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Anchoring Part II: How to set the hook, prevent dragging and retrieve snagged anchors.

Sailboat Rigging
A simple manual "pilot" gives you the freedom to leave the helm to work on the foredeck, check the charts or make coffee.

Knotty Know-How
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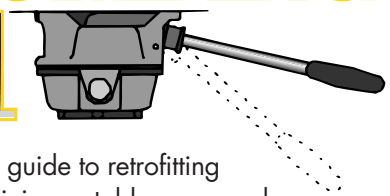
PLUMBING 101



A complete guide to retrofitting and maintaining potable, gray and seawater plumbing, bilge and scupper systems — plus how to install a hot water tank.

quickfix

Use this handy chart for quick and easy emergency repairs above and below the waterline.

Departments

Talkback — Coating for aluminum tanks; Oxygen and outboards; Alternator trouble-shooting; Compass repair; Restoring plywood; Reducing cabin noise; Bottom refinishing; Gaskets for Grampians; Fairliner info wanted.

Tech Tips — Original tips and tricks

TALKBACK Q&A

Coating For Aluminium Tanks

Q: I'm in the process of restoring a 10.2m (34') aluminum Striker Canyon Runner. My question is, what type of non-toxic coating would you suggest for the interior of the integral aluminum freshwater tank that currently has a PVC-based coating.
Tommy Lawrence, Houston, Tex.

A: Aluminum water tanks are generally not lined but, as yours is, I suspect it has an epoxy-based liner similar to a product used in hot-water tanks. Coatings are usually put on when the tank is new. You could apply a potable epoxy coating such as Devo Barrust 235 to your tank, which won't impart a taste to the water, but the tank must be absolutely clean and free of any dirt or you'll have adhesion problems. If the original coating is intact, I suggest you leave well enough alone. Aluminum was a popular choice for tanks years ago, but it eventually pits and corrodes through. Liners in aluminum tanks are discouraged because one tiny crack can trap water which accelerates corrosion. Modern tanks are made of either polyethylene or stainless steel.

Oxygen and Outboards

Q: I have a Coronado 25 sailboat with a lazarette compartment in the stern that houses a Honda 9.9 four-stroke outboard motor. When sailing downwind in light winds, we often resort to the "iron jenny." The engine runs fine for five minutes or so, then it gradually loses power. It never actually quits, but the revs keep fluctuating. This problem only occurs when we're cruising downwind and I'm sure it's caused by lack of air — the following wind tends to blow the exhaust gases back into the engine compartment. The hatch over the lazarette opens toward the bow, so it funnels any oncoming air down into the compartment, and there's an opening at the rear of the transom which should provide a current of air moving through this area. I've learned to live with this problem but it's rather frustrating. Can you provide a solution?
Bill Bondy, Sea Cloud, Erieau, Ont.

A: Engines starved of oxygen are a common problem on sailboats with enclosed motor wells. The only solution is to replace the carbon monoxide in the well with oxygen. This can be done quite easily and inexpensively by installing the type of bilge blower used with inboard engines. Installation involves cutting a large hole (usually about 7cm/3") for the grate with a jigsaw or hole saw. When marking the hole placement, pay particular attention to the location of all electrical wires, fittings, cables and other hardware located either below or around the cutout. You'll also need a blower hose, wiring, an in-line fuse, a switch (or you can wire the blower directly to the panel) and an exhaust grate or vent.
RF

Alternator Troubleshooting

Q: I recently bought a 1987 Celebrity VR190 with a 165-hp 3.7L MerCruiser. This engine has the crankshaft-mounted alternator with a remote, water-cooled regulator. If I trim the drive while cruising at 3,500 rpm, the alternator light flickers and the voltmeter drops to around 10 volts. I've heard horror stories about this setup — that it's expensive to repair, provides poor performance and is a fire risk, among others. I know there is a kit that allows installation of a conventional 65-amp alternator on this engine. My question is twofold: Do you know anything about this setup? Is it worth the money to convert the engine?
Gary Wortz, Wilmington, Del.

A: Before condemning your system, remember that a "hit and miss" approach to troubleshooting will lead to more frustration. As there are no Service Bulletins posted by Mercury Marine on your particular charging system, we can assume there are no known defects. First, check all battery and electrical connections. Bad connections are a common source of problems and should not be overlooked. Next, check the charging system output. If the output is okay, check the amperage draw from your trim and tilt motor. Also, check that your battery is in top working order. The price of a new stator for your engine is around US$180; US$285 for a regulator. An aftermarket 65-amp alternator, including brackets and hardware, is US$600. It's a Sierra part available at most marine stores. I suggest you troubleshoot first and replace parts later.
RF

Removing Sealant from Plastics

Q: What's the easiest method to remove cured sealant from acrylic windows?

A: There's no quick fix for removing cured sealant from glass or plastics. According to Daryl Johnson of 3M Marine, there is no solvent or cleaner that can soften sealants. Polysulfides and polyurethanes are designed to be resistant to chemicals. Silicones are less resistant but they do chemically cure. Removing these sealants using the tried-and-true mechanical method — a utility knife, putty knife or some kind of scraper and a lot of elbow grease — seems to work best. Once most of the sealant is removed, sand the area using a coated abrasive to remove the rest. Meanwhile, we'll keep looking for a better solution. If any readers know of anything that works, let us know.
JM

FAST LEARNER

Q: I was recently given a '72 Glastron ski boat with a Mercury 115-hp outboard. The bottom of the boat is in great shape but the deck and the interior are badly sun damaged. The gelcoat has cracked and is flaking off (if this were a car, I'd be getting out my sander). I was planning on using this boat as a learning experience; however, I'm having second thoughts. Is Glastron still in business?
Ron Breed, Desoto, Tex.

A: Get out your sander! Gelcoat is a porous mix of polyester resin and pigment that, when not protected from UV light, begins to break down, oxidize and become faded and dull, though it does not peel. Boats are often painted when color restorers and waxes fail to restore their color and gloss. A boat's hull is like the superstructure of a car; as long as it's solid, it's usually worth fixing. I recommend recoating, using one of the newer linear polyurethane paints, either a one-part (more user-friendly) or two-part product. You'll have to prepare the surface according to the manufacturer's directions. Cost is about $50 per litre/quart.
Glastron, a subsidiary of Genmar Industries, is still going strong. You can reach the company at: 700 W. River Rd., Little Falls, MN 56345; Tel: (612) 632-8395, Fax: (612) 632-1438.
JM

Restoring Plywood

Q: I have just stripped my lapstrake hull to the bare wood and it appears that, after splashing about in the bilge for many years, excess fuel has soaked through

TALKBACK Q&A

from inside out. Is there some method of cleaning or removing the fuel prior to refinishing the bottom? The boat has a 1962 vintage lapstrake hull of fir plywood. Also, I've stored this boat in a dry garage for the past three years, where humidity runs around 60 to 70 percent. Should I be concerned about the moisture level in the boat prior to refinishing?
Rick Matson, Warrenton, Va.

A: Shipwright Duarte Picanco, of Noahs, a Toronto-based supplier of fiberglass and wood-boat building materials, offers these recommendations: First, check to see if the fuel has delaminated or rotted the plywood. Poke at the wood gently with a small slot screwdriver. If you are able to put the tip of the screwdriver through the first layer, or if the plywood shows any sign of delamination, it should be replaced. If the bottom is sound, clean the wood repeatedly with a strong degreaser such as acetone or TSP (trisodium phosphate, available at hardware stores) until all the fuel is out of the surface of the wood. Use lots of clean rags; paint will not stick to an oily surface. It would also help to seal the surface with a solvent-reduced epoxy, such as Industrial Formulators SI sealer, before painting. The moisture content of the wood should not be a problem; just try not to paint on a rainy day.

Reducing Cabin Noise

Q: My 9.3m (31') Coronet cabin cruiser has no insulation or flotation below the waterline and the cabin is noisy, especially when the boat is anchored. Can you recommend an easy solution?
Eli Harris, Roberts Arm, Nfld.

A: The only solution is to insulate the hull. Use a material that doesn't absorb water. Styrofoam is the least expensive but it's brittle and must be covered with plywood where it comes into contact with lockers, bulkheads and other hard surfaces to prevent it from breaking apart. Urethane foam is preferable. If the look of the final finish isn't important to you, you could rent a sprayer and spray the entire hull with urethane foam (wear a respirator while doing this). This will leave a rough finish. An alternative is to install sheets of solid urethane foam, cut to size and bonded to the hull with contact cement or epoxy. Make sure you do not cover any backing plates, thru-hull fittings, wiring and the like.
JM

GASKETS FOR GRAMPIANS

Further to our TECH TIP column in the FALL '96 issue, *DIY* reader Wilfrid Worland, of Toronto, Ont., has located a second and apparently less-expensive source of gaskets for Grampian 26 ports. The supplier is: Wefco Rubber Manufacturing Co., 2100 Osborne St. Unit #2, Canoga Park, CA 91304; Tel: (818) 886-8872; (800) 854-1220 from the U.S. only. You'll need part number 2357, which sells for US$1.50 per foot.

FAIRLINER INFO WANTED

Neil Vadnais of Fallbrook, Calif., is looking for repair and replacement sources for the 1962 9.6m (32') Fairliner he purchased recently. Send e-mail replies to nvadnais@connectnet.com.

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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TECH TIPS

JUG ORGANIZERS: Recycle plastic milk and water jugs for use as organizers. Cut off the tops and use them to stow small items in lockers, hold screws and parts when you're working on the engine or disassembling anything, or to catch oil or fuel drips when you're changing engine filters.

NEED A SPARK: When your outboard's spark plugs are badly fouled, you have no spares and the motor won't start, remove the plugs and clean them with a nail or vegetable brush and an ammonia-type glass cleaner. Reinstall the plugs and run the engine.
Phil Friedman, Port Royal Marine, Pompano Beach, Fla.

GOT THOSE PARKING LOT BLUES: When nighttime falls, it's often not easy to pick out your boat in a crowded anchorage, especially on foggy nights. Wrap bands of reflective tape in a distinctive pattern around the mast, radar arch or tower as high as you can reach. Carry a flashlight and you can always "home in" on your boat.

CHEATER KNOT: Use a rolling hitch (see FALL '96, page 32) to attach a cheater line to a genoa sheet when it's necessary to relieve tension while adjusting track cars.

A WASTE MATTER: The best way to dispose of dirty acetone or other solvents is to pour it into a large-diameter container, such as a bucket, and let the liquid evaporate. The solidified solvent waste can then be disposed of as non-hazardous waste (in most cases). Don't do this near an open flame or spark.

WINK IT OFF: To remove rust stains from stainless steel, use Wink, a household cleaner. Apply a light coating, full strength, using a dropper or a spray bottle. Scrub the surface with a toothbrush, working the Wink into the crevices. The product is hard on the skin (wear gloves) but it shouldn't harm the gelcoat [though it's always a good idea to do a test patch first].
Roman Folk, Toronto, Ont.

MUSTY COOLERS: Sprinkle baking soda inside empty iceboxes and coolers to keep them fresh and odor-free.

SPUD EXTRACT: Oiling, painting or varnishing in the cabin often leaves an undesirable smell (to some noses) that can linger for days. To remove these odors, place some peeled potatoes around the cabin.

VANILLA SEASONING: To remove paint odor from oil-based paints, add pure vanilla (not the artificial variety) at a rate of 125ml (4oz) to a litre (quart). Check with the paint manufacturer for compatibility before using.

OIL TIP FOR GM: To increase the oil-filtering capacity of General Motors' marine engines, replace the standard AC PF-25 oil filter with a large-capacity "truck" oil filter, such as the AC PF-932 (2 U.S.-quart capacity) or the smaller AC PF-35. These filters are longer so, before you buy one, check that you have ample clearance. I've used them for eight years with complete satisfaction.
Edward W. Osgood, III, Monument Beach, Mass.

HEADS UP: If you piece hose sections and adapters together before installing them, be sure to leave the clamp's screw accessible when the hose is placed in position.
Zora Aiken, Atelier, Fla.

SOAK 'EM BLADES: When water-pump impeller blades take a set during long disuse and the pump won't move sufficient water (or perhaps won't even prime) and you don't have a spare impeller, try soaking the impeller in warmed vegetable oil to take the set out and swell the blades. Diesel fuel will also swell most rubber-based materials, but don't expect the impeller to last long after such treatment.
Phil Friedman, Port Royal Marine, Pompano Beach, Fla.

ANCHOR PICK-UP: To release a fouled anchor, attach the rode to the crown of the anchor, and fasten it to the top of the anchor with four or five turns of whipping twine or waxed marlin. To free a fouled anchor, run across the anchor to break the whipping.
Sheilah Van Nostrand, Dream Catcher, *Keswick, Ont.*

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

CAST OFF

PART 2: THE ART OF ANCHORING

In our SPRING '96 issue we looked at anchor types and selecting ground tackle. In this segment, we examine anchoring techniques, setting the hook, how to prevent dragging and retrieval of snagged anchors.

By Sheilah Van Nostrand

Before determining where and how to anchor you need to first understand scope. Scope is defined as the ratio of the length of the anchor rode deployed to the water depth plus freeboard. For maximum holding power, anchor shanks require an angle as close to parallel with the bottom as possible. This allows the flukes to dig in deeper with heavy strains on the line, and is achieved by allowing lots of scope. Under favorable conditions, a safe minimum scope is 7 to 1. Here's an example: if the distance between the bow roller on your boat and the seabed is 4.5m (25') you would need to pay out 52.5m (175') of anchor rode for a 7 to 1 scope. Less scope can be used in a well-sheltered anchorage in calm weather once the anchor is set,, or when you're using chain and a larger anchor. In heavy weather, a 10 to 1 scope or more is better. In tidal waters, calculate the scope using the water depth at high tide.

A SECURE BERTH

Three features are desirable in a good anchorage: good holding ground, protection from wind and suitable water depth. Charts and cruising guides are both valuable sources of information. If a harbor providing protection from all sides is not available, you can opt for a cove rendering limited shelter or a windward bank, but watch for wind shifts that could swing you into a dangerous berth on a lee shore.

SETTING THE HOOK

A common mistake made by skippers when anchoring is not factoring in the boat's final resting place. Approach the spot where you want the boat to lie once the anchor is set and check the depth. Look around your boat, noting potential hazards (particularly at low tide). Bear in mind the possibility of a 360° swing around the anchor as the wind, current or tide changes. Observe the position of neighboring boats and the direction of their rodes. If you're unsure, ask boaters where their anchors lie. Try to visualize how your boat will swing so you avoid fouling lines or bumping into other boats.

A nylon snubber attached to the anchor rode cushions the shock loads.

Take a reading on the depth sounder and use this to calculate scope. Bring your boat to a complete stop then, as the boat begins to reverse slowly, lower the anchor, having previously checked for proper rode and anchor attachment and coiled sufficient line on deck to prevent snags or fouling. Do not throw the anchor.

To set the anchor, continue reversing slowly while paying out about one-half of the scope, then quickly snub the rode around a

ANCHORING TIPS

✔ For effective bow-to-helm communication, develop a prearranged series of hand signals (see Cast Off, SUMMER '95).

✔ Apply waterproof grease to the threads of the anchor shackle pin to prevent seizing.

✔ To extend the life of your anchor lines, splice a thimble at each end and alternate the ends to reduce stress loads and exposure to the elements.

✔ Watch your feet: Always stand behind the anchor rode when setting or weighing anchor.

✔ If you anchor frequently in the dark, attach strips of leather or cotton and pieces of marline with knots so you can measure the rode by feel as it passes through your hands.

cleat, bitt or windlass to maintain tension on the line and prevent damage to your hands. The anchor should begin to bite the bottom. Feed out more line, keeping a light tension on it. Once again, tighten the rode until you feel the anchor tug, then ease the line. Repeat the tighten-and-feed pattern several times until the anchor is set. A vibrating rode with little or sporadic stretch usually indicates a dragging anchor. After adjusting to full scope, secure the rode, reverse your engine and power back to drive the anchor flukes deeply into the seabed. In a crowded anchorage, you can shorten scope, if necessary, once the anchor is set.

To check if the anchor is holding, the simplest method is to take a bearing on shore. You'll need to take a new bearing when the boat swings with wind or current changes. But any other change to the bearing means the boat's dragging. Once the anchor is set, take note of your boat's position again and recheck periodically.

GET A GRIP

A single anchor in a protected harbor in calm weather is certainly adequate. In crowded anchorages or when there's not enough room to swing on one anchor, set bow and stern anchors (**Figure 1**). Drop one anchor close to shore with the rode secured to the stern and a second anchor offshore and held fast at the bow. Use a lighter anchor astern, so that in a blow it will break out before the bow anchor. Anchoring bow and stern demands quiet water with no chance that a strong wind on the beam will come up. The rocking action of the boat in a cross wind is not only uncomfortable, but the strain on the ground tackle can be tremendous. Before anchoring, check how the other boats are anchored. If other boats are

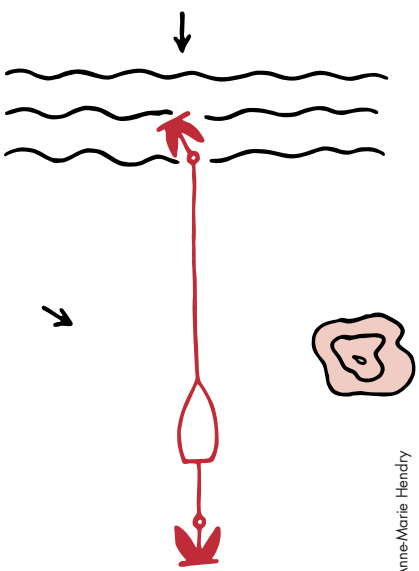


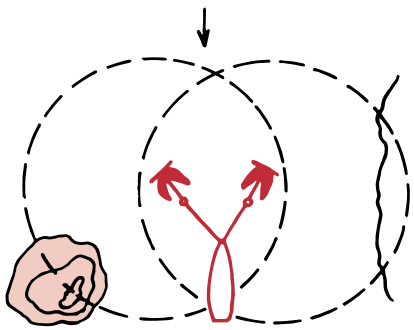
Figure 1

In crowded areas, or when there's not enough room to swing on one anchor, set bow and stern anchors.

CAST OFF

swinging on one anchor, they could swing into you if you are the only one anchored bow and stern.

For increased holding power in a blow, or to reduce your swinging circle, drop two anchors



AnneMarie Hendry

Figure 2

Two anchors set off the bow increases holding power in a blow and reduces your swinging circle.

at a 30° to 90° angle off the bow (**Figure 2**). Set the first anchor upwind, then power out at the desired angle and drop the second anchor. Adjust the rodes so the boat floats in the center with the rodes of equal length. This setup only works when there is no change of wind direction. Wind shifts of 90° or more will tangle the rodes. A third anchor set off the stern will limit your boat's swing.

When a change of wind direction is expected or when you're anchoring in a reversing current, set two anchors off the bow (**Figure 3**), lowering one anchor into the wind or current and a second anchor 180° downstream. Leave plenty of space to clear nearby boats when you swing. After the second anchor is set, cradle the boat midway between the rodes. Adjust each rode so that there is no slack in one when the other is taut. Known as a Bahamian moor, this allows the boat to swing in a radius only slightly longer than the boat and allows the boat to pull against one anchor or the other as the wind or current changes. Don't attempt this in a crowded anchorage when other boats are on only one anchor; you risk overlapping the swinging circles of neighboring boats. With this anchoring setup, there is often a slack rode which can chafe the hull, or on a sailboat, snag a keel or rudder. Boaters often tie the bitter end of the second rode to the rode of the first anchor using a rolling hitch (see Knotty Know-How, FALL '96, page 32). The first anchor rode is then payed out so that both rodes drop below the boat. Attaching a lead weight (called a sentinel) keeps the rodes below the boat.

ANCHOR WATCH

Changes in wind or current can cause any anchor to fail to reset if the boat swings far enough to oust it from the seabed. Depth-finder alarms set for a minimum and a maximum safety range will alert you when the boat swings out of that range. Anchor alarms on loran and GPS units are useful but are set for a wide radius taken from your boat's position at the end of the rode. Efficiency is questionable as some units are capable of reading only between 40m (131') to 100m (328'). An autopilot equipped with a course alarm can be set for the boat's initial heading at anchor and will beep if the vessel assumes a new heading. In high-risk areas, organize anchor watches by crew members. If you have a flair for the inventive, try rigging your own fool-proof alarm system by dropping a lead line off the stern or the beam. Play out some slack then attach the line so it rings a bell or trips some pots when the line stretches.

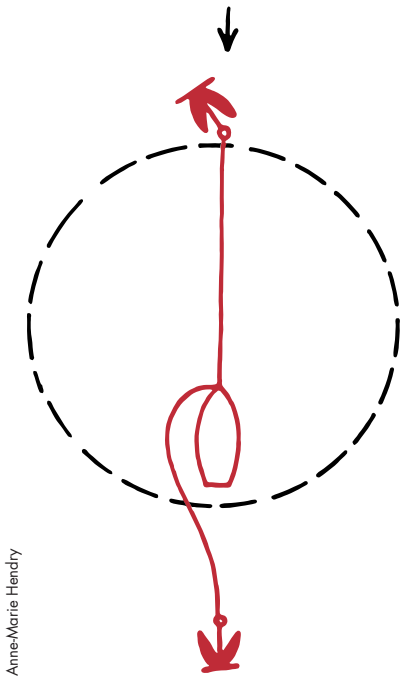
BREAKING LOOSE

Setting the anchor is easy; retrieving it requires muscle, teamwork and good planning, especially in

a crowded anchorage. Plot your moves beforehand, including the boat's course after you after raise the anchor. Use a prearranged set of hand signals (see SUMMER '95) so the crew can communicate with the helmsperson above the roar of the engine.

Slowly move ahead (or astern, depending on the setting) under power while quickly taking in the slack rode. (Wear gloves to protect your hands.) On sailboats without a windlass, lead the rope rode back to a primary winch and use the winch to help take some of the load. Just before the rode becomes vertical, securely cleat it. The boat's momentum should break the anchor free. If it doesn't, motor off to one side of the anchor, letting the boat pull it free.

When two anchors are set and both are located to windward, slacken one rode and motor up to the other, haul it aboard, then go back for the first anchor. If you're anchored in a strong current, retrieve the downcurrent anchor first.



Anne-Marie Hendry

Figure 3

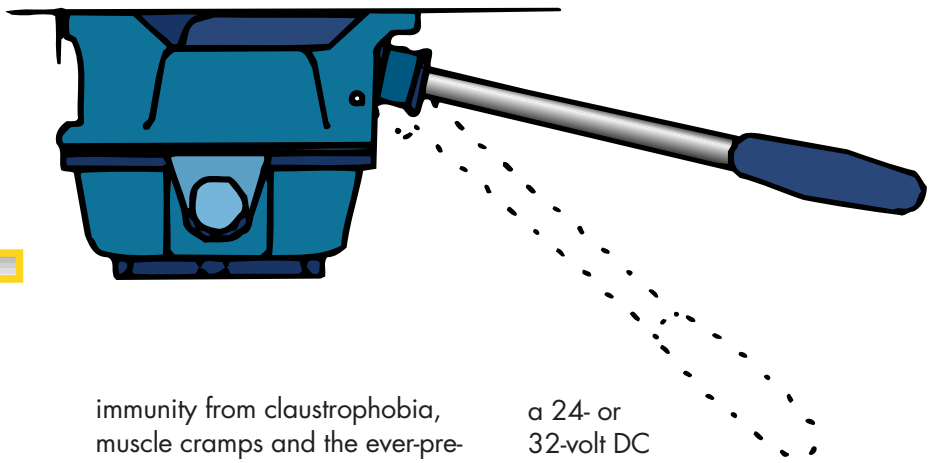
When a change of wind direction is expected or when you're anchoring in a reversing current, set two anchors at a 180° angle off the bow.

BOTTOM'S UP

When you're anchored in a rocky bottom or over what once was a thriving forest, the anchor may refuse to budge. If you used a buoyed trip line on the anchor, it can now double as a retrieving line. Pull on the trip line in the direction opposite to that of the rode and it will lift the anchor upside down.

A better method and one that doesn't require extra line that can easily foul, is to use an Ankorex (see sidebar "Just Launched" on page 14).

PLUMBING 101



By Nick Bailey

If you, like most *DIY* readers, own an older boat and are inclined towards self-reliance, you already know that plumbing seems to account for more than its fair share of trouble among the onboard systems. It's the little things — all those fittings that leak, pumps that won't, potable water that isn't, diabolical heads that always clog or smell, a seized gate valve or broken thru-hull (with sea water rushing in!) — little, nasty things that can ruin your whole day. And, it's the surveyor's emphatic disapproval of your scupper hoses or the holding tank that is about to explode because the vent is clogged. "Run for your lives. It's a bomb!"

Furthermore, because the boatbuilder originally installed many of these items before the deck went on or the twin V-8s were wedged in, you can't even reach the offending parts, let alone fix them. Never mind. If you have the plumber's prerequisites of grim determination, double-jointedness, a colorful vocabulary and a basic tool kit, as well as immunity from claustrophobia, muscle cramps and the ever-present bilge slime (get a tetanus shot), you are ready to take up arms against any plumbing problem.

This article will cover plumbing for potable, gray and sea water, and bilge and scupper systems. We'll discuss waste systems, holding tank retrofits and head maintenance in our next issue.

POTABLE WATER SYSTEMS

Potable water systems range in complexity from a single, small tank hooked to a manual pump in the galley to multi-fixture hot-and-cold-water pressure systems on larger yachts that can even include washing machines and ice makers (**Figure 1**).

Around 1970, typical equipment consisted of monel (most common) and some galvanized tanks and copper plumbing, often with a big Jabsco diaphragm pressure pump at the heart of the system. In the case of larger powerboats, a 24- or 32-volt DC electrical system was often the norm. Faucets and fixtures were not much different from what you would find at home. Smaller boats (under 10.5m/35'), especially sailboats, typically were not fitted with pressure water systems. Throughout the 70s and into the 80s, however, as boatbuilders encountered greater consumer demand for "luxury" systems, pressure water, hot water and many other comforts of home became more commonplace. Nowadays, those "comforts" are usually standard equipment in boats over 9m (30').

Galvanized tanks gave way to experiments with integral tanks in fiberglass boats (not always such a great idea) and then to the off-the-shelf plastic (polyethylene) tanks commonly used today. Copper plumbing was replaced by reinforced vinyl "clear braid" hose which, in turn, gave way to semi-rigid plastic pipe — often with proprietary self-clamping fittings such as the Whale System 15, Flair-It, Qest or Serkit systems.

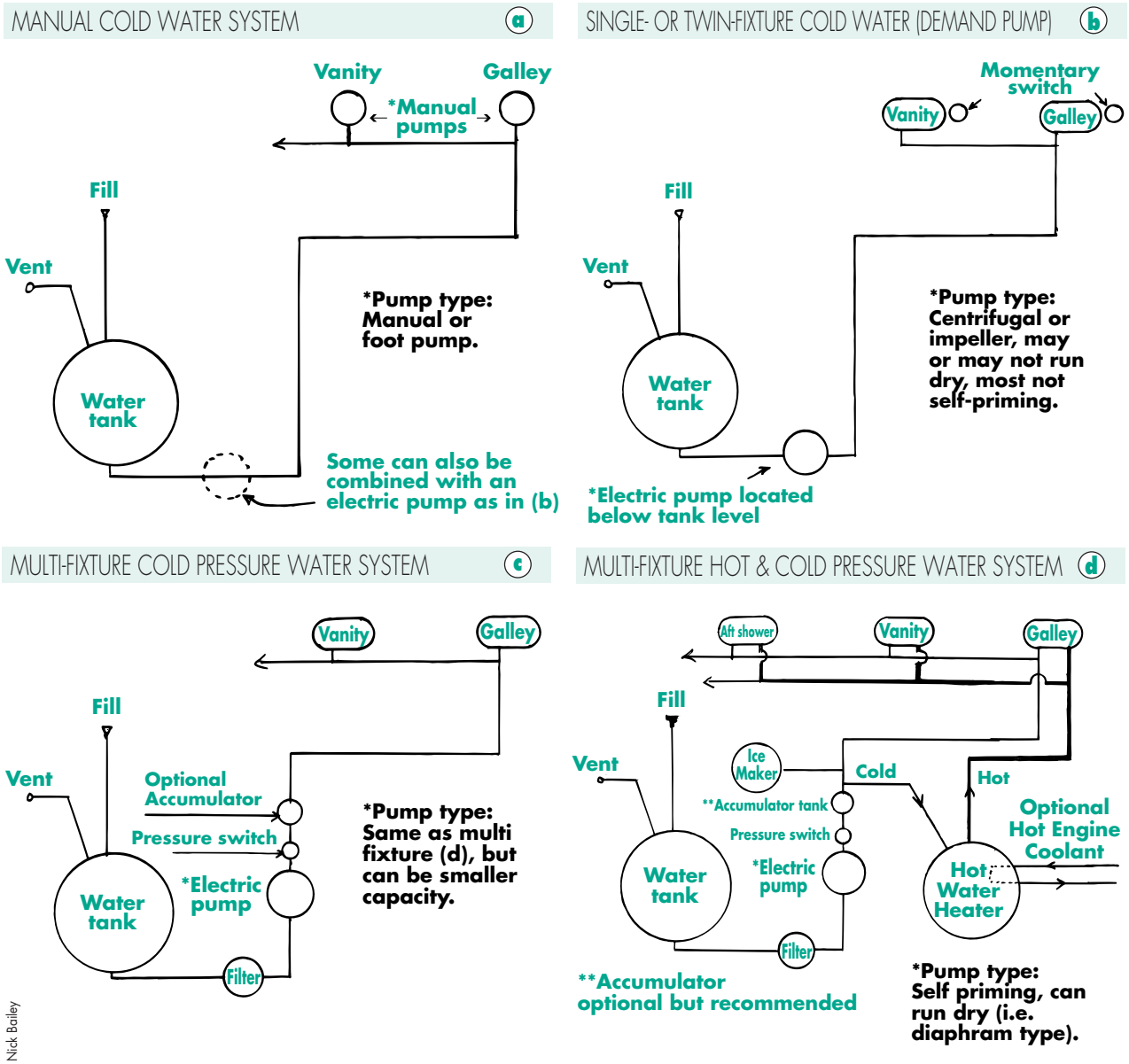


Figure 1

Sample water systems. A) manual cold-water system B) single- or twin-fixture cold-water system (demand pump) C) multi-fixture cold pressure water system D) multi-fixture hot-and-cold pressure water system.

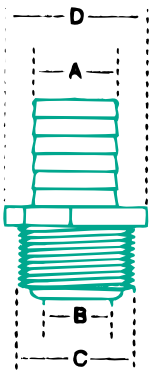
Reciprocating diaphragm pressure pumps are still popular, though they are being gradually replaced by rotary multi-lobe diaphragm pumps such as the Flojet Quad II (the originator), Groco P-9000, Jabsco Par-Mate or Par-Max, SHURflo Silencer and Whale Evenflo pumps. These pumps are usually quieter and less expensive, yet offer the same ability to run dry without damage and self prime that is characteristic of traditional diaphragm pumps.

Water at the touch of a button is also available in simple cold-water systems by fitting an in-line "demand" centrifugal pump that can stand alone or "flow through" and supplement an existing manual pump.

Before proceeding with any upgrades or repairs, however, check your water system in detail to verify hose or pipe sizes (**Figure 2**), the size and style of fittings and the exact model of your electric pump, if you have one.

Refits

Most water systems leave room for improvement, whether it's upgrading a cold-water pressure system to full hot and cold water or simply installing an in-line primary filter before the pressure pump. (This filter will eliminate problems due to debris jamming the valves; any



Courtesy of West Marine

Figure 2

The following chart shows how dimensions compare on various sizes of straight tailpieces. Note that the hose-barb end of the tailpiece (A) measures the same as its listed size, unlike the pipe end (C) which is not related. (Courtesy of West Marine.)

Size	A	B	C	D
1/2"	1/2"	5/16"	13/16"	2-1/4"
3/4"	3/4"	1/2"	1"	2-1/4"
1"	1"	13/16"	1-5/16"	2-1/2"
1-1/4"	1-1/4"	1"	1-5/8"	2-3/4"
1-1/2"	1-1/2"	1-1/4"	1-7/8"	3"

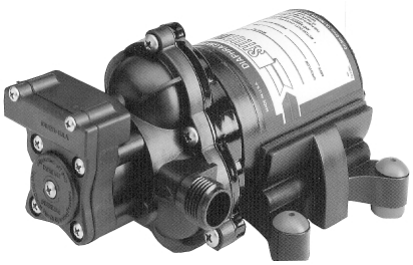
pressure system without one is bound to be troublesome.)

Here are some other upgrades worth considering:

1/ Add an accumulator tank. This is an air-filled tank connected to the discharge side of the pump. It will smooth out water delivery and stop the annoying rapid on/off cycling of the pressure pump.

2/ Replace the pressure pump with a new rotary-type pump. These are much quieter and some manufacturers offer an inexpensive rebuild kit for the old pump.

3/ Add a shower, whether it's a cold-only or a hot-and-cold-water system, a cockpit or swim-platform shower is guaranteed to be a popular addition to any pressure water system, especially after you've been swimming in salt water. Complete kits are available from several manufacturers (Attwood, Heater Craft and Whale are just a few examples). The kits incorporate a neat, recessed well for the mixer assembly. Just make a cutout in the cockpit wall or transom and tee into your existing plumbing. Make sure you know what you are cutting into — you'll want to miss fuel and water tanks, wiring, piping, or structural stringers — and that you have enough room to run the plumbing.



Modern rotary multi-lobe diaphragm pumps, like The Silencer from SHURflo, are quiet, can run dry without damage and are self-priming.

4/ Replace old faucets and mixers. Many attractive units designed specifically for boats are now available (Barka, Scandvik, SHURflo, Tempo and Whale are popular makes).

5/ Add a secondary water filter. A variety of in-line activated charcoal filters are now available that can improve your water by reducing the impurities that cause bad taste and odors. Most of these filters won't eliminate bacteria by themselves and must be used in conjunction with antibacterial tablets or additives or another filter. One exception is the New World filter (#7054), which uses a three-stage filtering process to remove bacteria. Another filter unit, the Water Fixer, also uses UV light to sterilize the water. If you've got a case of really stinky water, drain and sanitize the system first (see Maintenance on page 23). Water Fixer also sells an in-line UV chamber that's easily retrofitted in a boat already equipped with a filtration system.

6/ Electrify your manual water system.

Option 1: Whale and Jabsco offer small, in-line pumps complete with manual switches that can either work through your manual pump or replace it. This is a simple installation (though the centrifugal non-self-priming pumps have to go below tank level) and this type of pump won't be damaged if it happens to be switched on when the faucet is closed.

Option 2: By adding the appropriate faucets and, if necessary, upgrading the hose and fittings on your system, it's fairly easy to install a pump complete with an automatic pressure switch and convert to the convenience of a pressure water system.

TIPS

Anne-Marie Hendry

EMERGENCY PLUGS

*You should always have on board a collection of tapered softwood (pine or cedar) plugs sized to jam into a failed hose, a broken CPS (Cheap Plastic S!*t) thru-hull or when you have to disconnect a hose and the valve won't close. Corrosion can lead to sudden failure of a fitting, as can a lightning strike. A lanyard threaded through the plug is wrapped around the base to keep water pressure from pushing out the plug. These plugs are the ultimate plumber's helper.*

Flojet's 2840 with a Quad II rotary diaphragm pump and accumulator tank mounted on a plastic base makes a compact package for pressurized water installations on larger boats.

7/ Add a manual backup. Install a manually-operated pump in a pressurized water system to ensure that water can be drawn in the event of a power failure. Tee the hose for the hand pump upstream of the pressure pump.

8/ Add a deep sink. Older boats with shallow, oval-shaped sinks are easily retrofitted with deeper high-quality stainless steel rectangular ones or double sinks; on some installations the two basins may be the same dimensions as a single.

9/ Install a tank monitor. These units use everything from the old-fashioned dip stick to pressure, sonar or electric sensors to read the fluid level in the tank. Most work well in water or fuel but are unreliable in a holding tank. One of the more dependable units, the Tank Tender from Hart Systems, operates on air pressure. You simply pump air into the tank and a gauge reads the amount of pressure in inches of liquid. And since there's no wiring involved, these units are easy to install. The all-new electronic Tank Scan from Northern Research can monitor up to five tanks by means of a sonar sensor mounted on the outside of each tank, eliminating the need to cut into the tank.

General Installation Tips

Any plumbing work leads you into the question: "What size is it and will this fit to that?" Finding the answers to these questions is not made any easier by the fact that on any given size of NPT (National Pipe Thread) fitting there isn't any threaded part actually measuring that size (**Figure 2**). Hose-barb diameters generally measure at their nominal size but nominal sizes for hose are based on the inside diameter and bear no relationship to the outside dimension. On the other hand, pipe sizing is roughly based on the outside diameter.

Make sure the hose or pipe you use is food grade (garden hose is not acceptable). Clear PVC hose is fine for cold-water non-pressure systems. Clear braid reinforced PVC hose is okay in hot-and-cold pressure systems and is the least expensive.

Many argue that despite their higher cost, semi-rigid pipe systems are the easiest of all to install. Installation requires few tools (**Figure 3**) and you won't have to struggle to jam stiff hose over barb fittings or fiddle with hose clamps. Soften the hose in hot water, then rub a small amount of dish detergent or Vaseline on as a lubricant, or heat the hose end evenly with a hair dryer until it softens. Semi-rigid pipe won't kink as easily, either. If you do use semi-rigid pipe, however, plan very carefully and be prepared to order the fit-

Continued on page 22

Replacing old faucets and mixers with new, more-stylish designs is a worthwhile upgrade.

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Adding a Water Heater

If you live and cook aboard for longer that the occasional weekend cruise, hot running water is more than a convenience. The good news is that if your boat has a 110-volt shorepower system and cold water, you're already halfway to a hot-water system.

There are two completely different approaches to the problem: a storage-tank heater or a flow-through "demand" heater. The former is the most common type of system. It has a storage tank very similar to a household unit but with a smaller capacity. Heat is usually provided at dockside by a 1,500-watt 110-volt AC heating element and, while underway, by hot engine coolant recirculating through a heat exchanger in the tank. Units are available from Atlantic Marine, Raritan, Seaward and others. Never install a household water heater which is not ignition protected and could spark and cause a fire.

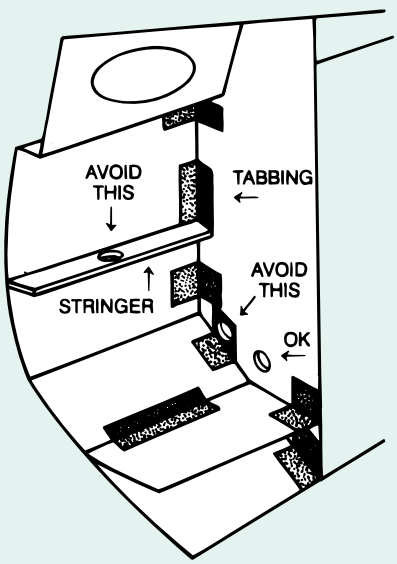
Demand heaters that do not store water but heat it immediately before use are usually fired by propane, are less common on boats and are beyond the scope of a do-it-yourself article. Work with explosive propane and the handling of combustible gases should be left to a licensed gas fitter.

In a similar vein, if you are not familiar with the basic 110-volt wiring required to hook up your hot-water heating element, you should seek the assistance of someone who is experienced. At the very least, have your connections checked prior to plugging in the heater.

When planning the layout of the system, especially the tank location, try to arrange a close look at the same model boat already equipped with a factory-installed system — and copy it where that's practical. Or you can contact the builder (if they're still in business) for guidelines. A professional-looking "stock" installation will always raise the resale value of your boat. You do, however, have the freedom to install more deluxe fixtures should your budget allow it.

The tank will need to sit on a level surface so a solid 19mm (3/4") plywood epoxy-painted shelf will need to be prepared and screwed or fiberglass tabbed into place (see **Figure 8**). Once the tank is shoehorned into place (usually a tight fit in a cockpit locker or in the engine room) and fastened securely, run your cold water (in) and hot water (out) lines with hose. For the "hot" side, good quality clear-braid PVC hose is pressure-rated at 65°C (150°F) and connects the traditional way with adapters and double clamped. (Make sure the clamps are tight, but not so tight they cut into the hose. If you see particles of hose squishing through the cracks in the clamp, you've destroyed the hose.) An even better choice is semi-flexible plastic pipe, which is more durable, less prone to kinks and usually has fittings that are less likely to leak and easier to assemble.

Threading piping through the boat is time-consuming and fiddly work. Access is often difficult and you will probably have to drill many holes through bulkheads. Be very careful! Before cutting or drilling anything, check on each side of the bulkhead or partition to ensure you don't cut into a tank, wiring or other piping, or structural stringers or tabbing that hold the bulkhead in place (**Figure 8**) . Fasten the plumbing every few feet with cable clamps or wire ties and try to keep it out of the bilge to prevent contamination. Avoid tight bends that can kink hose;



American Boat and Yacht Council

Figure 8

Before cutting or drilling anything when running piping, check on each side of the bulkhead or partition to ensure you don't cut into structural stringers or tabbing that hold the bulkhead in place.

Equipment list:

Description	Cost
6-gallon (typically) hot-water tank (may not include engine coolant heat exchanger and a place to put it!)	$350-$600
15-amp breaker	$25
14-gauge multi-strand boat cable	$1.37 per foot
Replacement mixer for galley (or additional single faucet)	$20-$100
Mixer for vanity (plus optional shower) and shower sump and pump	$20-$100
Hose or pipe sufficient to go from heater to galley and vanity	$10-$100
Tee for cold-water line, miscellaneous fitting connectors, elbows, clamps	$20-$100

instead, install a 90° elbow. The tee connection to the cold-water system can be made anywhere downstream of the pressure pump and before the first fixture. Hot water heaters need a check valve, either at the water inlet to the tank or at the tee connection so the hot water cannot flow back into the cold water. Make sure you have one. You may have to remove the sink to get access for your connections to the mixer or faucet. Provide for easy access to the tank, fittings and all connections for maintenance.

Any 110-volt wire used should be at least 14-gauge copper multi-strand boat cable and must be sized to the amperage and wattage of the heater; depending on the routing, you may need 12 or 10 gauge. Household single-strand cable is not safe in a boat because engine vibration and jarring from when the boat slams into waves fatigues the wire, leading to breaks and shorts and fires. The hot (black) wire connects to one terminal of the element and the neutral (white) wire connects to the other. Ground the tank via the green or bare copper wire.

Assuming you have a 110-volt system — a breaker panel and hull inlet with circuit protection that was installed to nationally-recognized codes (NFPA) — connect the white to the common neutral buss and install the breaker into an empty slot in the panel connecting the hot (black) lead to the breaker and the breaker's other pole to the hot distribution buss. Never directly connect a water heater to a power cord plugged into an outlet on shore. Don't do any wiring until you have unplugged and stowed your shorepower cord — a well-meaning soul just might plug it back in again at an awkward moment. Keep all 110-volt A/C wiring physically separate from your DC wiring. Make sure no neutral (white) wires connect to any ground within the boat — *this is critical* — and make sure your shorepower cord and main AC supply is properly grounded through the dockside power system. Now turn on the pump, fill the tank and turn on the power in that order to avoid heater element meltdown. Check for leaks. There will be a few. (Contrary to popular opinion, AC electrical service does not cause stray current corrosion; this is a DC problem, either within the boat circuit or through the AC grounding wire. If you're concerned about stray current corrosion, install a galvanic isolator or isolation transformer.)

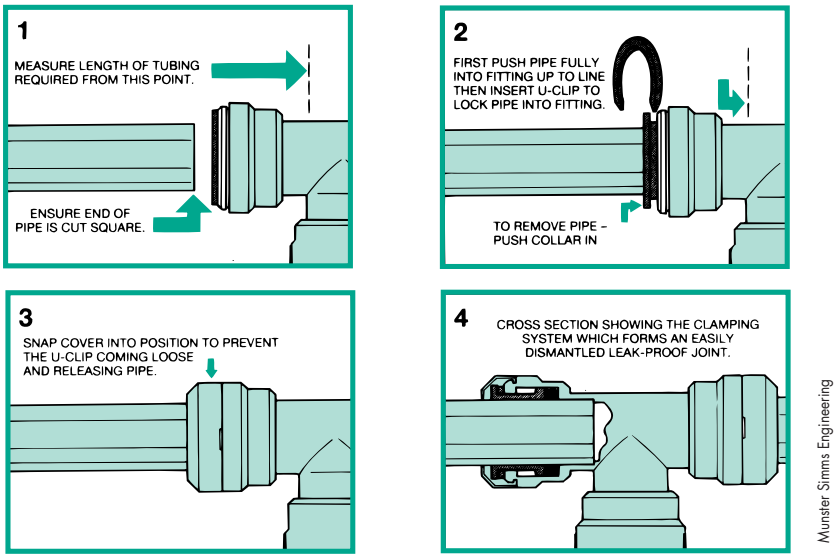
Next, hook up your engine hot-water heat exchanger — consult a mechanic or your local engine representative first. Some raw-water-cooled engines (early Yanmars for example) won't put out a steady supply of hot water; the temperature alternates between hot and cold as the thermostat opens and closes. Others, such as Atomic 4s, need a separate recirculating pump to help move the engine coolant through the heat exchanger.

PLUMBING 101

tings in advance; few retailers are likely to have everything you need in stock.

Make sure all pumps are wired following the manufacturer's directions and are fused properly. With wiring and plumbing, neatness counts. Seawater hoses should be top-quality fabric or wire-reinforced rubber. It's good practice to double-clamp hoses (this is not always possible) with clamps of all-stainless steel (including the screw) fastened so the screws are staggered (**Figure 4**). (The double-clamp rule applies to all exhaust and fuel-fill connections and, if possible, seawater connections mounted less than 15cm (6") above the waterline.) To prevent leaks when the hose and adapter fit poorly, or to seal existing leaks, apply sealant to the adapter only (**Figure 5**); do not apply to the inside of the hose. Don't use any toxic sealants like 3M 5200 or other polyurethane adhesive to seal leaks in a potable water system. Using sealants will make the removal of the hose for maintenance or replacement very difficult. Where a hose passes through a bulkhead or partition, you'll need to provide chafe protection. Use a rubber grommet (if you can find one the right size) or split a short length of oversize hose, wrap it around the system hose where it passes through the bulkhead and secure with tape or hose clamps.

For complex piping systems, it's a good practice to draw up a circuit diagram showing the location of hose runs, seacocks, connections and wiring terminals. File this in your maintenance log for quick reference when doing routine servicing or repairs.



Munster Simms Engineering

Figure 3

Whale System 15 semi-rigid pipe system is easy to install and requires no tools.
1 Measure length of tubing required from this point.
2 Insert U-clip to lock pipe into fitting.
3 Snap cover into position to prevent the U-clip coming loose and releasing pipe.
4 Cross-section showing the clamping system which forms an easily dismantled leak-proof joint.

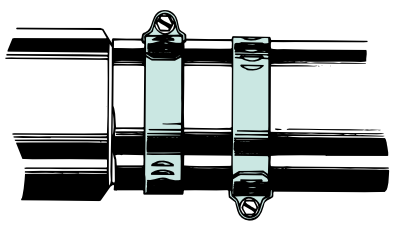


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Figure 4

Proper hose clamp installation.

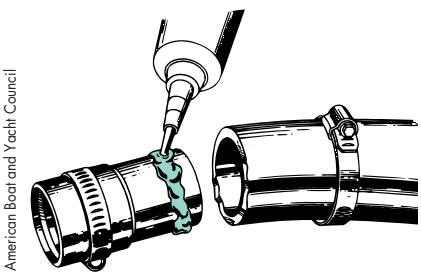

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Figure 5

To prevent or seal existing leaks when the hose and adapter fit poorly, apply a non-toxic sealant to the adapter only but take note: using sealants will make the removal of the hose very difficult.

Hot H_2O DC Alternative

So you don't have pressure water and don't want to mess with your shorepower or engine. In that case, Nautical Innovations' new Hot Springs Water Heater may be what you need. It's a plastic non-pressure-rated 15-litre (US 4-gallon), 12-volt heater that uses a 100-watt DC element (8-amp draw). This unit promises lukewarm to very warm water, 32°C to 40°C (90°F to 105°F), with a three-hour to overnight recycling time, depending on the temperature of the cold water going in. It's connected as an auxiliary tank by selector valve to a non-pressure system. This will provide a couple of foot-pump showers plus dishwashing daily and is well within the maintenance level of a small battery charger (keep an eye on your battery electrolyte levels). At US$200, it's a lot more civilized than a solar-heated "sun" shower water bag.

Atlantic Marine also offers a 100-watt DC element for its T Series stainless-steel heater, best fitted in the 15- litre (US 4-gallon) model. This heater can be used in a pressure system and has an optional engine heat exchanger (US$439 and up).

Maintenance

Given proper winterizing, a potable water system should not need much maintenance other than the occasional water-pump service or repair and finding and fixing the odd leak. If there are foul odors, or if the system becomes contaminated, disinfect it using standard household bleach (typically a 5.25% sodium hypochloride solution).

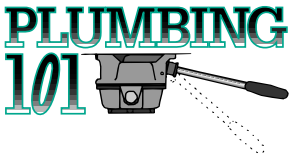
Exact instructions are given in the American Boat and Yacht Council (ABYC) standards manual, appendix H-23; here's a brief description of the sanitization treatment for water systems. (Keep in mind that bleach may be tough on rubber pump parts and it should never be used in heads.)

Step 1: Flush the system with potable water and drain it completely.

Step 2: Fill the system completely with chlorine at 100 parts per million and allow to stand for one hour.

Step 3: Drain and flush thoroughly with fresh water.

Step 4: Refill with potable water. If the tank still smells like bleach, you haven't flushed it enough.



You should also check your tank regularly for bacteria with a water-testing kit such as WaterCheck (CDN$9.95). Simply pour water into the bag and let it sit for 24 to 36 hours at room temperature. If the water turns blue, it may be unsafe to drink; drain the tank and rinse it using the method outlined above or another chlorine-based water treatment.

Rust is another common maintenance problem on older boats or steel boats with integral metal tanks. Corrosion eventually overcomes the galvanizing or epoxy coatings, first causing rusty water and then causing the tank (or hull) to leak. If replacement of the tank is not practical, it may be possible to gain access inside, grind or blast the corroded steel to "near bright metal" and apply a potable epoxy coating (white Devo Barrust 235, available from marine and industrial paint suppliers, can be used in this application). If the steel cannot be reached to be properly prepped, however, you'll waste your time trying to apply coatings over a bad surface. If there's even the slightest pinhole in the epoxy liner, the tank will start to rust and eventually leak again. In that case, it's time to think in terms of an auxiliary tank located elsewhere in the boat, or to consider major repairs — such as cutting out the tank and replacing it with a stainless-steel one. A flexible "bladder" tank (they're available in many sizes) or a custom-made epoxy-coated plywood tank fitted inside the old integral tank is also a viable option.

Adding a water filter will improve water quality, reducing bad taste and odors. This Water Fixer unit also utilizes a UV light chamber to sterilize the water.

Polyethylene tanks that have cracked can sometimes be repaired successfully; replacement, however, is the best option.

Pressure Water-Pump Repairs

Rebuild kits with detailed instructions are available for most high-end pressure water pumps; lower-cost pumps may not be worth the bother. The most common complaint is that the pump runs but doesn't pump; this is usually caused by debris in the one-way valves and dismantling and cleaning is all that is needed. If the pump won't run, check the voltage to the pump. If there's no problem with the voltage, the motor may be dead or the pressure switch may be malfunctioning. Using inadequate wire gauges or too-small-diameter hose will both cause motor burnout. Try shorting across the switch to see if the pump runs. If it does, replace the pressure switch. If the pump runs for a bit and then pops the breaker, you could have a bad pump motor, a weak breaker or a blocked waterline. Disconnect the waterline and try it again, then check the line for blockage.

If the pump runs on and is not shut off normally by the pressure switch, you either have a big leak or the pressure switch is faulty. If the pump cycles frequently, you have a leak you'll need to find. If the system is leak-free, replace the switch. If the lights dim when the pump goes on, either the pump is drawing too much current and you'll need to upgrade the wire size or you've got a defective pump motor, a blocked waterline or a weak breaker.

GRAY WATER AND SEAWATER PLUMBING

Gray Water

Gray water is any waste water other than the sewage from your head. Typically, galley and vanity sink drains are connected via hose to a valved thru-hull fitting ("seacock") and the gray water drains out the bottom of the boat. This works fine as long as your sink is well above the waterline. Sailboats have another problem. The sink that is above the waterline when the boat's at anchor may not be when you're sailing upwind with the boat heeled 20°. Owners of such boats soon get into the habit of shutting off the seacock when the sink is not in use; forgetting to do so is not conducive to domestic

FILLER 'ER UP

To prevent the heating element in the hot water tank from burning out when you recommission your boat, fill the tank with water before turning on the power.

TIPS *CONSERVE WATER*

Use seawater for clean-up jobs in the galley. If your boat has a washdown system, tee off the discharge side of the pump and hook up the hose to a manual pump or a kitchen-type sprayer mounted in a convenient place in the galley.

harmony — and adds unnecessarily to the excitement of cruising. When the drain is below the waterline, as it often is with a shower or in sinks in deep-draft vessels, you must collect the waste water and pump it overboard.

I have seen instances where the whole bilge served as the collection point for gray water. With any extended use, however, you will end up with bilge reek not dissimilar to that in an 18th Century frigate. That may sound romantic, but it isn't, especially if some among the crew are already feeling a bit green. A better option is a small, easily cleaned collection sump, or a tank with its own automatic or manually-switched submersible or self-priming diaphragm pump. This sump accepts drain hoses from one or more fixtures. While showering or draining a sink, you switch on the sump pump and the pump's discharge overboard will usually stay ahead of the incoming flow of waste water. Better yet, if the pump has a float switch, it will turn itself on. Any submersible pump or pickup strainer in the sump or gray water tank will require occasional cleaning to remove hair and other debris, so you must be able to gain easy access to the sump.

SEACOCKS, THRU-HULLS AND VALVES

In general, hull "skin fittings" and the hose systems connected to them are critical components, whether they are draining waste water out or letting fresh water in. The following anecdote provides an example of some of the little things that can sink you.

In the summer of '75 in Toronto, Ont., the influential owner of a new 9m (30') sailboat built by a well-known and reputable Canadian manufacturer received a call from his downtown marina. It seemed that his boat had inexplicably sunk at its mooring. After salvage, the builder's representatives discovered that the threads on the white metal nut holding the galley sink tailpiece in place had been machined a bit too thin and the nut (a 65-cent item) had split, letting the now disconnected sink drain hose and tailpiece fall just below the waterline (glub, glub, glub). Subsequent boats from this manufacturer all have a piece of wire holding up the tailpiece and a little tag on the companionway drop board that reads "Good seamanship dictates that all seacocks be closed when leaving the boat." This was a lesson learned — fortunately, no one was put in danger during the learning.

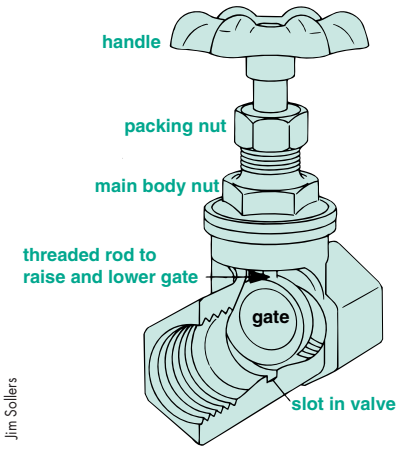


Figure 6

Gate valves fail without warning — they seize easily, the stem breaks if forced and debris prevents the gate from closing. Replace all valves below the waterline with quarter-turn ball valves.

You should carefully check your own below-waterline hardware and think about things that might cause

PLUMBING 101

a sinking. Hoses should be top quality, securely clamped and replaced immediately if they become cracked or weathered. Hose clamps should be all-stainless. Seacocks, thru-hulls and

Figure 7

Marelon fittings are better than bronze units as they don't corrode and require less maintenance.

valves should be fiber-reinforced plastic (such as RC Products Marelon fittings by Forespar), or bronze or stainless, but never brass nor CPS (Cheap Plastic S!*t!). Many boats sink every year from thru-hulls made of delrin or CPS. Impending failure is evidenced by cracking and crazing on the outside flange. Often, the thru-hull is sealed with a non-compatible sealant that attacks the plastic. Better to replace all CPS thru-hulls.

Seacocks should be quarter-turn ball valves because they are faster acting and less likely to seize. Gate valves (**Figure 6**), recognizable by the "tap" handle that is turned to open or close the valve, are a poor choice on a boat since you can't tell at a glance if they are open or closed. Furthermore, the gate that raises and lowers inside the valve as the handle is turned can easily be prevented from seating properly by debris, the valve seizes easily and the stem is easily broken off if forced. A worthwhile upgrade project is to replace all gate valves with quarter-turn ball valves. When you're installing new or replacement seacocks or valves, be sure their operation isn't hindered by other fixtures or hardware and that they are easily accessed for maintenance.

Marelon fittings (**Figure 7**) have been on the market now for many years and, in many ways, are as good as bronze units with the bonus feature of being immune to galvanic corrosion — the grim reaper of any underwater metal. Be careful which way and with how much torque you apply to a Marelon handle or it will break. Keep a few spares on board. Tip: If a Marelon valve jams, back off the large assembly nut until the handle turns (about one turn), then slowly retighten the nut while turning the handle until you feel resistance.

TIPS — REVERSING THE FLOW

For sailboaters only: Does water flow into the sink via the drain when your boat heels — either when sailing or grounding — rather than out of the sink? Install a one-way check valve in the drain hose.

Seawater (raw water) is often in demand on board — for engine cooling, head flushing, galley prewash rinsing, deck washing, air-conditioner cooling and so on. If you are adding a new seawater fixture, avoid the temptation to tee it off the engine intake. This could cause your engine coolant pump to suck air at a critical moment and overheat (leaving you with an expensive repair). You can safely tee off your gray-water outlets, though you may find your new pump clogged with hair or bits of galley trash. Our next issue will look at the particular requirements to handle seawater without siphoning and overflow of the head. If your head is below the waterline, this again can cause sinking.

Maintenance

All seacocks and valves need yearly lubrication and inspection. The traditional seacock has the thru-hull and valve as a single unit utilizing a tapered plug and seat either in-line or at right angles to the axis of the seacock. The plug has a hole in it which lines up with the outlet in the seat when the seacock is open. Such units have a lot of moving metal surface in contact and can get very stiff if not well greased. At least once a sea-

son, disassemble each seacock and lubricate and repair as necessary.

BILGE PLUMBING

The bilge pump is on one hand a convenience and on the other a critical safety system. There are a surprising number of boats that rely on their bilge pumps — planked wooden boats that never quite took up after launch; runabouts with leaky covers and badly scuppered cockpits; inboards and auxiliaries with dribbling stuffing boxes; and many others. If left unattended and not pumped they either promptly sink or sink after the first all-day rainstorm of the season.

Many people rely on their automatic electric bilge pump to keep their boats afloat without even being aware they're doing so. This is a dangerous position to be in because, sooner or later, every bilge pump stops working. (Of course, working in the marine service industry may cause my opinions to be biased; I don't get to see the reliable pumps!) Float switches jam or fail, batteries dry out or go flat, pumps burn out or are clogged with debris or rust which never sleeps.

If you are planning to install an electric bilge pump consider the following. There are basically two types: submersible centrifugal-style pumps (from Attwood, Depco, Groco, Lovett, Mayfair, Rule, SHURflo, Vetus and others) and non-submersible self-priming diaphragm types (such as the Flojet LF-12) with a strum box or screened pickup in the bilge. All bilge pumps require some kind of strainer or screen to prevent fouling of the impeller in the cage of the submersible unit or the one-way valves in the diaphragm pumps. Either type can be controlled by an automatic switch or manually triggered. The non-submersible unit has an advantage if access into the deepest part of the bilge is difficult (in deep-V boats,

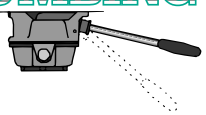
Corrugated hose typically sold for bilge-pump use is cheap, but the corrugations slow down the discharge rate and heavy tools or a carelessly placed foot will crush it.

for example). The submersible has the advantages of lower cost and, in some big models, very high flow rates. Both types can run dry safely, although the submersible pump bearings will eventually overheat if they become dry. Lovett pumps are the only submersible units that are UL approved, meaning they meet minimum vibration, shock and safety requirements.

Bilge pumps must be mounted on a flat surface and fastened securely with self-tapping screws, a good underwater adhesive or by clamping them to a bulkhead or stringer. Refrain from using the corrugated hose typically sold for bilge-pump use. The price is right but the corrugations slow down the discharge rate — according to Tom Hale, technical director of ABYC, the hose reduces outflow by as much as 40%. The smooth "cuffs" on the ends located every foot or so also don't allow enough room for two clamps. Smooth-walled reinforced PVC hose (as flexible as you can find) that won't kink or crush when it's stepped on is a better choice. Be sure the pump is wired correctly — hot wire is brown, ground lead is black. Wiring must be secured with cable ties and connections should be made well above the water level in the bilge. Short leads from the pump often make this impossible and you'll need to use adhesive-lined heat-shrink terminals. (See WINTER '95 for complete crimping instructions.) Consider using these anyway to ensure connections are impervious to water sloshing about in the bilge.

When choosing a pump, keep in mind how far the pump must push the water upwards before it goes over the side. Remember that nominal flow rates are based on zero lift or a zero head discharge rate. Installation factors — the type of hose and number of bends, how far the pump must push the water, the height of the thru-hull fitting — all affect flow rates. A fair lift is often required. This consideration is critical when you're deciding where to put the discharge fitting of any bilge pump so water won't drain back into the boat under any

PLUMBING 101



circumstances. Water reversal is a common problem in many boats that immerse the above-the-waterline thru-hull; the thru-hull is covered underway, causing a back siphon, and the bilge floods with water when the pump shuts off. To prevent backflowing, loop the discharge hose high above the water-

Every boat should have at least one high-capacity manual bilge pump as a backup.

line; don't use a one-way check valve which can trap crud and restrict flow. Unfortunately, either solution reduces a pump's discharge capacity and they are only effective where the thru-hull is installed a minimum of 20cm (8") above the waterline. On sailboats, the measurement is taken when the boat is heeled; installation is usually only possible when the discharge hose exits at the transom near the centerline. Where the thru-hull is mounted closer to the waterline you need to provide an anti-siphoning valve at the top of the loop or an air vent. This can be accomplished by teeing into a cockpit drain or into a shower discharge. All tees must be high above the waterline.

Lovett bilge pumps are the only submersible units that are UL approved and have replaceable parts.

Various automatic switches are available, from simple tilting floats that usually contain a switch triggered by liquid mercury (these can jam and foul) to air-pressure types (more reliable) and even sonic and electronic sensors (definitely more expensive; maybe more reliable).

Regardless of the sophistication of an electric pump system or even an engine-driven pump, power can fail and every boat should have at least one high-capacity manual bilge pump as a backup. (And, a large bucket! It's said that there is no manual bilge pump better than a frightened boater with a bucket and this is probably true but, at that stage, you are probably better off sending out a Mayday call on the VHF while pumping with the other hand!) These are positive displacement diaphragm pumps. Diaphragm pumps are rugged, can pass some debris and solids and are available in a variety of sizes. They can be installed internally with a deck plate or in the open on a bulkhead. Units are available from Henderson, Edson, Rule, Vetus and Whale.

If you own a small boat don't skimp on the pump size. Remember that given the same 2.54cm (1") hole in a hull, a small boat will fill and sink a lot faster than a large one. When fighting a leak, you need all the time you can get.

Maintenance

Bilge pumps don't need much maintenance. Simply keep the float switches and the bilge clean and free of debris and oil which can damage the rubber parts in most pumps. (Remember that submersible units generally have to be replaced when they fail, with the exception of the higher-end Lovett pump — all of whose components, be it a set of belts, switch or motor, are fully replaceable in the event of a failure.

And that brings us to the ultimate bilge pump: the wet or dry vacuum (Shop Vac). Granted, it only runs on shorepower, but it's the only pump that will get every last drop of water out of your bilge. Try it sometime! In our Thunderbird sailboat fleet it is considered essential equipment. In an emergency situation,a valuable alternative to a bilge pump is to use the intake hose of the engine cooling water pump. Debris in the bilge can plug the engine, so you'll need to attach a strainer (screen) to the hose end.

SCUPPER PLUMBING

Power- or sailboats with large open cockpits often come from the factory with woefully under-engineered scupper drains. Consider this worst-case scenario: a disabled or slow-moving boat in a following sea suddenly pooped and swamped by a big breaking wave. Would your boat survive this? Lots of big scuppers in the cockpit are a good thing. If possible, have them drain above the heeled waterline or you must install seacocks. If your cockpit is so deep that it is close to or below the waterline, any drains will have to go to seacocks installed in the bottom of the hull.

Sailboats with deep tee-shaped cockpits have particular problems because when they heel the scuppers are just as likely to pump water in as let it out. One-way flapper valves can help. Often the hoses are crossed from one side to the other so that the port drain goes to the starboard thru-hull or vice versa. This keeps the low-side thru-hull connected to the high-side drain and everything stays dry. This style of hose arrangement can be a liability during winter storage in northern climates, however, as it's difficult to avoid low spots that trap water in the hose. This water may freeze and block the scuppers or, worse, pop the hose off the drain fitting allowing the boat to fill up with water over the winter. (A good leak-free tarp is recommended.)

Powerboats have their own scupper problems. For example, there is a scupper system on a deep-V sportboat built by a reputable manufacturer that is supposed to drain the cockpit and engine hatches to a series of shallow aluminum channels. These channels lead to a thru-hull and flapper valve an inch or two above the at-rest waterline on both sides. If a twig, leaf or other small debris were to lodge in the one-way valve, forcing it to open, and if two people stood to one side of the cockpit, water would happily flow back into the boat and into the engine compartment. Yes, the boat will sink at the dock once the bilge pump quits. I've seen it happen. This type of scupper system needs serious reworking.

TIPS — A BAD FIT

Double-clamped hose connections are best but sometimes the fitting on the pump is not long enough to fit completely under the back-up (outer) clamp. When this happens, don't tighten the clamp so much that it partially collapses the hose.

Maintenance

Scupper hoses should be of the same high quality as others below the waterline and should be replaced if they become cracked or degraded. Follow the same maintenance procedure for seacocks or valves below the waterline as you would for those above.

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. He and his wife own and race a wooden Thunderbird that recently underwent a major refit. Watch for an article detailing some of their renovations in our next issue.

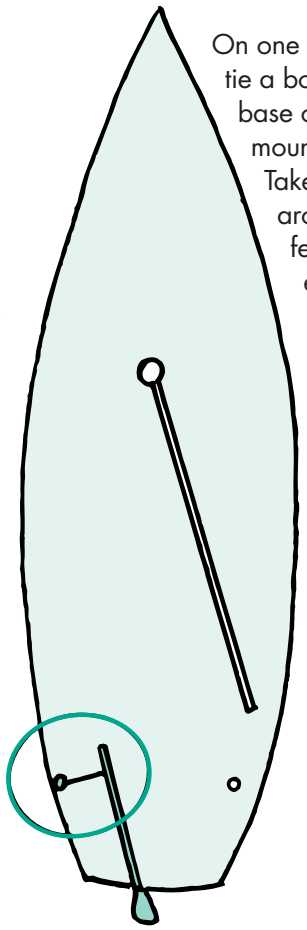
SAILBOAT RIGGING

A HELPING HAND

By Vicki de Kleer

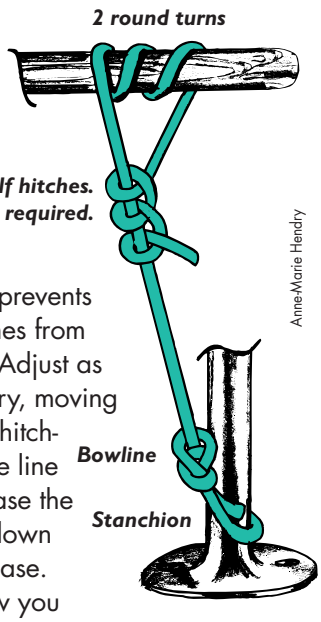
Here's a simple but very effective method of securing the helm when sailing single-handed if your boat is not equipped with an autopilot. Unfortunately, this tiller-to-sheet steering system works only when sailing upwind in a steady wind. And on gusty days, the tiller won't respond quickly enough and the boat will luff, then fall off, so you'll have to go back to hand-steering or heave-to when you need to leave the helm.

You'll need 2.5m to 3m (8' to 9.8') of 4-mm (3/16") nylon braid. (Any old and worn, i.e. soft, line works well.)



Rudder set to counteract normal weatherhelm of the boat.

On one side of the cockpit, tie a bowline around the base of a securely-mounted stanchion. Take two round turns around the tiller, a few inches from the end. Now sail for a few minutes to determine the correct position of the tiller, allowing for a slight weather helm. (You may need to balance the sails, adjusting the jib and main to minimize weather helm.) Pull the line snug to hold the tiller firmly in position and put three half hitches firmly around the taut standing part of the line.



Anne-Marie Hendry

Friction prevents the hitches from sliding. Adjust as necessary, moving the half hitches up the line to increase the reach, down to decrease.

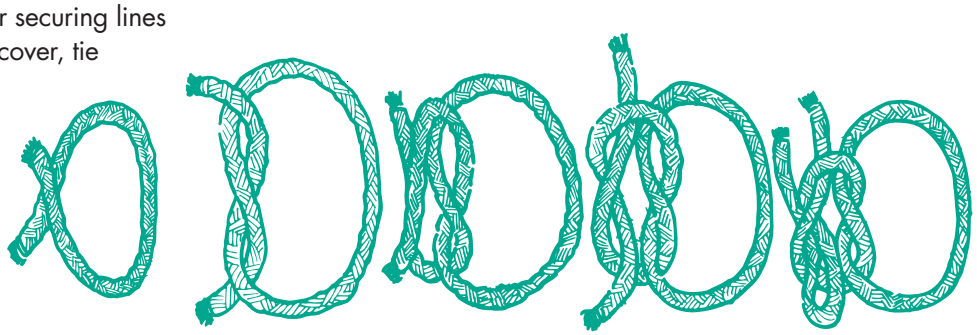
Now you have the freedom to leave the helm to work on the foredeck, check the charts, make coffee or whatever. If you have to suddenly change course, just slide the two round turns off the tiller and steer by hand.

As with any self-steering system, always keep a lookout for other boats and navigation hazards.

KNOTTY KNOW-HOW

Slipped Reef Knot

A practical knot for securing lines around the winter cover, tie downs, sail ties, coiled anchor line, hose or cable, or any wrapped bundle is the slipped reef knot.



Anne-Marie Hendry

A modified reef knot, it's very easy to release under load when the knot has tightened, especially with cold or numb fingers. To tie the slipped reef, make two overhand knots, one to the right, the other to the left (or vice versa) but leave a loop in the end of the second knot. To release, pull the doubled end and the top overhand knot will easily untie; the load then releases the second part.

ENGINE TROUBLESHOOTING

PROJECT: ONAN GENERATOR: Manual Choke Conversion

By George Van Nostrand
Photos by Sheilah Van Nostrand

There are hundreds of Onan gas generators, MCCK models 4.0 and 6.5 kW, still in use on older boats. Many are running with defective automatic chokes that fail to open when warmed up, resulting in poor fuel economy, oil dilution and excessive carbon buildup.

Figure 1

Conversion kit parts.

Here's a quick and easy way to check the efficiency of this unit. First, remove the air silencer/flame-trap assembly from the carbureter. Now, start the generator and run it for five to 10 minutes. While it's running, reach into the carbureter throat with your index finger to feel the choke butterfly position. It should be wide open. If it's not, replace the choke.

Figure 2

Automatic choke unit.

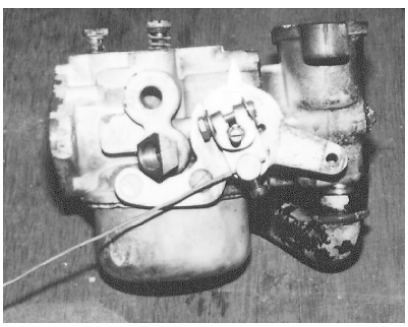


Figure 3

New lever assembly attaches to the wire of the manual control cable.

An original automatic-choke assembly replacement for the Onan is hard to find and, if you're lucky enough to locate one, quite expensive ($250). A simple cure is to replace the automatic-choke assembly with a manual-choke kit designed for inboard engines. Trot off to your local UAP/NAPA auto parts store and purchase a DOCAP #DXL-22 (**Figure 1**), which includes a 1.8m (6') cable and instructions for under $20. If a longer cable is required, buy a PAPCO choke cable, part #310-125 (3.9m/13') or #310-316 (4.5m/15'); both sell for $10 or less.

To make this conversion, remove the carbureter and take off the automatic-choke unit (**Figure 2**), leaving the choke shaft in. Install the lever from the manual-choke kit. Mount the control-cable knob on the bracket from the kit near the generator start switch. The control-cable housing must be secured to the generator near the end with the small bracket from the kit. Tighten the set screw on the control-cable wire in the new lever assembly on the choke shaft (**Figure 3**).

ENGINE TROUBLESHOOTING

Recheck the butterfly open and closed positions using the control-cable knob. Adjust the set screw on the choke wire of the newly installed lever assembly until the correct settings are achieved.

To operate the manual-choke assembly, pull the choke knob out (to close the choke), start the generator and, immediately after starting, push the choke knob in (to open the choke).

MAINTAINING ENGINE LONGEVITY

Ensuring that your engine is operated within its rated horsepower limits is the single most effective engine maintenance step you can take. Here's why.

By Phil Friedman

An engine develops horsepower in response to a load. This means that, at any given time, your engine can be turning out less or even much more horsepower than its nominal rating specifies. The more horsepower an engine produces, the more heat and internal stress it develops. Since these factors work to wear out an engine, excess horsepower production — or, more accurately, excess torque production — means accelerated wear and shortened engine life. Therefore, the key to achieving maximum engine longevity is to make certain that torque and horsepower levels are, at any given rpm, kept at or below the those specified by your engine's rating curve.

Contrary to common belief, there's no guarantee you'll maintain those levels by simply operating the engine below its rated maximum rpm. Running a 2,300-rpm-rated engine at, say, 1,800 rpm does not ensure that the engine is producing less than its maximum rated horsepower; you can overload an engine — and thus reduce its life span — at just about any rpm level. So what can you do?

One thing is be aware of throttle settings. Horsepower (a measure of work) is the product of torque (a twisting force) and engine rpm. Holding other factors constant, the amount of torque generated varies with the combustive force produced — that is, with the

quantity of fuel burned. This, in turn, depends on the throttle setting required to attain, or maintain a particular rpm level. If, for example, 1,800 rpm on a 2,300-maximum-rpm engine require full (or nearly full) throttle, you can infer that the engine is being forced to develop more horsepower than its rating allows for at that point on its rpm curve. And you can make a similar inference if your engine fails to achieve its maximum rated rpm, or takes an excessively long time to do so when accelerating.

An alternative way to keep tabs on torque and horsepower production is to meter fuel consumption. By comparing actual fuel burn with that specified on your engine's rating curves, you can pretty accurately judge whether your engine is being overloaded (being forced to produce excess torque, hence excess horsepower) at any point on its rpm curve. Moreover, since fuel burn varies with load, total accumulated fuel consumption is actually a better indicator of accumulated engine wear than operating hours. As Caterpillar senior applications engineer Bill Naugle said to me not long ago, "If you run a 10,000-hour engine only at idle, of course it will last a heck of a lot longer than 10,000 hours before needing an overhaul."

The bottom line is that fuel burn is closely linked to torque and horsepower production and, consequently, to internal heat and stress — factors that directly affect longevity. As Naugle further pointed out, "The most practical field indicator for determining accumulated engine wear is total accumulated amount of fuel burned." Indeed, Caterpillar's technical people believe that accumulated fuel consumption is a simple, but powerful and meaningful measure by which an operator can judge how long his engine will run between overhauls; and they have developed a scheduled service program that is indexed to such accumulated consumption. Contact your engine's manufacturer to see if they can provide similar guidelines.

TIPS

Why take chances with your two-stroke outboard? Use only brand name TC-W3 oils such as those distributed or made by Evinrude, Johnson, Pennzoil and others. These oils are certified by the National Marine Manufacturers Association (NMMA) and provide the best protection your outboard can have against ring sticking, carbon deposits and piston scuffing. When buying oil, look for the NMMA logo and TC-W3 rating on the label.

HOURS AND RATINGS

A diesel engine's nominal horsepower rating relates to a specific set of load and duty conditions. Rating nomenclature often varies from manufacturer to manufacturer, but three common rating designations are continuous, intermittent and maximum duty.

An engine rated at 100 hp continuous duty can be driven to produce 100 hp, hour after hour, day after day, week after week, for its entire designed life span (measured in hours of operation between major overhauls). Continuous-duty ratings are generally applied in commercial circumstances, in which constant loads are applied for extended periods of time.

That very same engine may have an intermittent-duty rating that allows more horsepower to be drawn out, albeit for intermittent periods, rather than continuously. And again, that same engine may have a still higher maximum-duty horsepower rating, which will involve higher levels of power production for only very brief intervals, in between which much lower loads are expected.

...develop a scheduled service program that is indexed to your engine's accumulated fuel consumption.

Depending on a particular manufacturer's practice, an engine rated for intermittent or maximum duty may have a shorter life expectancy (measured in hours of operation) than one rated for continuous duty. Indeed, when some manufacturers rate for intermittent or maximum duty, they also limit the number of running hours per year at high load levels to ensure that the engines in question last the target number of years. Others, however, say that an engine rated for intermittent or maximum duty will last just as long (again, measured in hours of operation) as one rated for continuous duty, provided that the actual load history of the engine conforms to their specifications for the rating.

Caterpillar provides an excellent detailed explanation of this and related topics in its booklet *Maintenance Management Schedules*, publication number SEBU6102. It costs about $5 and is available from your local Caterpillar dealer.

POWERBOAT RIGGING

COOL RUNNING

Monitor the condition of the impeller and water pump with a water pressure gauge to prevent overheating of your outboard engine.

Materials

Teleflex water-pressure gauge kit
Side-cutting pliers
Utility knife
Wire cutters
Extra cable ties
Crimp connectors (#8 studs)
Crimping tool
16-gauge stranded AWG wire
Polysulfide sealant
Rags

How do you know if your water pump is working properly? A blocked water intake, clogged overboard or plugged powerhead passages on the discharge side of the engine (caused by hard water) all can reduce a pump's efficiency. When this happens, water continues to stream out the exhaust overboard (tell-tale "peehole") or the exhaust relief holes (on older engines) but it's likely that the pump isn't pumping enough volume to cool the engine, a condition that can lead to expensive damage. When the water-temperature gauge on *DIY*'s test boat redlined while running at wide-open throttle (WOT), we cut our speed and idled back to port. (The engine overheating alarm never sounded.) A worn impeller was the cause and was replaced. If the boat was equipped with a water pressure gauge, we would have been aware of a potential overheating condition long before the engine overheated.

Few boats are factory-equipped with a water-pressure gauge, yet it's arguably one of two must-have onboard gauges (the other is a tachometer). Like a speedometer and as its name implies, a water-pressure gauge works off water pressure. A tube is tapped into the engine's cooling system and water pressure flowing through the tube registers on a gauge in pounds per square inch (PSI).

Teleflex water-pressure gauge kits (CDN$70/US$63) include a gauge, 6m (20') of tubing, cable ties, plumbing adapters and hardware (**Figure 1**). Gauges come in high and low profile and domed styles; pick one that closely matches your other gauges. They're also available in 15, 30 and 60 PSI, so you'll need to check your owner's manual or consult your dealer before making your purchase.

The following instructions are for our Mercury 150-hp V-6 outboard and also apply to Mariner V-6 models. A water bypass hose on top of the cylinder block made for an easy one-hour installation. Some installations, however, are much more difficult and require drilling a small hole in the front port corner of the lower engine cowling, or removal of the pipe plug from the cylinder-block cover. Included with the gauge are complete installation details and diagrams for all makes; follow the instructions carefully.

First, remove the cowling, cut

Figure 1

Teleflex water-pressure gauge kits can be installed on most outboards and come complete with tubing, gauge and connectors for less than CDN$70/US$63.

the bypass hose with a utility knife about 5cm to 7.6cm (2" to 3") from the 90° fitting on top of the cylinder block. Attach the female pipe-to-tube adapter on the plastic tee, then insert tee ends into the hose and secure with cable ties (**Figure 2**).

On V-6 models, the tubing is fed through the cable harness retainer. Because our engine didn't have a spare slot, we doubled up with another cable and filed the hole to accept the extra width.

Now, loosely route the tubing through the harness retainer, under switch boxes on the starboard side

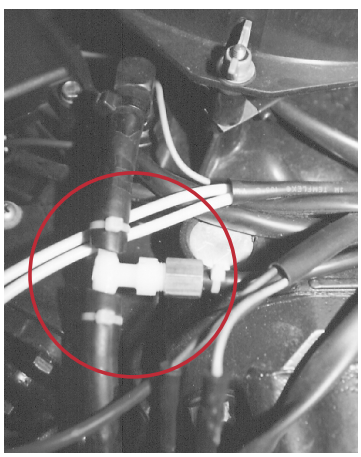


Figure 2

Installation is easy on engines with a water bypass hose: an adapter tees into the hose and inserts in tubing that connects to the gauge.

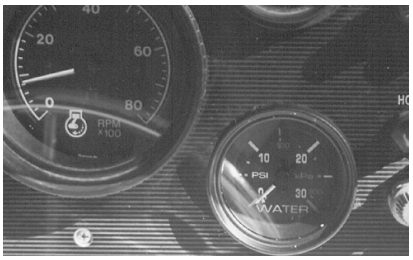
POWERBOAT RIGGING

and up to the water bypass hose. Engines differ — you'll need to find a clear route. Install tubing on the barb of the adapter and secure with tie straps.

Use side-cutting pliers to cut the cable ties holding the engine harness and tie-wrap tubing to this harness every couple of inches. (You'll need plenty of extra cable ties.) Tighten the ties with just enough pressure to make a tight bundle. Remember this is a plumbing hose, not a cable with a core, and you don't want to crimp the hose so water flow is restricted.

From the engine, route the tubing forward under the starboard-side gunwale. This is made easier with a messenger line; we used one left in place after we installed an hourmeter. Don't stretch the tubing; leave a bit of slack to allow full engine turning and tilt. Make sure the tubing is not kinked or pinched.

Select a suitable mounting location for the gauge so that it will be easy to read and where there is sufficient clearance behind the dash and easy access to wiring. The gauge fits into a standard 54-mm (2-1/8")-diameter hole, so we inserted it into a spare dummy plug (a pre-



The high-profile water-pressure gauge fits perfectly into a standard 54mm (2-1/8") spare hole on the dash.

Figure 3

drilled hole in the dash fitted with a plastic plug). When there's no spare and no room on the dash panel, you'll need a holesaw to drill a hole in the dash panel or in the bulkhead near the panel. Another option is to install the gauge on an auxiliary bracket (not supplied with the gauge) mounted on the dash. Apply a thin bead of silicone sealant to the rim of the gauge before installing it to keep moisture out, then fasten it with the supplied U-bracket (**Figure 3**). Make sure the gauge is straight before tightening (an assistant is helpful), and be careful not to overtighten.

Wiring is simple. Attach the black negative wire from the water-pressure gauge to the system ground or to a terminal marked "GND" on the back of any other gauge. Connect the white wire to the panel light switch, or to the "LT" terminal of another gauge, or to the accessory wire off the ignition switch. Use 16-gauge (blue) ring or captive-spade type crimp-on terminals and a quality crimping tool. Waterproof the connection with heatshrink tubing to help prevent corrosion. (See WINTER '95 for complete crimping instructions.) If either wire is too short, make a jumper of spare 16-gauge wire of the proper length and color.

Test the installation by turning the panel light on, or turn the ignition switch to "On" without cranking the engine and check that the bulb lights.

Cut the tubing to the proper length, leaving plenty of slack. Suck on the hose end to ensure a clear passage, then install on the barb fitting on the gauge and fasten with a cable tie. Tie-wrap the tubing to the steering cable or another firm support. Next time you run the outboard in water, check all fittings for leaks and retighten if necessary.

With the engine at idle, the water-pressure gauge normally registers 8 PSI to 12 PSI, and about 22 PSI at WOT — provided you're running with a good impeller. A sharp drop in pressure warns of a water blockage before the engine overheats. A gradual pressure drop indicates there's enough water to cool the engine but the impeller or water pump is failing and should be replaced. Tip: It's good preventive maintenance to replace the water-pump impeller every two years. We'll show you how in an upcoming issue.

ShopTalk

The Art and Craft of Hand Tools

You don't need a shop full of industrial-strength power tools to repair boats.

By Wayne Redditt

The most common misconception about wooden boats is that they're the most labor-intensive type of boat you can own. The truth, however, is that all boats, regardless of hull material, are notoriously labor intensive. Ask the fellow doing the osmosis bottom repair what he thinks about the wonders of fiber-reinforced plastic.

It's my opinion that most, if not all work required on a wooden boat is within the reach of a dedicated *DIY*er. It doesn't require a shop full of industrial-strength tools, either. Most repair work can be accomplished with simple tools you probably already own. Lumber yards or cabinet shops will thickness-plane new material for a fee, so let them absorb the cost of owning a 24" planer.

Fairing hull sides is one job that few people look forward to starting. But this job is also generally approached with the wrong attitude. Belt sanders and angle grinders aren't the best hull-fairing tools, nor will they will hurry the job along. In fact, nothing could be further from reality. Very few people, professional or otherwise, have the skill required to hold a heavy belt sander over their head while flawlessly smoothing down mahogany topsides.

To achieve fairness requires board sanding, regardless of hull material. A homemade fairing board, or one from 3M Marine, will do a perfect job: It doesn't require electricity; it won't "slip" and create a huge gouge that requires hours of attention to repair; and it's light and portable so you can work for long periods of time without fatigue. You can sand for hours with one of these

things. 3M boards are lightweight plastic and come in both rigid and flexible versions. And they accept 3M Hookit abrasive sheets (a hook-and-loop attachment system) so you can quickly and easily switch sandpaper.

There are other important reasons to develop the hand skills that go along with boat work. Unlike cabinetmaking and house carpentry, boat repair rarely has conveniently placed right angles. Table saws and radial-arm saws are not the greatest assets for the *DIY*er. How do you cut a curved edge on a table saw? To cut a bevel that rotates along an edge is beyond the capability of any power tool. But the simple block plane or spoke shave will make short work of that type of job.

Unlike wood dust, wood shavings are nonhazardous. Whenever possible, try to think of a way to do a job using a tool that cuts rather than abrades. Belt-sanding a 1/4" off the edge of a 12'-long plank is definitely not the way to go. You'll need to wear a mask if you're making dust and I'm convinced that, after a while, the indentations the dust mask leaves on your face become permanent!

Keep in mind that working over water with expensive hand tools is counterproductive. You worry so much about losing your stuff overboard that you can't concentrate on the job. In my mind, it's best to borrow tools when you're working over the water and buy a good magnet on a long string!

Another tip to remember: Any hand tool is safest when it's sharp. Dull chisels are less than useless. If you use your chisel to open cans of paint, don't go near the boat with it. Leonard Lee's book, *The Complete Guide To Sharpening* (Taunton Press), is must reading. The beauty of sharp hand tools has to be experienced to be appreciated.

When not messing about in his workshop, Wayne Redditt shares his expertise in boatbuilding, repair and restoration with the senior students of Georgian College's Marine Technology-Recreation course. Subsequent columns will discuss construction methods, restoration techniques, modern repair materials and other topics for builders and tinkerers of boats. Inquiries directed towards this column are welcome. Send your comments or questions via mail, fax or E-mail, attention ShopTalk.

DIY boat owner

quickfix

Use this handy chart for emergency repairs above and below the waterline.

PRODUCT	DESCRIPTION	USE	ABOVE WL	*BELOW WL	DIRECTIONS	WORKING TIME(21C/70F)	SUPPLIER	QUANTITY	PRICE
Captain Phab Creeping Crack & Leak Sealer	Waterproof acrylic latex liquid. Dries clear.	Hairline cracks and openings. AL, FG, PL, FB	Y	Y	Drop sparingly into crack. Repeat to fill.	NA	(905) 706-0583	59ml/2oz bottle	CDN$8.95
Creeping Crack Cure	Co-polymer clear sealant	Cracks and small openings. WO, FG, RU, PL	Y	N	Apply sparingly to dry and clean surface at 30 minute intervals until crack is filled.	NA	Capt Tolley's (705) 721-0143	59ml/2oz bottle	CDN$10
Excel Wood Glue	One-part moisture cure waterproof poly-urethane adhesive.	Gap filling and joining. Can be sanded and stained. WO	Y	Y	Apply by brush or roller. Dampen wood surfaces before applying.	20-30min. Clamp time-2-5hr.	Noahs (416) 259-7555	50ml/1.5oz 250ml/7.5oz	CDN$7.95 CDN$14.50
Excel Express	Same as above	Same as above	Y	Y	Same as above	5-8 min. Clamp time-40 min.	Same as above	10oz/118ml bottle	CDN$24.50
GIT-Rot	Two-part epoxy. Can be drilled, sanded and painted.	Filling holes, cracks, rot. WO, FG	Y	N	Inject into repair with syringe. Surface must be dry.	30 min.	Life Industries (803) 566-12251	4g/4oz bottle	CDN$17/US$11.75
Marine-Tex	Two-part putty. Non-magnetic, non-corrosive. Can be drilled, threaded or sanded. White, gray or tinted.	Holes, cracks, bonds metals and plastics. AL, ST, WO, FG, PL	Y	N	Apply to horizontal or vertical surfaces with knife, trowel or squeegee.	30-40 min.	ITW Philadelphia Resins (215) 855-8450	57g/2oz cans	CDN$13/US$7.98
PSI AQUAMEND	One-part epoxy putty. Can be drilled, cut, sanded, stained or painted. White color.	Holes, cracks. ME, WO, FG, PL	Y	Y	Knead to a uniform color. Apply to clean surface.	20-30 min.	Polymeric Systems (610) 935-1170 Alex Milne Assoc. (416) 742-49111	14g/4oz stick	CDN$13.95/US$6
PSI QUIKALUMINUM	Same as above. Aluminum color.	Holes, cracks. AL	Y	N	Same as above	5-7 min.	Same as above	114g/4oz stick	CDN$13.95/US$6
PSI QUIKPLASTIC	Same as above. White color.	Cracks, leaks and bonding of plumbing parts.PL	Y	N	Same as above	20-35 min.	Same as above	14g/4oz stick	CDN$13.95/US$6
PSI QUIKWOOD	Same as above. Simulated wood color.	Holes, cracks, gluing, joining.WO	Y	N	Same as above	15-20 min.	Same as above	114g/4oz stick	CDN$13.95/US$6
PSI REPAIRITQUIK	Same as above. Safe for potable water systems. Tan color.	Holes, leaks, bonding, filling, fabricating. ME, FG, WO, PL	Y	N	Same as above	4-7 min.	Same as above	14g/4oz stick	CDN$13.95/US$6S
Star brite Epoxy Putty Stick	One-part putty. Can be sanded, drilled, tapped or painted.	Holes, cracks, bonds metal, wood, plastic. ST, WO, FG, PL	Y	Y	Knead until changes color and apply.	NA	Star brite (800) 327-8583	114g/4oz stick	US$11.85
Star brite Epoxy/ Aluminum Putty Stick	Same as above	Holes, cracks, bonds aluminum. AL	Y	Y	Knead for 1 minute	NA	Same as above	114g/4oz stick	US$11.85
Star brite Quick Cure Steel Epoxy	Two-part epoxy withstands high heat and pressure. Can be drilled, tapped or sanded.	Holes, cracks, bonds metal parts. ST	Y	N	Mix two parts and apply to clean metal.	5 min. or less	Same as above	57g/2oz tube	US$8.60
Star brite Quick Cure Clear Epoxy	Same as above.	Holes, cracks, bonds materials.WO, FG, PL, ME	Y	N	Mix two parts and apply to clean surface.	5 min. or less	Same as above	28g/1oz tube	US$7.50
Star brite PVC Epoxy Repair Stick	One-part heat-resistant waterproof putty.	Cracks, holes, bonding PVC, PL	Y	Y	Knead until turns white.	5 min. or less	Same as above	114g/4oz stick	US$13.40
Woolsey Splash Zone Compound A788	Two-part putty. Sticks to wet or dry surfaces.	Patching holes and grouting. Al, St, Wo, FG	Y	Y	Mix with water and knead by hand. Keep wet. Apply immediately after mixing.	30-40 min.	Woolsey/Z-Spar	946ml/32oz can	CDN$66/US$45

*Can be applied with boat in the water.

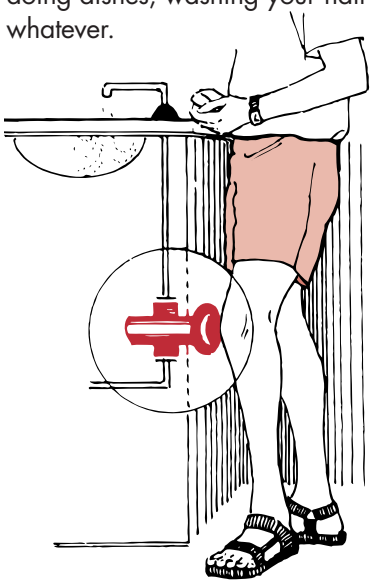
Legend: AL-Aluminum, ST-Steel, WO-Wood, FG-Fiberglass, RU-Rubber, PL-Plastics, ME-Metal (non-specific), FB-Fabric

Good Boatkeeping

By David and Zora Aiken
Illustrations by David Aiken

Kneecap Control

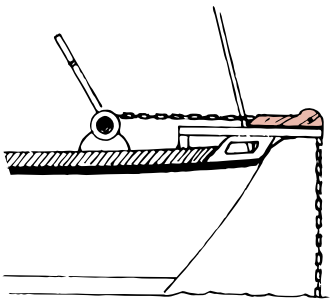
Foot pumps for galley or head sinks are practical in use, but in confined spaces, it's too easy to step on them when you don't want water. Instead of putting the pump on the sole, mount a push-button-controlled one (such as the Whale Tiptoe Mk4) on a vertical bulkhead under the sink so you can use your knee to control the water flow. With this setup, both of your feet stay solidly on the sole and you can maintain better balance when doing dishes, washing your hair or whatever.



Sailboat Roller Holder

Some sailboats have a raised metal plate on the bow which makes it impossible to attach a stainless steel anchor roller directly on deck. Here's a way to set up a practical roller system so the anchor can be raised and lowered with less risk of bumping the hull.

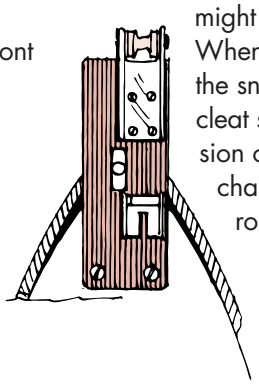
Use teak or oak, 5cm (2") thick, 18cm (7") wide and long enough so one end sits just in front of the windlass



and hawse pipe, and the other extends 25cm (10") or so beyond the bow fitting. Cut a slot about 5cm (2") wide and as long as necessary for the headstay.

Place the wooden platform in position. It will rest on the bow plate in front and on a separate wood support piece in back that's cut to the proper height so the platform sits horizontally. At the back corners of the wood, drill for two long bolts that will extend through the platform, through the support piece and through the deck. Use a backing plate below the deck. A metal strap under the forward end connects the wood platform to the bow plate and prevents the roller from lifting or shifting.

Now attach a stainless-steel anchor-roller fitting to the wood platform. (Windline offers a wide range of rollers to fit most anchors.) Check the windlass-to-roller lead. Add a chain stopper near the back end of the platform and a piece of Lexan to protect the surface of wood where the chain might rub.

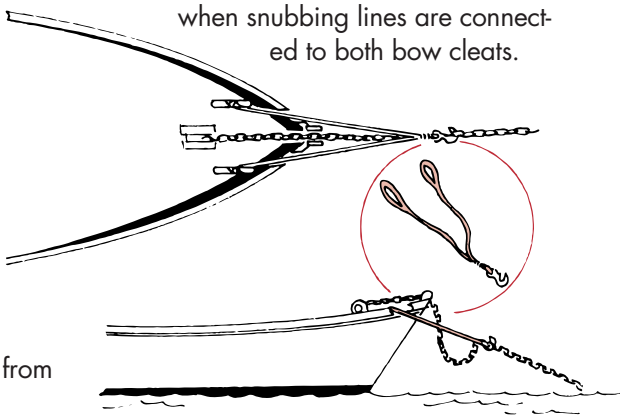


When anchoring, secure the snubbing line to a cleat so there's no tension on the section of chain resting on the roller.

Snubb'er Up

When anchoring with all-chain rode, many skippers use a snubbing line. Attach a hook to a short length of nylon line; grab the chain several feet down from the bow then tighten the line until the chain goes slack. This protects the boat and the gear from the effects of boat bounces and chain lurches.

A snubbing bridle — two lines leading to a common hook — helps to keep the boat sitting straight behind the anchor. It has less tendency to "sail" at anchor when snubbing lines are connected to both bow cleats.



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