FALL 1996

DIY boat owner

the MARINE MAINTENANCE MAGAZINE

Columns

DIY Projects

Easy-to-make canvas drink holder will hold cans or Tetra paks; Convert a shelf into a storage rack for spice jars; Make a traditional hardwood cleat; Metal turn buttons for securing floorboards and locker lids.

Electronics

SMARTER CHARGING: A guide to battery chargers includes charger operation, selection and installation plus battery options and maintenance.

Knotty KnowHow

Use a rolling hitch to secure one line to another.

Engine Troubleshooting

STERN DRIVES: Maintaining the lower unit plus a recommended maintenance schedule; How to assemble a fuel hose for a portable tank.

Powerboat Rigging

Troubleshooting trailer wiring.

Sailboat Rigging

Step-by-step installation of a permanent one-piece, custom-fitted mast ring.

For complete step-by-step stern drive maintenance refer to 1999-#3

For information on battery selection, sizing, and charging techniques refer to DIY 1997-#3 and 1999-#3

COVER UP

Protect your boat during the off season with a good cover — one that fits, is properly supported and allows for good ventilation.

For information on materials and repair options refer to DIY 1998-#4 and 1999-#3

OFF-SEASON STORAGE

Tips and techniques for preparing your boat for winter storage.

TAKE CONTROL

When you need an extra "shove" at the bow, a thruster gives you complete control.

For additional repair information, materials use, etc, see DIY 1995-#3, 1998-#3 and 1999-#3

BLISTER REPAIR TECHNIQUES

An expert offers these repair techniques and tips. Plus, extend your outside work time with this easy-to-build mini-boatshed.

Departments

TechTips Boat-tested tips.

TalkBack Refurbishing a '74 Cary; Help for Grampian owners; and Compass repair.

TECH TIPS

REMOVING BARNACLES: You can remove barnacles and other growth from your engine water intake thru-hull without hauling your boat and without using a diver to clear them. Close the intake seacock and remove the engine intake hose. Temporarily install a piece of hose on the seacock tailpiece that is long enough to reach above the waterline and support that hose in a vertical position. Open the seacock and run a straightened wire coat hanger or other rod down through the hose and seacock to clear the obstruction.
Phil Friedman, Port Royal Marine, Pompano Beach, FL

STOP THE HUM: When the straps that attach your convertible, T-top or bimini top to the deck vibrate in the wind, unfasten them and twist each strap one turn, then refasten. This changes the vibration frequency so the straps no longer hum.

IT'S A SNAP: When snap fasteners fail to close, often all that's needed is a lube job. Just dab some petroleum jelly on the inside of the fastener and move the spring with an awl or other tool.

ODOR EATER: Freshen stale cabin air and absorb odors with a few anti-static clothes drier sheets placed in strategic locations around the cabin.

CLEANUP FOR SEALANTS: To remove spilled silicone sealant off most surfaces use acetone; for polyurethane use rubbing alcohol; and for polysulfide use mineral spirits.

LET IT SHINE: When you're installing a new zinc anode on the shaft, sanding the shaft with emery cloth to a bright finish where it comes in contact with the anode will ensure a good contact between the two metals.

WASTE NOT: Recycle and reuse solvent that has been used to clean brushes and other tools. Strain the solvent through a paper filter funnel and store it in a sealed can marked "dirty." Reserve the solvent for first-time cleaning of paint brushes.

SOUND SIGNALLING: Use a coiled key ring cord to attach a pealess whistle (such as the FOX 40) to life jackets for emergency sound signalling.

CERTIFIABLY YOURS: Inscribe your name, address, phone number, vessel name and VHF call numbers in a prominent and readily visible location on your tender for easy retrieval and identification.

LAUNDRY DAY: For an instant spin dry, fold your clothes around the bow pulpit or shroud (on a sailboat) and twist tightly to wring out the water before hanging to dry.

RODE I KNEW: To determine how much rode is payed out when anchoring, mark it in 3m (10') or 6m (20') increments using a waterproof marker or a liquid plastic rope whipping.
Sheilah Van Nostrand, Dream Catcher, *Keswick, Ont.*

MILDEW ARRESTOR: Fill a spray bottle with a solution of one tablespoon bleach to one quart water and regularly spray-and-wipe boat interiors, carpets (check for color fastness first) and countertops in the galley and head. The solution will kill spores and retard mildew growth.

TOOL FOR CLEANING: Old toothbrushes make great tools for cleaning nooks and crannies on the deck or in the cabin. Keep a separate one in your toolbox for engine cleanups.

GETTING HOSED: When you need to install a length of reinforced vinyl hose, but it's slightly too small to fit on the barbed hose fitting and applying liquid dish detergent doesn't help, heat the hose end evenly with a hair dryer until it softens and expands. Place immediately over the barbed hose fitting.
Phil Friedman, Port Royal Marine, Pompano Beach, FL

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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TALKBACK

Refurbishing from the Outside In

Q: A simple repaint job of our 1974 8.4m (28') Cary Offshore powerboat has turned into a much bigger project and we are in need of some help. We are in the middle of stripping paint off the hull, which someone applied over the original gelcoat. Before repainting, we suspect we'll need to fair the hull. Some hull vents and other fittings have been moved and I suspect some fiberglass filling will be necessary in these areas. The fuel tank was leaking so we removed the complete interior and floor. Excessive rot was evident under the floor and we are not sure if we need to do any stringer repairs. As we are interested in doing as much of the work as possible ourselves, we need some advice on the various aspects of the job. Any help you can render would be greatly appreciated.
Ed Hussey, Director, Performance Boat Club of Canada, Scarborough, Ont.

A: Your task isn't too difficult providing you've got time to spare. The hull is easily faired with a mixture of epoxy and fairing compounds. See our SPRING '95 issue for an article on repairing holes using patches made of multiple layers of fiberglass cloth cured with epoxy resin. A good inexpensive reference booklet that will guide you through your hull repairs is *Fiberglass Boat Repair & Maintenance* by Gougeon Brothers. Call Payne Distributors at (905) 825-0200 for information on where to get this booklet. Once wood begins to rot, the spores migrate quickly though the boat. Because of this, all rot must be removed. You can remove the rotten wood, then provide reinforcement by gluing wood beams to the existing floors. It's a good idea to encapsulate the floors with fiberglass and epoxy to prevent any future rot. As you didn't specify the tank construction, I'm assuming it's metal — aluminum or stainless or mild steel. The leak probably comes from a crack on the weld and it's easily repaired by a welding shop. (Consider a shop with experience in marine components.) One shop we know of that does this type of work is Stainless Outfitters in Barrie, Ont., (800/268-0395). Before it can be rewelded, the tank must be thoroughly flushed with water so it's absolutely free of any fuel or fumes.

HELP FOR GRAMPIAN OWNERS

Replacing Cabin Windows

Q: I have a 1974 Grampian 26 and the windows have started to leak around the rubber seal which is starting to rot. The aluminum frames are riveted to the fiberglass and I'm very reluctant to drill them out and replace with bolts. I can cut the rubber seal from outside the boat. This will allow me to pop the window which has become badly discolored and will be replaced with either a Plexiglas or Lexan one. When you view the frame after cutting, there is a 12m (1/2") rubber facing which is in good shape. I could install the new window against it. I doubt whether I can find another rubber seal so what would be the best adhesive/sealant to use to secure the window? Also, is it worth spending the extra for Lexan?
Michael C. Priest, via E-mail

A: Grampian windows were manufactured by Bechlawatt in Belleville, Ont. and, unfortunately, there is no durable, long-term solution to your problem. The rubber holds the window in place and if it's removed, the window will fall out. You can replace it with a larger piece of acrylic but you must affix it to the frame using a marine-grade polysulfide sealant. Willem Boon of Bomon, a Quebec-based manufacturer of boat windows, recommends installing new acrylic (it's cheaper than Lexan which scratches just as easily) against the remaining rubber gasket and sealing the exterior with Tram Tape (available at most glass suppliers). But if you are going to keep the boat, you may want to consider investing in new windows.

Centerboard Removal

Q: The centerboard on the Grampian 23 I purchased about four years ago has not worked since I bought the boat. It's stuck inside the keel and I have tried everything possible from the outside to get it to come down. I spoke with someone who has the same boat and the same problem. He had cut open the turning sheave inside the boat to see if the cable was jammed between the sheave and the hull, but found no problem. Because of this I have been reluctant to cut mine open; however, at this time I cannot think of anything else that could be wrong. Do you have any thoughts or experience with this problem before I start cutting.
Malcolm Smith, Scotch Mist, *Thornbury Harbour. Ont.*

A: Stop, don't cut! A centerboard gets jammed either when it has split or when pebbles, mussels or other debris are lodged in the slot. The following procedure for removing a centerboard both on your boat and on the larger Grampian 26, which has the same system, comes from Gil Bibby, production manager of Grampian Marine from 1968 until the company closed in 1977. First, haul the boat out of the water and ensure that it is securely blocked 45cm (18") above the ground to allow the board to drop out. On either side of the 38mm (1-1/2") slot in the keel, 15cm (6") from the front edge, are four bolts, two per side. These bolts hold two L-shaped brackets that in turn hold the board in position. Remove the bolts. If these are corroded and you can't loosen them, apply a penetrating lubricant such as Captain Phab Corrosion Stop or a similar product, wait a few minutes and try again. If the bolts are seized, you will have to drill them out. Next, unwind the centerboard cable from inside the cabin. This should lower the board. If it doesn't, you'll have to pry the board and brackets loose. The board is heavy — be careful that it doesn't drop on your arm or hand. With the board out, remove the brackets and pivot pin. Clean all parts, including the keel slot, removing rust and grime. Paint metal parts with a rust inhibitor. Clean the board, repair if necessary, and apply a coat of antifouling. Check the cable and swage terminal for wear. Clean the keel slot and paint it. When dry, apply a light coating of marine-grade waterproof grease to the slot and cable. If you had to drill out the bolts, re-tap the holes for a larger bolt before reinstalling the board. Attach the brackets and pivot pin to the board and slide the board into the slot. Now that the centerboard is in working order, it should be removed, inspected and greased once a year. If you need more information, Bibby is an expert on Grampian boats and has most of the original Grampian drawings and some replacement parts. You can contact him at (905) 692-3244 or fax your request to (905) 561-4787.

COMPASS REPAIR

Q: Do you know anyone who can repair a Saturn compass or where I can get a replacement? I was cleaning and resealing the compass on my Sirius 21 when I dropped it. As a result, the clear plastic dome over the compass cracked and oil leaked out.
Ron Lefebvre, Capreol, Ont.

A: Saturn compasses are made by AquaMeter which has authorized warranty and repair depots across North America. Your nearest dealer is Brewer Bros. Marine Supplies at 65 Guise St., Hamilton, ON L8L 8B4; Tel: (905) 529-4114, Fax: (905) 529-4143. The company also repairs Ritchie and Danforth compasses.

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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COVER UP

When it comes to protecting your boat during the off season, there is no better investment than a boat cover.

Without some sort of protective cover, a boat exposed to the elements will continue to age. Sun, dust, dirt, rain and snow quickly deteriorate gelcoat and painted finishes. Before long, wood rots, mildew forms, mold grows and metals begin to corrode.

A properly fitted boat cover minimizes such damage, increases a boat's resale value and reduces maintenance so you're not having to do a major overhaul every year. As for security, a cover also deters vandals and thieves who are less inclined to break into a boat under wraps.

To Cover or Not

Exposure to the sun and moisture causes the most damage to an uncovered boat. Ultraviolet (UV) rays quickly dull the gelcoat finish and deteriorate painted and varnished surfaces. Airborne dirt, leaves and other debris collect in scuppers, cockpit drains and coamings and plug the drains. Water accumulates and soon breeds mildew and mold and begins to rot carpets, wood and fabrics. Water also collects in minute cracks and openings and, should it freeze, can damage deck fittings, engine controls, joints and seams. In northern regions, snow collects on deck and, when it melts, moisture wicks through the gelcoat layer and migrates down to the fiberglass.

The one drawback of covering your boat is lack of ventilation. Without good air flow across the deck and inside the cabin, things begin to rot. Using fabrics that breathe, leaving large openings at the bow and stern and adding vents to the cover all reduce the problem to a point far less damaging than the alternative — no cover. You'll save money and time initially by not covering your boat, but you'll also increase maintenance time and repair costs when it's time to relaunch.

If you decide not to cover your boat, at the very least you should seal the decks with a protective coating of wax. But with a good cover — one that fits your boat, is properly supported and allows for good ventilation — you can skip that step. All you'll have to do in the spring is wash the hull and deck, apply a coat of wax, touch up the teak and you're ready to cruise!

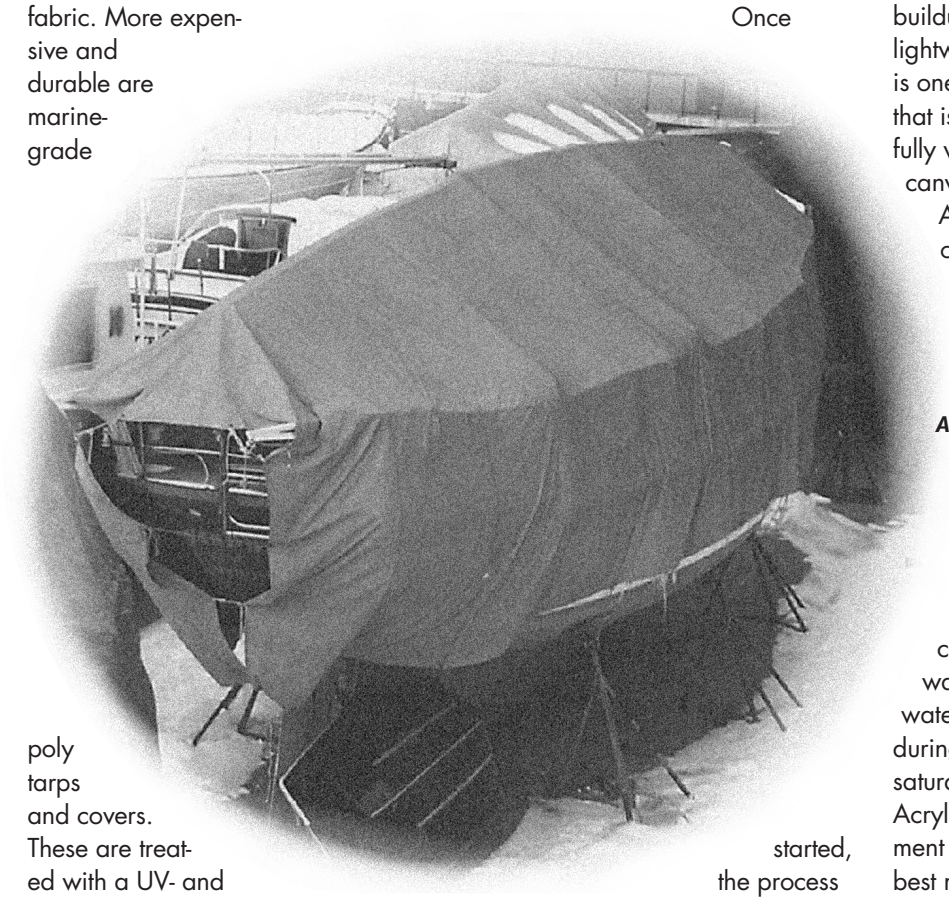
Fabric Options

The key to a good cover is its

strength, durability, water repellency and ability to let the air pass through it (breathability). Fabrics for storage covers and tarps are mostly woven polyethylene; cotton, acrylic, polyester and blends; and shrinkwrap, a polyethylene film with a UV inhibitor. Each material has unique advantages, and the possibilities are limited only by your budget.

Woven polyethylene (plastic) tarps are the most economical. The popular and very cheap blue ones last one season or less as the sun's rays quickly degrade the fabric. More expensive and durable are marine-grade poly tarps and covers. These are treated with a UV- and mildew-resistant coating and last three or more seasons with proper care. They must be securely fastened to prevent hull abrasion and inspected regularly.

Untreated cotton is one of the few fabrics that is 100% breathable. A natural fiber, it swells when it gets wet, the weave tightens so the canvas becomes waterproof. As it dries, the fibers open up, allowing the fabric to breathe again. Nowadays, however, most cottons are treated with a water-repellent and UV-resistant coating that resists stains and mildew but also reduces the fabric's breathability. Still, cotton's resistance to abrasion has no equal and its soft finish makes it an excellent choice for storage or trailering covers. When properly cared for, a cotton cover can last 10 years or more; but when water is allowed to pool or the cover is stored wet or in a damp place, cotton and cotton-blended covers quickly mildew and begin to rot. Once started, the process is irreversible.



A properly fitted storage cover has a substantial drainage system, lots of padding to prevent chafing, openings at the stern and bow and adequate tiedowns.

Off-the-shelf storage and trailering covers are an inexpensive option for small powerboats. Covers from Attwood, Canvas Products and Taylor are commonly blends of cotton, polyester and vinyl or treated polyethylene. Attwood's Blizzard covers are made of a non-woven polyester fabric with a PVC coating. Originally developed for boat-builders as an alternative to shrinkwrap for transport covers, five models fit boats from 4.2m to 6.3m (14' to 21').

Synthetic fabrics of vinyl, polyester, nylon, acrylic and blends are lighter, stronger and offer better UV, mildew and water resistance than cottons. Aqualon, a lightweight, vinyl-coated polyester is extremely practical for large boat tops. Triton and Top Gun are two brands of 100% polyester fabrics that are durable and easy to care for. Vinyls and polyesters do not breathe and must be vented to prevent moisture buildup inside the boat. Tyvek, a lightweight material made of olefin, is one of the newer high-tech fabrics that is not only breathable but is also fully waterproof and costs less than canvas.

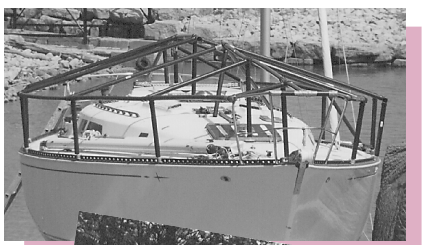
Acrylic's greatest advantage over vinyls and polyesters is that it breathes. Sunbrella, a 100% acrylic, is available in a myriad of brilliant solid and print colors. But the fabric is not waterproof, only water-repellent; water will blow through the fabric during heavy rainstorms and, once saturated, the cover will leak. Acrylic won't take a lot of punishment either; it abrades easily and is best reserved for cockpit covers, convertible tops or biminis.

Blended acrylics are a more waterproof and durable option. Sunbrella Plus is a polyurethane-lined Sunbrella that's more water resistant than 100% acrylic. Seamark is a premium-priced acrylic with a vinyl underside that's completely waterproof. Regatta is one trade name for a vinyl-laminated acrylic fabric suitable for covers.

COVER UP

Shrinkwrap offers a low-cost, one-time, short-term solution for protecting your boat. A sheet of polyethylene film is draped over the boat and a propane-fueled heat gun shrinks the film. It fits like a glove with no chafing or flapping and provides a fully waterproof, airtight seal; adding vents helps reduce condensation and mildew buildup. And, snow, ice and rain can't adhere to the slippery plastic surface.

If you boat in an extremely rainy area (the west coast, for one), consider buying a waterproof polyester or vinyl-blended fabric to keep the boat dry. As these fabrics don't breathe, you'll have to provide good flow-through ventilation to retard mildew growth. If your home port is in the sunny south, on the other hand, you'll need a fabric that resists continual UV exposure. Regardless of the fabric you choose remember that any cover is better than no cover at all.



Frames made of PVC (top), or galvanized pipe (bottom) are inexpensive and easily assembled to fit a variety of cabin and deck shapes.

A Perfect Fit

There are five requirements of a properly fitted storage cover: It should cover the topsides and, on larger boats, extend down to the waterline; it must be supported so it slopes downward from the deck centerline; it must be padded to prevent chafing in windy weather; it must incorporate some form of ventilation; and it must be securely fastened so it doesn't shred.

Tarps or fitted covers should be large enough to shelter the entire boat, from bow to stern pulpits (if you have them), and cover the topsides. A well-engineered framework supports the cover and prevents rain and snow from pooling on the fabric. On smaller boats, this can be as simple as adding adjustable aluminum posts or wooden or plastic bows positioned in the bow and cockpit. For larger boats, there are various ways of making a strong frame that will withstand the forces of wind and the weight of ice and snow.

A simple and low-cost frame is one made of polyester straps or rope. This light-duty framework is often assembled over large open areas before covering them with shrinkwrap. A similar but more durable drainage support system for fabrics uses a ridgepole made of 2x4s. Ropes spaced every 1m (3') or so attach to the ridgepole with a clove hitch and tie off to the toerail. A less temporary solution uses wood rafters made of 1x6s that extend from the ridgepole to the rail.

More complex frames of PVC, aluminum or galvanized steel pipe are easy to fabricate and can be assembled for under $200. Ridgepole and uprights built of 5cm (2") diameter PVC pipe are joined with elbows then drilled and fastened with machine screws.

Shrinkwrap fits like a glove but traps moisture. Vents help to reduce condensation and mildew buildup.

Small blocks of pressure-treated wood, drilled with deep holes the diameter of the pipe, support uprights and protect the deck.

TIPS ENGINE COVERS

Cover outboard engines to keep dust out but don't use an airtight covering, such as plastic sheeting, because it holds in moisture.

Uprights are notched to fit over the rail or slide over the stanchions or after the stanchions are removed, are inserted into the bases. Padding is added where the uprights touch the deck to protect the deck from chafe, then each one is anchored with a rope lashing to the rail.

Metal frames are not as simple to build as PVC ones. They're made of 19mm (3/4") or larger diameter conduit and you'll need to borrow or rent a pipe-bending machine to form-fit the uprights. Pieces are joined with U-clamps, electrical elbows or duct tape. Small blocks of pressure-treated wood, drilled with deep holes the diameter of the pipe, support the uprights and protect the deck. Carpet placed under the blocks protects the deck finish. The framework is then tied to the boat in several places.

Regardless of the material you use for the frame, position the ridgepole high enough so the sides slope at least 30° so the cover easily sheds rain or snow. Pad all sharp edges and wear points — ridgepole ends, bow and stern corners, pulpits, bridge decks and windshields on powerboats and stanchions on sailboats (if they are not removed) — with towels, thick rags, scraps of foam or carpet to prevent the cover from tearing.

Leave tarp ends open to increase air flow and reduce condensation buildup in the cabin.

Custom-fitted covers usually have openings at the bow and stern for ventilation. When "tenting" your boat with a tarp, leave openings at the bow and stern to increase air flow and reduce condensation buildup in the cabin. Large-diameter PVC pipe or sonotubes attached to

COVER CARE

With a little TLC, quality tarps and covers will last for many seasons. Trailering covers should be cleaned frequently before dirt, debris and other airborne pollution accumulate and become embedded in the fabric. Storage covers should be cleaned and inspected for wear and repaired before being packed away.

To clean covers made of cotton and cotton blends, remove any loose particles with a soft brush, rinse with fresh water and clean with a commercial canvas cleaner or a mild solution of non-detergent soap, such as Lux or Ivory, and lukewarm water. Rinse thoroughly to remove all soap residue and air dry. Never use detergent or harsh cleansers. Cotton can also be dry cleaned.

Vinyl and laminated covers are best cleaned with a product formulated for such use, but check first to ensure its compatibility; some vinyl cleaners may bleach or stain. Small acrylic covers can be cleaned in a washing machine on a gentle cycle with cold water and double the normal amount of detergent.

For tough stains on acrylic fabrics, dissolve 125ml (1/2 cup) of non-chlorine bleach and 63ml (1/4 cup) of Ivory in one gallon of water. (Nothing cleans stains from cotton; stains and dirt deposits are permanent.) Soak the fabric for 20 minutes then rinse in cold water.

Any cleaning removes a fabric's protective chemical layer and the fabric must be treated periodically with a water repellent that is rolled, brushed or sprayed on with a garden sprayer. It's a good practice to renew the finish every two to four years and more often with cotton or blends that mildew easily.

During the off-season, occasionally check the condition of the cover. Look for rips or tears and for places where the cover might chafe the hull. On pre-made covers, consider reinforcing wear points at windshield corners and transom edges with fabric patches (you can get scraps from a canvas shop) attached with fabric glue or contact cement to the underside of the cover.

Before storing a cover or tarp, dry completely after cleaning, treat the fabric and then repair all rips and chafed areas. Small tears in polyethylene tarps and covers are easily repaired with duct tape applied from the inside. Other fabrics require patches that are either glued or sewn on. Stow the cover in a dry, well-ventilated area. Vinyl, polyester and acrylic may be stored wet for a few days at the most; never pack cotton wet and never stow in a damp place as the material mildews quickly.

Editor's Note: Various brands of canvas water repellents were torture tested by DIY's product reviewers on the west coast. Complete test results will follow in an upcoming issue.

COVER UP

the ends of the ridgepole provide an adequate supply of fresh air. Extend the tubes over the bow and stern with a slight downwards slope. Tape or tie the cover around the tubes to form a tight seal to stop rain and snow from getting under the tarp. It's a good idea to leave deck vents and hatches open or remove one or more hatch boards to ensure a continuous flow of air through the cabin. The addition of air scoops or vents in the cover enhances air flow through the boat.

Securely tie down the cover with polyester or nylon cord or rope so it won't flap in strong winds. Tarps have a rough finish and any flogging easily abrades gelcoat and painted finishes. Plastic jugs filled with water or canvas bags stuffed with sand and attached around the perimeter will maintain even tension on the cover. Place padding under tiedowns and grommets to prevent them from scratching the gelcoat or paint.

TIPS

VAPORS AWAY

Always ventilate canvas enclosures on powerboats when you're running the engine. Exhaust fumes contain carbon monoxide which is poisonous and can be fatal in large doses.

The Bottom Line

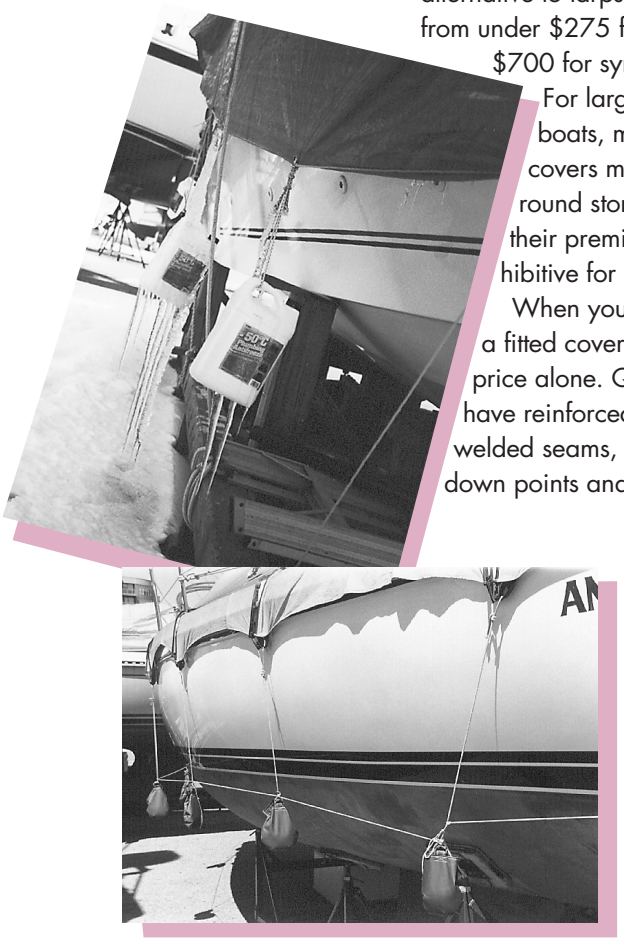
Cover prices vary depending on the cover material, size and complexity of design; fitted covers, vents and zip-out sections add to the cost. Shrinkwrap is applied by a skilled contractor and averages $12 to $25 per linear foot. Vents are included for that price but some shops charge extra for labor. A 8.4m (28') flybridge cruiser requires about 12m (40') of materials and a day's work to complete the job. Shrinkwrap is recyclable if you can locate a firm that does this, but it must first be absolutely clean and free of all foreign matter.

Polyethylene tarps are the cheapest ($10 to $75) but, since they deteriorate quickly, higher quality poly tarps treated with a UV coating are a better buy. A 6m by 12m (20' by 40') treated tarp costs less than $200 and, if it's securely fastened and tears are repaired promptly when the cover is removed, it will last two or more seasons.

Boats laid up on shore for four to six months during the winter months need adequate protection from the elements.

For powerboats under 7.5m (25'), pre-made fitted storage or trailering covers made of cotton, polyester and blends are a better alternative to tarps. Prices range from under $275 for cottons up to $700 for synthetic fabrics. For larger power or sailboats, made-to-measure covers make the best all-round storage covers but, their premium price is prohibitive for many buyers.

When you're shopping for a fitted cover, don't consider price alone. Quality covers have reinforced overlocked or welded seams, plenty of tie-down points and reinforced corners. If there is a wide price discrepancy between canvas suppliers, find out why. This is one aftermarket product where you usually get what you paid for.



Plastic jugs filled with water or canvas bags stuffed with sand and tied around the hem of the cover maintain an even tension and prevent the cover from flapping in the wind.

OFF-SEASON STORAGE

Tips and techniques for preparing your boat for winter storage.

FUEL ADDITIVES

You should add a conditioner to fuel tanks to stabilize the fuel and eliminate condensation. When added to gasoline tanks, a stabilizer dissolves gum and varnish deposits and prevents new ones from forming, removes water in the fuel and keps the carburetor from icing up and the fuel line from freezing. Diesel tanks require the addition of a biocide to prevent algae growth, which can occur when water is present in the fuel, either from water-contaminated fuel or condensation.

Using the amounts specified on the package labels, pour the additives into the fuel tank before haulout and run the engine so the treated fuel has a chance to run through the lines and filters.

TIPS

Take your cockpit, mooring or trailering covers, biminis and convertible tops, dodgers and awnings in for repair over the winter, or order new ones in the fall before you put the boat away. Otherwise, you'll be waiting in line next spring with the rest of us who leave those details until the last minute.

SHORING THE HULL


FIGURE 1

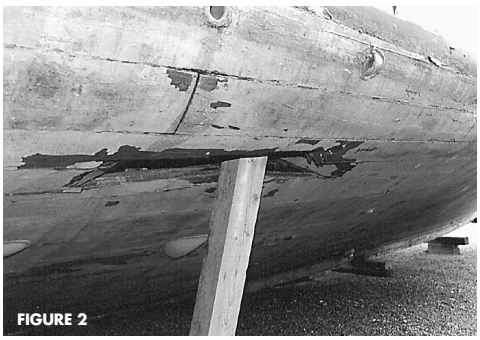
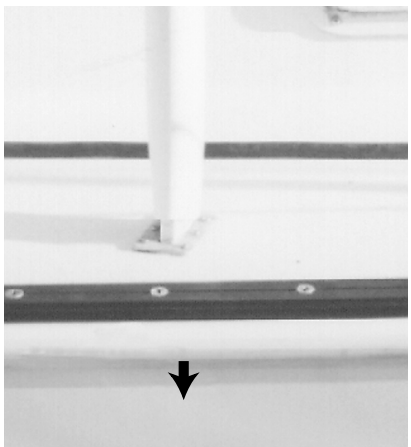


FIGURE 2

Care must be taken when storing a boat on land — many insurance companies will not cover damage caused by boats that are not properly supported. The entire boat — including the keel — must be properly and evenly supported. Rigid cradles must be firmly blocked with wedges under pads so that each shore bears about the same load. Shoring a hull with wood beams or jack stands offers a fast and easy means of supporting a boat, provided the loads are evenly distributed. Both should be set on squares of plywood to prevent them from sinking into the ground and stands should be joined by chains (Figure 1) so they don't spread under load. Again, wooden wedges or pads placed against the hull help to distribute the load and prevent "hot" spots on the hull (Figure 2). While the boat is laid up, frequently check that shores and wedges have maintained their correct position and loading.



A LIFT UP

During haulout, slings must be positioned so they don't damage underwater fittings, such as transducers or thru-hulls or a prop shaft or strut; even an experienced boatlift operator may pick up a boat incorrectly. Some boats have marks for sling placement embedded in the hull. If your boat doesn't have these, create your own; before they're removed, mark the position of the slings on the hull with strips of tape. Then, using a highly visible paint or a waterproof marker, mark fore and aft sling points on the topsides near the sheer line. This will help the next lift operator, who won't have to work "in the dark." It's also a good idea to bring your camera on haul-out day and, while the boat is suspended in the slings, take photographs of the hull and underwater structure. You'll be better prepared in the future if the boat ever requires emergency underwater repairs while afloat.

TO CLEAN OR NOT

When it comes to preparing a fiberglass boat for outside winter storage, the question often arises whether to clean it now or in the spring. The answer is largely a matter of preference.

A thorough washing and waxing at the end of the season helps to repel dirt during storage and provides added protection from the sun. Never use a heavy-duty cleaner, unless you're sure to follow it up with a wax or polish. Stronger cleaners, especially ones containing a degreaser, will strip off all the wax and protective sealants you've previously applied and expose the gelcoat. Storing a "bare" boat is an invitation for heavy oxidation and permanent stains. If you decide to wax your boat, be sure to also buff it right away as some waxes harden when left on and are difficult to remove.

Putting off cleaning until spring isn't necessarily bad, either. In the fall, use a mild boat soap to remove surface dirt without harming the wax underneath. This probably won't remove waterline scum, grease or rub marks, but it will give you a jump start on your spring cleaning next year. In freshwater, the algae and scum that accumulate below the waterline are often much easier to remove when they're left over the winter to die and dry out. Then in the spring, stains can be easily removed with a heavy-duty cleaner or one of the special hull cleaners sold for this purpose. These are acid based and remove stains with very little scrubbing — just brush or roll on the product, let stand for a few minutes and rinse with lots of fresh water.

TIPS

Unless your memory is better than mine, I strongly recommend you assign a storage place for all your loose boat parts. Package small items in envelopes or food containers and label all containers with an indelible marker. Then stow the lot in a box, bag or whatever, in a designated section of your basement or a storage locker.

DEEP FREEZE

Freezing temperatures can result in major damage and expensive repairs to your boat's water systems. Drain all water tanks, freshwater lines and filters, the hot water heater, bilge, sump and washdown pumps, head, cockpit shower, icemaker — every system where fresh water flows. Where you can't reach the equipment (a bilge pump, for example) or are unable to remove all the water (such as in the head), add a mixture of 50% antifreeze with 50% water and pump it through the system.

There are two types of antifreeze: propylene glycol (plumbing antifreeze), a non-toxic and biodegradable solution, and ethylene glycol or common automotive antifreeze. The latter is highly toxic, affecting pets, birds and animal life, and our water supply — as little as one teaspoon can be fatal. You can use ethylene glycol to winterize your engine, providing any overboard discharge is collected for disposal later, but never use it to winterize your freshwater plumbing system.

A more detailed discussion an types and uses of antifreeze appears in DIY 1998-#3

OFF-SEASON STORAGE

TO DO LIST

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

TAKE THE WORRY OUT OF WINTER STORAGE

For boats that are stored outside, we've compiled a list of routine checks you should perform in the fall or at regular intervals during the winter.

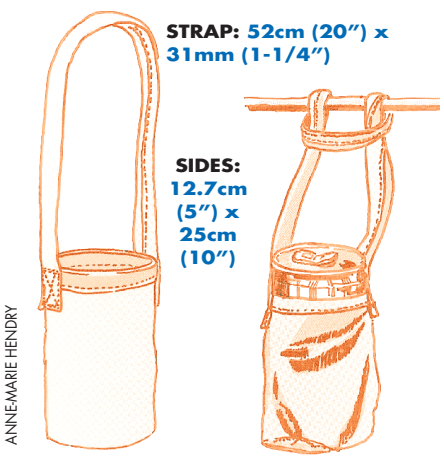
- As soon as the cold weather sets in, check that you haven't left any item on board that could freeze. Check that all cabin cupboards, lockers, drawers, access hatches, berth tops and floorboards are open to ensure adequate flow-through ventilation.
- Remove all absorbent materials that remain on board, such as cushions, rugs, blankets, books, charts and clothing. Such materials extract moisture from the air and quickly mildew. Chemical air driers using a silica gel or similar are worth the investment.
- If your boat is poorly ventilated and humidity is a problem, you'll need to dehumidify the air with an electric dehumidifier; you'll need to maintain a power source to the boat all winter. Once it's installed, close all vents and hatches or you'll be dehumidifying the outside air as well.
- Because of the risk of theft, strip the boat of everything that's "liftable."
- Check the condition of the boat cover. Look for chafing against the hull and damage to the fabric. Secure tiedowns if necessary and remove excess snow accumulation.
- Check the cradle, lateral shores and wedges for even distribution of the load and adjust them if necessary.
- Inspect jack stands periodically, as frost can alter their position.
- Turn the engine over a few times by hand to lubricate the bearings and cylinders.
- Operate the seacocks to prevent seizing.
- Turn the prop shaft at regular intervals.
- Check for ice damage to the cockpit and cabin.

DIY PROJECTS

BEVERAGE HOLDER

Boats never seem to have enough drink holders. They are often positioned out of reach on powerboats that do have them and sailboat builders have yet to discover that sailors also need a resting place for beverages. Here's a simple and effective drink holder that's also easy to make. Made of three pieces of weather-resistant lightweight canvas or acrylic, it's designed to hold cans, but you can also make it square to fit Tetra paks.

First, sew the side together with a 12mm (1/2") seam allowance. Turn under a double narrow hem on the top edge and stitch in place. Attach the round bottom, sewing a narrow seam. To make the strap, cut a piece of cloth 53cm long x 7.6cm wide (21" x 3") and press under a narrow hem along the ends and one edge. Fold the strap lengthwise so the folded edge lies over the cut edge and is positioned in the center.



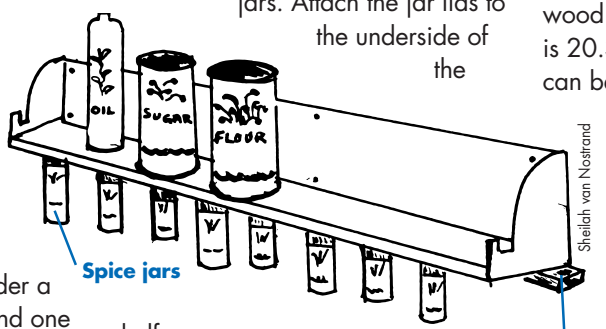
ANNE-MARIE HENDRY

Finished measurements are marked. You'll need to allow for hems and seam allowances.

Sew in place close to the folded edge. Lay the holder flat with the seam to the back and in the center, then mark the sides. Overlap the strap about 44mm (1.75") down the sides where you've made your marks; stitch the strap to the holder on both sides using a boxed "X" pattern. To hang the holder, fold the strap over a railing or lifeline and pass the holder through the middle.

A SPICEY IDEA

Here's a great way to store spice jars. Attach the jar lids to the underside of the shelf or a cupboard so the jars hang out of the way and don't take up precious shelf space. Before you install the lids, hold each jar in place with the lid screwed on tightly and the label facing out. Mark the lid front with tape or a marker so that when you screw on the jar, the label will face out. Hold it in position and drill two holes for #6 flathead screws; two fasteners stop the lids from spinning when you unscrew the jars.

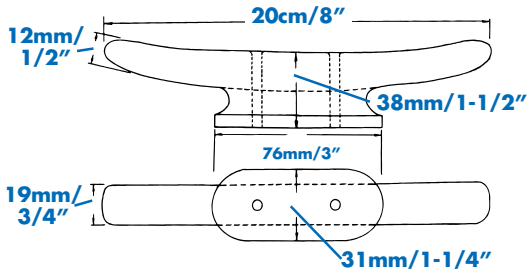


Sheilah van Nostrand

From Sheilah van Nostrand, Dream Catcher, *Keswick, Ont.*

MOORING CLEATS

Many boats are built with inadequate mooring cleats. Not only are there too few, but those supplied are not capable of handling heavy loads from anchor or tow lines. Marine stores sell large cleats made of metal or hardened plastic but these are extremely heavy. If you've got an afternoon to spare and are handy with woodworking tools, a better solution is to make a traditional hardwood cleat. The cleat in our diagram is 20.3cm (8") long, but the design can be adapted to make any size.



ANN-MARIE HENDRY

Find a scrap of 31mm (1-1/4") oak, mahogany or teak. Trace the cleat outline onto the wood and cut the shape with a band saw or fine saw, such as a coping saw. Finish off with a block plane, rasp or Sur-Form tool, round all edges, then sand.

Preserve the cleat with coats of oil (varnish wears off). Mount cleats with a polysulfide sealant and thru-bolt, using a backing plate or oversize washers under the deck to distribute the load. It's a good practice to angle the cleat a minimum of 10° to the direction of pull to prevent the line from jamming.

PREPARING FOR A KNOCKDOWN

Securing all horizontal hatches in the event of a knockdown was one of those nagging jobs that I kept meaning to do before we headed offshore.

Wind and or wave action can knock a boat over to the horizontal. No one wants to believe that this is going to happen, but statistically it is not unlikely, especially if you plan to cruise offshore, or like to sail with a full press of canvas (such as when you're racing or flying a spinnaker).

On *Two-Step*, we tried to envision what would happen inside the boat in a knockdown and prepare for it. With the boat on her side, we realized our biggest problem would be loose objects. All the hatches that are normally vertical, such as the lockers behind the settees, already have secure hatches, but the lids under the seats and all the floor hatches rely on gravity to keep them in place. I started a project to secure all hatches and locker lids to help keep the interior in order should we be knocked down.

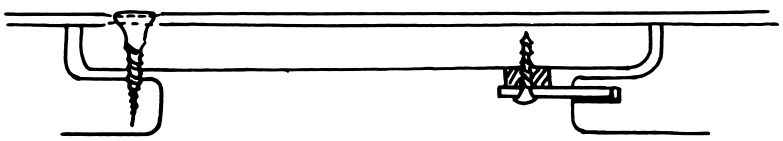
To secure the hatches under the settee cushions, I cut a long piece of 3mm (1/8") by 50mm (2") aluminum bar into turn buttons, 22mm (7/8") in length, with a countersunk hole in the middle for a 6mm (1/4") machine screw. For cutting the basic shapes, I used a saber saw with a typical medium-toothed blade and then a metal file to get nice round corners. In general, I find aluminum can be worked with wood-working tools. I applied Locktite on the threads before putting a washer and nut on the bottom, and left the nut a bit loose so that the latch could turn easily.

These hatches lift out entirely (they are not hinged) so I also had to hold the opposite side down. I accomplished this by using a similar aluminum tab that is securely fastened with two screws to the settee top. The hatch slides in under the fixed tab and then the turn button turns to hold the other side (Figure 1).

Figure 1

Anne-Marie Hendry

Figure 2



Hatches in the floors were held down at one end using an aluminum tab on the underside of one end. This is screwed in the floor and fits in a slot chiseled into the subfloor support (Figure 2). A wood filler block between the tab and the floor makes up the depth difference. There are numerous options to hold the other end in place. I decided my home-made turn buttons were not "showy" enough. For a couple of small hatches that are not opened very often, I just screwed the one end in place (the other has a tab). For the main hatches over the bilge, I used a latch that sits flush in the floor. Perko make some nice looking ones for this purpose (part #1032), and I'm sure there are also many other ways to do the job; it all depends on the type of hatches and the construction of the surrounding settees and floors.

I thought of this project as insurance. We naturally do all we can to avoid being knocked down, but if we ever are, we will not have the added confusion of locker contents spilled everywhere and the danger of floor hatches floating around in a treacherous interior.

From Paul Shard, Two-Step, *currently cruising in the Carolinas.*

ELECTRONICS

SMARTER CHARGING

Maximize battery life with a connect-and-forget, three-step charger.

As most boats spend more time at the dock than under way, to get optimum performance and longer life from your batteries they must be properly charged.

Until the "smart" charger, ferro-resonant chargers were the only option. Smaller, lighter and more efficient, smart chargers regulate output voltage and current while maintaining a constant voltage to the battery regardless of load variations. You just plug in the alternating-current (AC) cord or connect the charger to a generator and forget it.

Our discussion begins with a look at how batteries function — the very first step in understanding the ins and outs of battery charging.

Battery Basics

There are two kinds of batteries, the flooded-cell battery (also known as lead acid) and the sealed gel cell. Flooded-cell batteries consist of a lead antimony plate grid construction. Antimony gives the plate strength, but also causes a battery to self discharge. A standing (no loads) flooded-cell battery begins to discharge after about two days. When a flooded-cell battery discharges, its plates are progressively converted to lead sulfate which, when recharged, converts back to the original mixture of lead, lead oxide and sulfuric acid.

The more expensive gel-cell batteries have a gelled electrolyte and lead calcium plates, and the fact that they are sealed to prevent hydrogen gas emissions is particularly desirable on boats. They are especially suited for applications in which a boat has no access to dockside power; gel-cell batteries can take a higher rate of charge, their charge absorption rate is twice that of a flooded cell and they self discharge much more slowly; a gel cell can stand for months before needing to be recharged. Gel cells are about 50% more expensive than flooded-cell batteries, however, and won't last as long as flooded-cell batteries unless careful charging procedures are adhered to.

Most flooded-cell batteries have a specific gravity (SG) of 1.265. When a 12-volt battery has been standing for 24 hours, without any loads, its fully charged voltage reads 12.7 volts. This is known as the open cell voltage (OCV). Above 12.7, the battery is charging; below 12.7 it's discharging. In order for a battery to accept current, it needs .5 volts potential over the OCV, or 13.2 volts. No battery will accept charge at a decent rate until it's up to 13.5 volts.

You can force a battery to be charged by quickly raising the voltage. Though this is an acceptable charging practice, forcing a battery to take current at a greater rate creates excessive heat. When high voltage continues for an extended period, flooded-cell batteries begin to bubble. (The gelled solution in a sealed battery doesn't bubble; heat permanently damages the battery.) Ideally, a charger should raise the voltage to the point where the battery begins to accept charge at a rapid rate and then the charger drops the voltage.

As lights and bilge pumps switch on and off, a battery must be maintained at a sufficient voltage to accept a small amount of current to replace its natural tendency to discharge. This is known as floating a battery — maintaining a constant voltage regardless of load variations or AC power fluctuations. For flooded-cell batteries, the constant or float voltage is 13.2 to 13.5 volts. Gel-cell batteries are typically floated not much higher than OCV.

Out With The Old

Comparing the performance of conventional ferro-resonant chargers to smart chargers is like comparing carbureted fuel systems to electronic fuel ignition.

Battery chargers rectify AC current to direct current (DC). This is done via either electronic check valves or switches, and is controlled by a transformer or electronic circuit boards. The traditional ferro-resonant chargers (also referred to as taper chargers) have been around for many years. They output current to a given voltage in a two-step charging cycle. As battery voltage increases, current from the charger decreases. When ferro-resonant units finish charging at 13.8 volts, current has "tapered" to a trickle of amps. They do this so as not to overheat the battery but, as a trade-off, it takes a week or longer to fully charge a battery. Ferro-resonant chargers usually float-charge a battery at a high 13.6 to 13.8 volts which is very close to a flooded-cell battery's bubbling point. These chargers only deliver 65% of their rated output; a 35-amp unit, for example, outputs a maximum of 20

amps, yet costs as much or more than a comparable smart charger.

A "smart" charger is a liberal term for any charger with a regulator. Some have transformers while newer high-tech units are electronic and are often referred to as switch-mode or high-frequency chargers. A microprocessor-controlled regulator controls the output voltage and current of the charger. Add DC loads and smart chargers increase output to replace voltage consumed by the batteries. When you turn off your lights, refrigerator or TV, for example, the battery voltage will still be exactly where it was before the battery was loaded. Inverter/chargers with "smart" technology have magnetic-type transformers and do double duty: They provide AC power from the house battery to power appliances, and output DC power to charge the battery.

Smart Charging

Modern smart chargers and inverter/chargers are switching devices that utilize a three-step charging cycle to charge batteries quickly and safely.

The process starts with a bulk charge, a high-amperage output for a short period to rapidly boost battery voltage. This step replaces 70% to 80% of the battery's capacity.

When the battery reaches the second stage, known as absorption voltage, the charging current is steadily dropped while battery voltage is maintained. This stage typically outputs 14.2 to 14.4 volts, until the battery arrives at a 95% charge state. When this happens, the charger again shifts gears, dropping to a float-charge cycle of about 13.2 volts. This three-step cycle maintains the batteries indefinitely without damage, regardless of load, AC changes or frequency changes when the charger is hooked to a generator.

A fourth and separate cycle on some smart chargers is an equalization charge that is initiated manually. Flooded-cell batteries that have been float charged for long periods develop a condition where cells charge unequally and must be periodically equalized. (This step is not recommended for sealed batteries or you'll void the manufacturer's warranty which limits the charge to around 14.1 volts.) As we've already learned, fully charging a battery converts the sulfate back into electrolyte. When float charging, sulfate becomes stubborn and, if a battery stands (no loads) for six to eight weeks, the sulfate hardens and crystalizes. Recharging will not remove it and capacity is reduced significantly. This can be prevented by equalizing which, ideally, should be done every two months.

The voltage level at which a charger should equalize is a point of contention. According to Ron Smith of RSI Marine Services, a Seattle-based firm specializing in custom electronic installations on mega yachts and commercial fleets, the industry standard equalizes the cells at 2.35 to 2.4 volts per cell, or 14.1 volts for a 12-volt system, 28.2 for a 24-volt system. Other electronic installers, however, maintain that an effective equalization voltage must be 15 to 16 volts and point out that some chargers "kick start" batteries with this higher voltage for up to eight hours. While kickstarting quickly raises voltage, it also creates more heat which may permanently damage the batteries. McCarron chargers and some other brands are built with a maxi-

The "smarter" choice: (Left to right) Heart Freedom inverter charger, Vetus inverter charger, Statpower Truecharge 20, McCarron VMI, Newmar PhD-25, Charles 5000 and Trace M1512 inverter charger.

mum output voltage of 15 volts. Equalizing the cells at a lower voltage takes longer, as much as 24 hours, but does less damage to batteries.

Smith recommends that when charging above 15 volts, you'll need to unplug onboard electronics. The power supply in most electronics, such as VHF radios, stereos and GPS units, are normally regulated at 15 volts maximum. Higher voltages may blow the circuits.

Crank Up The Volts

The desire to replenish lost voltage as fast as possible has put tremendous demands on charger manufacturers. Boaters expect that one hour running a generator or short stints hooked to shorepower should be sufficient to maintain battery efficiency. Because a battery or battery bank dictates the rate at which it will take current, based on the voltage output from the charger, the only way to charge faster — that is, to force current into the battery — is to raise the voltage.

As voltage increases, charging times diminish. Take a 100 amp-hour-rated battery, for example, that's discharged to 70 amps. Connect it to a 20 amp-rated charger to raise the battery capacity from 70% to 95%

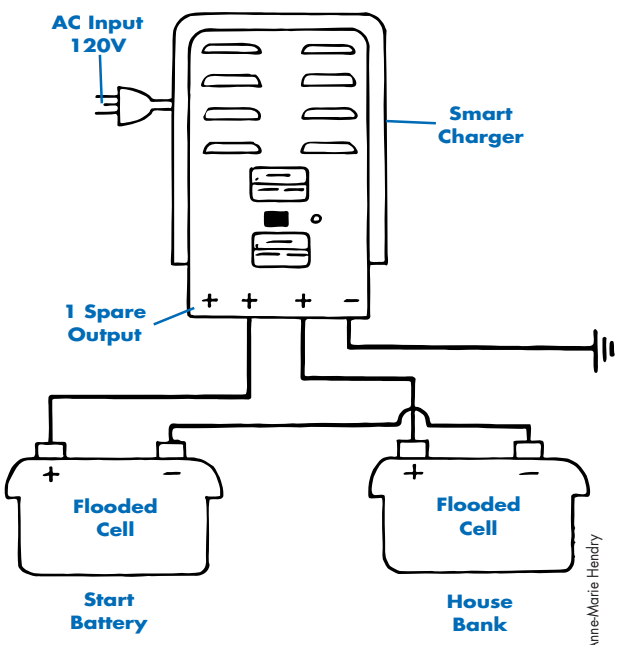


Figure 1

On a typical multi-output installation with minimal power requirements, banks connect directly to the charger.

ELECTRONICS

and add 25 amps. (Because of battery resistance, getting the last 5% or 5 amps in a battery takes a very long time, regardless of the size of the charger, and those last few amps are generally ignored.) With the output voltage of the charger regulated at 13 volts, charging would take 56 hours. Raising the output voltage of the charger to 13.5 volts reduces charging time to 5 hours. At 14 volts charging takes 4 hours, and at 14.5 volts you shave off another 10 minutes.

Selection

Many companies — including, Charging Systems, Charles Marine, Guest, McCarron (formerly Ratelco), Newmar, Statpower, Professional Mariner, Vetus and others — supply a wide range of smart chargers for marine use. These chargers are permanently installed, hard-wired to one or more batteries. Portable units from Guest and Deltona (SuperSmart) connect to the battery with alligator clips. An inexpensive option for small runabouts, daysailers and personal watercraft, such units are designed for recharging batteries only and should only be used in a well-ventilated area or off the boat to avoid the risk of an explosion.

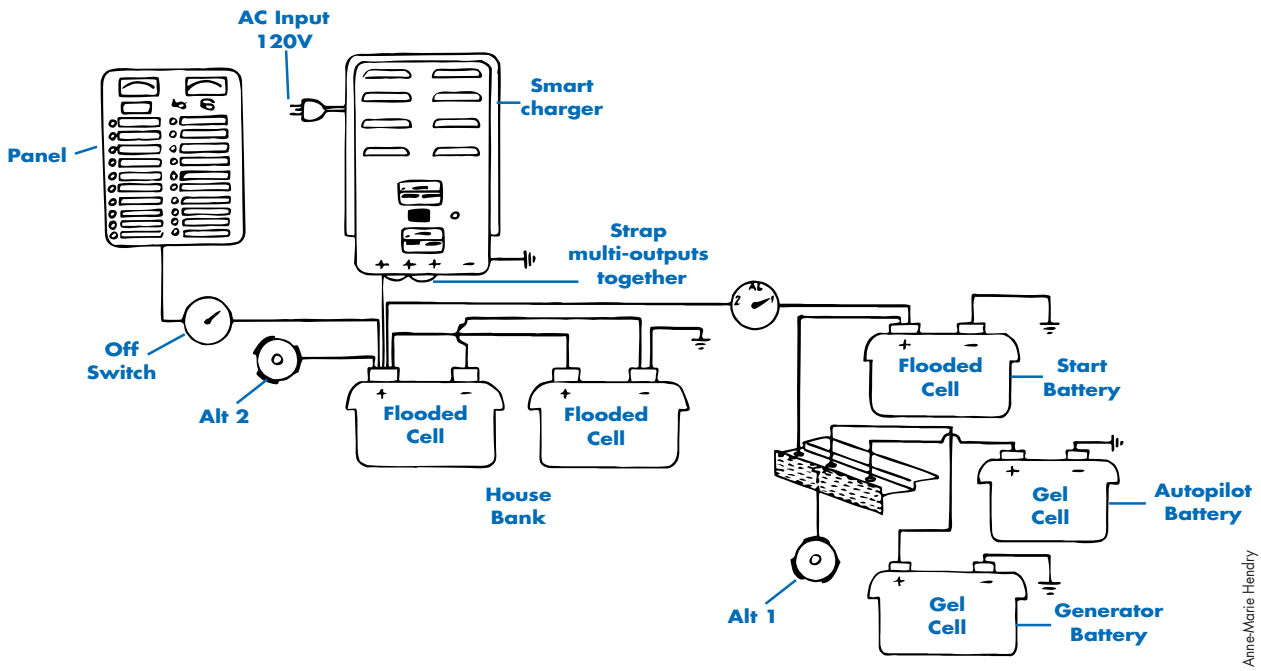


Figure 2

A model installation currently employed on a midsize Tollycraft or Ocean Alexander, the multi-outputs are strapped together and the charger connects only to the house bank.

Desirable features on smart chargers include reverse polarity protection, adjustable voltage settings, charge indicator meters or lights, noiseless operation (see *Interference* below), and over-voltage and over-heat protection. Units installed in the bilge area, battery

compartment, and engine areas containing gasoline-powered machinery or gasoline fuel tanks or near other explosive vapors must be ignition protected (an Amercan Boat & Yacht Council standard). Charles Marine chargers are the only units that are UL approved, meaning they meet minimum vibration, shock and safety requirements.

Smart chargers are preset to output at a given voltage and most high-end units have some way of manually adjusting the charge, float and equalization output voltage to the battery bank. A switch on some units lets you select for either flooded- or gel-cell batteries. (It's not a good idea to mix the two). Others are dedicated units accommodating only one battery type. Statpower's Truecharge line also features a "top up" function; every 21 days it automatically checks the batteries and runs any part of the charge cycle as needed. Switch-mode chargers rely on fans for cooling and some better units have an alarm in case the fan fails.

Before shopping for a battery charger, you must first calculate the average DC load in amps on your battery when charging and when not charging. (See the FALL '95 issue for the formula for calculating DC loads.) For example, a 40-amp continuous-duty rated charger (see *The Ratings Game* below), adjusted to output at 13.2 volts on float mode, will maintain batteries at a fully charged state when the DC load equals 40 amps while charging is taking place. Should the load increase to 42 amps, the charger must borrow 2 amps from the batteries. To maximize battery life, select a charger that is equal to the average DC load plus another 10% or 20% of the load. When AC power is only available occasionally, then you should also know how much time the charger takes to recharge the batteries after operating DC loads, allowing for the DC loads when charging.

The Ratings Game

Not all smart chargers are created equal. And since there are no rating standards, amperage ratings vary by manufacturer. Certain chargers are rated on intermittent duty, some on continuous duty, and others don't publish a rating at all.

Some chargers only deliver their full rated current for a short time at the beginning of the charge cycle. When they get too hot or when shifting voltages, these chargers go into a cool-down phase, rapidly decreasing output to about 50% for extended periods. In this case, a charger with an intermittent-duty rating of 100 amps is actually only outputting 50 amps. Conversely, a 40-amp continuous-duty rated charger is capable of putting out a maximum of 40 amps at a given temperature for most of the charging cycle. Look closely at a charger's specifications and, if it's not listed, ask the supplier for the continuous-

duty rating. Inverters are usually continuous-duty rated in watts (watts divided by volts equals amps).

Interference

Most smart chargers are filtered to varying degrees of success against electrical and mechanical noise. Switch-mode chargers that switch on-off very fast usually make more noise.

RFI or radio frequency interference is transmitted through the air and interferes with radios and stereos. EMI or electromagnetic interference is the noise radiated though the power line and the boat's wiring. Most noise will occur or increase during the bulk-charge cycle.

Other interference is caused by AC ripple. When a charger rectifies AC into DC, some of the AC passes on through to the DC line. This is known as AC ripple and is measured in millivolts (1,000th of a volt). RSI Marine Services' Ron Smith suggests that most unfiltered, high-frequency "noisy" chargers and inverter chargers have between 500 millivolts and 1 volt of ripple. Higher-end chargers, such as the McCarron series, are filtered to better than 300 millivolts of ripple. (In comparison, communications equipment is often filtered to .27 millivolts.) Ripple causes battery plates to overheat, a condition that is more injurious to gel-cell batteries. Because of this, Smith recommends that sealed batteries not be used with high-frequency or inverter chargers. As most manufacturers do not publish ripple values, you'll have to ask.

Hook Up

Installations vary depending on your power requirements. In a typical, multi-output installation with minimal requirements, each bank connects directly to the charger (**Figure 1**). In a more power-hungry installation, the multi-outputs are strapped together and the charger connects only to the house bank (**Figure 2**) which runs the electronics, lights and so on. The master switch is normally left in the "1" position and the start battery starts both engines. Two sealed batteries operate the autopilot and generator and are charged only off the alternator

on the starboard engine. In the event of an engine failure — if an alternator belt breaks, for example — the master switch is placed in the "2" position to start the engines off the house bank, or to the "All" position to start the engines off the house bank and start battery. The generator can be turned on when additional charging power is needed.

Banks are connected in parallel — connecting all positive terminals and negative terminals. This increases amp-hour capacity but not the voltage. Two 12-volt, 100-amp-hour rated batteries connected in parallel operate as one bank delivering 200 amp-hour capacity. (In a series connection, one positive battery terminal connects to the negative terminal of the next battery, increasing voltage but not the amp hours.) As chargers can only be adjusted to one float voltage setting, the multi-bank outputs should not be used to charge banks where the batteries are of different types (flooded or gel cell).

Problems occur in a parallel connection when one battery is weaker than the others or not of equal size. (Always use batteries of the same amperage capacity — for example, two, 200-amp batteries.) The battery with the lowest resistance determines the output of the charging cycles. A manual selector switch installed between the house and starting banks eliminates this problem. During a lay-up period, the switch is put in the "All" position, after all batteries are fully charged.

The Cost

Units range from CDN$249/ US$190 for a 5-amp, two- bank charger to CDN$1,000/US$1,500 and higher for a 50-amp, three-bank unit. Inverter chargers from Heart Interface and Trace Engineering connect to one or two batteries and start at CDN$1,000 /US$750.

Smart chargers are expensive, but the money saved when you don't have to replace batteries will more than repay your investment in the long run.

Many thanks to Ron Smith of RSI Marine Services, a marine electronics firm based in Seattle, Wash., for assistance with this article.

BATTERY FITNESS

Specific gravity (SG) readings taken with a hydrometer are often misleading if not interpreted correctly. The heavier the electrolyte the higher the state of charge. In a healthy battery, all cells will typically have an SG of 1.265, meaning the electrolyte weighs 1.265 times more than pure water. A difference between cells of up to .03 calls for an equalization charge. A difference of .05 or more indicates an unfit battery. Incorrect SG readings are often caused by an inaccurate hydrometer or not correcting for the temperature of the electrolyte; before taking an SG reading, there must be no load (charge or discharge) on the battery for 24 hours. Readings must also be taken before adding water. Always wear gloves and protective eye wear when using a hydrometer.

TAKE CONTROL

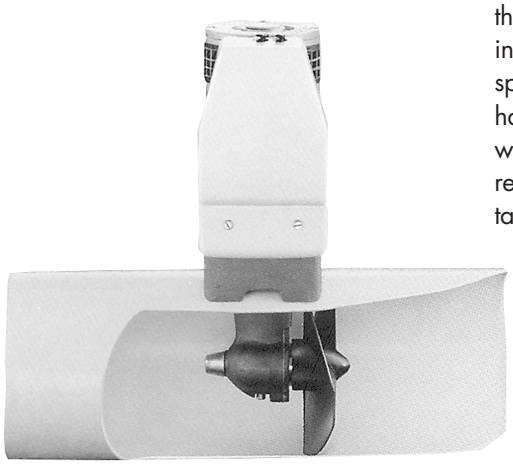
A bow thruster is the perfect remedy for maneuvering in close quarters.

By Nick Bailey

Maneuvering in harbors, marinas, narrow channels or crowded locks or docking in tight quarters can be extremely demanding, particularly when the wind and current are against you.

A bow thruster counteracts the tendency of a boat's bow to "blow off" as it allows direct lateral control. A propeller mounted in a tunnel in the bow section (or installed in the aft end as a stern thruster) is driven by an auxiliary motor. This produces side thrust that swings the bow. Simply pressing a button or moving a joystick moves the bow of a boat sideways to either port or starboard, and rotates the boat 360° within its own length.

When you need an extra "shove" at the bow, a thruster gives you complete control — it's the next best thing to having someone on the dock with your bow docklines in hand. Usually reserved for larger power yachts, bow thrusters work equally well on sailboats.



The 7-hp Side-Power Twin combines top performance with easy installation and fits in a compact space.

Performance Considerations

Power The most typical powerboat handling problem is docking with the wind direction anywhere from abeam to dead ahead. As the vessel slows for docking, the bow's resistance to lateral forces decreases and, at the same time, rudder effectiveness drops off, particularly with the small rudders designed for planing speeds. This means that at slow speeds, because most powerboats have their center of wind resistance well forward of their center of lateral resistance, the bow will act like the tail feathers of a wind vane and want to swing away from the dock downwind — out of control.

This is the most common cause of minor docking accidents. An experienced operator, especially with the added leverage of twin engines, can control this tendency by "walking" the boat into the slip. But on a windy, gusty day, even the best drivers often prefer to back into the wind while docking.

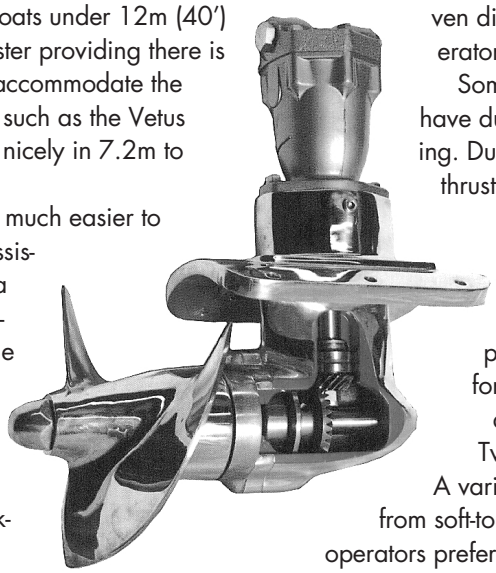
Where the classic bow thruster installation makes the biggest difference in handling is in the single-engine displacement power vessel. These boats usually have tall super-

structures that tend to catch the wind. A deep, roomy forefoot provides an ideal location for thruster installation. Monk, Grand Banks, Krogan, Oceanis and Sealord trawler-style motor yachts 9m (30') and larger, for example, are often fitted with bow thrusters.

Even owners of light planing boats under 12m (40') on the waterline can fit a bow thruster providing there is enough of the bow underwater to accommodate the thruster tunnel. A compact thruster, such as the Vetus 23kgf with 12.7cm (5") tunnel, fits nicely in 7.2m to 7.8m (24' to 26') boats.

Sail Larger sailboats are also much easier to handle in close quarters with the assistance of a bow thruster. Combine a traditional full-keel hull with a small-horsepower (hp), single-prop engine and the wind resistance of a mast and furled headsail plus the crew on the foredeck, and you have a boat that may not go where you want it to when docking in a breeze.

Sometimes the problem is less that the bow blows downwind than the lack of close-in maneuverability of this type of boat. Once again, a skilled driver can manage, but a thruster makes it easy. For example, the Whitby 42, C & C Landfall 43 and 48 and any cruising sailboat over 15m (50') are good candidates for a bow thruster. Small, compact thrusters are the preferred choice for the bulk of sailboat applications.



Easy-to-service motors on Keypower hydraulic thrusters are completely contained in the hull which prevents contamination of the hydraulic fluid with seawater.

Components

Almost all thrusters share the common design feature of a propeller or dual props mounted in a tunnel that runs athwartships below the waterline as far forward in the bow section (or aft in the stern in some cases) as possible. Props are gear- or belt-driven by a motor mounted on the outside of the tunnel inside the boat.

One different approach is to have the thruster prop assembly retract behind a flush-mounted panel in the bow. Hydra-Power Systems and Lewmar (formerly sold under the Richfield brand) both offer retractable types for serious bucks. While the thruster in the raised position gives a completely clean, fair hull section with minimal drag, retractable electric units should have a manual backup for lifting the unit when there's a power failure. Some Lewmar models also articulate; when mounted at the stern, the thruster turns to propel you home should the main engine fail. Retractable thrusters must be installed during boat construction as they are virtually impossible to retrofit.

Units range in power from 2 hp with a 12.7cm (5") tunnel up to very large units of 200-plus hp in a 91cm (36") tunnel for mega yachts. Power is either hydraulic or electric up to about 10 hp and typically only hydraulic above 10 hp; large models for ships are often driven directly by a separate engine or generator.

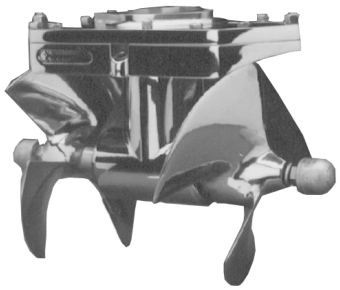
Some models use single props; many have dual props, preferably counter-rotating. Dual props produce marginally more thrust per input horsepower than single prop thrusters. Provided the props are perfectly matched and counter-rotating, dual props have the advantage of equal thrust port and starboard, and more thrust for a given tube size — up to 50 hp in a 20cm (8") tube on Shipwrights Twin Prop thruster.

A variety of control configurations exist from soft-touch keypads to big joysticks. Many operators prefer the "eyes of the boat" feel of joystick control but care must be taken not to "bang shift" — instantly change the drive from

TAKE CONTROL

one direction to the other without pausing — because you may shear the pin. Some joysticks can be set up with a timed delay to prevent sudden changes. Most thrusters can be installed with more than one control station (at both the main helm and flybridge, for example).

Tunnels are made of fiberglass, steel or aluminum (for aluminum boats). It may seem as if the athwartships hole in the bow would create a lot of drag but, in reality, with smaller thrusters drag is not really noticeable and probably would only be of concern on a racing sailboat.



Shipwrights Twin Prop 50-hp thruster delivers greater thrust in a small 20cm (8") diameter tunnel.

Before buying a thruster, you must first verify that there is sufficient room in the forepeak to fit the tunnel and the drive motor which can be installed either horizontally or vertically, and that the forefoot is deep enough to allow the unit to be mounted far enough forward to have effective leverage. Some hydraulic units like the Bow-Power from Marine Hardware mount at virtually any angle — a bonus where interior space is restricted.

Servicing of all units is made easier if the engine, pump and other components are serviceable from inside while the boat is in the water.

Electric vs hydraulic

Electric units are simple to install and can operate independently of the engines. Most of the large electric units are protected from burnout, but these are not designed for continuous duty and will need to cool off after a few minutes of constant use. (Most docking situations only require brief thruster use anyway.) Large-gauge cable runs through the boat, or a separate thruster battery is installed forward (and can do double duty for the windlass). Cables that connect to a forward battery must be of adequate size to prevent a critical loss of charging voltage. (See Wiring Handbook in the WINTER '95 issue.)

Hydraulic installations are more complex and can take some time to set up and de-bug. Power takeoff brackets for the pump are mounted on the engine, solenoid control valves setup and hoses run through the boat. If the boat already has an existing hydraulic power system for winches, windlasses, davits and so on, then you are already halfway there. Remember, though, if the engine driving the pump stalls, so too does your thruster. A boat with twin engines is better — one engine drives the thruster at adequate rpm while the other engine powers the boat at lower rpm. In situations when prolonged use of the thruster is required or where thrust requirements exceed 180kg (396lb), an hydraulic system should be considered.

Driving Force

Thruster performance depends on a boat's displacement, the shape of the underwater section and height of the superstructure. Heavier boats and those with high superstructures, such as houseboats or flybridge cruisers that are susceptible to side winds, obviously require more power.

Efficiency also depends on the positioning and rating of the thruster and the size of the tunnel. Thruster manufacturers define efficiency by hp and/or thrust.

Horsepower is the capacity of a motor, rated in hp or kW and, as such, is not directly related to the ultimate output of the thruster. Thrust is the force required to move the bow sideways, measured in pounds or kg (1 kg equals 2.2 lb. of thrust). It factors in the capacity of the motor; the shape, dimension and number of revolutions of the propeller; and the tunnel length and depth of immersion as well as power losses in the tunnel. Most recreational boats use tunnels, 12.7cm to 30cm (5" to 12") in diameter with 3 to 20 hp, producing thrust in the 25kg to 160kg (55lb to 352lb) range.

Though thrust is a more accurate measurement of a thruster's performance than hp, it's still a theoretical rating. Some manufacturers (Lewmar is one) supply actual load ratings under controlled conditions, known as bollard tests. Such tests provide the true rating of the amount of thrust, measured in pounds per hp of a thruster when placed under load.

When comparing units, look at output relative to tunnel size. The smaller the tunnel, the better the leverage with minimal drag. Ideally, you want the biggest push from the smallest tunnel. Small tunnels reduce hydrodynamic drag and allow for the farthest forward positioning, a bonus for shallower-draft hulls.

Lewmar's all-new lightweight 200 TAE is bollard test-rated at 14 to 20 pounds per hp.

Installation

Installation of electric units is fairly simple; the problem is in installing the tunnel. It must be positioned as far forward and as deep as possible, allowing for adequate tunnel length. It must also be immersed for at least half of its diameter or it will suck air, cavitate and lose effective thrust. On planing powerboats, the tunnel must clear the water when the bow rises. Avoid any installation that will subject the motor to water dripping down the hawseholes or to ground tackle.

Measure the bow carefully to ensure the tunnel will fit, then order your thruster complete with tunnel and controls. You might want to install the tunnel in the fall after haulout, then leave the mounting of the mechanical and electrical components until spring.

Read all instructions carefully before starting. If you have any doubts, contact the supplier or a professional

TAKE CONTROL

installer. Following the instructions for tunnel installation, carefully measure and remeasure to the exact center of the tunnel on both sides. The tunnel must be positioned parallel to the boat's waterline and perpendicular to the boat's centerline. On fiberglass boats, drill a pilot hole through the hull at each center point. Slide a rod through the holes and check the positioning. Using a compass or other scribing tool, mark the outside diameter of the tunnel on each side. Cut the tunnel opening using a jig saw. Dry-fit the tunnel and fiberglass on the inside, trim to fit, then glass on the outside (or weld the tunnel in place if you have a metal hull) using the normal structural fiberglass procedures. (If structural integrity of the hull is suspect, have a professional install the tunnel.) Cut the drive mount hole in the tunnel, secure and seal the drive on the tunnel inside the boat and install the prop(s).

On installations close to the waterline, an optional protective grill can be installed to prevent flotsam from fouling and breaking the prop or shearing the pin. Grills, however, reduce efficiency of the unit and may even generate more drag than an open tunnel. (Lewmar units substitute a cush-drive that stops the prop in the event of a blockage.)

Wiring is straightforward. First, check what cable size is required for the anticipated amperage (250 to 500 amps DC) over the planned length of the cable. (A separate battery forward, as described above, is a viable option.) Small 12V DC electric thrusters (4 hp) require a minimum battery capacity of 100 amp hours (a typical 27 series starting battery); a midsize 7-hp thruster demands 150-amp-hour capacity (4D size) battery as a minimum. Electric units larger than this typically require a 24-volt DC system and two 4D-size batteries in series (one battery positive terminal connects to the negative terminal of the other battery).

The Vetus 23kgf fits in a 12.7cm (5") tunnel — ideal for boats in the under-9m (30') range.

Complete all power wiring neatly and provide a fuse or breaker of adequate capacity. Then mount and wire the controls in the appropriate location near the main engine controls.

The typical electrical thruster installation will take a professional yard three to five days, depending on the number of control stations, difficulty of wiring routes, number of extra batteries required and so on. For example: one day for tunnel installation; 1-1/2 days for basic DC wiring including soldered cable ends; one to 1-1/2 days for controls and control wiring; and a half day reserved for glitches. A larger thruster requiring structural mods and 24-DC electrics or any hydraulic thruster takes longer.

Hydraulic installations are more complex and involve mounting the hydraulic pump, installing the hoses, wiring and solenoid valve and filling the system with oil and bleeding it. Check the installation instructions carefully before you start; options vary depending on the application and the manufacturer can help design the proper setup.

Operation

Make sure the gear box oil is topped up, launch the boat and test the unit — do your test in open water away from other craft. With a push-button system, push the red (port) button to turn the bow to port; the green button moves the bow to starboard. With a joystick control, you move the stick in the direction you want the bow to move. Depending on the sideways speed, the boat may continue to move after you release the control. A typical thruster operation lasts five to 20 seconds, depending on the water and wind conditions; practice in different wind and current conditions to get used to the timing.

Thrusters are an expensive upgrade but also an investment that adds value to your boat. The more complex the unit you choose, the greater the cost. But most boats bigger than 12m (40') are better off with a bow thruster. You may not use one very often, but when you need to, there's no substitute.

Nick Bailey has been in the marine service profession for more than 20 years and currently is service manager of Bristol Marine in Mississauga, Ont.

TYPICAL INSTALLATION COST

The following shows the cost to professionally install a 4 hp Side-Power thruster in a 10.8 (36') fiberglass trawler with dual-station controls using existing batteries. Prices listed are in Canadian dollars.

4-hp thruster	$3,456
Joystick controls	480
Electronic control box	260
Fiberglass tunnel	220
300-amp fuse and holder	140
Cabling and misc. material	362
Labor	
24 to 40 hours	
@ $65 per hour	$1,560 to $2,600
Sublet	
Haulout, block,	558
Launch at commercial marina	
Total	$7,036 to $8,076
	(plus applicable taxes)

Note: Sailboat installation costs about the same, less $240 for one control.

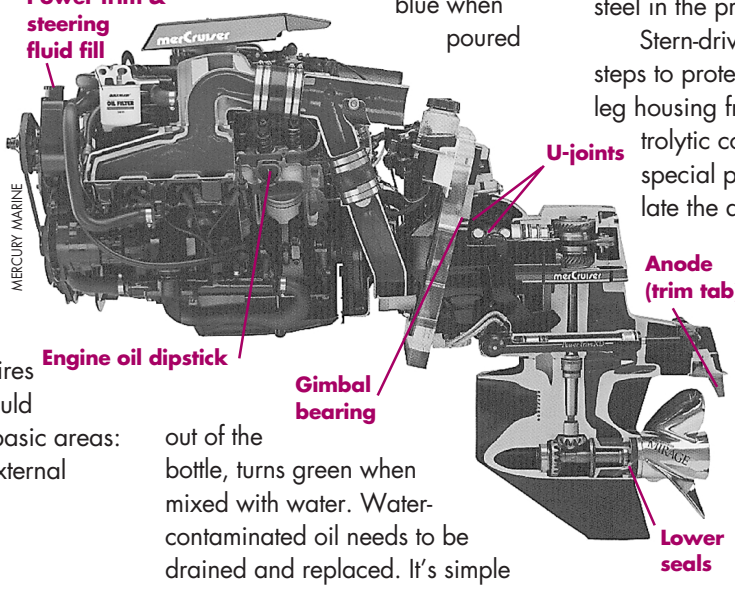
ENGINE
TROUBLESHOOTING

A LEG UP ON MAINTENANCE

Stern drive outboard legs require special attention.

By Phil Friedman

A stern-drive propulsion unit has its drive-leg sub-system outside the boat, where water tries constantly to work its way past the propeller shaft seal into the lower gears, and where galvanic and electrolytic corrosion do their best to attack the outboard leg housing and associated external components. So, while engine maintenance for a stern-drive installation is exactly the same as for a comparable straight inboard setup, the stern drive's outboard leg requires special attention. You should concentrate on two very basic areas: internal lubrication and external corrosion.



Oil Changes

With respect to internal lubrication, regular checking and changing of the gear oil in the outdrive leg is what it's all about. In the first place, oil can work its way out past the lower shaft seal(s), so a sharp eye is needed to guard against excessively low levels and ensure that oil is added as required. (Be careful, however, not to overfill, and to drain off any excess.)

In the second place, small amounts of water can work past those same seals. This can degrade the oil's lubricating properties and lead to accelerated wear. As well, in such cases there is the danger that small pockets of water, which have not emulsified, will displace the oil between the mating surfaces on gears and bearings, resulting in a lack of lubrication and severe local damage at those spots. Consequently, when checking oil levels, you should also watch for signs of water contamination.

Water contamination shows up as "milky" gray streaks in regular oil, and occasionally as an overall milky condition. High-performance gear oil, which is blue when poured out of the bottle, turns green when mixed with water. Water-contaminated oil needs to be drained and replaced. It's simple enough; just follow the instructions in your owner's manual. But remember, if you repeatedly find water in the oil, your lower seals need to be checked and possibly (or probably) replaced.

Corrosion Protection

As for external corrosion, the critical factor is that the outdrive-leg housing is an aluminum alloy casting and as such, is potentially the target of galvanic and electrolytic corrosion.

Galvanic and electrolytic corrosion occurs when a natural "battery" is formed by connecting in circuit two metals of differing natural electrical potential (aluminum and bronze, for example) and immersing them in an electrolyte (a current-carrying liquid). In such circumstances, the metal with the higher electrical potential or voltage, the "anode," is literally eaten away by the metal with the lower potential, the "cathode." Unfortunately, the cast aluminum of a stern-drive-leg housing has a high natural electrical potential compared to most other marine metals, and therefore is usually in an "anodic" position relative to, say, the stainless steel in the propeller or shaft.

Stern-drive manufacturers take steps to protect the aluminum drive-leg housing from galvanic and electrolytic corrosion by applying special paint coatings that insulate the aluminum casting from the surrounding water (the electrolyte). Manufacturers also attach sacrificial anodes (usually zinc, which has an even higher natural voltage than aluminum) to place the aluminum in a cathodic (non-corroding) position in any galvanic circuit. And in some cases, a stern-drive installation may incorporate impressed-current cath-odic anti-corrosion systems, such as Quicksilver's MerCathode system, to "block" destructive galvanic and electrolytic currents. The first step in stern-drive maintenance is, therefore, to ensure that all such protective systems remain fully functional.

The insulating coatings are fully effective only if they remain intact. Once paint is abraded or otherwise damaged in even a small area (for example, where you dragged the

TIPS

ANODE-DOTES

When the engine's sacrificial anodes are not deteriorating at all, check to see that they're installed correctly. Anodes need proper electrical contact with the aluminum housing and they must be left unpainted and unwaxed so as not to interfere with their contact with the surrounding water.

bottom of the drive leg through a sand bar) the exposed aluminum will start to corrode. Worse, the corrosion formed on aluminum has a nasty habit of "creeping" under and lifting the surrounding coatings. This creeping will lead eventually to failure of large areas of the protective coating. Thus, what started as a small paint breach on a drive-leg housing can quickly lead to serious corrosion if it's left uncorrected.

Some stern-drive manufacturers offer special waxes that enhance the longevity of the protective paint. And most manufacturers also offer special touch-up kits for repairing and maintaining the integrity of paint coatings. These are economical and easy to use, so there's no excuse for not to attending to paint breaches on a regular and timely basis. It's also a big mistake to fail to regularly replace sacrificial (zinc) anodes, especially if your boat is wet-moored in salt water. The trim tab on a MerCruiser engine doubles as an anode; OMC Cobra and Volvo Penta have a horseshoe-shaped anode mounted on the front of the outdrive.

Frequent Care

Beyond assuring proper internal lubrication and maintaining exterior anti-corrosion coatings and sacrificial anodes, there are a number of other steps a conscientious owner or operator can take to maintain the drive leg. For example, if you cruise in salt water and your boat is dry-moored (racked or on a lift) between uses, it's a big help to rinse the entire exterior of the drive-leg assembly with fresh water every time it's used (in addition to any internal freshwater flushing you do). Freshwater rinsing helps remove salt and other contaminants from corrodible surfaces, crevices, and joints, thereby preventing accelerated corrosion.

It's also a good idea to remove the propeller and recoat the splined shaft with water-resistant grease at least once a season, or twice a year. This helps avoid the damage that invariably occurs to the prop shaft and seals when you or a mechanic have to hammer off a seized propeller.

You should cycle the trim/tilt system frequently. Here's how: Raise the outdrive leg to its full-up position, then lower it to its full-down position. Do this two or three times to bleed the system and keep the hydraulic cylinder rams lubricated. Remember, when you store the boat, to return the tilt/trim system to a position that keeps the hydraulic rams fully retracted in their cylinders. This assures regular lubrication of the stainless steel shafts of the hydraulic rams. Indeed, if you're leaving your boat for an extended time, you should coat any exposed ram shafts with water-resis-

RECOMMENDED BASIC STERN DRIVE MAINTENANCE

In all cases, refer to your owner's manual for manufacturer's recommendations, procedures and preferred products.

TASK	FREQUENCY
Check Level: engine crankcase oil	Before each use
Check Level: closed-cooling coolant	Weekly
Check Level & Condition: drive-leg oil	Weekly
Check Level: power-steering fluid [1]	Weekly
Check Level: power-trim pump oil [1]	Weekly
Cycle power trim	Weekly
Check water pickups for growth/debris	Weekly
Check battery condition & electrolyte levels	Weekly
Check Condition: sacrificial anodes	Weekly
Check Condition: drive-leg protective paint	Weekly
Check & Lubricate: linkage pivot pins[3]	Monthly
Lubricate U-joints[4]	Every two years
Check tension and condition of engine belt(s)	Every 100 hours or 60 days
Remove prop & lubricate prop shaft	Every 100 hours or 60 days
Flush seawater section of cooling system [2]	After each use in saltwater

NOTES:

[1] *If applicable to your unit.*
[2] *Optional and only practical if boat is dry-stored.*
[3] *Includes steering linkages and gimbal bearing*
[4] *An important procedure, this involves pulling outdrive off (six bolts hold the drive).*

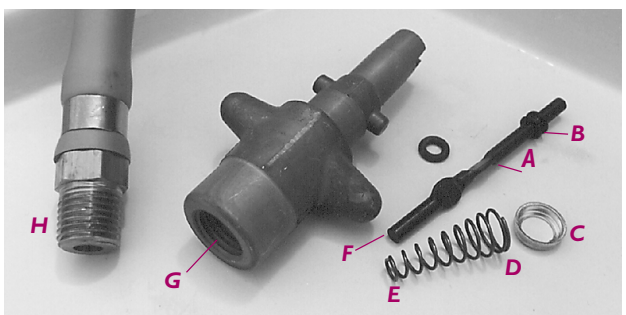
tant grease. When hydraulic rams are left extended with the shafts exposed for long periods of time, the protective coating of hydraulic fluid on the shafts can be washed away. The shaft surface then corrodes and, when you next cycle the trim/tilt system, that corrosion-roughened surface will damage the cylinder's hydraulic seals, leading eventually to excess fluid leakage and the need for seal replacement.

When it comes to stern drives, the watchwords are inspection and prevention. Persistent effort in each of these areas will yield big-time results.

MISSING LINK: PUTTING TOGETHER A FUEL HOSE

When our kicker engine was stolen from our test boat last fall, a replacement outboard arrived from the insurance company with a new fuel tank still in its original carton. But as winter had arrived, we packed all away in storage until spring.

Upon outfitting the boat earlier this season, we opened the carton and found a tank plus a fuel hose minus one end and a sealed plastic bag full of several parts. Assembly instructions were, naturally, not included so with hose and bag in hand, we traveled to our nearby dealer.



Should this ever happen to you, here's how the hose fitting goes together: Slide the rubber O-ring over the top end of the plunger (A) and seat it in the middle of the raised collar (B). Insert the cup washer (C) into the wide end of the spring (D), then slide the spring, narrow end first (E), over the bottom end of the plunger (F). Insert the plunger, O-ring end first, into the threaded end of the barrel (G). Wrap Teflon tape around the hose threads (H) and, holding the hose end with a wrench or vise grips, screw on the barrel until tight.

These instructions are for assembling a Mercury tank fitting and likely won't apply to other brands as tank fittings vary with each manufacturer. Incidentally, the dealer couldn't remember how to assemble the fitting and had to consult the service manual.

POWERBOAT
RIGGING

TROUBLESHOOTING TRAILER WIRING

A faulty ground wire is the number one cause of light failure on trailers.

When a friend asked us to tow their trailer we assumed the plug on our tow vehicle, which connects to a tandem axle boat trailer, would be interchangeable with other trailers. What should have been a quick connect-and-drive-away job resulted in three hours of troubleshooting a wiring system. Our 12-volt test lamp (fortunately we had packed the electrical kit) showed the juice was getting through but we couldn't find a good ground. Unable to resolve the problem, we reluctantly shelled out $50 for a portable, magnetic-mount Tow-A-Lite from U-Haul, mounted the lights on the rear of the trailer, attached the wiring to the plug on the tow vehicle and drove away.

A bad ground between the trailer and tow vehicle is the number one reason bulbs won't light up. Most trailers attach the ground wire from the tow vehicle to the trailer tongue, and a ground leads from a taillight to the rear of the trailer. This setup uses the steel frame of the trailer as the intermediate conductor. Other lights then ground directly to the trailer frame.

Problems occur when a circuit lacks a single good ground. Sometimes dirt or rust on the frame or corroded connections between the wiring and frame block the ground. Even rust on the drawbar may prevent a good ground connection to the tow vehicle. Tilt trailers often have problems when the steel frame deteriorates at the pivot point and breaks the ground. Paints act as an insulator and may also interrupt a circuit. If you've recently repainted your trailer or purchased a new one, it may be necessary to remove some of the paint to find a good ground.

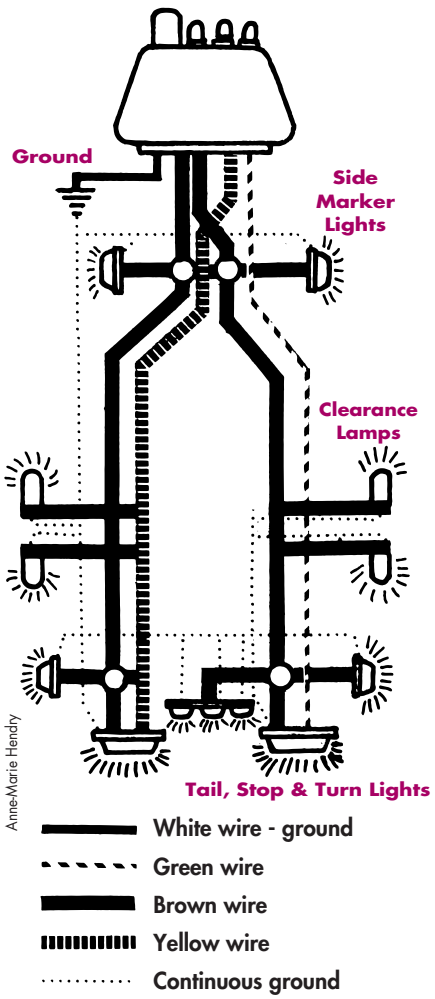


Figure 1

Typical trailer wiring scheme. To minimize problems with a faulty ground, a continuous grounded harness — shown as a dotted line — connects all lights to a common ground.

Wiring problems also occur when a circuit has more than one ground. When one of the grounds fails due to corrosion, a loose connection or broken wire, the circuit then attempts to find an alternate ground. This causes lights to flicker or other non-related electrical components to operate. Your trailer lights may operate but a faulty ground wire causes the running lights to blink when you activate the tow vehicle's brake lights.

Correcting faulty wiring involves examining the entire system. Trace the wires, looking for loose connectors, chafing or other signs of trouble. Hitch the trailer to the tow vehicle and turn on the vehicle ignition. Using a 12-volt test lamp, hold the negative wire to the trailer frame and the other to the tow vehicle plug. If the tester fails to light then there's no ground.

Check your trailer's wiring setup before making changes as wiring schemes may differ on custom-built trailers or older trailers that have been modified. The usual color scheme for trailer wiring is: white wire for ground to trailer frame; brown for taillights, front and rear side lights and rear marker light; yellow for left side brake and turn lights; and green for right side brake and turn lights.

When you can't find a ground and time allows, rig a continuous grounded harness. It's similar to DC wiring in a

boat's cabin, where all ground wires lead to a negative bus bar and one wire leads to a common ground, and there is minimal chance for a break in the ground wire.

In most cases, you should not have to touch the trailer's existing wires to run a continuous ground **(Figure 1)**. Lead a common ground wire (shown in Figure 1 as a dotted line) from the ground on the trailer plug along the frame. Ground wires from all individual lights are then spliced to the common ground wire. Use a Cole Hersee Quik-Tap to connect the two wires without stripping **(Figure 2)**. For a waterproof seal, put a dab of silicone on the ends of the connector.

With the right tools and an emergency backup system for occasional use, you'll be better prepared for those unexpected repairs. The Tow-A-Lite saved the day and, while the cost seemed rather extravagant at the time, it now resides in our tool tub (we started with a bag many years back) so we won't be stranded again.

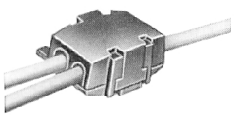
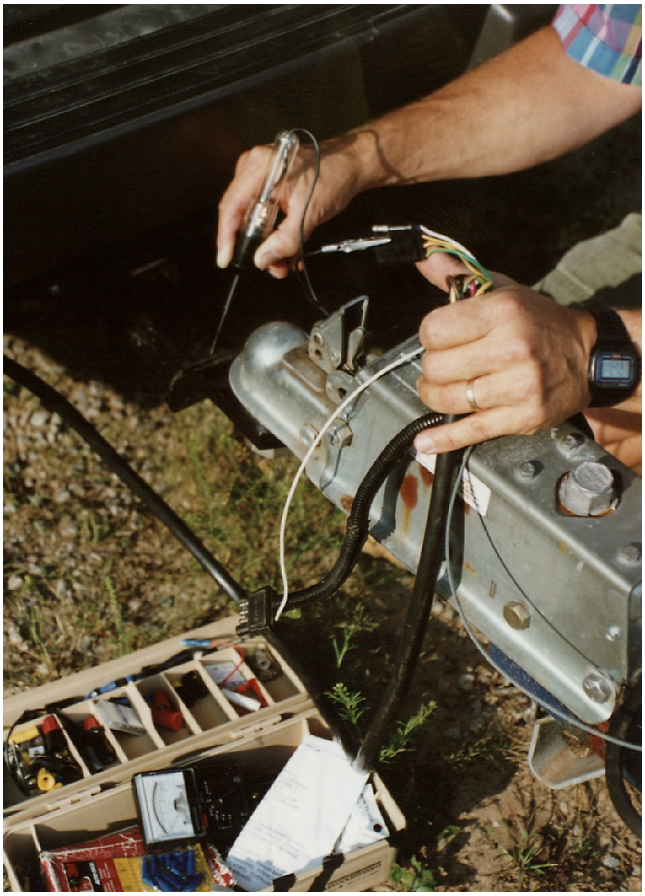


Figure 2

To splice two wires without striping, use a Cole Hersee Quik-Tap.



SAILBOAT
RIGGING

WEDGE NO MORE

Replace mast wedges with a permanent one-piece, custom-fitted mast ring.

MATERIALS

Spartite Kit
5cm (2") masking tape
Utility knife
Slot screwdriver
Plastic drop sheet
Rags
Petroleum jelly
Cotton swabs
Acetone
File
Plastic model paint (optional)

Mast wedges can be a source of aggravation for owners with keel-stepped masts. Countless hours are spent tweaking the mast and fiddling with wedges every time the spar is stepped. During the season, wedges fall out and are lost or they swell with water and crack. Shifting of the mast at the partners puts tremendous and uneven loads on the deck and water passing through the mast boot leaks into the cabin below.

Spartite, a two-part polymer, is the modern solution to the age-old problem of sealing and supporting keel-stepped metal, wood and carbon fiber masts at the partners. With the mast in position in the boat, a liquid plastic solution is poured into the cavity between the mast and the partners. Once cured, it forms a snug-fitting ring (shrinkage is less than .001") that virtually eliminates leaking at the partners. The ring distributes loads equally and locates the mast exactly in the same position every time the mast is stepped.

Spartite is available in two versions and two sizes for trailerable, racing and cruising boats from 3.6m to 72m (12' to 240'). The cruising version, the 901 Cruise, is for boats with a gap of 12mm (1/2") or more between the front of the mast and the deck collar. A harder compound, the 961 Race, is for boats that sail with excessive loads on their masts, use excessive backstay pressure or have unstayed rigs like a Nonsuch or Freedom.

Installation

Like so many great ideas, Spartite originated from the need of one individual (a co-founder and partner of the company) who, in this case, purchased a boat with a keel-stepped mast and fed up with broken and lost wedges was determined to devise a better mousetrap.

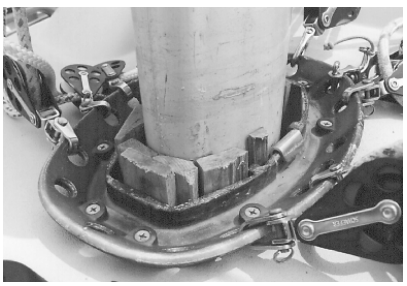


Figure 1

We arranged a demonstration of the product with John Osborn of Transat Marine, the Canadian distributor. Our test boat was a C&C 35 Mark III, owned by Glen Kenmuir and docked in Bronte, Ont. This boat presented a more challenging installation than normal because it has stainless-steel tangs mounted on either side of the mast that hook on to the deck collar at an angle.

With the spar centered and properly tuned, the mast boot and wedges and any rigging that would interfere with the installation were removed (Figure 1). At this point, unstayed masts and some stayed masts must be stabilized to prevent movement. This is achieved by tying the mast with lines and blocks or driving wedges from underneath inside the cabin. If the mast pumps during

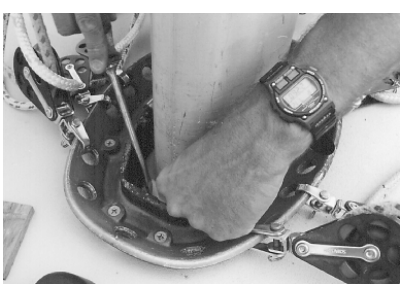


Figure 2

installation the result will be a loose fit. (Consequently, Spartite should never be installed in strong winds.) This step was unnecessary on the C&C as the tangs held the mast rigid.

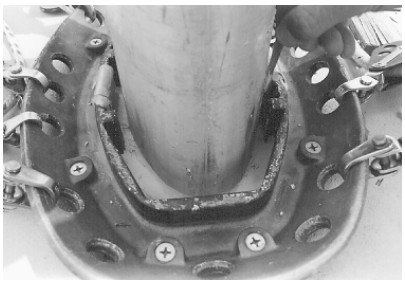


Figure 3

After removing dirt, tape residue and old glue off the mast and collar, we unpacked the 901 Cruise kit and found Spartite parts A and B, rolls of closed-cell foam, modeling clay, a plastic mixing pot, stir stick, rubber glove and application instructions. You'll also need petroleum jelly, a drop cloth, rags, masking tape, a utility knife, tools for packing the mold materials, a file, cotton swabs and acetone for clean-up.

We formed a mold to contain the liquid solution by slicing the foam into strips and, using a slot screwdriver (or similar tool) packing it from the top and from underneath in the cabin into the cavity (Figure 2). We pressed the foam down 5cm to 7.6cm (2" to 3") below the top edge of the deck collar. Then we separated the clay into strips, kneaded until it was soft and pressed it over the foam completely filling all gaps around the mast track and tangs. (A thin stick or blunt-end tool helps to lay the clay in place — Figure 3.) Then we leveled the surface with a finger, smoothing the clay out to the edges to form a tight seal. THIS STEP IS CRITICAL. The clay must completely seal all edges or the liquid Spartite will leak through the foam into the cabin. When all edges are sealed you should not be able to see any light passing through the mold when viewed from inside the cabin. As a precaution, we covered the area under the step with plastic sheeting to catch any drips.

Figure 4

An application of petroleum jelly with cotton swabs (a finger works fine too) keeps Spartite from sticking to exposed surfaces (Figure 4). We liberally coated the inside and top of the deck collar, the sides of the mast, the mast track and clay surfaces. It's important to wipe

SAILBOAT RIGGING

off any jelly deposited on the outer edge of the collar with acetone, then wrap this edge with masking tape. Multi-layers of tape create a strong and rigid dam, which should be about 2.54cm (1") high when you're finished (Figure 5). (Owners of boats without deck collars will need to build a clay dam.) The tape (or clay) dam holds the solution until it sets. A plastic drop sheet taped in place around the edge of the collar will protect the deck.

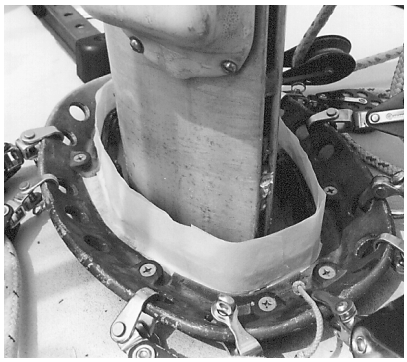


Figure 5

Next we doned the rubber glove and combined Part B with Part A, following the instructions, then slowly poured the molasses-like liquid into the mold (Figure 6), filling the cavity to a height of 6mm (1/4") above the top of the deck collar. Any spilled product can be cleaned up with acetone before it cures. (Cured Spartite, like any epoxy product, is removed by sanding or scraping.)

It's important to keep the boat as level as possible until the material begins to thicken, which takes 15 minutes or so, depending on the temperature. Spartite sets in two hours at 21C (70F), at which time the tape can be removed and the top edge trimmed with a file (Figure 7). (The product can be applied in temperatures as low as 10C (50F) but it takes longer to cure.) Another 48 hours

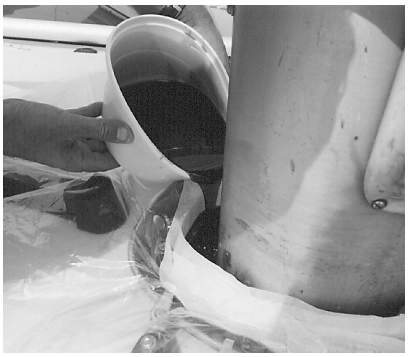


Figure 6

curing time (in warm weather) is required before you can remove the foam and clay from below and load the rig or sail. The polymer ring reaches a full cure in about seven days, depending on the temperature and humidity.

Simple and straightforward, the entire procedure usually takes an hour to complete. More complicated installations — on boats with mast tangs (such as our demo boat), or where there's a collar mounted on top of the deck or one without a flange or sleeve, for example — take a little longer. On race boats with masts adjustable fore-and-aft, the product is poured with the mast centered and spacers are added as needed.

To protect the ring from UV rays, which can craze or chalk the surface, you can sand and paint it with plastic model paint or cover it with a boot; match the color of your deck for a professional finish. This is a purely cosmetic step, however, as weathering won't affect the structural integrity of the product.

The Spartite ring should easily come away from the collar when the mast is unstepped. When restepping the mast, it may be necessary to slide the ring up a few inches. (Lubricate the spar with petroleum jelly to reduce friction.) With the mast positioned in the step, attach the shrouds then push the ring back down into the deck collar. Where mast fittings prevent the ring from sliding, cut it into two pieces and reinstall as a two-piece ring. The manufacturer recommends applying a bead of silicone sealant on the mast before reseating the ring to ensure a watertight fit — a mandatory procedure on boats with bendy rigs. On boats with lots of backstay tension and masts that pump, the ring may lift slightly at the front. If this happens, you'll need to drill, tap and fasten machine screws through the deck collar and into the ring. Remember to remove the screws when you unstep the mast.

Prices range from CDN$138 to $280 (US$86 to US$162), depending on the kit size and version. To determine the size you need, estimate the surface area of the deck opening in inches, subtract the square-inch area of the mast at the partners, multiply by the depth of the cavity in inches and add 1/4". We used the small kit which contains sufficient material for 53 cu. in. or less. The large kit fills up to 106 cu. in.

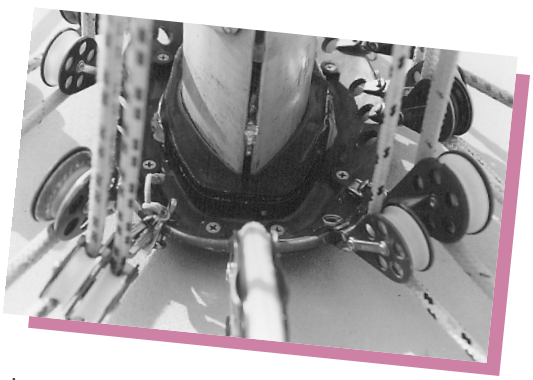


Figure 7

Spartite isn't cheap. You can stockpile many years worth of wedges, C-clamps and mast boots for less money. But when we factor in the convenience, effectiveness and performance of this product, we feel it's money well spent.

BLISTER REPAIR TECHNIQUES

The DIY FALL '95 issue looked at the factors affecting blister formation, bottom paint removal, hull preparation, ways to dry the laminate and basic blister repairs and prevention. In this article, an expert shares some of his repair techniques and tips.

By Ken Hendry

You have just hauled out the family boat and while washing the hull you notice small round bumps all over the bottom. Some are the size of a pencil eraser, while others are larger and a few have a crack in the middle. On some spots the outer layer of gelcoat has flaked off exposing a dark-colored laminate underneath.

Many boaters now recognize these spots as blisters, caused by moisture migrating through the fiberglass and accumulating in cavities that fill with an acid-like fluid. Blister repair has developed from a trial-and-error process to a fairly well understood operation with a good likelihood of success. For now, the best protection against blistering is to apply one of the various waterproof epoxy barrier coatings developed for this purpose. Such products are available from Easy Epoxy, Interlux, Jotun, Matrix Adhesive System, Sikkens, West System and other suppliers. Most are made for do-it-yourself application and come with step-by-step instructions.

One of the most popular products, the Interprotect System by Interlux, has been used for many years as both a preventive measure and repair method. It consists of an epoxy sealer, a fairing compound and an easily applied coating that can be put on in a relatively short time. Before starting, obtain a copy of Interlux's Technical Bulletin #900C (call 800/INTRLUX to order). The company also has a handy question-and-answer INTERFAX service (dial 800/685-7151) that will provide you with complete painting specifications for your boat.

To Blast or Not

When I hauled a customer's 1984 8.1m (27') Regal cruiser last fall, I found that it had developed many small blisters spread all over the bottom. The hull was coated with a bottom wax which like antifouling paint, had to be removed before any blister repair could begin. In the early stages, blistering occurs directly under the gelcoat and the repair is straightforward. Where there are only a few small blisters, these can be opened up individually using a grinder without removing the gelcoat on the rest of the hull. If the bottom is covered with larger blisters, or where you suspect the blisters may go into the laminate, the entire gelcoat layer must be removed by grinding or sanding, which is painstakingly slow and messy work, or blasting with baking soda or sand.

Blister cavities are very difficult to find — grinding often misses spots that are covered with a thin veneer — and any missed areas will reblister after treatment. The Regal had 20% to 30% blister coverage, and to alleviate concerns about the "wetness" of the laminate, the decision was made to have the hull sandblasted. Blasting tends to find blisters and weak areas that are not yet visible.

Sandblasting must be done by a qualified operator; in unskilled hands, the process can blast a hole right through the laminate. (The Armex Accustrip system, which uses a baking soda-based abrasive, is a more passive process and does less damage to the hull.) To prepare for sandblasting, tape the waterline and lay drop cloths everywhere. Be prepared for a lot of fiberglass dust. The operator will put heavy tape over other areas that must be protected

from the sand. Block the boat high enough so there's reasonable access underneath and you'll get a better job. Keep the area where blocks contact the hull to a minimum to avoid the need to hand sand later.

After sandblasting, immediately remove the tape, otherwise it seems to grow into the fiberglass. If sandblasting reveals more blistering and a saturated laminate, or signs of delamination which may affect the structural integrity of the hull, you'll need to decide whether to remove additional layers. This is a drastic step; before you go that route, seek advice from a qualified marine surveyor.

I used a Dremel, a variable-speed hobby-type die grinder, with a 5mm (3/16") diameter round-tipped rotary file, to open up the blister holes uncovered by blasting the Regal's hull. If the hole was shallow, we did not further abrade it; when the void had penetrated the laminate, however, we widened it and cleaned it out. Fortunately, most of the blister holes were shallow and the Dremel penetrated no more than its diameter and about the same width. Be prepared to spend lots of hours on your back. An automotive garage creeper is invaluable if the boat is high enough. Wear protective clothing and eye protection when popping the acidic fluid-filled blisters. After opening all the cavities — again, make sure you get them all — rinse the hull with detergent and fresh water (preferably hot) to remove any contaminants.

The Regal was stored in a dry shed for the winter with all hatches and ports open to allow air to circulate through the boat. During the dry-out period, the hull is rinsed occasionally with water to dissolve the glycols, a liquid component of polyester resins that, unlike water, does not evaporate.

Invest in a garage creeper (the kind automotive mechanics use) and be prepared to spend lots of hours on your back.

How Dry is Dry?

The moisture content of fiberglass must be reduced to an acceptably low level but determining this level can be a problem. The Interlux bulletin suggests taping a 30cm (12") square of clear plastic to the hull, sealing all edges with tape and leaving it for at least 24 hours. If condensation forms under the plastic, the hull requires further drying. When this test produces a dry inner surface, the boat is probably ready for coating. A moisture meter provides a semi-accurate reading, but it's expensive and interpretation is questionable. (See *When is the Hull Dry Enough?* on page 43.) In areas where the harsh winters dictate six months or more in dry dock, there's probably sufficient time to achieve a dry hull. (Use the plastic patch test to double check.) If you are unsure, a surveyor can provide valuable advice.

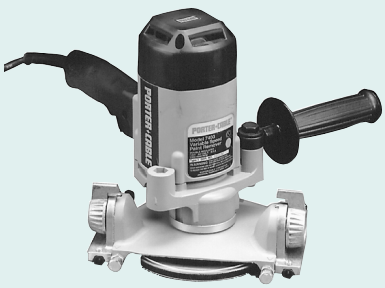
3-Step Application

Once you've opened up the blisters and dried out the hull, the first step in the Interprotect system is to apply Interlux 1000, a low-viscosity, two-part epoxy resin. It brushes on and seals blisters and any bare laminate as well as providing a base for Interprotect 2000 (or 3000 spray formulation). Where the blisters are scant, the Interprotect 1000 can be applied directly to the cavities only. If there are a lot of holes and exposed bare laminate, however, the entire bottom must be sealed. It's important that no fiberglass strands extend through the sealer as these will provide a direct conduit for water incursion. Follow the manufacturer's instructions carefully; the epoxy pot life is short, typically 20 minutes for the 1000 and temperature is important — on a hot day you will have less working time. Working with epoxy isn't difficult but it is exacting. (Gougeon Brothers (517/684-7286) publish two excellent reference manu-

POWER STRIPPING

Repairing a badly blistered hull involves removing the bottom paint, gelcoat and often several layers of laminate, a task that is simplified by using a Porter-Cable model 7403 Paint Remover (CDN$270).

A heavy-duty paint and gelcoat stripper it features a 15cm (6") diameter 36-grit tungsten carbide disc that uniformly "shaves" the surface. A special plate attachment lets you adjust the depth of the cut to remove an even amount of material and leave a fair, smooth surface for coating with epoxy. This stripper will generate a large quantity of dust so you'll need to wear protective clothing, gloves, goggles and a respirator. If you presently own a Porter-Cable model 7402 vertical disc sander, you can purchase the bottom attachment, backup pad and hardware separately.



als on blister repair and epoxy techniques.)

Next two or more applications of Interlux 417/418 filler are worked into the blister cavities. Use a squeegee or putty knife wider than the holes. Again, watch the pot life and mix only small amounts at a time. A trick I use is to work in small areas, sealing with 1000 and, soon after, applying the filler while the sealer is still "green." After the first

Fill pinholes with fairing compound and a putty knife held at a low angle.

area is filled the next area can be coated with sealer, filled and so on. Once the epoxy hardens beyond the "dent with fingernail stage" — after standing approximately eight hours in 20C (68F) daytime temperatures or overnight at the 10C (50F) temperatures I had during the Regal repair — the surface must be scrubbed with a 3M Scotch-Brite pad and water to remove the amine blush (a by-product of epoxy resin), then sanded with 80-grit paper and wiped with solvent. So watch the overcoat times and plan your sealer and filling times carefully.

When the filler coat is dry, thoroughly sand the hull to remove any high spots. Bright lights directed along the bottom will reveal any low spots; they show up as shiny areas and require a second application of filler. (A tip: when you use lots of filler sanding may be more time consuming, but you can also avoid refilling.) Finish sanding with 80-grit paper.

The next stage is the application of multiple coats of the Interprotect 2000. Vacuum the work area to remove all dust residue, then wash the bottom with solvent. Mask the waterline using 3M Long Mask or another quality weather-resistant tape. Following the manufacturer's instructions, mix up a batch of 2000 and let it stand for 20 minutes before

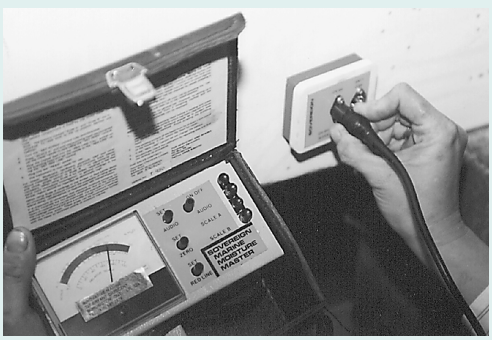
WHEN IS A HULL DRY ENOUGH?

A moisture meter serves two purposes in blister repairs: to assess the moisture content of a laminate, and to determine when the laminate is dry enough to be recoated. It's an important tool that lets you diagnose the problem, but it may not be a true indication of a hull's wetness.

Moisture levels at which blistering occurs vary from boat to boat. A boat identified by the moisture meter as being very wet may have no visible symptoms, while another boat that meters reasonably dry may have a severe case of the pox. Moisture content can also vary over a very small area, because polyester laminates absorb moisture unevenly. The depth to which a meter can detect moisture also affects the readings; some meters may not detect the wetter layers underneath.

When the Regal I repaired was metered soon after sandblasting, the hull above the waterline read 5% on the meter, and anywhere from 18% to 25% — or approximately 2% moisture by weight — on the bottom. (A soaking-wet hull might contain 3.5% moisture by weight.) The bottom was metered at regular intervals throughout the winter and numbers written on the hull. By spring, the hull had held at 18%. Because of the random readings, I called in a surveyor. As the moisture content had stabilized, the surveyor confirmed that it was reasonably safe to coat as the laminate was as dry as it was going to get.

So how do determine when the hull is ready for coating? If you have any doubts as to the "dryness" of the hull, call in a surveyor. When readings are questionable, the only truly accurate means to determine the exact moisture content is to remove a hull core sample and send it to a lab for testing.



GIMME SHELTER

Extend your outside work time with this inexpensive, easy-to-build mini-boatshed.

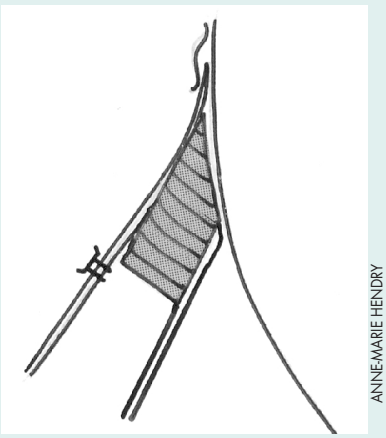
By Paul Shard

PAUL SHARD

Repairing a boat in the off season is easier with a tent made of plastic sheeting and wood frames.

When we had the huge task of relaminating our hull (*DIY* SUMMER '96) we realized we had to erect a shelter to protect us and the boat from the vagaries of our northern climate and so the boat would be ready for spring launch. We based the design on a lean-to, laying 2x2s against the topsides. Over this frame went a curtain of 6-mil plastic sheeting. Inexpensive and strong, this shelter takes only a few hours to erect. (Check local planning regulations before you build.)

Since we wanted clear access to the hull bottom from the boot stripe down, we needed 3m (10') long vertical supports. On boats that draw less than 1.8m (6'), supports 2.4m (8') in length or shorter would be adequate. In that case, 1x2s could probably be substituted. Bevel the top of the supports so they lie flat against the topsides, then wrap the ends with duct tape to prevent them from scratching the hull. Tape each 2x2 to the hull to hold it in place. Unfortunately, we taped these on with duct tape and had to remove the weathered tape with toluene. A better choice is 3M 4811or some other tape that doesn't transfer its adhesive to the hull when it breaks down.



ANNE-MARIE HENDRY

Bevel the top of the supports so they lie flat against the hull.

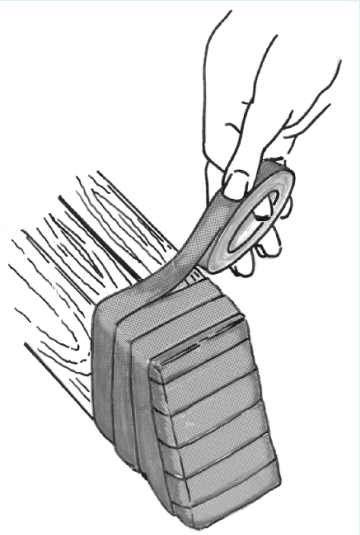
With the supports leaning against the hull, we unrolled the plastic sheeting and tacked it to the 2x2s with a staple gun. This is best done on a fairly calm day. The load on the staples from wind gusts is substantial, so we used small cardboard pads to reinforce where the staples went through the plastic. Strips cut from plastic lawn edging — a trick used by builders using it. Five to six coats are applied with solvent-resistant foam rollers (the product goes on like paint) , but these will start to come apart after a few hours, so plan on at least one roller per coat. Wear protective clothing and a paint/solvent respirator when working with epoxies or paints.

When you're finished, your coats of 2000 should be 10 mils or 0.010 inches thick. A nifty way to measure thickness is to paint the same number of coats "wet on wet" on a piece of tape, then determine the thickness of the tape using a caliper, with and without the 2000. For example, the tape used on the Regal measured 0.006, so we applied successive coats until the surface measured 0.016. The label on the 2000 can also provide information about the number of coats and their thickness.

Interlux specifies four to 18 hours curing time between coats, depending on the temperature of the hull, after which resanding is necessary — and you do not want to sand this thing again. The minimum times are to permit complete vaporization of the solvents in the 2000. Trapping solvents with a second coat is just about as damaging as water left in the laminate.

Epoxy coatings are not UV resistant and must be overcoated with an antifouling paint. Interprotect 2000 has the advantage over other epoxy brands as it can be overcoated with Interlux Fiberglass Bottomkote, or another compatible bottom paint within a few hours of applying the last

Interprotect 2000 is rolled over a smooth, fair hull surface.



ANNE-MARIE HENDRY

Wrap the top ends of the uprights with duct tape to protect the hull.

of cold-molded boats — also works well. Attach the top edge of the plastic to the hull using two layers of weather-resistant tape, such as 3M 4811— a plastic tape used to hold shrinkwrap or plastic tarps during long-term storage. We used electrical tape and this turned out to be reasonably waterproof but, just to be sure, we made a rain gutter of tape by placing the tape edge on the hull a few inches below the top of the plastic and folding the tape in half. The tape sloped towards the stern so any rain running down the inside of the plastic would drip onto this tape gutter instead of running over the work area.

Your choice of tape for this whole project is critical. As we found out, duct tape disintegrates after a few months outdoors. It also leaves a gummy adhesive residue on the gelcoat that resists removal. In the end, we found that toluene took it off the topsides, but we suggest you check your hull finish before trying any tapes or solvents. Electrical tape peeled off nicely after quite a while in the sun but needed to be maintained constantly.

This shelter did exactly what we hoped: It kept rain and wind-blown dust off the bottom and, acting like a greenhouse on a sunny afternoon, it helped raise the temperature to dry out the hull and cure the epoxy barrier coating. Depending on the vagaries of your local climate, it should protect the hull for many months.

Costs

2 x2s 3m/10′	
25 pieces @ $2.35	*$58.75*
6-mil plastic	
3m x 30m (10′ x 100′)	*$40.*
Tape, staples	*$15.**
TOTAL	*$113.75***

**Price increases when using weather-resistant 3M 4811 plastic tape.*
***Cost estimate is in Canadian funds.*

Using shorter 2x2s or using 1x2s reduces the cost by nearly 50%.

coat without resanding — and we'll do anything to prevent having to go over the bottom again.

When properly applied, an epoxy barrier coating provides long-lasting protection. Occasionally, however, osmosis can restart and blistering reoccurs within a few seasons. This happens when the hydrolyzed wet laminate is not completely removed, or inadequate hull preparation results in poor adhesion between the epoxy barrier coat and the substrate. Should blisters reform, repair as necessary on a spot basis and then recoat as before.

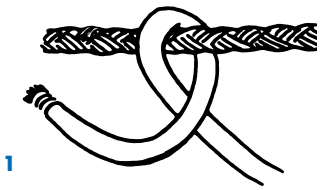
Ken Hendry is co-owner of Hendry's Trent Talbot Marina in Beaverton, Ont., and does engine and hull repairs and servicing.

KNOTTY KNOW-HOW

Securing Rope to Rope

To secure one line to another, such as when you're attaching one anchor rode to another in a Bahamian moor, use a rolling hitch. Holding the bitter end of the second line, take a turn around the standing rope then cross it over itself. This locks the line.

Add two half hitches and pull the knot tight. On very stiff ropes, add a third turn before the half hitches so the knot doesn't slip.



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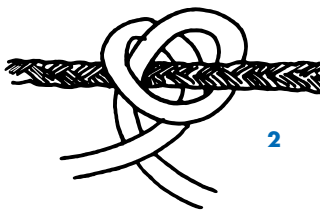

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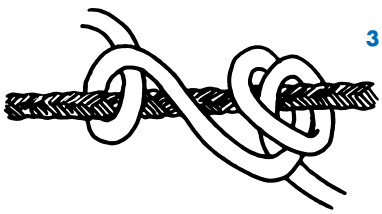

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Anne-Marie Hendry