your ability to retrieve it, there are times when it is desirable to set two.

For small boats on day trips in protected waters, choose a versatile anchor of a suitable weight and holding power for your vessel. Then stow a second anchor for emergency use. For cruising boats, three anchors can provide an efficient mix: light lunch hook for brief stops in protected waters while you remain on board; a working anchor for regular overnight service; and a third, larger storm anchor selected for its superior holding power in extreme weather conditions. Caution dictates that there always be at least one anchor ready for deployment within a minute or less in an emergency, such as engine failure in a crowded, narrow channel.

PUTTING IT TOGETHER

The rode consists of all the gear between the anchor and the boat. Use nylon line, which doesn't rot when stored wet and is very elastic, stretching a third or more under load. Three-strand twist outstretches its double-braided cousin by about 50%, but braid is easier to handle and stow. Here again, buy name-brand quality — your holding power depends on it.

Much of the advantage inherent in nylon is lost by buying too large a line, thereby losing the benefit of stretch. The ability of a line such as nylon to stretch and gradually absorb the heavy shock load on fittings and ground tackle is of particular value when a boat surges at anchor in steep seas. In rough waters, a nylon snubber attached to the line will absorb even more of the shock.

A short length of chain, 1.8m to 2.4m (6' to 8'), is sometimes attached between the anchor and its three-strand nylon rode, particularly when the boat will be anchored in rocky or coral bottoms. Contrary to popular belief, short lengths of chain only aid in setting the anchor and keeping the shank parallel to the bottom in calm conditions; stronger winds lift the chain off the bottom.

Cruising boats and boats fitted with windlasses often use all-chain rodes. However, as the extra weight alters a boat's speed and trim, all-chain rodes are not recommended for modern, lightweight cruisers.

When buying chain, it's essential to match the link length to the windlass pulley. Of the three most common types of chain used for anchoring, BBB has more links per foot and is marginally stronger than Proof Coil; High Test is stronger than both.

When you're attaching line to chain or the anchor, use galvanized or nylon thimbles and galvanized or stainless-steel shackles. Use a screw-pin anchor shackle secured with wire or a nylon tie, or a bolt-type shackle. It's a good practice to limit working loads of shackles and thimbles to

CAST OFF

one-fifth the rated breaking strength of rope. Shackles can be bypassed by attaching the rode directly to the anchor with an anchor bend or bowline, then tying an extra round turn on the ring and seizing the free end to the line.

Table 1 — DETERMINING RODE SIZES

Use this chart as a general guide when purchasing anchor rodes.

LOA	3-STRAND NYLON	CHAIN
up to 25′ up to 7.5m	3/8″	3/16″ PC
27′-31′ 8.1m-9.3m	7/16″	1/4″ PC
32′-36′ 9.6m-10.8m	1/2″	1/4″ PC
37′-44′ 11.1m-13.2m	9/16″	5/16″ PC/BBB
45′-50′ 13.5m-15m	5/8″	5/16″ PC/BBB

NOTE: Rode sizes are based on the use of high-quality anchor line. Both line and chain diameters are rated for winds up to 30 knots.

Keep in mind, however, that knots reduce the strength of a line by 40% or more; splices by about 15%. Refer to **Table 2** for suggested line and chain diameters in winds of 30 knots or more.

The weakest part of the rode is the splice; it should be of a reasonable length, taut and firmly seized at the join. Also pay close attention to the quality and fit of the splice on the thimble. It should be a tight, snug fit and seized (or whipped) around the line and at the "V" of the thimble.

Lastly, on larger boats be very sure to attach the bitter end of the rode to a large cleat, mooring bitt or eye bolt, to avoid accidental loss of the anchor. Never permanently attach the anchor in a small rowboat or runabout until you're ready to use it. In the event of a capsize, the anchor could sink the boat.

PART 2 in our anchor series continues in the FALL issue with a look at anchoring techniques and tips.

DIY PROJECTS

ADD A VENT

Materials

12mm (1/2") plywood
Cleat stock, 2.54cm x 2.54cm (1"x1")
10.1cm (4") threaded cowl vent
10.1cm (4") threaded deck plate
10.1cm (4") diameter PVC pipe
Teak finishing ring
Epoxy glue
Marine paint
Nylon insect screen

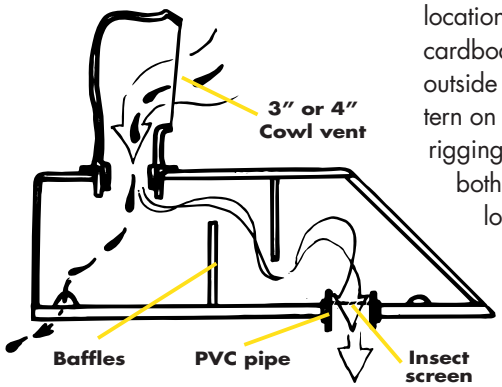
Nearly 95% of all fiberglass power and sailboats are inadequately ventilated. When a boat is left closed for a week or so, humid air turns the cabin into a greenhouse that grows all sorts of harmful water-based matter — namely, mildew, corrosion and wood rot. When you're on board, even a few hours spent in a stuffy, smelly cabin can be unbearable.

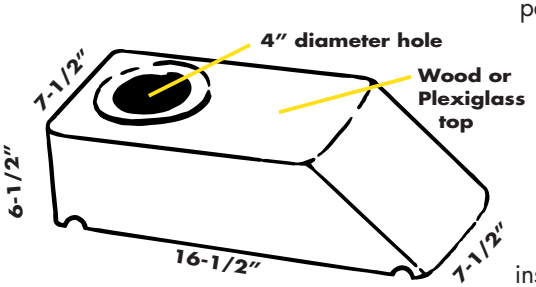
Bad ventilation is easily remedied by improving air flow. One of the most effective ways to do this is to add a pair of cowl vents mounted on dorade boxes. This design is a lot simpler than the teak dorades with dovetail joints crafted for custom yachts. Made of 12mm (1/2") epoxy-coated plywood or StarBoard (see next page), they require minimal woodworking skills.

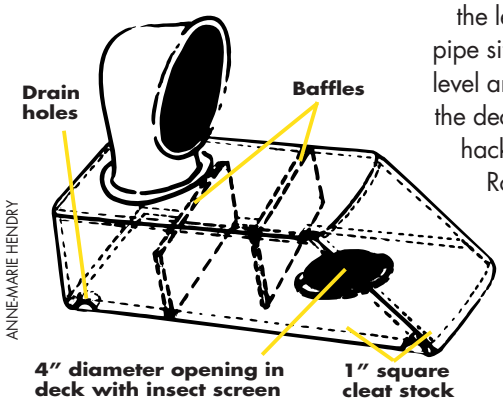
Although most dorade boxes are rectangular, the forward edge of our design is sloped to reduce windage. To hide exposed edges of the plywood, sandwich the ends between the sides; the top then overlaps all upper edges.

Follow our diagram and cut out all the pieces. Also cut two pieces the width of the box, one 5cm (2") and the other 7.6cm (3") in height. These are glued to the interior and act as baffles to prevent rain and spray from entering the cabin.

Cut four oval drain holes about 19mm (3/4") deep, near each corner on the bottom edge. (Cut only two holes on one side if the box is to be mounted flush against the cabin side.) Glue 2.54cm (1") square or right-angled strips (cleats) to the inside top and bottom edge of the ends and sides, avoiding the drain holes. Secure with C-clamps until dry. Then, glue the box ends to the sides, lining up the outer surfaces.







ANNE-MARIE HENDRY

Use pipe clamps and small screws, if you need them, to hold everything in place until the glue dries. Now glue the baffles into position. (See diagram for placement.)

Tightly screw on the vent to the base plate and, using the latter as a template, mark the hole on the box top. Make certain the vent will face forward when it's installed. Cut the hole about 5cm (2") from the aft edge, centered on the top, using a jigsaw.

To determine the most suitable location on deck for the vent, make a cardboard template of the dorade's outside dimensions. Position the pattern on deck, carefully avoiding any rigging, wiring or other obstacles both on deck and below. Select a location with minimal deck camber, if possible, and avoid positioning the vents over berths, as they draw a lot of air. Transfer the shape to the deck with a pencil.

Now mark the air hole into the cabin. Center the PVC pipe in the dorade, about 25.4cm (10") from the back edge. Using the pipe for a template, trace the outside edge. Cut the hole, insert the pipe and file to fit. From below in the cabin, mark the length so the top edge of the pipe sits about 5cm (2") above deck level and the lower edge is flush with the deckhead. Cut the pipe with a hacksaw and glue it in place.

Round all corners and edges with a small block plane, rasp, Sur-Form or other shaping tool. Sand everything smooth with an orbital sander and 120-grit paper. Dry-fit the box again to the

DIY PROJECTS

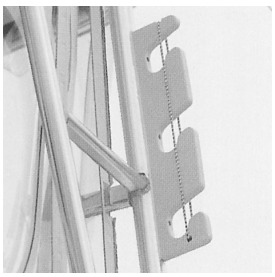
deck. Place in position and use a bevel gauge to measure the deck angle. Using a plane, file or sander (or whatever you feel most comfortable with), bevel the lower edge to match the deck. Dry-fit the box again and repeat the bevelling process as necessary until the box rests evenly against the deck. Mark the placement of the screws and drill pilot holes in the deck. Screws must fasten to the cleat stock. From inside the cabin, redrill the pilot holes to fit the screws, drilling into the cleat stock. Apply three to four coats of epoxy to all inside and outside surfaces, following the manufacturer's instructions. Finish with an epoxy-based enamel or polyurethane marine paint. Attach the vent base plate to the box top with polysulfide sealant. Mount the box on deck with screws threaded from the cabin deckhead. Now fasten an optional teak ring (available at marine stores) to give a professional finish to the interior.

The large 10.1cm (4") vent draws a lot of air; keep a wool sock or hat handy to plug the hole on cool nights. If bugs are a problem, you'll need to fashion an insect screen to fit over the PVC tube. When combined with a solar exhaust vent (see *DIY Projects,* SUMMER '95), you'll have the freshest cabin in the harbor.

SYNTHETIC ALTERNATIVE TO WOOD

If you're tired of stripping, sanding and painting or varnishing exterior wood trim, or you need to replace decayed plywood components, there's an alternative.

StarBoard from King Plastic Corp, is a strong, durable marine-grade polymer fabricated into sheets of various thicknesses and as thin as 6mm (1/4"). It does not rot or fade and cannot delaminate. It's pre-finished surface has a matte texture that repels stains, is scuff- and scratch-resistant and easy to clean.



KING PLASTIC CORP.

This synthetic material is easily cut or drilled with standard woodworking tools. You can use StarBoard to replace wooden items such as swim platforms, chair bases, ladder steps, cockpit grates, baitwell hatches, rod holders, handrails, galley counters, tables and cabinets — the potential applications are endless. It's available in six standard colors to match most common gelcoats.

The product is easy to work with. Simply measure, cut and fit. StarBoard cuts easily with a table saw or radial arm saw, using a carbide blade with 50 to 70 teeth. No additional finishing is necessary. For professional results, finished edges can be rounded with a router. A router bit with four spiral flutes works best as it ejects plastic chips away from the cutting surface and minimizes overheating which gums up the bit. You can even hide the fastener holes with wood bungs cut from StarBoard.

StarBoard bonds to fiberglass, aluminum, steel, wood, plywood and itself with a specialized two-part King StarBond adhesive dispensed from a glue gun that can be purchased or rented from your local StarBoard supplier.

DIY has arranged to make some items out of StarBoard this summer and we'll give you a detailed report in our Winter Annual Boat Refit issue.

ELECTRONICS

GETTING A FIX ON GPS

Unless you've been hibernating in Cyberspace, I'm sure you've heard about the Global Positioning System, or GPS. Operated by the U.S. Department of Defense, the system was declared fully operational in June 1995 with the launch of the last of 24 satellites. These satellites cruise in six orbits at an altitude of 20,000 km (12,400 miles) and signal their position and altitude above sea level (on some units) every second, 24 hours a day.

Understanding GPS operation is actually quite simple, when theory isn't muddled with modulations, dilutions, dopplers, pseudo-somethings and other GPS terminology. (For all the GPS ins, outs and how-tos, pick up a copy of *The Users Guide to GPS* by Bonnie Dahl.) GPS operates on microwave-based carrier signals, much as your household microwave oven does. Each satellite is equipped with a highly accurate atomic clock and sends out a time signal in nanoseconds — that's one billionth of a second. A GPS receiver reads the time measurements and calculates its own latitude/longitude (lat/lon) position based on its distance to a particular satellite.

At any given time there are at least 21 satellites transmitting, 10 of them below the horizon. GPS receivers are programmed to identify each satellite, its orbit, its check code and how far away it is. When your GPS receiver locates the satellites, it evaluates in two or three dimensions exactly where you are. A 2D search provides an X-Y-type fix; a 3D fix calculates altitude as well — which isn't required for marine applications, of course, unless you're airborne.

To obtain a 2D position, a receiver needs at least three satellites — four satellites for 3D. It "hunts" the skies for satellite signals located within a cone shape **(Figure 1)**. Known as preferred orientation, most receivers read only the signals within this cone, locking onto from three to six satellites to obtain an accurate time measurement. A unit that reads signals from satellites orbiting outside this cone will receive inaccurate times and erroneous lat/lon.

Receivers also look for satellites with the best geometry and the lowest electrical interference. This information is presented as a signal-to-noise ratio, a measurement of how well the unit is receiving the signal. A low ratio means the satellite or a constellation of satellites is low on the horizon and the geometry is poor. Receivers have different ways of presenting the signal-to-noise ratio, depending on the brand.

GPS accuracy is largely determined by selective availability, or SA, an operational mode imposed by the U.S. military. It's an error intentionally planted in the GPS system that degrades accuracy 15m (49.2') or more to the right or left of the receiver's location. Contrary to what we printed in our SPRING '96 issue, SA fluctuates around 100m (328') 95% of the time, depending on the U.S. political climate.

Differential GPS (DGPS) is a whole different system and is more accurate than standard GPS lat/lon. Most units, except for the rock-bottom-priced ones, are differential-ready. This means they have the capability to receive correction signals from land-based reference stations. These stations continuously monitor

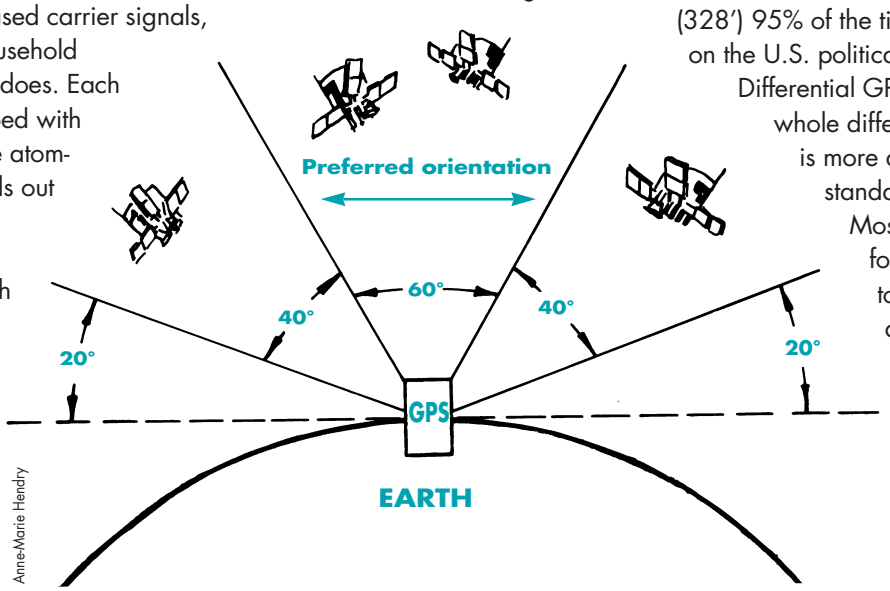


Figure 1

A GPS receiver needs only three satellites within its preferred orientation cone to obtain an accurate lat/lon. Satellites orbiting outside this cone, either right or left or centre, will be watched or ignored by a receiver.

ELECTRONICS

the signals for the GPS satellites and calculate geographic and SA errors. Revised measurements are then broadcast to a DGPS receiver that applies the corrections to the satellite signals, and the result is an extremely accurate navigation position correct up to 3m (9.8') most of the time.

DGPS requires installation of a second antenna — actually, a loran antenna, and an interpreter. Some manufacturers are now offering combination VHF and GPS antennas. A portable unit will require a cable link of some kind. DGPS also comes with a premium price tag. It can add $1,000 or more to the total cost.

Performance Versus Price

When shopping for a GPS unit you need to consider application, performance, user-friendliness, screen display, waterproof construction (important for using a GPS in the cockpit) and power and add-on options for portable models.

Consider how you intend to use the unit, now and in the future. Portable units are the most popular with boaters. You can transport your portable GPS between boats, use it for other outdoor activities, or take it home to practice on or to help you plan your next cruise. Most portables run on AA 1.5-volt batteries, either alkaline or

The preferred choice of many boaters, hand-held units often compromise performance and accuracy for portability.

rechargeable ni-cads which last about twice as long. GPS "engines" are power hungry, however, and portable units can burn through six AA batteries in about five hours, depending on the unit and the temperature; more expensive units will operate for a longer period. Defaulting to a 2D search will reduce battery consumption by about 10%. If you want a portable unit, purchase one with a 12-volt power adapter, bracket mount and external antenna so you can operate the unit belowdecks. (GPS cannot read through moisture.) Installing a 12-volt power outlet in the cockpit will save batteries. And holding your portable GPS well out in front will maximize signal reception.

A fixed GPS with an external antenna is a good choice when the unit will be used on board only one boat. Fixed units connect to the boat's 12-volt supply and outshine portables in both performance and accuracy. Fixed units are more expensive than basic portables, but adding options to enhance the efficiency of a portable, increases the cost to near the price of a fixed unit anyway.

Screen presentation is another consideration. Fixed units have larger screens that display multiple pieces of information simultaneously, while portable units provide minimal data on tiny screens. Obviously, the more data that's displayed, the less often you need to punch the keys to get to the desired information.

Options on some GPS units include audible anti-theft alarms and man-overboard functions. If you plan to communicate with an autopilot, chart plotter, radar or fishfinder, you'll need a unit with a NMEA 0183 interface. If you own a laptop, a PC interface lets you download GPS information into navigation software. A laptop is a cheaper option than a dedicated plotter and it can be used for myriad other tasks.

GPS receivers range from $300 for low-end portables to $2,500 for fixed units. Prices generally reflect the accuracy level of the unit. A good receiver can tell you where you are up to the available SA (15m/49.2' or better). A lower-priced unit may place you in the

30m (98.4') to 50m (164') accuracy range, despite the degraded SA. High-end units generally track and hold satellites better than their less-expensive relatives. When you buy, you get what you pay for.

The antenna type and location (see Installation) is the key to signal reception and receiver performance. Fixed units have a remote antenna mounted on a stern rail or some other above-deck location. Portable units often have linear phase antennas (also known as quadrifilarhelix) — the stubby, cube-shaped type. A better antenna for many applications is the more expensive patch type, a square, wafer-thin antenna used with fixed units and placed inside some portables.

Before buying a GPS, visit your dealer for a hands-on demonstration. Examine the durability of the unit. Is it waterproof? Check the quality and size of the display. Is it user-friendly? Ask for the manual and, following the instructions, try moving through the key sequences. Is it easy to learn or will you be living with the manual in your other hand? The more keys, the longer the learning curve. This is especially true with a portable GPS, whose operating system you'll have to become very familiar with because of continually changing screens.

Fixed Installation

A fixed GPS unit is as simple to install as an AM/FM radio. Select a flat, smooth bulkhead in a dry location, if the GPS is not waterproof. Mount the unit close to the nav station (if you have one), as you'll need to refer to your charts, and in a place where the keypad is accessible and the screen is easily read. Using the supplied template, drill the mounting holes and mark the cutout. Cut the hole with a hole saw or jigsaw, insert the instrument and fasten it to the bulkhead. Connect the positive wire to a distribution panel or switch, and the negative wire to a common ground. Attach the antenna cable and interface cable, if the unit has one. Use cable ties to support the wires and cables. Unlike a loran, a GPS receiver doesn't require a huge ground or an isolated battery, and noise filters are rarely used. Mounting a unit on a swing bracket near the companionway allows viewing from the cockpit; leave lots of slack in the wires and antenna cable to allow for expansion. You can also install a repeater (about CDN $300) in the cockpit or flybridge.

The palm-sized antenna needs a clear shot at the sky and should be placed away from rigging, metal objects and other obstacles. Preferred locations are on a standard VHF antenna bracket on the stern rail or, on a powerboat, above the flybridge. Never mount the antenna underneath cockpit canvas, such as a camperback. Microwave energy absorbs water molecules (that's what

ELECTRONICS

heats food in a microwave oven) and wet canvas will prevent the GPS from receiving signals.

Mismatched Signals

Unlike loran, GPS is not affected by magnetic or electrical interference or lightning. But while the atomic clock is extremely constant, there are inherent problems with the microwave carrier that causes lat/lon errors.

Positive and negative ions form peaks and valleys in the ionosphere (80 to 120 miles above the earth) and the earth's atmosphere. This affects the speed of GPS signals, causing them to slow down, bend or refract. Water vapor also affects the signal.

Small yet powerful, palm-sized GPS antennas receive microwave-based signals from orbiting satellites.

The Silva NAVIMAP digital chart plotter links to the Silva GPS and provides a simple way of measuring distances and programming waypoints into the GPS.

Signals also have a tendency to bounce or reflect off structures, such as buildings, rocks or trees, before getting to your receiver. This is known as multipath error. Instead of going directly to a receiver, the signal takes a more indirect path. Better receivers compensate for this problem but it still can cause some measurement error, depending on the unit.

Any moisture — such as dense cloud or pea-soup fog — between the antenna and the microwave signal lowers the signal-to-noise ratio. To test this theory, put your hand over the antenna and watch the ratio fall. Some GPS signals may warble around big cities with excessive radiation, the so-called "greenhouse" effect, or from "wormholes", (and it's only Star Date 1996) caused by the thinning ionosphere. And as with loran, electronic spikes through the system from engine start-ups can cause software crashes.

Tally the probability of the errors mentioned above, then factor in a random SA, signal geometry and antenna positioning, and the position inaccuracy can be very small or quite large, depending on the unit. Locking onto a home fix in the morning is no guarantee that you'll arrive at the exact position when you return.

As with any electronic navigation device, don't rely solely on what you see on the display screen, especially in bad weather conditions. Think of GPS as a navigational aid, a finely precisioned electronic tool that, like your home computer, requires a manual backup. Coupled with good plotting skills and common sense, a GPS helps make every cruise a safe one.

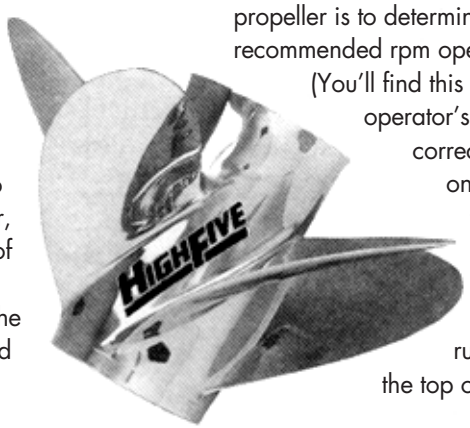
ENGINE
TROUBLESHOOTING

EVALUATING PROP PEFORMANCE

Matching your boat and engine to the right prop can make a noticeable difference in overall speed and performance.

Propellers are the most important factor in a boat's handling, ride, comfort level, speed, acceleration, engine life, fuel economy and safety. The correct prop can improve a powerboat's top-end speed by several mph; a mismatched prop affects stability, can ventilate in turns at top speed and can cause chine walking. Maneuverability and control, especially when docking, are noticeably improved on a sailboat that's paired with the right prop.

Factors to consider when selecting a prop include: the boat's length overall; gross weight, including the boat, motor, fuel, passengers and usual gear; your style of boating (racing, cruising, fishing or skiing); and the local water and current conditions. On larger cruisers and sailboats, the design of the boat plus engine size, gear ratio and shaft diameter also directly influence propeller performance.



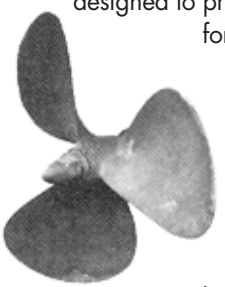
Overall performance is relative to the prop's diameter, pitch and number of blades. In a prop size of of 15x10, the diameter is 15" and the pitch is 10".

Diameter is twice the distance from the hub center to a blade tip. Increasing the diameter improves acceleration and may also reduce cavitation. A large prop also generates more thrust than a small one but, if it's too large, reduces the engine's maximum rated rpm. Conversely, a prop that's too small will cause the engine to cavitate and over-rev.

Generally, the most efficient prop is one with the largest diameter that fits the space available. Installation limitations usually dictate how much the diameter can be altered. On sailboats where the prop is in an aperture, there may not be sufficient blade-tip clearance to swing a larger prop. (In some cases, a large prop can also increase hull vibration.)

Pitch, the distance a prop would move in one revolution, is responsible for rpm on an inch-by-inch basis. A lower pitch provides more pulling power while a higher pitch almost always increases top-end speed but reduces hole shot and acceleration. Cupped blades, which have a small curve or lip on the trailing edge of the blade, react like a higher-pitched prop, giving them more bite in the water, improving rough-water stability and reducing cavitation.

The first step in finding the right propeller is to determine the engine's recommended rpm operating range. (You'll find this listed in the operator's manual.) The correct propeller is one that provides the desired performance and allows the engine to run at or near the top of the recommended rpm range while carrying a normal load. When an engine doesn't reach the rated rpm it runs hotter, may overheat and puts a load on the pistons, crankshaft and bearings. If, however, an engine revs past the recommended rpm it will wear faster.



NO LONGER GUESSWORK

Boat engines are generally factory- or dealer-equipped with stock props designed to provide satisfactory performance over a wide range of boat types and operating conditions. When your boat doesn't run at the recommended rpm or could benefit from improved handling or speed, propeller manufacturers, marine dealers and prop shops can provide guidance in choosing the correct propeller size and style.

For a $55 fee, Bayview Propeller Repair in Woodview, Ont. (705/654-4409), for example, will prepare a detailed computer analysis to determine the best prop for your needs. First, they'll send a questionnaire that asks for detailed data about your boat, engine and propeller as well as background information, such as how the boat is used and what you're hoping to achieve — better hole shot or top-end speed, say, or more control in turns or increased handling when docking. You'll need to provide: the manufacturer's name and model of the boat and engine; engine data, such as rated horsepower and rpm, shaft size (inboard) and gear ratio or reduction at the gear case; the diameter, pitch, number of blades and rotation of your current propeller; the maximum

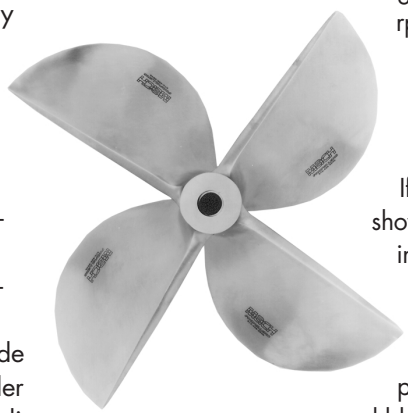
TIPS

BE KIND TO YOUR PROP

Damaged props decrease speed, affect performance and burn more fuel. The vibration from damaged prop blades can ruin seals and bearings in the lower unit, cause serious prop cavitation and reduce the life of the gearcase and powerhead. Inspect your prop regularly for chips and dents and if you find damage, have it repaired as soon as possible.

propeller diameter possible (tip clearance); and the boat's current maximum rpm and hull speed in knots or mph.

With this information and input from past statistical results plus knowledge from Bayview's 32 years of experience sizing props, Dennis Johnson, manager of Bayview Propeller, can advise you on your prop requirements. Before computers, when prop sizing was done by hand, it could take a day to arrive at a near-match that often was incorrect and normally required fine tuning by trial and error, according to Johnson. Computers eliminate the guesswork and, usually within a few hours, will provide a perfect propeller match for all applications, with the exception of small high-performance powerboats (see Trial and Error).

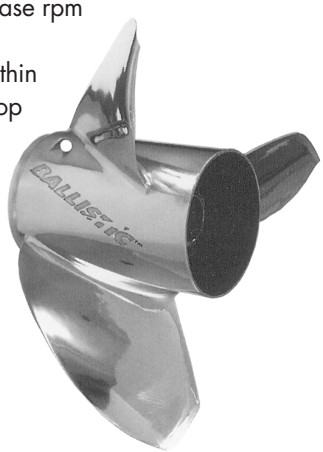


POWER: DIALING IN RPM

With runabouts and small cuddy cruisers, you can check prop performance by comparing tachometer readings to the boat's top speed. Refer to the owner's manual to find the recommended wide-open-throttle (WOT) or top speed range, and the engine's peak horsepower rpm. Take the boat for a ride with a medium load and run it at WOT with the engine trimmed out. If your on-water tests show the engine is exceeding the recommended WOT and rpm range, you have two options: increase prop pitch or switch to cupped blades. If, instead, the engine doesn't reach the recommended WOT, prop pitch must be decreased or cupping must be elimi-

ENGINE TROUBLESHOOTING

nated. In either situation, a 5cm (2") increase or decrease in pitch will result in roughly a 300 to 400 rpm drop or rise. Changing from an uncupped to cupped propeller, or cupped to uncupped, while maintaining pitch and diameter, will typically reduce or increase rpm by about 200.



Once the WOT rpms fall within the recommended range, the prop is correctly matched to the engine's rpms. However, some aspects of performance, such as poor holeshot or top-end speed, may not yet be achieved. This can be corrected by switching propeller models or styles and, again, matching the size to meet the proper WOT rpms.

There are a wide selection of three, four and five-blade propellers for outboards and stern drives. All-purpose, three-blade stock aluminum props are the least expensive, retailing for around $200. Stainless props can be as much as five times stronger than aluminum and, when it comes to high-speed performance, peak blade efficiency and bite, are tough to beat. Standard stainless props cost $350; more high-tech props such as the five-blade Quicksilver High Five or OMC Renegade push $700.

The new three and four-blade line of stainless-steel Ballistic props from Attwood are a good compromise if you're looking to improve top speed at an affordable price. Depending on the pitch, these props sell for less than CDN$439/US$380. Props are shipped in a durable plastic carrying case that doubles as an on-board storage case for your spare prop.

On larger boats, a prop evaluation also considers the designed hull speed and engine reduction gears. Consider

TIPS AS THE PROP TURNS

If your engine is right-hand rotating, then the propeller should be a right-hand prop; if left-hand rotating, then it needs a left-hand prop. Rotation is marked on the prop hub as RH or LH. Check the hub before ordering a replacement prop.

this example: a 9.6m (32') Wellcraft St. Tropez cruiser powered with twin Crusaders. Maximum rated horsepower for these engines is 350 hp at 4,400 rpm. Equipped with 17x17 three-blade props, the boat runs at 4,500 rpm and a slow top speed of 32 mph at WOT.

Bayview Propeller did a computer sizing for the owner and recommended changing the size of the props. The analysis also showed the boat's tachometers were faulty. (A knowledgeable prop shop can often discover mechanical problems with the engine or transmission when doing a sizing. It's important when recording the maximum rpm that tachometers are accurate.) When in doubt, have the results confirmed by a technician. With new tachs installed and the boat re-propped with two 17x16, three-blade cupped props, the Wellcraft reached 36 mph at 4,350 rpm.

SAIL: TAKE CONTROL

For the past thirty-some years, two-blade propellers were standard issue on sailboats. Such props were adequate for light-displacement boats but on heavier boats, they provided inadequate acceleration (especially in strong currents or high seas), control and maneuverability. Sailboats need a prop that delivers the maximum thrust for the engine and gives the operator complete control in most situations.

In many cases, performance is greatly improved with a three-blade prop of the largest diameter that will fit. (Folding and feathering props are beyond the scope of this article and will be reviewed in a future issue.) The marked increase in thrust from three-blade props will deliver better control and handling that greatly outweighs the extra drag.

Consider the example of a Alberg 29 — a modified full-keeled boat with a prop installed in an aperture. The powerplant is a Yanmar 2GM inboard diesel rated for 15 hp at 3,600 rpm and with a 2.62:1 reduction gear ratio. The owner complained the boat lacked control when docking and was powerless in strong currents. Bayview Propeller generated a computer analysis and recommended a Michigan 15x10, three-blade prop. As there wasn't room to swing the 15, however, the owner had to settle for a 13x12 prop which gave sufficient blade-tip clearance without added vibration. The smaller prop develops 154.8kg (344lb.) of thrust, compared to 167kg (371lb.) for the larger prop, a loss of 7.5%. That may seem like a small percentage, but in heavy seas, the boat will be noticeably slower to maneuver. The other option recommended by Bayview Propeller was to decrease the gear ratio which would then allow installation of a smaller-diameter prop.

ENGINE TROUBLESHOOTING

TRIAL AND ERROR

Propellers are not cheap and you can spend a lot of money before you get the right one. A computer analysis will avoid most problems, suggesting a prop that's perfectly matched for boats, other than custom boats, due to lack of prior data, or small high-performance powerboats. (With performance boats the prop will be the right one for the boat, but the analysis doesn't specify the fine-tuning gains of as small as 1 mph required on these boats.)

Deal with a reputable shop and understand the exchange and adjustment policies before you buy. Many prop shops will either rent you a prop to try or sell you one on the understanding that if it doesn't meet your expections, it can be exchanged for a prop of another size. With any rental or exchange program, if you damage it, you buy it.

11 TIPS FOR TROUBLE-FREE CRUISING

1 Run your engine once a week. This dissipates moisture, circulates the oil to protect internal engine parts and charges the battery.

2 Warm up **gasoline** engines no longer than three minutes at the dock. Running under load at a slow speed brings the temperature up faster. Excessive cold idling causes oil dilution, air pollution and wastes fuel. **Diesels** operate better warm and should be run at idle speed for at least 15 minutes before departing.

3 Check the battery electrolyte levels and top up with distilled water as you need to. Clean the terminals and tighten them with appropriate tools. Never disconnect a battery while the engine is running as it will cause the alternator to burn out.

4 Daily inspections when running the engine include checking the engine oil and fuel levels and inspecting the belts and cooling system for leaks. Keep a watchful eye on temperature gauge and voltmeter readings.

5 Check engine water flow on start-up and periodically during operation to ensure the water pump is working.

6 Regularly examine **outboards** and **stern drives** to be sure there is no monofilament fishing line around the propeller shaft seal which can cause oil leakage.

7 Periodically check hoses and hose clamps, all bolts, belts and fasteners and tighten and replace where necessary.

8 Routinely check the level of the oil reservoir on the inside of the transom found on some newer **stern drives**. Also check the hydraulic steering fluid level.

9 Replace rusty outboard metal gas tanks which can clog filters and carburetors, resulting in poor performance or even failure to run.

10 Maintain a log of checks and repairs. Either buy a separate log, incorporate the data with your cruising log, or write the information in a simple notebook that is kept on board.

11 Make a point of listening to and learning the sounds and "feel" of the engine, drive train and shift and throttle controls.

POWERBOAT RIGGING

UPGRADE TO HYDRAULIC STEERING

TOOLS

- Assorted wrenches
- Screwdrivers
- Socket set
- Vice grips
- Hammer and mallet
- Hex key set
- Prybar
- Rags

Hy-Trac kits contain everything needed to install an hydraulic steering system on most boats and engines.

Drivers of boats equipped with mechanical steering systems, especially high-horsepower, high-speed, single-outboard boats, often wrestle with the steering wheel to steer the boat. This is caused by torque. As the propeller turns, the resistance it meets in the water creates torque, which feeds back through the steering system to deliver a pronounced "pull" at the wheel.

Outboard, stern drive or inboard-powered boats can virtually eliminate torque feedback by upgrading to an hydraulic steering system. A low-maintenance system, hydraulic steering is also highly responsive — the engine turns the instant the wheel is turned. This makes docking and maneuvering easier and the boat tracks straighter with minimal steering effort.

DIY spent an afternoon with Rick Frank and Barb Taylor of Barrick Engines in Etobicoke, Ont. (416/798-8411), observing Rick as he installed a Hynautic Hy-Trac hydraulic steering system in a 5.4m (18') Bass Cat. A former automotive mechanic, Rick specializes in servicing all makes of outboards — especially high-performance models — as well as stern drives.

The high-priced bass boat was rigged with a 200-hp Limited Edition Johnson and factory-equipped dual rack-and-pinion steering. Space limitations behind the dash, however, restricted the movement of the cables, causing them to seize when the wheel was turned hard over. Owner Bob Peters, a top-rated tournament bass angler, needed to replace the current setup and considered three steering options: power, rotary and hydraulic.

Power steering was ruled out right away; it lacks the sensitivity necessary for high-speed control and robs engines of horsepower, losing 8 to 10 mph at the top end. Mechanical rotary steering would deliver a marginal improvement in performance and the two helms in this dual-steering setup would fit neatly behind the dash, but it would still require upkeep of a mechanical system. And as each rotary helm would cost $400 anyway, Peters opted to spend $250 more to gain the improved performance and handling of an hydraulic system. Hydraulic steering costs nearly twice as much as some mechanical systems, but requires little maintenance and will last the lifetime of the boat.

Hynautic Operations, a division of Morse Controls, and Teleflex Marine sell steering kits packaged with everything you need for a refit. The Hy-Trac system installed in the Bass Cat included 15m (50') of hydraulic hose, hydraulic fluid and mounting bolts to fit all engine brands. Components accommodate a wide range of dashboards and engines — helms mount infront of or behind the dash and cylinders have reversible port or starboard hookup — but you may need to improvise.

Installation is easy for the home mechanic and requires only basic hand tools. Rick completed the dual-steering installation in the Bass Cat in three hours. However, unless you've installed a system before, allow four or more hours to complete the job, depending on your boat's existing steering setup and cockpit layout.

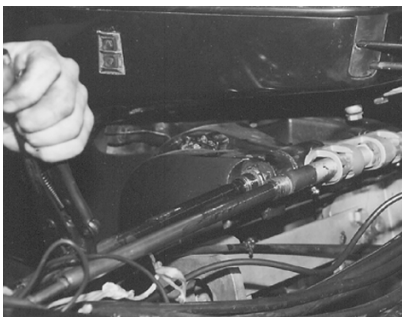
What follows is a general look at the procedures for removing a dual rack-and-pinion steering unit and installing a Hy-Trac two-line hydraulic

POWERBOAT RIGGING

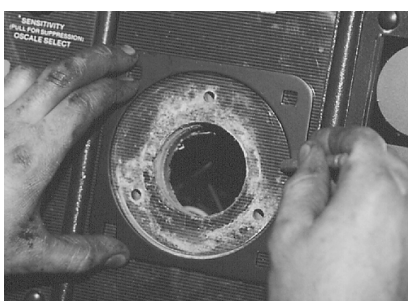
system. (For detailed instructions on removing mechanical cables see our *Powerboat Rigging* column in the SPRING '96 issue.) We recommend that you read your installation manual carefully before beginning, particularly the air purge instructions — any air in an hydraulic system can cause steering malfunction.

1 Remove the plug in the center of the steering wheel using a screwdriver or prybar. Unscrew the 5/16" nut under the plug with a wrench. (You may need an impact gun to loosen it.) There are two ways to remove the wheel: Rent or borrow a steering wheel puller, or recruit a friend to pull the wheel straight up, lifting evenly on both sides of the wheel, while you hit the shaft with a mallet. One good smack should pop off the wheel. Next pry off the bezel.

2 Remove the three bolts (some units have four) and self-locking nuts that hold the helm. Lightly pull down the steering racks from behind the dash. Do this carefully as racks are a popular place to fasten other wires. Use side-cutting pliers or wire cutters to remove all the attached cable ties. Remove the eight bolts that hold the two racks. (A single-cable system has one rack and four bolts.) Remove all cable ties attached to the steering cables.

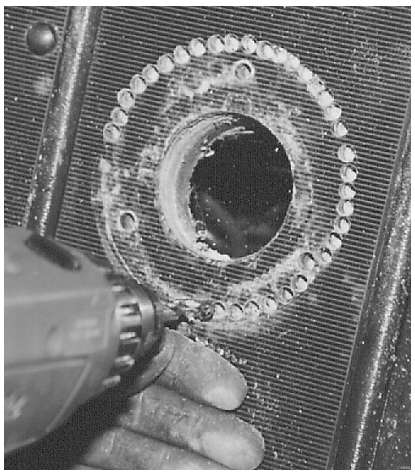


3 Disconnect the steering cables at the engine by removing the nuts on the cable ends and the draglink bolt. Attach vice grips to the cable and bang with a hammer to extract the cable from the tilt tube. When there's not enough clearance between the tilt tube and splashwell to draw out the cable, place a metal punch or rod on the cable end and hammer away, bending the cable as necessary. (If you prefer to keep the mechanical cables, the engine must be removed.) Tape a rope messenger line to the cables at the dash and slowly pull from the transom. Cables may snag, often on other wires, and feeding is easier on boats with unrestricted gunwale access.

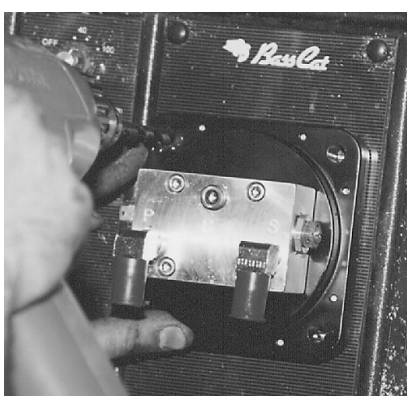


4 Now you're ready to install the new system. Use the supplied template — our kit came without one, so we used the trim ring —

to trace the 4-1/2" cutout for the helm. On a black dash, use a color marker or etch the line with an awl.

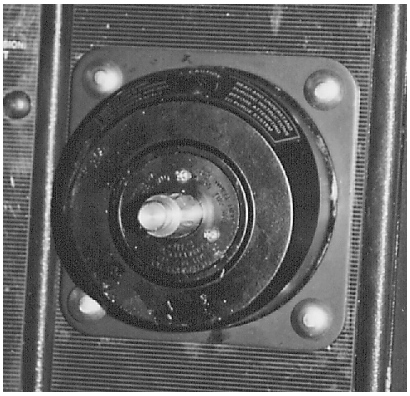


5 To make the large circular cut, Rick drilled a series of holes with a 1/4" drill. Ream the holes so they connect and the cutout piece will fall out easily. Lay the template (or trim ring) over the hole and file the edge, if necessary, to ensure a tight fit. Smooth the edge with a file. If your dash is flat (ours wasn't) you can use a jigsaw, but cover the underside of the base plate with masking or electrical tape so you don't scratch the dash. Remember when you're drilling into fiberglass to wear safety glasses and a dust mask.



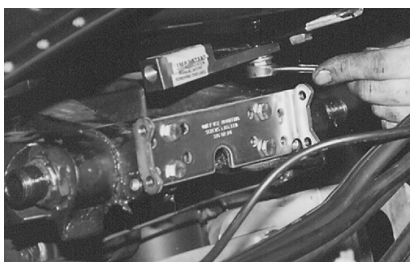
6 Insert the helm from behind the dash, back side facing out and properly oriented so that when it's mounted correctly (right side out) it will be straight and the fill plug on top. Drill the four mounting holes. Before continuing, vacuum the area to remove all fiberglass dust and residue. Ensure that the protective caps on the helm, cylinder and hose ends remain in place to prevent dirt from entering the system.

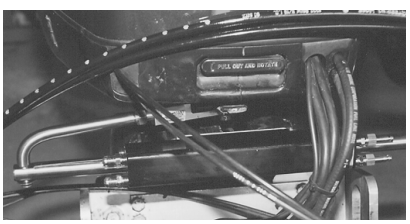
7 Remove the helm, reinsert it from the rear of the dash with the shaft facing out, place the trim ring over the dash, insert four carriage bolts and hand tighten. Slide the wheel over the helm and



POWERBOAT RIGGING

thread the nut on loosely. You'll center the wheel with the engine after you install all the components. Securely tape the hydraulic hose to the messenger line at the dash and, with someone feeding the cable at the helm, pull it through to the transom. Check your manual for the correct placement of the factory-installed brass ends on the hose. These fittings connect to the helm on our Hy-Trac system. To run two hoses together, as we did, fold the single hose in half, form a loop, secure it with tape, then attach the messenger line to the loop. Mark the port hose with tape at both ends.



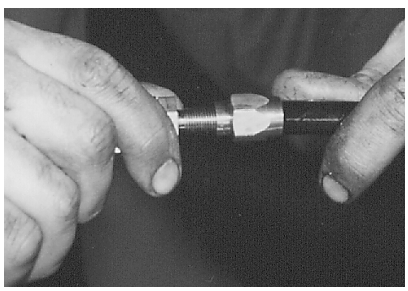


8 Remove the extra mounting tube and bracket (on dual- steering setups only). Now mount the cylinder bracket to the front of the engine using the specified bolts. Remove the old draglink, bolt on the draglink bracket applying a spare coating of Loctite (supplied in the kit) on the threads, then attach the new draglink. Fasten the cylinder to the bracket with Allen screws. Use a screwdriver or rod to pull the cylinder ram so it aligns with the draglink and attach the nut loosely.

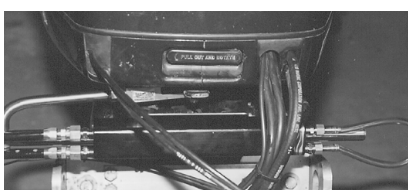
MAINTAINING HYDRAULIC STEERING

A hydraulic system requires only general maintenance and will never rot, break or seize. A few simple maintenance steps should ensure long-lasting operation.

- Check the fluid level at the helm regularly. If it's low, fill with a hydraulic-steering fluid recommended by the manufacturer. The oil should fill to just below the threads of the filler cap.
- Visually check all fittings around the helm and cylinder assembly for oil leaks. Turn the wheel hard over in both directions to pressurize the system. Check for leaks at all line connections.
- Inspect the helm pump and cylinder for possible seal wear as indicated by oil leakage. Where a leak is evident, contact your dealer for servicing.
- Check hoses for leaks, chafing or other visual signs of wear.
- Apply grease to all moving parts between the steering system and engine using a marine-grade waterproof grease.
- Periodically spray all exposed components with a water- displacing lubricant/protectant.
- When the system is used in salt water, check for signs of corrosion and periodically wash down the cylinder assembly with soap and water and wipe down the helm to avoid salt buildup.
- Occasionally take the wheel off and make sure the helm shaft is well lubricated with a marine grease or Never Seize. This prevents galvanic corrosion between the wheel and shaft.
- If the steering seems mushy or slow to respond, or you hear a clicking noise at the helm, check for air in the system and bleed, if necessary.
- Contamination of the hydraulic fluid is the most common cause of system failure. Some manufacturers recommend draining and replacing the hydraulic fluid annually to prevent contamination.



9 Measure the length of the hydraulic hose, then add an extra 1.2m (4') to allow for error and to simplify the hookup. Use a sharp utility knife and cut the hose squarely. Remove any burr on the inside edge of the hose and lubricate with a specially formulated hose oil, or you can substitute automatic transmission fluid — any other lubricant is not compatible with hydraulic systems. Following the instructions, carefully screw on the two-part, self-locking brass hose fittings. Now, attach the hydraulic hose to the proper port and starboard fittings on the helm and cylinder and tighten. Tighten the four carriage bolts holding the helm.



10 Clean the bleed fittings on the cylinder then slide the clear 1/2" ID tubing over the nipples. Assemble the bleed kit following instructions.

POWERBOAT RIGGING

11 Rick holds the container of hydraulic fluid above the dash and slowly turns the wheel to port then starboard, five times per side. As he continues turning, resistance decreases and he can turn faster. Air and fluid exits through the clear tubing at the cylinder end.

12 When the air "burping" stops, right the container, remove the adapter from the helm unit, clean any excess oil with a paper towel and reinstall the fill plug. Close the bleed nuts at the cylinder and remove the clear tubing. Tighten the bleed nuts on the helm unit.

13 Check for leaks at all hose connections. Refer to the manual for draglink adjustment. Center the engine, align the wheel, tighten the steering wheel nut and insert the center plug. Pull any slack in the hose inside the gunwale and fasten to the wiring with cable ties.

SAILBOAT RIGGING

UPGRADING MAINSHEET TRAVELLER SYSTEMS

TOOLS

Assorted screwdrivers
Drill and bits
Wrenches or socket set
Sealant

By Thomas Fogh

Upgrading a mainsheet traveller system is one of the easiest and most rewarding improvements that you can make to your boat. A properly functioning traveller adjusts easily to optimize sail trim for speed and keep the helm in balance, particularly in gusty wind conditions. If the person who trims the traveller on your boat finds it difficult or uncomfortable to handle, then you are a candidate for a traveller upgrade.

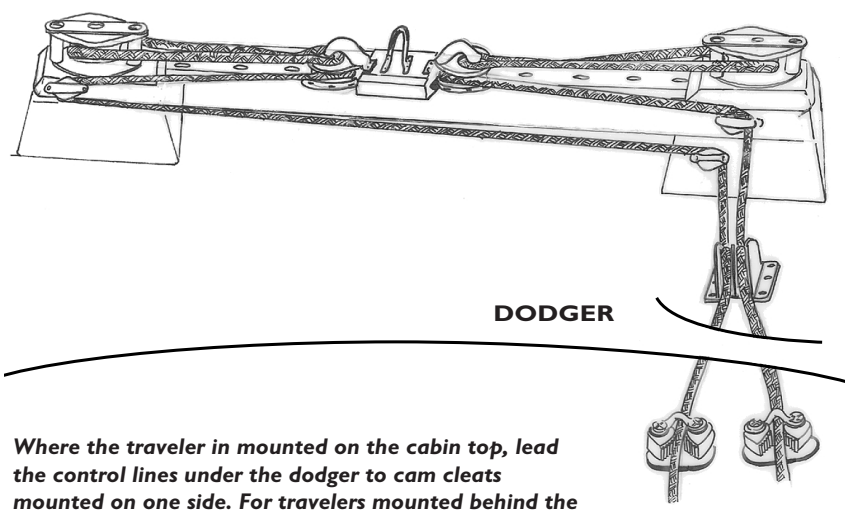
When it comes to upgrading a traveller, it's important to look at the performance advantages of an efficient traveller system. The most obvious benefits are ease of sail trim and helm balance. When you're sailing short-handed or with non-sailors or family, the crew can make regular adjustments to a properly set up traveller, for optimum performance, rather than leaving it in one position.

A very basic system consists of a track, car, two adjustable track stops and track ends. Adding control lines routed through blocks and cam cleats reduces friction and can increase the purchase from 2:1 to 6:1, depending on the setup. Newer high-performance systems have windward-sheeting traveller cars. Such cars have integral cleats mounted on the cars so they can be pulled to windward without requiring the leeward control line to be released.

Upgrades can consist of simply adding a few blocks to an existing system at a cost of $10 to $75. Many production boats come factory equipped with a system that is adequate for light winds, but as the wind increases, the effort required to trim a traveller can be an exhausting workout for some crew. Traveller controls should be powerful enough to move the car easily under all loads and be located where the helmsperson or crew can operate them conveniently.

Quick and inexpensive improvements include: installing a spring (smaller boats) or a stand-up toggle (larger boats) to hold the mainsheet block in an upright position; mounting fairleads on cleats to help cleating and uncleating at sharper angles; or leading control lines under the dodger to cam cleats (**Figure 1**). You can improve basic systems with the addition of a new car and end stops designed for a continuous-line system (**Figure 2**). If your boat is equipped with such a system and remote cleating, adding swivel cam cleats will facilitate cleating from practically anywhere in the cockpit. Should you decide to remove the old track and install an entirely new system, you have the option of adding all the above features, depending on the setup.

Figure 1



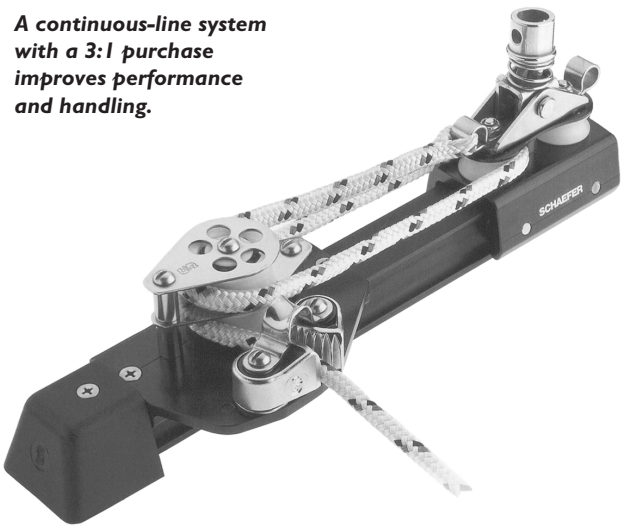
ANNE-MARIE HENDRY

Where the traveler in mounted on the cabin top, lead the control lines under the dodger to cam cleats mounted on one side. For travelers mounted behind the helmsperson, lead the control lines forward, along the cockpit seat backs to cam cleats on each side.

There are three basic ways to mount a traveller: on the cabin house, behind the helmsperson (aft mounted) and in the cockpit. For cabin house-mounted travellers, the remote cleating setup (**Figure 1**) is one that is commonly used. Such systems usually do not allow the helmsperson to trim the traveller; this setup requires a crewmember to be in charge of traveller adjustments. The control line is usually lead to the aft edge of the cabin house; however, this makes trimming difficult for people sitting on the rail. By installing swivel cam cleats the

Figure 2

A continuous-line system with a 3:1 purchase improves performance and handling.



SCHAEFER MARINE

traveller can be adjusted from various positions in the cockpit.

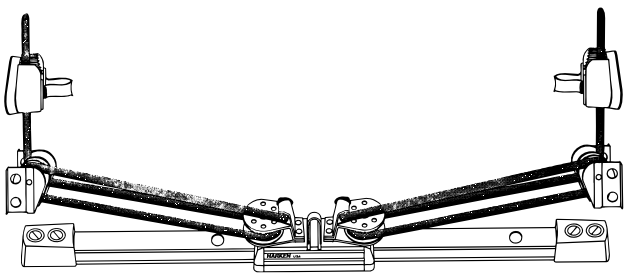
An aft-mounted traveller, where the traveller is behind the tiller or wheel, is not as popular these days as it once was. There are two options here for increased performance. The first is to move the entire system forward, if possible. If this is not desirable, then consider remote cleating, where the control lines lead forward along the cockpit seat backs to a cleat that is within reach of the helmsperson or mainsheet trimmer. Having a continuous-line system allows the leeward side to be uncleated so the traveller is easily pulled to windward, when necessary.

Cockpit traveller systems are the most common type for smaller boats. Some models have cleats mounted on the traveller cars. This setup can be difficult to uncleat when the crew is sitting on the windward (high) side. A more common solution is to lead the control lines vertically up from the car to a turning block and cam cleat mounted on each side of the cockpit seat back. (**Figure 3**). This allows the crew or helmsperson to trim the traveller while sitting on the high side without having to reach in to

grab the line or struggle to cleat it. Mounting control- line cleats correctly is critical. If they're not angled correctly, the operator may have to lean in to release the control line, or cleat it with a foot. Do a dry run and execute all maneuvers before drilling fastener holes.

Figure 3

In a cockpit system, control lines lead vertically up from the car to turning blocks and cam cleats mounted on each side of the cockpit seat back.



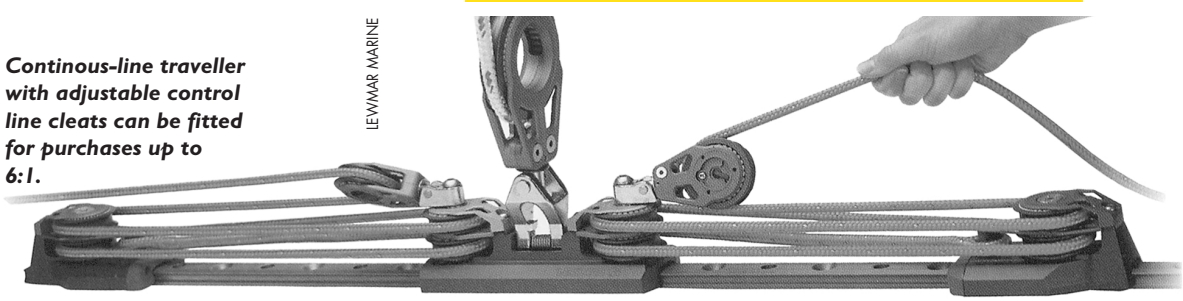
HARKEN

When you install a completely new traveller system, the track you select will depend on the size of your boat and configuration of the deck and cabin house. Most pre-drilled travellers use 10.1cm (4") hole spacing on the track, allowing you to use the original holes drilled in the deck for your old traveller. (European track and boats have marginally wider hole spacing.) Installation involves simply removing the old track, bolting the new one to the deck and bedding the fasteners in a marine-grade poly-sulfide sealant. Various screwdrivers, a drill and bits, and wrenches or a socket set are the only tools you'll require.

Some pre-1985 tracks (Nicro-Fico and others), don't fit this standard hole pattern. If you cannot find a track with a similar bolt pattern, you have two options: Fill the holes with epoxy and redrill, or purchase a sliding-bolt

Figure 4

Continous-line traveller with adjustable control line cleats can be fitted for purchases up to 6:1.



LEWMAR MARINE

track. Sliding-bolt tracks from Lewmar Marine have no visible fasteners; instead, the bolt heads slide in a groove on the underside of the track. This lets you retrofit a new track using any bolt-hole pattern without having to match the original fastener holes. Bent tracks or ones with compound curves can be easily custom-ordered from your dealer.

There are numerous ways of setting up a new traveller. Once you select the desired track and placement, factor in the number and physical strength of your crew and their personal preferences, then set some priorities following basic principles: 1) the line must lead to the person trimming the traveller; 2) there must be enough purchase to allow the mainsail to be trimmed while sailing to windward, especially in heavy air, without undue strain on the trimmer; 3) proper-size blocks and line must be used to minimize friction and maximize purchase (check with your dealer or the traveller manufacturer). When you purchase traveller components, follow this simple rule: the bigger the block, the smaller the line, the easier a traveller system operates.

There are few upgrades on a boat that are as inexpensive, simple and rewarding as improving a mainsheet traveller and line controls. While these are typical traveller installations, use them as a starting point. The type of sailing you do and the setup of your boat will determine which installation is best suited to your needs. No matter what traveller you choose, the end result is always the same — a properly functioning traveller will save you time and muscle-power on the water.

Thomas Fogh is manager of Toronto-based North Marine and has sailed competitively in Optimists, Lasers and Laser 2s, Solings and Tornados, in which he placed second at the 1992 Olympic trials. He a member of the Canadian Sailing Team and is currently campaigning a Soling for a spot on the 1996 Olympic team with his father Hans and John Kerr.

TYPICAL PRICES

Traveller Setup	Abbott 22	C&C 41
Continuous Line w/ cleats on end stops	$500	$900
Remote Cleating	$600	$900
Cockpit System	$450	$1,000

RECIPES FOR GREAT GALLEYS

Whether it's small or large, new or old, a galley's convenience, functionality and safety are of prime importance.

By Sheilah van Nostrand

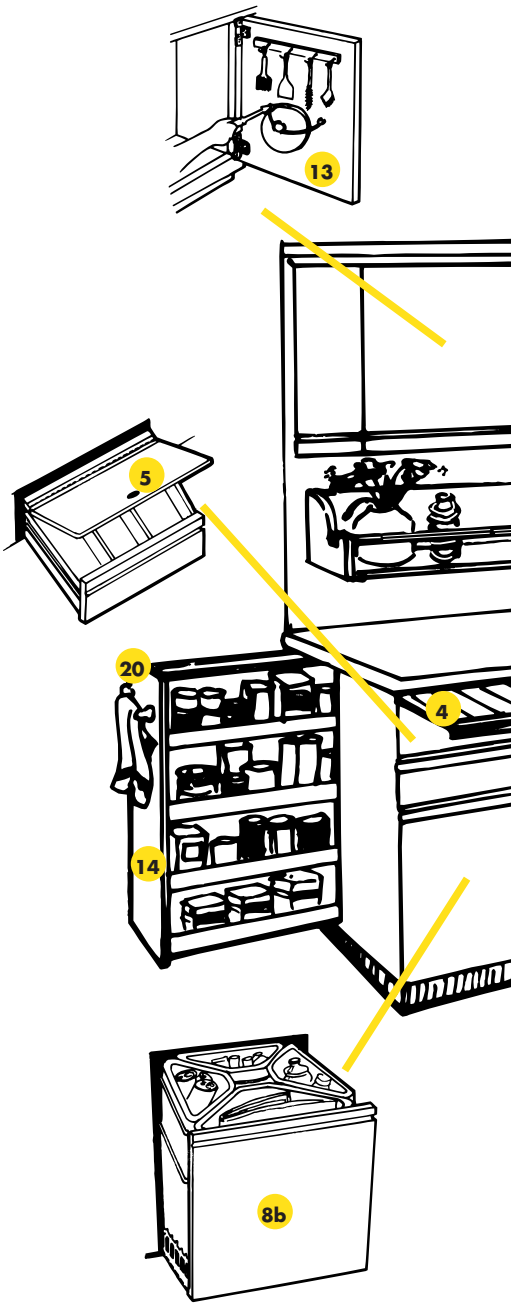
Galleys on most boats are mediocre, at best. Considering their cramped quarters and limited counter and storage space, cooks have good reason to mutiny. While the compactness of a boat's galley does place everything near at hand, boat designers often overlook the necessities that can transform a galley into an efficient food-preparation center.

Among the main requirements are that the galley be accessible, safe and make meal preparations faster and simpler. Beyond those basic assumptions, your galley can be tailored to your specific needs. For example, a galley for a singlehander will require less workspace than one for a family of four. The galley offers all sorts of possibilities for the adventurous do-it-yourselfer.

Add a Counter or Two

As most boats lack sufficient counter space in the galley for food preparation, consider making a cutting board to fit over the sink **(1)**. Cut a slot or a hole near the back edge of the board, place a bowl in the sink under the slot and you have a ready-made compost catcher. If the stove does not already have a drop-down cover over the elements, create additional work space by adding another cutting board overtop **(2)**. Support the board with rubber-tipped cleat stock so it sits above the elements.

Still need more work space? Extend an existing countertop by adding a fold-down table **(3)** that attaches to the counter with a piano hinge. Or cut a rectangular slot in the facer board below the counter and install a pull-out cutting board **(4)**. The top drawer is commonly used for cutlery and other odds and ends. Consider adding a lightweight, 3mm-thick (1/8") masonite cover or, better still, a see-through acrylic cover **(5)**. Lay the cover on 6mm (1/4") side supports and add a finger hole near the front and a light-duty piano hinge on the back edge. When this lid is down it helps prevent unwanted crumbs from falling into the drawer and doubles as an extra countertop. On smaller boats without a utensil drawer, make a wooden holder with dividers for cutlery and mount it vertically on the countertop or on the inside of a cupboard door.



Need More Shelves?

Don't overlook existing wall space. Here, the carpenter in you can really strut your stuff. Between sink and window, over the stove and counter, there is often space for an attractive and highly functional shelf. Make it long or make it short, make it fold with a hinge and support straps or

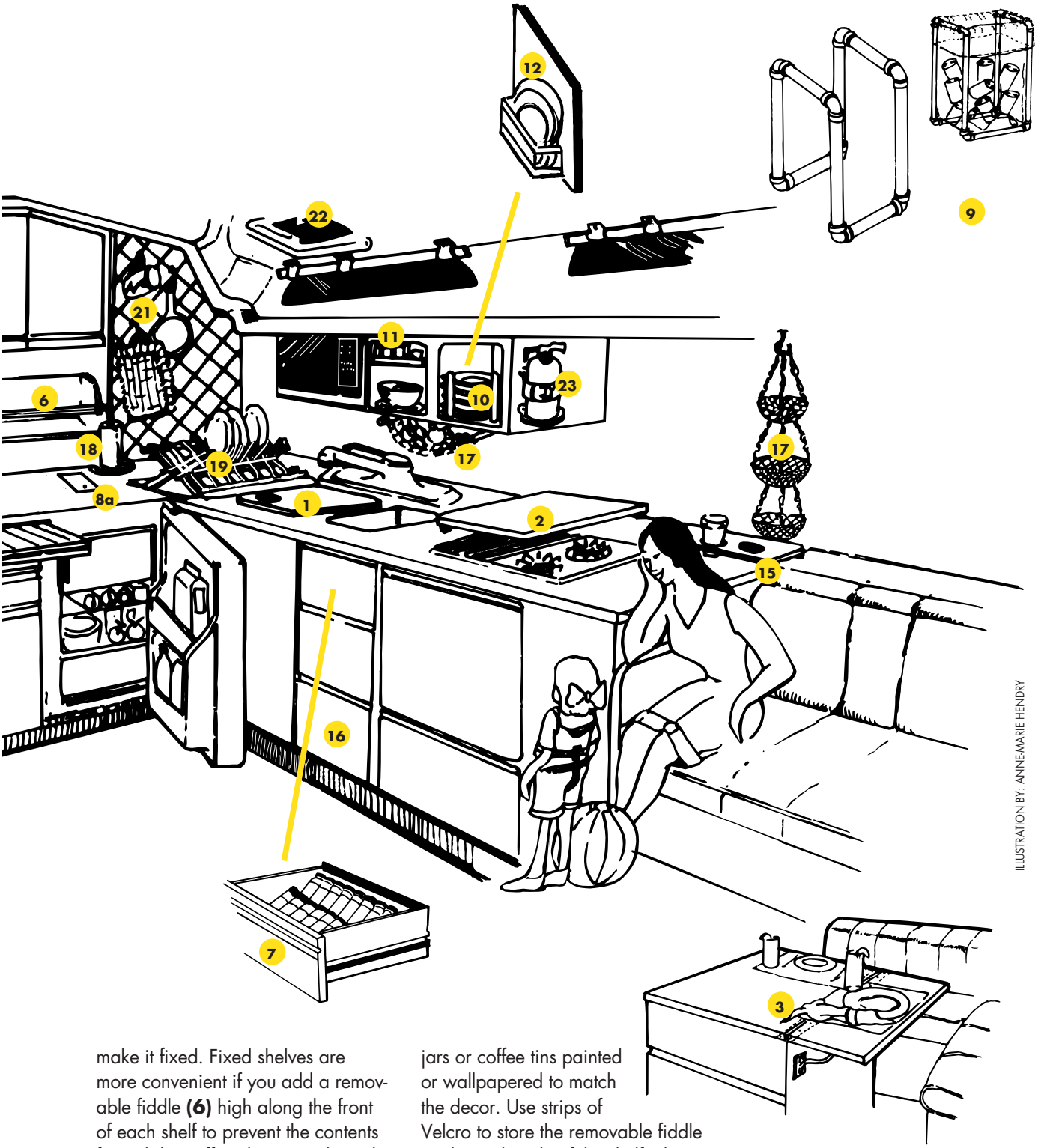


ILLUSTRATION BY: ANNE-MARIE HENDRY

make it fixed. Fixed shelves are more convenient if you add a removable fiddle **(6)** high along the front of each shelf to prevent the contents from sliding off and soaring through the cabin while the boat is under way. This is a handy location for frequently used dry goods, such as sugar, coffee, tea, and so on, which you can store in plastic peanut butter jars or coffee tins painted or wallpapered to match the decor. Use strips of Velcro to store the removable fiddle on the underside of the shelf when it's not needed. Spice jars stow neatly in a drawer near the stove **(7)**. Install plywood dividers in the drawer at an angle to separate the contents and so the jars lean forward.

Stash the Trash

Now that the meal is in progress, what are you going to do with all the

GALLEYS

wrappings and trimmings? No problem! Just lift the lid on your in-counter garbage disposal unit **(8a)** and drop the garbage in. Some boats have a corner cupboard under the counter which is very difficult to get at and not very functional or efficient. Buy an appropriately sized plastic container, then cut a hole the same diameter as the container in the countertop over this dead space. Glue on some cleat stock so the lip of the basket rests below counter level. The lid can be hinged for added convenience, or left loose and simply removed with a finger hole or a handle. Use plastic shopping bags as liners for your container. A deep drawer is easily converted into a recycling garbage bin **(8b)**. Insert four plastic bins held by wire racks to hold newspapers, bottles, plastic and cans.

Speaking of plastic bags, there are some inexpensive plastic-bag holders of various shapes and sizes on the market — or you can make your own out of wood, plastic, cloth or PVC **(9)**. Cut 38mm (1-1/2") pipe to fit the space, join the pieces together with 90° elbows and PVC cement, then stretch a plastic bag over the holder.

TIPS — NO SURPRISE PACKAGES

Using a permanent marker, write the contents of containers, as well as the date the food was packaged, on a piece of tape, then stick the tape to the container. This will reduce search time and help ensure that you use the food before it spoils.

Cupboard Conversions

If you've moved a ton of stuff from your home kitchen to the less-than-adequate galley, you may be wondering where you're going to store it all. For a start, explore the possibilities of converting existing cupboards. Dishes, for example, are easily stored in cupboards **(10)**. Place a plate or bowl in a cupboard so it touches the back wall and one side wall. Cut two or three lengths of 6mm or 9mm (1/4" or 3/8") dowel slightly longer than the stack of dishes is high, but still short that you can remove three dishes at a time. Place the doweling vertically against the dishes, spaced as necessary to hold them in place, then drill holes the same diameter as the doweling about half way into the bottom of the shelf. Glue the dowel pieces securely in place. This system prevents dishes from thrashing around yet allows for easy access. Keeping the dishes to the back of the cupboard provides space at the front for a plastic revolving spice rack mounted on the inside of the cupboard door. In another cupboard, trim the upper shelf back and attach a permanent fiddle **(11)**. Use the lower shelf for plastic mixing bowls and storage containers. On the inside of the door, buy or make a holder for pot lids **(12)** or hang the lids on the insides of cupboard doors with light line or shock cord **(13)**.

If you have enough space — and we're talking 12.7cm (5") max — add a pull-out pantry in the end of an existing counter **(14)**. And somewhere at the back of the counter or on the cabin sides, you should find a niche for a small teak or acrylic glass rack **(15)**.

TIPS — SAVING ENERGY

To reduce the swinging-door syndrome at mealtimes, store like foods such as salad fixings, fresh veggies, meats, cheeses, fruits and condiments together in large, shallow plastic trays before transferring them to the fridge, ice box or cooler. When you need them, you can quickly remove only the necessary containers, then repack and return them after use.

FUEL FOR THOUGHT

One of the most important steps in furnishing this repast, of course, is cooking it. Stoves should be designed, manufactured and approved for marine use and you'll find a variety of alcohol, kerosene, propane (LPG), compressed natural gas (CNG) or electric stoves available for use on boats.

Electricity is likely the safest source of heat for cooking aboard but, of course, you'll need shore power or an auxiliary generator. Pressurized alcohol is probably the least safe-fuel. It has scant detectable odor, demonstrates little or no color to its flame, and is lighter than water and therefore able to float on top of it. Alcohol, like kerosene, also has a tendency to flare up unexpectedly. The exception is Origo's line of non-pressurized alcohol stoves. These Swedish-made stoves are safe and efficient. *DIY*'s editor replaced an older kerosene stove with an Origo 3000 and, except for the sometimes messy filling of the fuel canisters, it's been a convenient and reliable "cooker."

Propane and its safer cousin, natural gas, are the most widely used fuels on larger boats. However, both present a serious safety hazard if they're not installed and operated in compliance with strict codes. Install a fume detector with both fuels. And remember that using a portable stove with portable LPG or CNG bottles attached is prohibited inside a boat with accommodation. Stoves should be fitted with splash-proof protectors. An exhaust vent or opening hatch **(22)** over the stove helps get rid of cooking odors and keeps the cabin cooler. Do not store small propane cylinders or charcoal lighter fluid on board. Charcoal should be stored in a sealed metal container to keep it dry and contain the highly combustible coal dust. Last but not least, have fire extinguishers at the ready, but away from the cooking appliance for safety's sake **(23)**.

Microwave ovens offer some onboard advantages over electric and fuel-powered stoves. Available in a variety of sizes and wattage ratings, microwaves reduce cooking time and emit much less heat into the surrounding cabin. If your boat has counter space available for a microwave, your only concern is the power supply. Boats equipped with generators are home-free; others must determine battery consumption and add extra batteries (if required) and an inverter. Due to their size and weight, microwaves must be well secured and adequately ventilated. When choosing a unit for marine use, it's worth paying a little more for a model with splash-resistant, touch-pad controls rather than knobs. Touch-pad controls are much more resistant to moisture intrusion and therefore less likely to cause problems, especially when boating in salt water.

STORAGE TIPS

Tin cans are always a problem because of their weight and bulk. It's a good idea to stow them low. The bottom shelf of the pantry **(14)**, bottom drawer near the sink **(16)** or under a galley seat are ideal locations. If you're storing tins in the bilge, first remove their labels and identify the contents of each tin by writing on it with a waterproof marker. Pots and pans are also bulky and heavy and should be stored low. Camping stores carry an interesting array of stackable cooking pots with removable handles that take up very little space.

GALLEYS

Have you ever wondered why carrots, apples and other fruits and veggies are packaged in bags with holes? This is no fluke; the holes really extend the freshness and quality of produce. Try using Ziploc vegetable and fruit bags with freshness "vents" that emulate the bags used by produce growers. Fresh fruits and veggies (such as potatoes, carrots onions, oranges, etc.) also need air circulation to prevent rot and mildew. Open-weave baskets, nets or wire baskets **(17)** hung in a cool airy location are all suitable.

Consider preparing meals at home and freezing them. This reduces meal-preparation time at the boat and helps keep the ice box cold. Store like foods together, such as salad fixings, meats, dairy products, fruits or condiments, in plastic containers or trays. Remove drinks, lunch fixings and snacks for the entire day and store them in a smaller container or cooler to avoid having to continually open the main cooler. Extra blocks of ice (rather than cubes) will keep for several days in a separate cooler if the cooler lid is sealed completely with duct tape, then placed in the coolest spot aboard.

TIPS

EASY ID

When storing cans, jars or boxes in a drawer, locker or under a dinette seat, label the top with a waterproof marker for easy identification and to reduce frustration when labels come off. Remove labels from all cans stored in the bilge to prevent clogging the bilge pump.

CLEAN UP

Once the meal has been devoured, it's time to clean up the mess. Returning to the countertop, add a plastic tote tray that sits on a piece of non-skid rubber mat near the sink and holds the dish soap, hand soap, a sponge and the sink stopper. (Non-skid matting has 101 uses as shelf liners, between dishes, under glasses and as place mats.) If wall space or under-the-counter space is limited, consider an upright paper towel dispenser **(18)** made with a 3cm (1-1/2") dowel, either on a stand or mounted directly on the counter. Use a large plastic lid wrong-side up with a hole or "X" cut in the middle for the dowel to keep the roll of towel raised off the countertop. A plastic, collapsible dish rack **(19)** with an integral base for water collection folds down to 6cm (2-3/8") and occupies minimal space in a cupboard. Hang a couple of towel or dishcloth racks on the inside or outside of a cupboard door or at the end of a counter (**20**). Attach odd-shaped items, such as a small broom and dust pan on decorative wire **(21)** and your clean-up apparatus is complete.

After all these renovations, alterations, repairs, revisions, additions, improvements and modifications... you deserve a night out at the best gourmet restaurant in town!!

COOL SENSE

Another major aspect of galley prowess is managing food and refrigeration. Ideally, the temperature for foods that spoil should be between 1.1C and 4.4C (34F to 40F). Refrigeration works best when the coolant is above the food. So, in the cooler or ice box, use a container on side rails or a rack to hold ice above the food. In a 12-volt or AC fridge with a freezer unit, conserve power by rotating plastic containers of ice or frozen beverages between the freezer unit and the top shelf of the fridge. More effectiveness can be obtained when the cooler is not overcrowded and there is constant air movement. Check out your local camping store for a small fan called Fridge Mate. It runs on two D-cell batteries that should last a month or more and occupies no more space on the bottom shelf than a jar of mustard.

Keep a food thermometer in your cooler or fridge or purchase one that provides a temperature probe to be taped strategically in an icebox, fridge or cooler while the digital readout remains attached to the outside. This option is particularly handy for battery and/or AC-operated units. If the temperature rises above 4.4C (40F), just turn the power on and leave the door closed.

KNOTTY KNOW-HOW

ONE ROUND, TWO FIGURE AND A HALF

We've included this knot for owners and crew members who incorrectly belay a cleat. Incorrect cleating can often create one of two problems: The line comes loose because it's not locked with a figure eight knot or you cannot free it quickly because the first turn of the line doesn't wrap around the base of the cleat. A good rule of thumb is: one round turn, two figure eights and a half-hitch to hold it.