1999-#4

DIY boat owner

the MARINE MAINTENANCE MAGAZINE

ANNUAL BOAT REFIT

REFIT

REPOWER OR TRADE?

Although it's considerably less expensive to repower an older boat than purchase a new one, there are some conditions other than cost that you need to consider before making that decision.

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By G. Kevin Alston

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TALKBACK Q&A

Removing Ghosts of Names Past

Q: I recently removed the painted name which had been on the stern of my boat for 15 years. Is there an effective way to remove the old paint's "ghost" that has been left behind on the gelcoat?
Bob Vigneaux, Ipswich, Mass.

A: Such is the nature of gelcoat, which fades when exposed to UV. Such fading can extend into the material for a .0001" or more. There are no "magic" miracle liquids that will restore the color of the faded gel. Given time, the gel that was under the old name will begin to change color to match the rest of the transom. It may never completely blend in though, if not sanded and buffed. You could sand the entire transom surface to blend in with the old name. Of course, the rest of the hull is now a different color, but in a few months, it will fade and should blend in. Sanding may be risky on older boats that have had many years of buffing, as you may sand through the gelcoat into the laminate. In this situation, water sand using 400-, 500- then 600-grit paper and buff, or spray new color-matched gelcoat over the entire transom, sand then buff. Both methods require some experience in order to maintain a fair surface. You could also paint the entire transom with a polyurethane paint (refer to DIY 1998-#2 issue for complete painting instructions) that matches the color of your boat. That will eliminate the tedious job of sanding the gelcoat, but may be difficult to achieve a perfect color match. I suggest you try a small experiment: Lay out your new transom name temporarily. Find a spot where a letter of the new name intersects both the faded and original gelcoat. In other words, a place that the graphic will cover if this experiment doesn't work. Now sand with 400-grit waterproof sandpaper, keeping the surface wet. If the "edge" blends in with the unfaded areas, then continue sanding with finer grit paper. The object is to eliminate the scratches of the coarser grits. After 600-grit paper, apply buffing compound with an electric buffer. Buff until the gloss returns. You may have to use two grits of buffing compound (coarse and fine) to get the shine you want. Stand back and look at the surface. If you can't distinguish the outline of the test area, then all is well and you can finish the remaining surface.
— *Wayne Redditt*

Tapping into Dockside Water

Q: I just purchased a 1983 Catalina 30 sailboat and am a liveaboard. I want to install dockside water so I don't have to constantly fill the water tanks during the winter. I have purchased the pressure reducing valve that flush mounts to the boat. From what I understand, you must bypass the holding tanks and go straight to the water pump.
Mari Kirby, "S\V Moonstruck," Norfolk, Virginia

A: The line from the regulator goes into the pressure water line after the electric pump, then directly to a tap. DIY 1998-#3 issue has a complete step-by-step feature on installing a pressurized water system including hook-up of the water pressure regulator. One cautionary note: Be sure to turn off the water connection on the dock when you leave your boat. Should a leak occur in the onboard plumbing, your boat would be at risk of sinking.
— *Jan Mundy*

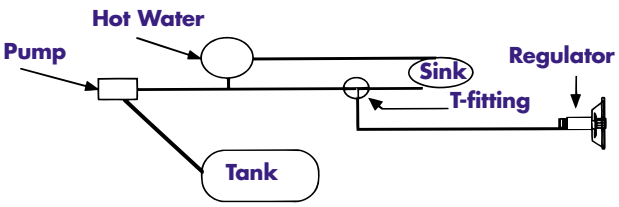
To Step or Unstep?

Q: I have read conflicting arguments regarding whether the mast should be stored stepped on the boat or upstepped and laid on a rack. The owner of the marina where we store our boat, says he hasn't dropped a mast in 19 years.
William Trent, Barrie, Ont.

A: Although leaving a mast standing when dry docked is standard practice in some areas, we don't recommend it. A stepped mast subjects the deck, hull and rigging to considerable stress that over time can cause spider cracks and crazing in the gelcoat. This not only weakens the laminate but also creates a source for water migration and potential delamination of the deck if cored. The damage potential is not worth the $80 or so a yard charges for mast unstepping. Better to unstep the mast, remove spreaders, masthead instruments and antennas, protect nav and spreader lights with a foam wrap and bundle everything together.
— *Jan Mundy*

Solar Panel Hook-up

Q: I have a 15-watt solar panel that I leave plugged into a 12-volt receptacle and it charges two banks of batteries. Is there a danger of overcharging the batteries? Do I need a charge controller and where should it



install if I want to keep using the distribution panel?
Christian Gagnon, "Soltera," Kingston, Ont.

A: Chances are a 15-watt panel won't overcharge a marine battery, although it's a borderline case with an under 100 amp-hr model. Check the voltage regularly (at least once a week) to see if you even approach an overcharge state. If you do notice slight overcharge, or if you just want inexpensive insurance, you can get a simple controller for under $60. This is wired between the panel and your 12-volt receptacle, so everything else in your system remains the same. The only other device I always recommend when installing charging sources is some method of reading how much current you are putting into the battery.
— *Kevin Jeffrey*

Cure for Clogged Head Hose

Q: How can you avoid calcium build-up in head hose over a period of usage while living aboard? Is there any product or technique to avoid having to remove the lines and Y-valves and clean or replace them every year or two?
Jim Phillips, "Free Spirit," Hilton Head Island, S.C.

A: According to Victor Willman, manager, technical services for Raritan Engineering, there are a couple of solutions for this problem, depending upon its severity. If the problem is such that the passages are restricted and won't pass toilet paper or sewage, the best system is to remove the connecting hoses and beat them on the dock to break up the deposits, then blow out the hose with compressed air, or replace the hoses. Before the problem becomes that severe, flush the system with a solution of muriatic acid (31%). As it's a hazardous material, be sure to read and follow all warnings on the container, wear eye protection and rubber gloves. Pour 7.5L (2gal) of tap water into a plastic bucket, then add 473ml (16oz) of muriatic acid. Shut off the incoming water supply to the toilet and pour this solution into the bowl. "Dry" flush (no water coming in, pumping out only) until the solution has passed into the discharge line(s). Add 3.78L (1gal) of freshwater to dilute any acid solution that remains in the bowl. This will negate the possibility of the acid attacking the ceramic bowl or any internal parts of the toilet. Don't flush the toilet; let it remain unused for 45 minutes. Now turn on the flush water supply to the toilet and flush the toilet for the equivalent of 15 to 25 flushes. During the period that the toilet sits unused, the acid solution will dissolve the accumulated calcium deposits. Flushing the toilet several times after the waiting period pushes the dissolved calcium deposits out and flushes the hoses. For manual toilets, now add 59ml to 118ml (2oz to 4oz) of vegetable oil to the bowl and

flush a few more times to lubricate internal parts. The toilet and hoses should then be in a condition similar to before the calcium build-up occurred. To help further slow calcium build-up, add 88ml (3oz) of white vinegar to the toilet bowl every two weeks, flushing it through the system. Vinegar dissolves the calcium, but at a much slower rate than muriatic acid. Or install Raritan's Toilet Water Kit. This consists of a reservoir bottle, a special adapter that is installed in the incoming water supply line to the toilet, connecting hose, and a complimentary vial of Raritan Concentrate, a deodorant-lubricating, calcium-retarding solution that's diluted with water (or fill the bottle with vinegar). You cannot use this kit with toilets that use onboard pressurized freshwater, only with seawater-flushing toilets that

have a positive displacement pump on the intake side.
— *Victor Willman, Raritan Engineering,*

Hot Water From A Cobra

Q: My boat has a '96 5.8FL Volvo SX Cobra engine with a raw-water cooling system and an Atwood 23L (6gal) freshwater heater with heat exchanger couplings. Do you have a do-it-yourself method of connecting the water heater to the engine raw-water cooling system?
Steven Czepiga, "Nordic Yankee," Copenhagen, Denmark

A: There are several ways to hook up your engine raw-water cooling to your water heater. The best method usually picks up the hot water from a tee in the hose leading from the engine coolant recirculation pump to the thermostat housing and returns the hot water to a fitting on the intake manifold or thermostat housing. There is a stock Volvo/OMC water heater/cabin heater fitting kit (part number 3856265) for this and it should be available from any authorized Volvo or OMC dealer. This provides all of the fittings you need except the appropriate length of 16mm (5/8") ID automotive heater hose.
— *Nick Bailey*

TECH TIPS

PINHOLE NOZZLE: When you winterized your water pumps, did you also de-ice the nozzle? Washdown pumps and showers are often fitted with a plastic hose nozzle and handle. Non-corrosive, it's a better choice than a metal one, but should temps drop below freezing, the water-filled handle freezes then cracks and water now blows through hundreds of pinholes rather than exiting at the nozzle.

RUBBER VISE: To clamp odd shapes when gluing parts together with no marring of the surface, use bicycle inner tubes or surgical tubing, if you have a source.

PATTERN LAYOUT: A spray adhesive (i.e.3M Spray Mount) is ideal for temporarily holding patterns on wood or plastics for tracing or cutting. The spray is available from office or art supply stores and patterns can be reused without recoating.

FLOSS MENDER: Keep a pack of waxed dental floss in your spares kit to seize parts together and do other emergency repairs. Made of polyester, it resists most fluids and UV rays.

TOE SAVER: Replace existing eye straps, pad eyes, and other toe stubbers that anchor canvas tie-downs and straps, with stainless-steel lift rings. These lie flat so there's nothing to trip over when the cover is stowed or removed from the boat.

USE BRONZE OR BRUSH: After sanding teak rails or mahogany panels, then rubbing them down with OOO steel wool, you'll have a great surface to apply the paint or varnish. But several weeks later you will see little brown spots, namely rust from the steel wool, in the finished project or on gelcoat. Painted and varnished surfaces will need redoing. To remove rust spots from gelcoat, try toothpaste; the flouride sometimes removes rust.
Doug Powles, "Bear," Bellingham, Wash.

BILGE DE-ICING: If you moor your boat in an area were temps drop below freezing, be sure to put antifreeze in the bilge. Rainwater that freezes prevents bilge pump float switches from activating. A bilge full of ice can damage engine mounts, plumbing, wiring, most everything in the bilge.

SURROGATE GASKET: When you're in a pinch and need a gasket quick, carry a strip of self-adhesive, closed-cell foam tape, commonly used for weather stripping. Cut to the desired thickness and length, pinch the ends together to make the needed shape and lay in place. It may take a few snips to get the correct size.
Vicki de Kleer, "Mollyhawk," Oakville, Ont.

SCRAP PLEXIGLAS: When you need only a small piece of Plexiglas, one source is a hockey arena. The white plastic covering on the boards is about 3mm (1/8") thick and easy to work with. Some are 11mm (7/16") thick, up to .9 sq.m (10 sq.ft.) in size, and are frequently broken into pieces during the games. Plastic cleaner should remove black puck marks.
Dennis Angle, Beamsville, 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 it to info@diy-boat.com.**

ShopTalk

JOINING PLYWOOD

Two easy methods to make your own oversized sheets of plywood.

By Wayne Redditt

Plywood is one of the more useful materials used for boat construction. Decks, cabins, bulkheads and cabinetry are just a few of the uses of this versatile material.

There is a considerable variation in quality of plywood panels. All plywood is graded according to standards set by various associations. Marine-grade plywood that conforms to BS 1088 has to meet stringent requirements for quality of face and interior veneers, voids, splits, knots, glue type and other standards. Such plywood is generally more uniform, predictable and durable than the lesser grades. Cost is higher and availability may be an issue, though there are plenty of mail-order suppliers.

Sizes available run from standard 4x8 sheets to 4x16, 5x10 and portions of these sizes. To join plywood into longer sheets may be accomplished in one of two ways: making a step scarf or bevel scarf. In both cases, the object is to create a joint that allows the material to remain at its nominal thickness throughout the joint and to maintain flexibility comparable to the original sheet. This means no hard spots when bending or flexing the panel after joining.

The step scarf requires a circular saw, chisels, clamps and epoxy for gluing, as well as a straight edge layout tool. Begin by determining the best scarf length for the material thickness that you are using. A ratio of 8:1 (length to thickness) will ensure a sufficiently strong bond for any use onboard. Lay out the length of the scarf on both pieces to be joined (**Figure 1**). In

Figure 1

the step scarf, you must lay out a series of sequential "steps" that match exactly on both pieces. It simplifies things if you can make the cuts to the bottom of a glue line, as this indexes the joint automatically. Study the laminate to see if this is feasible. If not, make the scarf to the middle of the laminate. The saw cuts let you chisel to the reference plane easily.

Begin by setting the depth of cut on the circular saw. Use a cutting guide to keep the cut perpendicular to the length of the sheet. After making the first set of cuts, reset the depth of cut for the next step. Continue on both sheets until a set of steps has been roughed out with the circular saw. Chisel away the waste material (**Figure 2**). It doesn't have to be a perfectly smooth finish. Epoxy thickened with microballoons will fill the gaps. Make sure that all high spots are

Figure 2

removed or the resulting joint will be thicker than the original material (**Figure 3**). To clamp the middle of the sheet when you are joining an entire 1.2m- (4'-) wide sheet, requires the use of cauls. Epoxy joints don't need excessive pressure to make a good bond. As long as there is some squeeze-out of excess glue, you can be sure you have a good bond line (**Figure 4**).

The second type of scarf joint is the bevel scarf, which is quite easy to fabricate with just a hand plane (**Figure 5**). Begin by laying out the scarf distance as for the step scarf. Remove the waste material by planing across the sheet, not off the

Figure 3

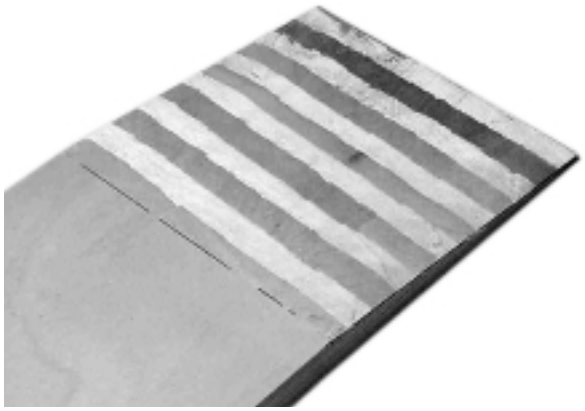
edge. To prevent edges from splintering, plane from each side into the center. As you near a straight line from your mark to the edge of the sheet, a set of parallel lines will

Figure 4

develop in the laminate. This allows a quick visual indication of the flatness of your scarf. Attempt to develop perfectly straight parallel lines. To develop the feather edge you should place a waste piece of material under the edge and plane into it slightly. This will prevent the feather edge from crumbling away. Keep your plane sharp, as plywood glue lines are notoriously hard on blades.

When gluing a bevel scarf it's important to first prime the joint. Apply unthickened epoxy to the exposed end-grain and then reapply more epoxy. Only when the entire scarf is "wet" should you apply the microballoon filled epoxy. If you don't epoxy saturate the end grain, the plywood will absorb the epoxy out of

Figure 5



the filled mix, resulting in a dry joint. Don't make your filler mixture too thick; a custard-like consistency should be about right.

There are many books proposing methods to make scarf joints with power tools. If you are making only one or two, I suggest sticking to the hand tool methods. You would spend more time making the jigs required than it takes to shape the scarf.

About the author: Wayne Redditt teaches boatbuilding, repair and restoration at Georgian College's Marine Technology-Recreation course in Orillia, Ont.

ELECTRONICS

USING BATTERIES TO PRODUCE AC POWER

If your total AC load is moderate and your battery capacity and charging system sufficient, an inverter can eliminate the need for any other AC power source.

By Kevin Jeffrey

Today's boaters want the comfort and convenience of using standard household appliances on board, such as coffee makers, microwave, toasters, TV, VCR, stereo, drills, sanders and other power tools. Away from the dock an alternative source of AC power must be provided. Boaters with larger AC appliance loads have traditionally chosen an engine-driven power source such as a gen-set (refer to DIY 1999-#2 issue for gen-set selection, installation and options) or a modified AC alternator running off the main engine (for information on high-output alternators see DIY 1998-#2 issue), yet these devices don't match the freedom, convenience and quiet operation offered by DC-to-AC inverters. Inverters are relatively small and lightweight, low cost and reliable. Installation is uncomplicated, and there is no additional engine to maintain as with engine-driven AC power sources.

How They Work

Inverters don't actually create electricity; they only change it from one type to another. Inverters take DC power stored in a battery bank and convert it to household AC power. They simultaneously raise the voltage and invert DC to AC power and supply this electricity either directly to a built-in AC outlet on small inverters or to the AC circuits installed on the boat (**Figure 1**).

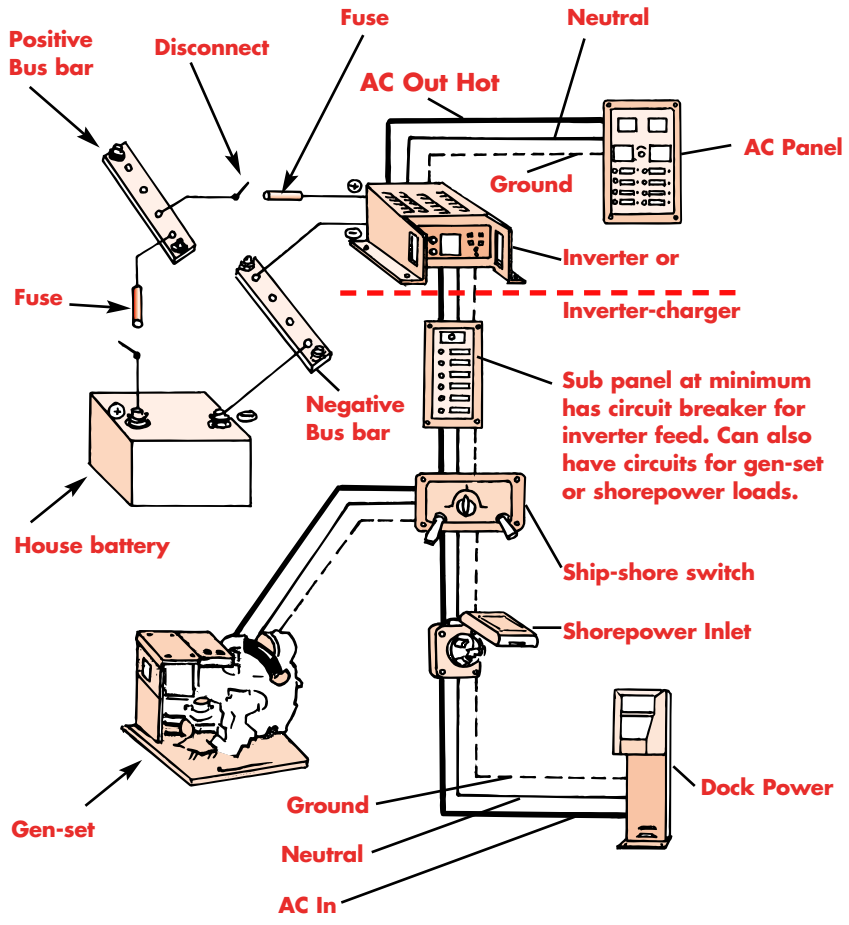
Inverters need to draw power from a battery bank, although if charging sources are operating and the current produced is adequate, the inverter won't deplete your batteries.

Power Options

The big difference when using an inverter for AC power is that engine(s) do not need to be running when you are using AC appliances. Of course, the batteries must eventually be recharged with an engine-driven power source, but it's usually possible to schedule engine-driven charging for more convenient times.

Inverters are most practical for combined AC loads up to 2,500 watts, particularly where the larger loads are intermittent, or only on for short periods of time. Even though the current draw of large intermittent loads may be high, the total energy consumed is usually moderate (**Figure 2**).

Figure 1



Typical inverter powerboat or sailboat hookup to AC outlet on inverter; inverter-charger installation connects to onboard AC circuits, gen-set and shorepower as shown below dotted red line.

ANNE-MARIE HENDRY

Inverter-chargers: (top left, clockwise) Heart Freedom Marine Series, 1,000 to 3,000 watts; Statpower Prosine 2,500 and 3,000 watts; Trace Mariner Series, 2,000, 2,500 and 3,000 watts .

Loads that are usually not supplied by inverters include: AC-to-DC battery chargers — you would be using battery power to charge your batteries; air conditioning, unless supplemented by an engine-driven, high-output charging source; and appliances with large heating elements such as water heaters, space heaters and electric ranges. If the size of your total AC load places you on the borderline between an inverter and an engine — driven AC power source, try staggering the use of AC loads to make it work — don't run the power tools at the same time dinner is cooking in the microwave.

If your total AC requirements exceed the practical limits of an inverter and you need to invest in an engine-driven AC power source, an inverter is still useful for quiet-time loads and for some smaller continuous loads. Under these circumstances, you might be able to get away with a relatively inexpensive inverter.

Many inverters also double as smart-charging, high-output AC-to-DC battery chargers (known as inverter-chargers), eliminating the purchase of an additional piece of equipment. Use the inverter in the battery charger mode when the engine-driven unit is running, then with the engine shut off, use it in the AC supply mode as needed. The same applies for AC power connections while at a dock. Use the utility-supplied AC power with the inverter in the DC battery-charging mode; use the inverter in the AC supply mode when utility power is not available.

Statpower's portable PowerPac provides 300 watts continuous AC power and combines an inverter, 18 amp-hour battery and a smart battery charger.

ELECTRONICS

Understanding Ratings

As you might suspect, an inverter's size and weight is proportional to its rated output, and also whether or not it's designed to operate as a battery charger. Inverters are rated for both continuous operation and for the ability to surge initially for starting motors. High quality models have surge ratings up to three times their continuous output rating. Inverters come in a wide variety of continuous rated outputs, from small 50- to 250-watt pocket inverters — ideal for powering computers, radios, tape decks, TVs and VCRs — to large units of 3,000 watts or more.

Input voltage lets the buyer know the range of battery supply voltages over which other specifications will be valid. Typical inverters operate on either 12- or 24-volt DC input voltage ranges. Most of the better sine wave inverters allow battery input voltages to vary over the battery bank's entire normal operating range (around 10 to 15 volts DC) without disrupting output voltage. Some inverters are equipped with low battery cut-out protection that prevents the inverter from working if the battery voltage drops below a preset or adjustable voltage setpoint.

An inverter is also rated according to the AC power output voltage. Current models are available with roughly 110-volt/60-Hz output (North American models) or 220-volt/50-Hz output (European models). Actual ratings list the exact output voltage and the allowable variation (± 2% is good, 4% to 5% is common).

Figure 2

Calculation of Electrical Energy Consumed for 12-Volt System

Amp draw of loads x time they operate = Energy out of batteries

Example: Anchor light 1 amp x 10 hours = 10 amp-hrs removed from the batteries

Example: Toaster 80 amps x .03 hours (2 minutes) = 3-4 amp-hrs removed from batteries

Fine Tuning

Main buying features on inverters are waveform, idle current, efficiency and charging mode. As inverters attempt to duplicate AC electricity from utility companies, which is in the form of a pure sine wave, they are classified by their waveform. Modern solid-state inverters produce either square-wave, modified sine wave, or pure sine wave output. While the new pure sine wave inverters can run any AC appliance without harm or annoying "buzz," at this time they are more expensive and often less efficient than modified sine wave versions. Most boaters choose modified sine wave inverters, but there are many good pure sine wave models available for those that need them.

Figure 3

Appliance	Typical Wattage	Appliance Run Times / Amp Hours *							
		5 Min.	15 Min.	30 Min.	1 Hr.	2 Hr.	3 Hr.	8 Hr.	24 Hr.
13" Color TV	50	.33	1	2	4	8	12	32	96
19" Color TV	100	.66	2	4	8	16	24	64	192
VCR	50	.33	1	2	4	8	12	32	96
Lamp	100	.66	2	4	8	16	24	64	192
Blender	300	2	6	12					
Curling Iron	50	.33	1	2					
3/8 Power Drill	500	3.3	10	20					
Icemaker*	200			2.6	5.2	10.4	15.6	41.6	83.2
Coffee Maker	1000	6.6	20	40	80	160			
3 cu' Refrigerator*	150			2	4	8	12	32	96
20 cu' Refrigerator*	750			21	42	84	126	336	672
Compact Microwave	750	5	15	30	60	120	180		
Full Size Microwave	1500	10	30	60	120	240	360		
Vacuum	1100	7.3	22	44	88	176	264		

HEART INTERFACE

The number in each box represents the total amp hours used in a 12-volt DC system. Divide amp hours by two for 24-volt systems.
****Refrigeration is typically calculated using a 1/3-duty cycle.***

Inverters without chargers: (top left, clockwise) Exeltech 125 to 1,100 watts; Heart Jazz Series 50 to 2,500 watts; Statpower Portawattz 600 to 3,000 watts.

A modern inverter uses very little idle current — standby power when the unit is on but no load is being drawn — compared to engine-driven AC power sources. An efficient inverter may only consume half a watt on standby, whereas an engine-driven AC power source will be cranking away, consuming fuel whether you're using the AC power or not.

Inverter efficiency varies with output power. Most modern sine wave inverters operate above 90% efficiency under moderate appliance loads, usually somewhat less for smaller loads. This means that the inverter consumes less than 10% of its output power whenever a moderate load is drawn. A graph depicting power versus efficiency for a typical inverter is given in (**Figure 4**). A unit's rated efficiency is usually listed as its average efficiency over a given range of output power. For example, one inverter is rated at 90% efficiency at half-rated power, while another is rated at 85% to 96% efficiency from 50 watts to rated power.

Some inverters have a high-performance, three-step battery-charging mode as a standard feature. These units are labeled inverter-chargers. A 1,500-watt inverter-charger operating at 12 volts can charge up to 70 amps when AC power is available; 2,500-watt inverter-chargers can produce approximately 120 amps at 12 volts.

Many inverters come with voltage and current meters and basic controls, either integral to the unit or offered in a remote panel.

Cost and Selection

First decide how much continuous power you need. Small 50-watt pocket units (US$75) can handle a laptop computer, while a 150- to 250-watt unit (US$150) can also handle a computer, TV-VCR combination, blender and small power tools operating one at a time. If you feel you need a 1,000 to 2,000-watt inverter, see if a 1,500-watt unit (US$900 with charger, US$600 without) will meet your needs, even if you have to stagger appliance use. This size is particularly practical, since the cost is reasonable and it can run almost anything that operates on standard household outlets, which are typically on circuits rated at 15 amps at 110 volts. For larger applications, 2,000- to 4,000-watt units (US$1,200 to US$3,000) are available.

Now decide if you want a unit with battery-charging mode. Even if you presently have a battery charger, chances are you'll improve performance dramatically by using an inverter-charger.

Select the input and output voltage you need. Most marine applications require 12-volt input; output depends on where you expect to use the inverter. Boaters who mainly use their boats in North America should purchase a unit with 110-volt AC output. For occasional travels to Europe and other locations with 220 volt/50 Hz power, simply carry a 220 volt/50 Hz battery charger.

Finally, choose the waveform best suited to your needs. Laser printers and some other electronic devices need pure sine wave output, but almost all other appliances will work well on modified sine wave output. If necessary, you can always get a modified sine wave unit (up to US$3,500 for a 4,000 watt inverter-charger) to handle most of your needs, and a small pure sine wave unit (US$400 for a 400 watt) for a particular appliance. Exeltech offers several units from 125 to 1,100 watts, Statpower's Prosine units range from 1,000 to 2,500 watts, and Trace has models from

Remote panels: Trace new RC-7 remote panel provides complete inverter control and system monitoring and can be mounted anywhere on the boat; Statpower ACS control/monitoring panel for Prosine units; Heart Link 2000 for two battery bank system.

2,500 to 4,000 watts.

Battery Capacity

Imprudent use of even a small inverter can drain a typical battery bank. The battery bank the inverter is connected to must be capable of supplying full instantaneous current to the inverter. For example, an AC power draw of 1,500 watts results in a DC current from the batteries of almost 140 amps at a 90% inverter efficiency. Since I recommend that a battery bank's capacity be four times the maximum current draw, a bank of approximately 560 amp-hours would be advisable. The battery bank must also have enough reserve capacity to supply all AC and DC loads drawn from that bank between normal charging cycles.

Installation Tips

Wiring between the inverter and the batteries must be properly sized. Cable size depends on inverter output and length of run between inverter and batteries. Cable sets with varying gauges of wire and wire lengths are available from any independent power system supplier. For larger inverters, 2/0 or 4/0 welding cable in 1.5m to 3m (5′ or 10′) lengths with cable lugs are available.

Most inverters on the market have an internal fuse or circuit breaker and an on-off switch that serves as a safety disconnect for the unit, but there is still a need for a main fuse and safety disconnect between the batteries and the inverter.

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

REPOWER or TRADE?

Although it is considerably less expensive to repower an older boat than to purchase a new one, there are some conditions other than cost that you need to consider before making that decision.

by Jan Mundy

Suppose you own an older boat that you really enjoy but you're fed up messing with those unreliable, cursed engines. Perhaps you'd like more speed, better performance, fuel economy or range. Do you buy a new boat or keep the boat you have?

Before you consider repowering, you must first confirm the boat's true value. Obviously, a boat with a market value of $50,000 doesn't warrant new $70,000 engines, regardless of the emotional attachment. Also, the boat must be in good shape. This is especially important for cored boats (concern for delamination) and old "woodies" where increased power can wrench the boat apart.

"We strongly recommend having a survey by a certified surveyor," says Alan Bramble, president of Tolchester Marina (410/778-1400), a full-service yard and marina located on the eastern shore of Chesapeake Bay. Bramble knows a lot about repowering boats. The yard, which employs 22 craftsmen, has gained a widespread reputation for repowering boats, averaging 30 jobs per year.

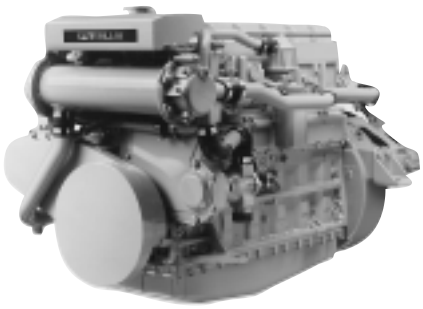
"Normally a repowering job is financed and a lot of lenders demand a survey before and after it's completed."

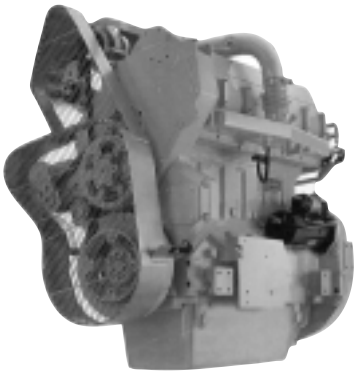
To find an accredited surveyor, ask your insurance company or marina operator, or contact associations like Boat/U.S. for recommendations.

The most common repower is gas to diesel. Diesel engines used to be physically larger than gas, but modern technology has brought the horsepower-to-weight ratio equal to gas, or within a couple hundred pounds. Diesel engines can deliver 50% more fuel efficiency, about one-third increase in fuel economy (based on a 350hp) and unquestionably better performance. "When you have a slow gas boat that you've changed to a fast diesel boat, the boat rides in the water better, it's drier, more comfortable and a lot more fun," Bramble explains.

Most boats, '96 vintage or older, in sound condition, are good candidates for new engines – older Bertrams, Carvers, Chris-Crafts, Silvertons, Vikings. Occasionally, new gas-powered boats are repowered with diesel engines to increase their long-range capability – trading for one that can handle long, offshore passages usually means losing too much money in the transaction.

"Of half the boats we repower, we double their speed," explains Bramble, who gives this example: "We had a 11.4m (38') double-cabin Chris-Craft with twin 270hp, small-block 350 cu.in. Chevys that maxed at 13 knots. We replaced with twin 315hp diesels and now the boat cruises at 30mph."





Technology has reduced the horsepower-to-weight ratio of diesel engines nearly equal to gas, making gas-to-diesel repowering a favorable option for older boats.

Buying Right

Once you've made the decision to repower, the next step is to select an engine, a task made easier when the builder is still in business. If the boat is still in production, contact the factory for suggestions. Alternatively, research what diesel options were offered when the boat was built. Otherwise, you'll have to go on the recommendations of the yard, which is reason enough to select a reputable yard experienced in repowering comparable or alike boats.

"The toughest question is which engine to install," says sales and service manager Charles Shriley. "Power systems today are all very good. Caterpillar, Cummins, John Deere, Volvo, Yanmar and others all have long warranties and prices are competitive. After we establish the horsepower, we prefer the customer choose the brand."

It's best to obtain a couple of quotes, but warns Bramble, accept only a firm contract job. "You need to know exactly what you are getting into from the beginning for it's unlikely you can come up with more money than borrowed from the bank."

Before you commit, check the shop's reputation. How long has it been in business? How many repowering jobs has it done? Ask for a list of references. Also, ask your lending institution for a referral.

Repowering involves installing a totally new power system with labor averaging 400 hours for mid-cabin or sportfishing 35-footers, 500 hours for aft-cabin models.

What You're Paying For

While it's substantially less expensive to repower a used boat than purchase a new one, it's still a major investment. At the high end, for example, repowering a 18m (60') Hatteras with 3406 Cats, a close estimate is US$175,000, compared to US$1.5 million for a new boat. Now downsizing, consider a 1985 10.5m (35') Viking, a very saleable boat with gas engines. If you install twin 350hp diesels with generator and all the frills at a cost of US$70,000, you've got a boat with a high resale value. A comparable boat equipped with diesel engines costs about US$300,000.

These quoted prices include a totally new power system: new fabricate engine beds, exhaust system, fuel filters, air intake ventilation, hoses, thru-hull fittings, fuel system from tank to engine (not necessary to replace aluminum tanks), batteries, wiring, gauges, control cables, engine panel, shaft, strut and propeller. Options add to the price of the job and include: engine soundproofing upgrade, synchronizer, air seps, prop shaft cutters, drip-less shaft seals, magnetic fuel filter (i.e. Algae X), tank overflow check valves (i.e. Racor Lifeguard), exhaust flappers and exhaust tips. Since most boats when built were factory set up for either gas or diesel engine options, seldom does the boat's structure need strengthening to accommodate the increase in horsepower.

GOOD DEALS IN USED BOAT MARKET

A recent study conducted on behalf of National Marine Manufacturers Association (the same organization that produces 20-some boats shows), on the used boat market in the U.S., indicates that sales of used boats, 9m (30') and larger, were nearly four times new boat sales.

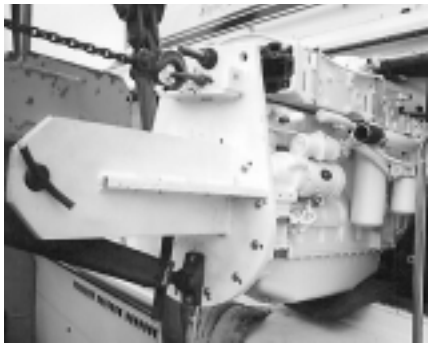
Not surprising there are some good deals on well-built used boats, especially those that were overbuilt in the '70s when resin cost just $2 per gallon.

"If you're looking for a quality used boat, don't overlook one with burned-out gas engines," says Alan Bramble, president of Tolchester Marina in Chestertown, Maryland.

Repowering with a warranted diesel increases the resale value should you decide to sell the boat, which translates into profit. "Buy a good older boat, diesel power it and you've got a super package," Bramble adds.

Repowering a 35-footer, mid-cabin or sportfishing model, takes upwards of 400 hours shop time and more than 500 hours on aft-cabin boats due to lack of access.

To avoid chopping the boat – most old and new engines don't fit through the companionway hatch – engines are taken completely apart and passed through cabin windows, and the new one is reassembled inside the boat. "We've only cut about five boats in the 27 years we've repowered boats," Bramble says.



To avoid chopping the boat, engines are disassembled and passed through cabin windows, then reassembled inside.

A typical repower by Tolchester Marina begins with removing the old engine, then cleaning and scrubbing the bilges. Shriley recommends applying Spray 9 with scrub brushes: "Never use a pressure washer for it makes a mess." Then the bilge is painted: "We know we'll mess it up again so when the job is finished we'll touch-up the accessible areas," Shirley explains.

Completion of the mechanical work is followed by on-water testing and propeller matching. "When finished you've got an old boat but virtually everything that has to do with the power system is new," Bramble adds. "The customer should open the bilge and it should look like a new boat."


EZ KOLD

NEW REFRIGERATION SYSTEM OR A BETTER ICE BOX?

Both the functionality and performance of a refrigeration system depends on the efficiency of the ice box. An expert examines answers to common refrigeration problems and provides new strategies to produce a tolerable, if not outstanding, energy efficient and reliable refrigeration system.

By G. Kevin Alston

Few systems on a boat are as controversial, problematic and generally misunderstood as refrigeration. If you're among the many boat owners interested in improving the performance of your refrigeration system, it's quite likely that you are not too sure whether you are going to get more for your money by adding insulation to your existing box, ripping the box out and rebuilding, or simply leaving the box as is and installing a higher quality refrigeration unit. How you proceed depends on where you are starting and what you ultimately want to achieve.

Ice box Efficiency

Are you trying to reduce energy consumption or increase interior volume? Perhaps you need to stabilize your erratic box temperatures or reduce frost build-up on the holding plates. If your goal is to increase the interior volume of your ice box, then your only option is to rip out the old one and rebuild it. If you want to reduce energy consumption, you may actually be better off putting your money into a higher quality refrigeration system than rebuilding your ice box. Before making a decision, you need to determine the quality and condition of the box insulation.

How much insulation do you currently have? Most people significantly overestimate the role that insulation plays in determining the amount of energy that a refrigeration system will consume. A refrigerator on a boat cruising in the tropics only gets about 50% of its total heat load through the insulation. The other 50% comes from a number of sources, primarily the introduction of warm food and drinks. Since energy efficiency varies among different brands of refrigeration systems, the unit you have (or plan to buy) may affect your decision about how to handle the insulation. For example, if you only have 5cm (2") of insulation but purchase an expensive, high-efficiency refrigeration system, you will use far less energy than if you re-insulate with 15cm (6") of foam but keep your low-end "power hog" unit.

In freezers, heat through the insulation accounts for typically 80% of the total load (versus 50% in refrigerators) making good insulation comparatively more important. Since most cruisers pack their freezers to the limit, the heat coming through the insulation must first pass through all the food between its entry point and the evaporator/holding plate before it's removed. In a poorly insulated box it's likely that the food resting furthest from the evaporator/holding plate may fail to freeze no matter what the refrigeration system. You should consider 5cm (2") of insulation in a refrigerator and 7.6cm (3") in a freezer to be the acceptable minimum if you have first-rate refrigeration equipment. If you have a low-end or mid-quality system, plan on 10cm (4") and 15cm (6") respectively of foam thickness for a 5-cubic-foot refrigerator and 3-cubic-foot freezer. Of course, those looking for the "ultimate" solution will want to go for the heavy insulation and the high-end refrigeration unit.

Is your existing insulation wet? Many boats that have had a refrigeration system operating regularly for a year or longer will likely have wet insulation. This is due to a misunderstanding among boat manufacturers (and virtually all buyers) as to what causes the problem and how to prevent it. Boats with moisture-saturated insulation have either been insulated using pour-in type foam construction, which fills all of the air gaps and spaces around the box, and/or have added moisture barriers to the outside of the foam. All insulation foam (except extruded polystyrene) must be installed with at least a 12mm (1/2") air gap between it and any surrounding cabinetry. Also, plastic and foil moisture barriers only serve to trap water after it permeates through the small pinholes that are

FACT VERSUS FICTION

Before planning your ice box project consider these common but erroneous refrigeration and insulation concepts:

Myth #1 *Closed-cell urethane foam does not absorb water.* It absorbs just as much water as open-cell foam only it takes a little longer to do it. The moisture permeates directly through the cell wall.

Myth #2 *It's important to use a good moisture barrier to keep the foam from getting wet.* Moisture barriers are far more likely to cause a moisture problem than to prevent one. The only sure way to prevent moisture saturation when using foam is to either leave a 12mm (1/2") air gap or to use an extruded polystyrene such as Styrofoam "blueboard."

Myth #3 *Stainless steel is a good building material for a liner.* Because the sides tend to ripple when welding a stainless box, pockets form between the liner and the insulation which act as reservoirs for condensation. It's also very difficult to make a stainless-steel liner watertight. Once the caulking begins to loosen (about a year) the water in the box has a direct path into the foam.

Myth #4 *Space blankets, aluminum-covered foam bubble-wrap and similar radiant-heat barriers offer a good alternative to traditional foams and expensive vacuum-panel superinsulation.* Aluminum is the active ingredient in such insulation products and it does reflect radiant heat. Radiant heat, however, accounts for only a tiny fraction of the load on a boat's refrigerator ice box where nearly all heat is transferred through conduction rather than radiation. Since aluminum is one of the best thermal conductors around, it's one of the worst things you can use for ice box insulation.

Myth #5 *Front-opening ice boxes are less energy efficient than top-opening ones.* This is irrelevant, because the hot air that rushes in to fill the box contains very little heat. Only 9 BTUs must be removed to cool 5 cubic feet of 38°C (100°F) air to 2°C (35°F). Even the smallest refrigeration system only takes a few seconds of compressor run time to remove that heat. Front-opening boxes are certainly more accessible — not unloading half the cold food while digging for something at the bottom of a top-opening box does save some energy.

Myth #6 *Small gaps in the foam causes a huge decrease in insulation performance.* Degradation in insulation value resulting from a gap in the insulation is directly proportionate to the area that gap covers. A box that is 50% covered with R-30 insulation and 50% no insulation will have the same performance as a box that is entirely covered with R-15 insulation. This remains true so long as there is no exchange of air through the gap.

Myth #7 *A box lid or countertop that sweats when a cushion or heavy cloth is placed on it is a sign of poor insulation.* Under humid conditions even the best insulated boxes sweat when topped with a seat cushion or similar insulator. Be sure to maintain at least a 2.5cm (1") air gap between all cushions and ice box surfaces.

inevitably present in the barrier membrane of the finished box.

To check for moisture, drill a 6mm (1/4") hole in the bottom of the box. Stick a cotton swab into the hole. If it feels wet when you pull it out, you only have one decision – rip out and rebuild the box. Not only will moisture prevent any refrigeration system from working properly but also it may eventually lead to dry rot and major structural problems.

Super or Foam?

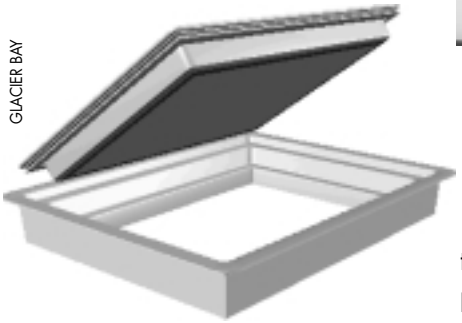
A new concept in thermal insulation is known as superinsulation, a general term given to insulation materials which dramatically out-perform common foams, blankets and other "trapped gas" insulation.

Superinsulation relies on a total or partial vacuum supplemented by various filler materials for high thermal resistance. In such partial vacuums, the "filler" performs a variety of important functions including the interruption of the mean-free-path of heat transmitting molecules.

The main advantage of superinsulations is that they can have three to 10 times the insulation value of polyurethane foam. Some products also simplify new box construction by including the box liner as part of the insulation panel. The primary disadvantage is the cost, totaling several thousand dollars for a large ice box.

The question of whether or not to use superinsulation is a fairly simple one to answer. If you need the space you'll probably find the cost of superinsulation to be a bargain; if you have adequate room in your box, even with 15cm (6") of foam, there may be no reason to pay the extra money.

Prefabricated ice box hatches, such as Glacier Bay's Ready-to-Mount units, are a tradeoff between the value you place on your time and the budget allocated for the project.



GLACIER BAY

A Proper Ice box

No matter how you do it, improving your ice box is a major undertaking. The first thing you can do to improve efficiency is to add insulation to the inside of existing ice boxes. This is practical only where there is sufficient usable space in the box and the existing foam is of good quality. Technautics offers a custom-made Vacuum Panel Reinstallation Kit (US$40 per sq. ft.), a 2.5cm (1") high-density compressed foam equivalent to 12.7cm (5") of urethane foam with an R-30 insulation factor. If you decide to rebuild the entire box, you now have an opportunity to plan the design so it meets your personal needs and efficiently accommodates the refrigeration system you plan to use. Take the time to properly plan the project and it probably won't turn out to be as daunting as it first appears.

JAN MUNDY

For a quick fix, add a gasket to the ice-box hatch to improve box efficiency.

Box size: Most cruisers find that a box division of 2/3 refrigerator and 1/3 freezer space is about right. The total volume of the boxes should not significantly exceed your projected needs. A cruising couple living aboard a 12m (40') boat would probably find a 5- to 6-cubic-foot refrigerator and a 3-cubic-foot freezer to be about right.

Freezer compartment: A "spillover" system is one in which the evaporator (or holding plate) is placed only in the freezer compartment and the cold air then spills over through a gap in the dividing wall to cool the refrigerator. If you are planning to have both a refrigerator and freezer, this is not a recommended setup. Not only are the box temperatures very erratic (those little shutter gizmos don't really help much) but the entire system will be much less energy efficient than if you use a system which separately cools evaporators in each compartment. The dividing wall should completely seal the two sides from each other and have at least 5cm (2") of foam insulation.

Drains: Unless you plan to use your box only as an ice box (i.e. no refrigeration) do not install a drain and sump (never empty into the bilge); just sponge out accumulated water. If you want to have a way to actively drain water out, install a foot-operated pump. Plumb a hose so that it

TYPICAL HEAT LOAD SOURCES

REFRIGERATOR R-30, 15cm (6") foam

Influx through the insulation	60%
Incoming warm food	30%
Box opening	2%
Door/hatch gasket leakage	4%
Food respiration	4%

FREEZER R-30, 15cm (6") foam

Influx through the insulation	89%
Incoming warm food	4%
Box opening	2%
Door/hatch gasket leakage	4%
Food respiration	1%

draws water up from the bottom of the box and out through the same holes into which you plan to run your refrigerant lines. It's clean, efficient and won't smell up the box like the water in a drain sump can.

No curves: Why do so many boatbuilders insist on duplicating the curve of the hull with ice boxes? Not functional, it adds very little additional space. Most boat manufacturers install the holding plate evaporator on the curved side, resulting in a "pocket" behind that is difficult to clean. Now that you have the option, make the sides as vertical as possible.

Door placement: Doors (or hatches) are likely to be the most difficult part of the project if you choose to build them yourself. Front-opening doors can actually be more energy efficient than top-opening doors so long as they maintain an airtight seal. Even on top-opening doors, a good long-lasting gasketed seal is important for energy efficiency and minimum defrosting. Some good alternatives to building your own door are offered by Glacier Bay and RParts. Both come complete with door, frame and double gaskets, one of which is magnetic.

Box liner: The choice of box liner material is an important one. If you are using superinsulation panels you can purchase them with a facing (i.e. fiberglass) that doubles as the new liner. If you are using traditional foam you will need to build the liner separately and then attach the insulation to it. Wooden boxes covered with epoxy resin-saturated fiberglass are common but must be neatly finished with epoxy fillets to obtain smooth seams and corners. Tip: A white-pigmented finishing coat aids in cleaning. Another option is to have a plastic fabricator manufacture the liner out of 9mm (3/8") polypropylene sheet. Polypropylene has low thermal conductivity, is USDA approved for use with food, easy to clean and 100% watertight.

STEP-BY-STEP ICE BOX REBUILDING

Step 1 Original factory-installed galley with top-opening freezer (left) and refrigerator had heavy, poorly insulated, non-gasketed access hatches. Box insulation quality was poor and a water test revealed the presence of moisture.

Step 2 Countertop lifted and entire galley including box liners, insulation and sink are removed.

Step 3 Water-saturated fiberglass below the freezer insulation. Adjacent wooden bulkhead and floor have early stage dry rot.

Step 4 After drying the hull and repairing dry rot, box cavity is lined and "squared" with extruded polystyrene foam. Use 2.5cm (1") of foam when installing superinsulation panels; otherwise, layer foam up to 15cm (6") total thickness.

Step 5 Custom-made panels (in this case, Glacier Bay Barrier Ultra-R) installed with fiberglass facing inside to form new box liner. Seal corners and seams with fillets of thickened epoxy (see "Working with Epoxy" DIY 1998-#4 for complete instructions). Since vacuum panels cannot be punctured, fabricated brackets are epoxied in place to hold holding plates.

Step 6 After painting box interior, install refrigeration holding plates. New box has multiple, smaller sections and front-opening door to increase functionality and improve access.

Step 7 Install new countertop base, sink and three top-opening prefabricated frames.

Step 8 A layer of Corian (or Formica) over countertop base provides an easy-to-clean surface.

Step 9 Install hinges and facing on hatches, and wooden trim finishes the boxes.

GLACIER BAY

Rebuilding Tips

No matter how you choose to proceed, remember that planning is the key. Measure as much as possible and take the time to produce templates before cutting the insulation. With the countertop off, you'll be able to clearly evaluate your situation. You may still want to add insulation to the inside of the box. If the foam is poorly installed but dry, it may be possible to use a sharpened pipe, crow bar, big screwdriver or similar device to dig the existing foam out from around the liner. You can then slide in new panels of high quality sheet foam or superinsulation around the liner. When installing extruded polystyrene or superinsulation panels use a pour-in type foam to hold everything in place. When using closed-cell polyurethane, be sure to leave a 12mm (1/2") gap around the outside making the pour-in approach impractical.

Using prefabricated hatches and superinsulation panels can dramatically simplify the process and reduce the amount of labor involved, but increase the project cost.

About the author: G. Kevin Alston is president and founder of Glacier Bay, Inc. of Oakland, Calif., which specializes in thermal control for mobile and electronics applications.

SAILBOAT RIGGING

SAIL FIXER-UPPER

Shop Tested

This patented process removes mildew, metal marks, rust, oil, grease, blood, spider poop and what-all, and adds a resin treatment that restores the sail to its original stiffness at about 1/10 the price of new sails.

By Zora and David Aikin

Dirt on a sail is the last thing a serious racing sailor worries about — sails are replaced long before stains can settle in. Other sailors, however, have neither the need nor the funding for such a luxury as instant sail replacement.

On most boats, sails spend years onboard, stowed in dark, damp lockers, sometimes ignored for weeks at a time, slowly developing an ultimately serious case of "motleyester." When a wet sail is stuffed in a bag, the mildew fungi cheer. Add to this primary sail-destroyer all the other stainmakers found on boats, and one day as you're checking sails for trim, you realize your one-time lovely white sails require serious help.

The good news is that help is available from a company (appropriately called SailCare, 410 9th St., Ford City, PA 16226; Tel: 800/433-7245) that not only gets rid of all that nasty dirt, it also rejuvenates the fabric with a fresh resin treatment that incorporates a UV protectant, a mildew resister and a waterproofing agent.

Some years ago company president Bill Toy developed this "sail-saving" technique known as the LaMauney Process. Until that time, the company specialized in drapery cleaning. Of course, there's a big difference between drapery fabric and sailcloth, and between the kind of stains each fabric might accumulate and the amount of time the stains usually stay untreated. Still, polyester had already come to drapery manufacturing, so Toy had a good start on his sail-care challenge. Then, too, he was a sailor; the incentive was there on a personal basis.

Today, the SailCare process transforms thousands of sails from grubby and limp to clean and strong, allowing owners to postpone a new-sail purchase for a few more years. Considering that the cost for cleaning is about 1/10 the price of a new sail, that's an undisguised blessing.

The company doesn't make the impossible claim of promising you you'll have a new sail when it's finished. The refurbished sail cannot be returned to its exact new shape (that would be expecting a bit much), but it will have a better shape than it did in a preclean state. It will stretch less, and get you where you want to go without having your sailing buddies laugh and point at your green-and-rust-colored abstract.

Pre-check for Sail Fitness

How do you know if a sail is worth this treatment? You may want an expert opinion, but SailCare suggests three tests you can try yourself. First, determine if there is any resin left in the cloth. Resin provides waterproofing and some UV protection. To do this, take a sailmaker's needle and find what you consider an especially bad spot on the sail. Poke the needle in and listen for a "pop." That's the sound of the fibers separating. Continue to push the needle into the fabric. If you must really push hard to force the needle through, that's a good sign, the sail may be salvageable.

***BEFORE:** It wasn't our intention to test SailCare by giving them an impossible project, but when we unfolded our genoa even we were surprised at how awful it looked. Clumps of mildew were growing happily atop a base coat of blue antifouling paint, the result of a tug-of-war with the ocean. In addition to the basic blue paint and the variegated-color mold, there were a few gray blobs indicating mud-dauber nests, one or two rust spots, and the unavoidable bow-pulpit swing-rings. We had a worst-case mess.*

***AFTER:** When the genoa was returned, we were very surprised to see that SailCare had done the seemingly impossible. Most of the sail is white again. A few smudge marks remain, but are only faintly visible, mostly because we know where to look. The process worked amazingly well on a sail we had long since considered beyond salvage. Best of all, it feels like a new sail, having once again acquired the customary stiffness of sailcloth.*

Next, fold the fabric, and press down on the fold. Then try to tear it. If you succeed, the sail loses the "save" test and you can go shopping. If you can't tear it, that's another good sign.

Now look at the general shape of the sail. If it's so badly stretched you can't recognize the original shape, it probably can't be helped. If whole panels need to be replaced, it's probably not worth doing. In either of these cases, the recommendation would be to purchase a new sail.

If the sail passes the poke, fold and sight tests, ask yourself what you want from this sail. Will you expect near-perfection so you can win weekend races by a few seconds or do you want a reliable sail to cruise from port to port? If you fit the latter picture, then pack up the sail and send it off to the experts in Pennsylvania.

Two-Step Restoration Process

When your sail arrives, it will be carefully measured, then checked for required repairs. The measuring is done not only to calculate the square footage, but also to have a record of the size and shape for later comparison. No repairs will be done until you have been notified of the specifics, and have given your approval. Apart from the expected stitching repairs plus fixing all the temporary repairs you've made, you may wish to add some optional

items, such as another row of reef points, a furling system or replace batten pockets.

Some stains are stubborn. Hard to remove are those caused by rust, blood and soy sauce. Even more difficult are the rub marks left by metal bow pulpit, stanchions or spreaders. Worst of all are the spots made by old-fashioned creosote and any of the odd "mystery" stains. All of these SailCare treats on an individual basis. The stain is tested and if it can be identified, chances are better that it can be at least partially removed. The process usually lessens those that can be neither identified nor removed.

Cleaning and stain removal is step one of SailCare's process. Equally important is step two, which replaces the resin that gives sailcloth its original stiffness. The same specialized machinery that's used for drapery cleaning is used for sails. Toy holds nine patents, one of which is for a steam injection unit that maintains the temperature in the machine to within 2° of ideal. Temperature is key to the success of the process: heat helps to release the dirt, and heat sets the resin. Excessive heat, however, could shrink the fabric.

SailCare keeps extensive background information on many sails, so it "knows" (by fabric type and weight) what works best for each. During the standard tumbling process, the dirt is gradually released from the cloth, and when no particles are visible in the fluid, the sail is clean.

The same machine is used for the resin application — cleaning fluid out, resin in — while the machine is still warm. Unlike the absorption that occurs when ordinary fabric is soaked in liquid, the resin doesn't actually penetrate the fibers of the cloth. Rather, it seeps into and fills tiny gaps in the weave. It's not a coating, so it cannot flake off. This is what company literature refers to as polymerization of the fabric. The process is very much like the original treatment that changes plain polyester fabric into sailcloth. However, this process treats only a single layer of cloth. To re-resinate a used sail, the resin must often penetrate through multiple layers of cloth.

Obviously, this is a special kind of resin, and it, too, is patented. It's water resistant, but SailCare makes it even better by including another waterproofing agent (also patented), an antifungal (to retard the growth of mildew) and UV protection. All of these have proven their worth on the sails of charter fleets in the Caribbean and the Mediterranean for the past five years.

The Bottom Line

So which of your sails can be cleaned? All sails made of a Dacron-polyester blend. Light nylon sails may be cleaned, but these are not usually resin treated and the colors may run.

(With polyester, color is part of the manufacturing process, so it cannot bleed. Nylon, however, is colored separately, so it can and often does run.) Mylar, not being a fabric with a weave to fill, is not a candidate. Surprisingly, synthetic fabrics (i.e. acrylics) are not accepted. They are too susceptible to shrinkage, and even the smallest amount could be significant when trying to refit a bimini or dodger. The exception is a headsail with an acrylic cover, which is handled carefully to prevent shrinking of the cover.

When you pack your sail for its "spa" treatment, do the standard accordion fold, smoothing out each fold in the same way you would for long-term storage, roll it into a tight, compact shape and package it in a sturdy box. Whichever courier you choose, don't forget the insurance. Expect to pay shipping both ways.

Turnaround time will naturally depend on the company's workload, but five to 10 working days is an approximate starting estimate. You will get a warranty, too: 100% satisfaction for the first season.

SailCare's process costs (in U.S. funds) .85¢ a square foot for Dacron sails, .35¢ a square foot for nylon. Typical price to clean the mainsail of a Catalina 22 is $94, for an Islander 36, $218. All repairs are extra.

Keep it Clean

Once your sails have been restored, you can keep their freshness longer with the same general care you'd give any new sail: just keep it clean, salt-free and dry.

If you need to wash a portion of the sail, use lukewarm freshwater and a mild dishwashing detergent like Ivory Liquid. (You might also choose one of the environmentally safe products like those sold by Shaklee or companies with a similar focus.) Spread the sail out flat, and wash the spots, using a sponge (never a brush of any kind). Rinse and dry thoroughly. Never stow the sail wet.

Another caution: Never put sails into a swimming pool, thinking the chlorine will bleach the dirt into oblivion. The chlorine may instead yellow the sail, or worse, make it brittle, aging it way before its likely replacement time.

I was embarrassed to ask the SailCare people if our sail was the worst they ever handled, it had to be close. In any case, we are glad to be able to recommend the service of a company that truly delivers what they promise. You'll find SailCare at many boat shows, or check its web site at www.sailcare.com.

About the author: Zora Aiken and husband David are the authors of "Good Boatkeeping" and "Good Cruising" published by International Marine. The Aikens currently live aboard "Atelier," berthed in Grasonville, Maryland.

ENGINE TROUBLESHOOTING

CLEAN BURNING FUEL

Avoid fuel problems and engine failure with a properly installed and maintained fuel filtering system.

By Robert Hess

Boat fuel tanks are vented to allow for changes in fuel level from full to empty. The tank vent has to be large enough to handle the air displaced by the rapid filling of the tank as well as the fuel consumed by the engine at top speed. Because filling the tank displaces fuel and air much faster than the engine consumes fuel when it's running, the vent hose is much larger than fuel hose, usually 16mm (5/8") ID or larger.

Even when the boat is docked, the vent constantly circulates dirt and moisture-laden air in and out of the tank as barometric pressure and air density change. When air enters the tank and stops moving it drops much of the dirt it's carrying. When ambient temperature drops to the dew point, the moisture in the air condenses to form water droplets which cumulate in the fuel. Water can also enter the tank through a loose filler cap or an improperly installed vent.

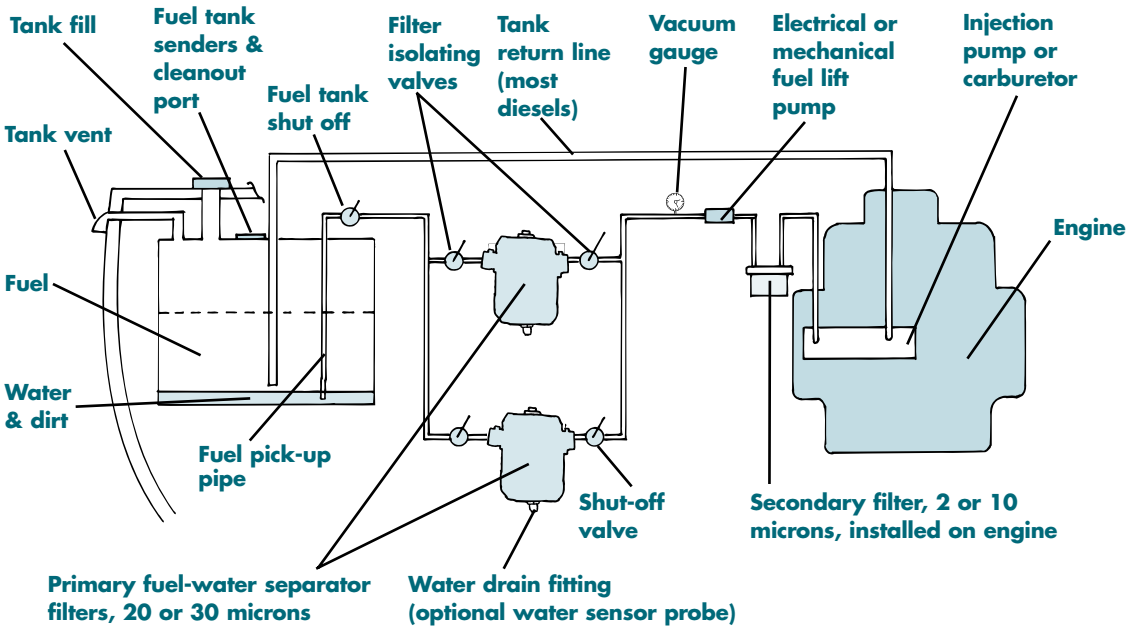
Bacterium Collectus

Dirt and water are heavier than fuel and drop to the fuel tank bottom when the boat is at rest. Also located in the tank bottom is the end of the fuel pick-up tube. In boats that are docked or stored for extended periods, especially with a nearly empty fuel tank, water levels often rise above the pick-up tube. Starting the engine draws "raw" water (and contaminants), but no fuel. When underway, fuel sloshing in the tank agitates the contaminants that are then sucked up with the fuel by the pick-up tube.

If water, dirt or algae in the tank reaches the delicate mechanism of a diesel engine's fuel-injection system it can cause serious damage. The fuel-injection pump is actually lubricated by diesel fuel – contaminants can damage it in the same way dirt or water in engine oil damages an engine.

Besides causing abrasive damage to a gasoline engine, contaminants can plug jet orifices in carburetors, fuel-injection pumps and injectors. Water and dirt collect in the bottom of the carburetor float bowl. Since the carburetor's main jet, which feeds all the carburetor fuel circuits, is located in the bottom of the float bowl, sufficient quantities of fuel contaminants either partially block the jet and cause a misfire, or completely block it and the engine stops. Old-style AC mechanical fuel pumps incorporated a small, quickly removable sediment bowl in the pump body which was designed to let water and dirt settle out of the fuel before being pumped to the carburetor float bowl.

TYPICAL MULTIPLE INSTALLATION



Primary fuel-water separator removes water and contaminants; secondary filter with a finer micron screen catches any remaining minute contaminants. Two filters installed in parallel with shut-off valves provide servicing of one unit while the other supplies fuel to a running engine.

Racor primary diesel fuel-water separator with metal base to protect see-through glass bowl from breakage. For safety reasons, glass or plastic bowls are prohibited on gasoline-powered boats.

Bug-Free Fuel

A properly designed fuel filtering system minimizes most fuel problems. Fuel filters remove dirt particles from the fuel before they reach the engine. The particles are held in the filter element until it's replaced with a new one during engine servicing. A delay in replacing a filter loaded with dirt can cause engine fuel starvation that can lead to a misfire and a lean condition that can damage the engine or result in a complete shutdown.

Water separators separate water from fuel that's collected in a bowl under the separator until it's manually drained. Because the bowl capacity is usually less than a quart, the bowl must be frequently drained when operating the engine – it's possible to filter gallons of water in just a few days, even hours, if there is an abundance of water in the tank. Once filled, the water overflow is discharged to the engine. Diesel water separators can be fitted with optional water sensor probes connected to control panel warning lights and buzzers. They warn that the water separator bowl is holding a lot of water and needs to be drained soon.

Fuel filters and water separators are commonly combined in the same housing, with the water and sediment storage bowl located under the filter and separator element. Outboard and diesel engine fuel-water separators are often fitted with glass or clear plastic bowls, which are handy to monitor the color and clarity of the fuel. A petcock water drain valve facilitates removal. Gasoline inboard or stern drive engines require metal bowls that must be drained to determine if any water is present. Bowls are fitted with screw-in drain plugs to prevent a fuel spill should the plug accidentally vibrate open. Many gasoline-powered boats built before 1980 were originally fitted with glass sediment bowls and fuel filter petcock drains which, for safety reasons, should be replaced with steel sediment bowls and drain plugs.

Spin-on combination fuel-water separator canisters, commonly used with stern drive and outboard engines, have no drain system and must be replaced to dispose of the

FILTER CHANGING

Changing a filter can be a messy job if the fuel spills from the filter when it's removed from the housing. In the case of a gasoline filter, a fuel spill can be dangerous, causing an explosion or fire.

Before changing any filter turn off the fuel tank valve and any valves on either side of the filter, then place a pail under the filter assembly. Turn the battery main switch to the "Off" position. Extinguish any open flames (i.e. stove) and have handy a fire extinguisher. Refer to the engine service manual to determine if the system is pressurized and how to depressurize the system, if needed. Place a pail or other catch basin under the collection bowl if the filter has a drain on the bottom. Drain some of the fuel from the filter bowl into the pail. Remove the filter housing or canister and catch all spilled fuel in the pail. Replace rubber seals or O-rings with new ones included with the new filter. On diesel engines with mechanical fuel pumps, half fill the fuel filter with clean diesel fuel before installing the new filter. This filters the fuel and reduces engine-cranking time at startup. Engines with electric pumps will fill quickly as soon as the pump starts running at startup. Some filter units have manual primer levers that can be used to fill the filter housing after installation. Once the system is charged with fuel, check the filter O-rings and gaskets for leaks. Run the engine for 15 minutes, then turn it off and wipe filter assembly to check for leaks.

A diesel without a self-bleeding system may need to be bled before it will start. To do this, open the injection pump bleed screw if it has one. Bleed each injector by loosening each injector line slightly at the injection pump (not at the injector unless there is no other way to do it) while cranking the engine (lift the decompression lever) until air stops spitting out at the joint. Once the engine starts, it usually bleeds the remaining air left in the injection system. Be very careful not to let the high-pressure diesel fuel hit your skin, since diesel injection pumps generate such high pressure they can actually inject diesel fuel through the skin, causing very serious injury. With the boat tied securely, run the engine for 15 minutes in gear to be sure there are no air bubbles.

TIPS

FINDING THE FUEL BLOCKAGE

Need to solve a mysterious fuel starvation problem? A likely source is a blocked tank vent line, commonly from an insect or spider nest. Here's your clue: Increased fuel tank fill time accompanied by fuel fill pipe spit-back during refueling.

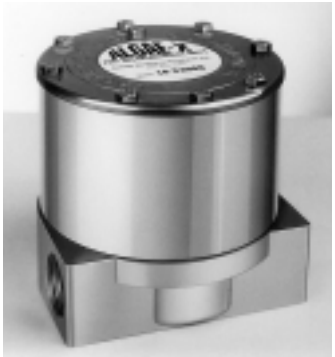
water collected. Like all water separators, they quickly fill with water when there is a lot of water in the tank and the engine has been running for extensive periods. With their all-metal housing, it's impossible to tell how much water has accumulated. The first indication that the canister needs replacing is when the engine shows symptoms of water in the fuel, such as loss of rpm or rough running, which is often too late for some owners. The instruction sheet that is packed with one popular brand states: "Replace filter element a minimum of once per year or more often if operation indicates." Carry a spare canister or two onboard to avoid unwanted breakdowns.

To check for water on spin-on, canister-type fuel-water separator used with gasoline engines, remove it with an oil-filter wrench and empty contents into a clear container. Clean filters can be reused but require a replacement gasket.

Fuel-water separators come in myriad configurations and specifications. Portable tanks don't usually require separator-filters as most have a vent shut-off and the small capacity allows for very little water to condense out

FATAL ATTRACTION

A discussion on fuel filtration systems would not be complete without mentioning the "algae eaters" for diesel fuel, such as Algae-X. This product operates in conjunction with a conventional fuel-water separator assembly. Installed in the fuel line between the tank and the primary separator, it apparently removes the bacterial sludge and slime (algae) before it gets to the fuel filter. It does this by passing the fuel through a magnetic field to transfer the kinetic energy in the microbes into electric energy (a process known as induction), thus disrupting the balance, killing the microbes and cleaning the fuel. The benefits are many: less frequent filter changes, increased injector life, diminished smoke, improved fuel economy and reduced engine maintenance.



– Jan Mundy

ENGINE TROUBLESHOOTING

of the air. Boats with built-in tanks with open vent lines may produce a lot of water, and so require a fuel-water separator. Diesel engine injection pumps are considered to be more sensitive to water and contaminants than gas engine carburetors. Many are fitted with turbine-type fuel-water separators which force the fuel above the bowl to spin in a vortex, boosting separation and collection of contaminants.

Flow Ratings and Filter Sizing

An engine's maximum power output, fuel delivery system and fuel type determine the specification for the filter media size rating, fuel flow capacity and filter capacity.

Fuel filter elements are rated by the size of dirt particles they can pass, measured in microns. A micron is 1,000th of a millimeter. Common element media size ratings are 1, 2, 10, 20 and 30 microns, with 1 being very fine and 30 average. The finer the filter element the more particles it collects and the more frequently it needs servicing, unless it's sized large enough to handle the increased amount of contaminants. Always specify brand-name filters and components to ensure consistent quality and reliability.

Fuel-water separator for gasoline inboard or stern drive engines has metal bowl that must be drained to determine if any water is present.

Racor filter elements are color coded by micron rating.

A rough rule-of-thumb suggests gasoline engines be fitted with a fuel system with a minimum flow rating of 10% of the engine maximum horsepower rating, or in metric, 50% of the engine maximum power rating. This means a 50hp gas engine, for example, requires a fuel system with a flow rating of at least 5gal per hour; a 33kW engine requires a fuel system with a flow rating of at least 16.5L per hour.

Since most diesel engines recirculate their fuel to the injection pump and back to the fuel tank they need a higher flow capacity. They are usually fitted with a fuel system with a minimum flow rating of 20% of the engine maximum horsepower rating, or in metric, 100% of the engine maximum power rating. A 50hp diesel engine, for example, requires a fuel system with a flow rating of 10gal per hour; a 33kW engine requires a fuel system with a flow rating of at least 33L per hour.

Installation Guidelines

Fuel-water separators installed in boats must comply with the engine manufacturer's recommendations for filter media size and fuel flow rating. Carefully follow the filter manufacturer's recommendations for mounting and system configuration. Select an easily accessible location, allowing space for a catch basin under the canister to catch fuel spills. Mount the unit close to the engine but isolated from batteries or hot exhaust manifolds, in case of a fuel leak. On gas-powered boats, be sure the engine compartment is well vented to remove fumes before installing.

TIPS

• Plan ahead with a filter changing kit. Collect all the tools you need to change filters — plastic container, spare filters, O-rings, gaskets, filter wrench, dental pick for removing O-rings and other necessary tools — and place in a small tool box or plastic tub.

• Use a water-finding paste or sticks, available from automotive supply houses and some gas stations, to determine the presence of water in your fuel system. If the stick turns color, you have water in the tank. A small jar lasts a very long time.

• One of the reasons for a fuel blockage that's difficult to diagnose is the filter screen located on the end of the tank pick-up tube. Contaminants clog its fine-meshed screen, restricting fuel flow. Next time you service the sender or tank, remove the screen. Fuel now flows freely to the primary water-separating filters where it can more easily handle the dirt and contaminants.

• While this may seem obvious, make sure the filler cap is marked "diesel"or "fuel" and not water. It's not uncommon for a well-meaning crew or drowsy owner to unintentionally fill a fuel tank with water or vice versa.

American Boat and Yacht Council (ABYC) requires all installations use proper fuel hose (UL 1114 or SAE J1527), all-stainless hose clamps and the correct grade and type of corrosion-resistant fittings. Pipe thread fuel connections must be sealed with Teflon paste or fuel-resistant thread sealer compound (never a tape which may leak). Make sure you con-

NO MESS, NO FINE

How do you know when the fuel tank is full? Wait until fuel spills out the tank vent? If fuel doesn't spill overboard when refilling, it's possible it will when underway from agitation or thermal expansion. Besides staining topsides and damaging graphics or paint, fuel pollutes the environment. Should a spill occur when Big Brother is watching, you can expect a fine as high as $5,000.

Racor's Lifeguard fuel/air separator for diesel and gas engines, vents the air and directs fuel back to the tank. This inexpensive (US$55) device installs easily inline in 16mm (5/8") vent hose.

– Jan Mundy

nect the fuel lines in the proper direction of the fuel flow. Avoid 90° fittings because they can restrict fuel flow. If they must be fitted, the next larger hose and/or fitting size should be used. Install a shut-off valve at the fuel tank to prevent fuel siphoning and ground all metallic components of the fuel fill system in contact with the fuel and fuel tank so that resistance to the boat's ground is less than 1ohm.

Many installations use a large primary fuel-water separator assembly with a 20 or 30 micron filter element mounted in a convenient spot for servicing, and a secondary or final fuel filter with a 2 or 10 micron element mounted on or near the engine. The goal of using multiple filters of increasingly small filter media (small micron rating) is to build extra capacity into the system, and to allow for the cost-effective replacement of all the filters in the system at the same time. Dual filters are sometimes installed at each stage, connected in parallel with isolating valves so that each filter can be changed with the engine running. (Refer to schematic on page 29.)

An optional vacuum gauge mounted between the filter and the fuel pump monitors filter condition and allows for replacement of a clogged filter before it causes problems. The vacuum reading corresponds with the amount of suction the pump requires to draw fuel, and rises as the filter becomes increasingly blocked.

About the author: Robert Hess operates Atomic Four Engine Service in Vancouver, B.C., and specializes in sales and rebuilding of Universal gas and diesel marine engines.

POWERBOAT RIGGING

PUSH-BUTTON STARTING

Shop Tested

Replace your boat's existing ignition key switch with a reliable keyless ignition system and leave your key worries behind.

Story and photos by Jan Mundy

Quicksilver Keyless Ignition kit includes a keypad, control module, hardware and detailed instructions.

"Did you remember the keys?" "No, I thought you had the keys." Or perhaps you've stepped from the boat onto the dock and dropped the keys into the depths beyond. Maybe inserted the key into the ignition switch only to have it break from corrosion.

If any of these sound familiar, we have a solution: install a keyless ignition system. Quicksilver's Keyless Ignition for outboards and gas stern drives or inboards needs no key – just enter a four-digit access code, press a button to start the engine and you're off and running. Based on keyless entry systems developed for vehicles, push-button features include integral choke/fuel enrichment (outboard version only), audible signals and starter lock-out to prevent accidental starting of a running engine. On boats with bilge blowers, entering the access code automatically activates the blower, which operates on a three-minute timer. Another benefit is security – the unit is preprogrammed to start only when the proper access code is correctly entered, a definite theft deterrent.

We installed the outboard version, part number 87-830863A2 (US$108/CDN$139), on our 6.6m (22') walkaround cuddy with 150hp Mercury outboard. Units are available from Mercury and MerCruiser dealers, however, you don't need a Mercury product as units adapt to most competitive engines. Be sure to order the correct one for your engine.

Kit comes with keypad, all necessary hardware and color-coded wiring. You'll likely need extra butt connectors and heat-shrink terminals, depending on the installation.

Installation

The unit's modular design simplifies the installation, but wiring, depending on the original setup, can be rather complex. Of the three hours it took to install the system, more than half was spent wiring, then another two hours to troubleshoot and rewire the dealer-installed dash instruments (see "DC Troubleshooting"). Read installation instructions completely before attempting the installation. Take time to compare the wiring schematic with the boat's panel wiring. Our panel was easily accessible, by simply removing a fabric-covered bulkhead, other boats may not be so lucky.

Installing the keypad requires drilling a hole in the dash for the cable, mounting the control module, then hooking it up to a power source. You'll save time if the keypad, which measures 4.5cm by 9.5cm (1-3/4" by 3-3/4"), covers the original key switch hole. If not, you'll have to drill a new access hole in the dash panel for the ribbon cable. To install on a Plexiglas dash, drill oversize holes and use longer self-tapping screws.

Inspect the back side of the panel for any wires that may be damaged when drilling. Ensure location of keypad is accessible to operator while seated at helm, there are no obstructions behind the dash and the control module mounts with enough cable length to reach the keypad. Operation of control module may be affected by radio frequency interference (RFI), so it's important not to mount it close to a depthsounder or fishfinder. Carefully follow the wiring instructions, matching the color coding. All wiring terminals must be the heat-shrink variety to protect connections from moisture.(For complete step-by-step DC wiring procedures see DIY 1998-#4 issue.)

Operation

The convenience of using a keyless ignition cannot be overstated. Follow the detailed instructions to program your four-digit access code, then press "Run." This turns the unit on, activates the oil-warning horn (not equipped on all engines) and energizes the gauges. Press "Choke" (number "9" key) and

Original dealer installation shows eight negative wires crowding the "GND" post on the tachometer, leaving barely enough space to thread the nut.

Panel rewired with a negative bus bar for attaching negatives from gauges. Negative lead from ignition control module is shown on the left, negative lead to "GND" on tach is on the right.

DC TROUBLESHOOTING

When properly installed, the Quicksilver Keyless Ignition is a foolproof, virtually seamless device. A unit that operates intermittently, as was the case with our installation, results from a wiring harness short, bad crimp or faulty ground.

Before cutting the wiring harness to hook up a keyless ignition, I highly recommend that you ensure the boat's key switch is fully functional. Wiring problems typically happen after installing an accessory. If you didn't have problems before installing the new ignition system, then it's easier to retrace your steps and find the fault. Otherwise, you'll have to troubleshoot the boat's entire wiring, a complex and time-consuming proposition.

Before doing any wiring, turn the master switch to the "Off" position or remove the negative battery terminal from the battery post – a short caused by touching a negative to a positive terminal usually blows a fuse or trips a circuit breaker.

Checking connections with a multimeter revealed a bad crimp connection. The dealer-installed gauges were wired with automotive terminals, which naturally had corroded. Also, all ground wires, eight in total, connected to the single-pole "GND" (ground) on the tach, a hasty but common practice that resulted in one negative wire shorting on the "IGN" (positive) post on the tachometer. Mounting a negative bus bar easily rectified this: negative lead in from the ignition control module, one lead-out to the tach ground. Remaining negative wires from the gauges connected to the bus bar, except three wires that weren't long enough to reach the bar. These, along with the negative lead from the bus bar slipped over the tach's "GND" post.

"Start" simultaneously (check instructions for actual choke usage), to start the engine. Press "Stop" to stop the engine. To restart, simply press the "Run" key, then "Start." To arm the system and lockout the starter, reenter your access code and press "Stop." Entering the correct code, reactivates the system. Audible chirps from the control module indicate activation, code input and lockout.

Before leaving the boat, check that the system is armed: push 'Run" and if gauges activate, reenter your access code and press "Stop." Again, press "Run" to check.

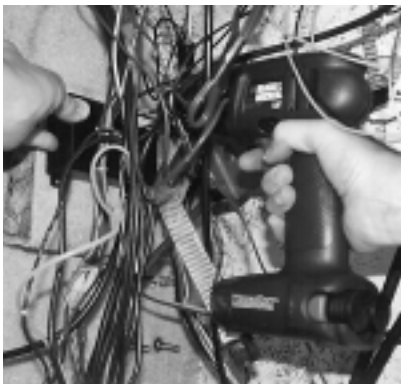
Should you forget your code, enter the factory-preset master code and reprogram your access code. The system also defaults to the factory code when it loses power (dead battery) or is disconnected from a power source (i.e. extended storage) for longer than three days.

While a keyless ignition is surely one of those amenities you probably could do without, it's comforting to now arrive at the boat knowing you're not held hostage to keys. Once you get accustomed to having a keyless ignition and overcome the odd memory lapse still asking for keys, you'll probably detect some power tripping as you press a few buttons and the engine starts.

INSTALLING A KEYLESS IGNITION SYSTEM

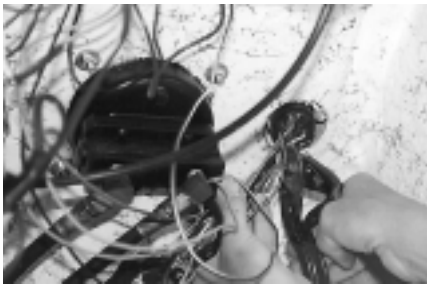
Where keypad size is too small to cover original 5cm (2") key switch, use the supplied paper template to drill the slot for the ribbon cable and four mounting holes. Inspect back side of panel before drilling for accessibility and any obstructions. We replaced self-tapping mounting screws with stainless-steel wood screws for mounting the keypad to the plywood-cored fiberglass dash.

Although the keypad is gasketed, coat mounting surface and around slot cutout with polyurethane sealant/ adhesive (we used 3M 4200 Fast Cure) to form a watertight seal.



Securely mount the control module in a convenient location within reach plus some slack of the keypad ribbon cable, the tachometer or negative bus bar, and way from other electronics.

Plug together the two ends of the ribbon cable, then wrap the connection with supplied self-adhesive tape.



Cut all ignition wires at the back of the key switch, which in this photo remains mounted in original location. The wiring harness from the control module matches exactly the wire color coding of the original key switch and shift control box.

Strip ends of all wires, removing about 6mm (1/4") of insulation, to prepare for crimp terminals.

Crimp terminals onto wire

Crimp terminals onto wire (top) and using a heat gun, shrink the ends until sealed, but not burnt. If you're not familiar with these terminals, do a few test pieces first to determine amount of heat needed.

Completed installation. The key switch (shown left in the photo) is normally replaced by the keyless keypad, except where the switch is oversized and its mounting hole too large, as was the case in this installation. The original key switch was reinstalled (this should confuse a thief) until we find another gauge, likely a voltmeter, to take its place.

EQUIPMENT

DINGHY STORAGE SOLUTIONS

The advantage of using a davit system to stow your dinghy is obvious but many systems fail because of overloading or faulty installation. Here's what you need to know to select and install a proper davit system configured for your boat.

By Jan Mundy

One of the pleasures of boating is landing at a favorite anchorage, launching the dinghy then going touring, visiting other boats, water-skiing or diving, fishing or exploring ashore. All dinghies, whether an inflatable or hardshell, require secure storage. Towing isn't practical most of the time and downright risky in rough weather. Ditto for deck storage on most boats. Better quarters for the dinghy are davits. These systems hold the dinghy, keep it clean and deter theft.

When accurately configured for your boat, properly sized to the dinghy, aptly installed and correctly set up, davits should function trouble-free. Most problems occur from overloading, faulty installation or an unbridled dinghy — if not secured so absolutely motionless, a swaying 90kg (200lb) dinghy casts a lethal load.

Because of the myriad boat styles and mounting arrangements, davit systems are built on a semi-custom basis and typically purchased manufacturer direct. This way, the buyer presumably gets expert advice in mixing and matching components to obtain the best configuration for his/her boat. Before davit selection can begin, you need to do some planning: select the dinghy, decide where it's to be mounted, and then determine the overall lifting weight.

Dinghy Requirements

Before purchasing a davit system, you should first choose a dinghy and decide where best to store it. Saltwater cruisers may need a more robust dinghy than inland boaters, one that handles seas without drenching the crew or swamping. A good guideline is to have the dinghy's load capacity twice that of its weight. For example, a dinghy weighing 90kg (200lb) should be able to safely load 180kg (400lb).

Another consideration is the potential to change a boat's handling characteristics by adding a heavy mass concentrated in a small area. A typical 3m (10') dinghy with a 15hp motor weighs anywhere from 112.5kg (250lb) to 126kg (280lb) actual weight. Transom mounting a dinghy with a 6hp engine in davits on a 32-footer likely will have no effect. Double the weight by carrying a personal watercraft (PWC) on the same boat and you're sure to alter the characteristics.

Now examine your boat's transom (or deck) and determine the amount of usable space without interference from engine vents, ladder, platform, tanks, etc. Most stern-mounted davits look best when they are mounted perpendicular to stanchions (rails). Measure the distance apart for mounting of the davit arms. As a rule, the reach of the arms for stern davits is half the beam of the dinghy, except boats with canoe sterns that require a greater reach. To help configure the best system for your boat, Edson supplies full-size paper templates at no-charge and recommends they be cut out, mounted onto cardboard and placed onboard. Now estimate the location

Atkins & Hoyle swim platform system utilizes a removable rotating davit to lift and rotate dinghy onto a cradle.

Edson cast aluminum large, compact and low-profile davits fit a variety of mounting locations, heights, and dinghy packages up to 112.5kg (250lb).

Ocean Marine's rail-mount davits with horizontal strut tie the two davit arms together to eliminate sway.

Least expensive clip-on davits place the dinghy on end on the swim platform. Normally, the motor is removed before hoisting.

of the dinghy pick-up points. You'll need to mate these points to the davit spacing as many systems allow misalignment of only a few inches.

The next step is to marry the dinghy to a davit system properly sized to your boat.

Products and Options

There are five basic systems to hoist a dinghy: clip-on, where the dinghy rests on end on the swim platform; rail, both fixed and rotating, fastens to stanchions and dinghy hangs over deck or stern; traditional bolts to the deck or transom so dinghy hangs over the stern; rotating mounts on foredeck, bridgedeck or swim platform; and professionally-installed hydraulic-powered elevators mount

TIPS ROUTINE CHECK-UP

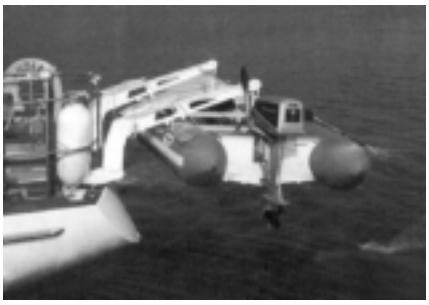
Periodically check the davit mounting bolts. Should they come loose you risk losing the davit and possibly punching a huge hole in the transom.

Rotating davits are ideal for on-deck lifting but are not necessarily the best solution as stopping movement can be difficult in rough seas.

on a swim platform to lift large dinghies over 450kg (1,000lb) or PWC.

Clip-on davits (i.e. Weaver) are an economical choice for powerboats in sheltered waters with small inflatables and outboards up to 10hp, but the motor must be removed before hoisting. If you want to leave the motor on, you'll need a rail, traditional or rotating system. Of these solutions, rail mounts are the least expensive and most popular, especially for sailboats. Available from Atkins & Hoyle, Forespar, Kato Marine, Kingston Anchors, Ocean Marine, St. Croix and others, they are ideal for dinghies up to 3m (10'). Some systems not only mount to the rail but can also mount to a bulkhead or transom. Some units are removable, some rotate (for powerboats), some do both. Easily installed in a couple hours, fittings fasten to the rail and universal bases mount to the deck or transom. If your dinghy is heavier than a rail-mount davit system can safely carry, you'll need a traditional or rotating system.

Designed for heavier dinghy-engine packages, deck- or transom-mounted traditional davit systems (i.e. Atkins & Hoyle, Edson) come with fixed or adjustable riser arms in lengths 25cm to 101cm (10" to 40"), depending on the boat's



Davits must raise the dinghy high enough so in large seas the motor won't drag. Shown are Edson cast aluminum traditional davits.

With davit arms extending out to .9m (3") and longer, a 81kg (180lb) dinghy-gear-motor package puts tremendous loads on the stern.

requirements. Heavy dinghies may require optional support kits mounted on the transom or swim platform.

Rotating davits (i.e. Atkins & Hoyle) lift, rotate, then put the dinghy

Tailored-to-fit, Atkins & Hoyle cast Almag 35 davits can be mounted vertically or horizontally to the deck or transom and in case of a wrong measurement are fully adjustable in reach, height and angle — just rotate the geared connections to the required angle and tighten to place the dinghy at the proper height and position in davit arms.

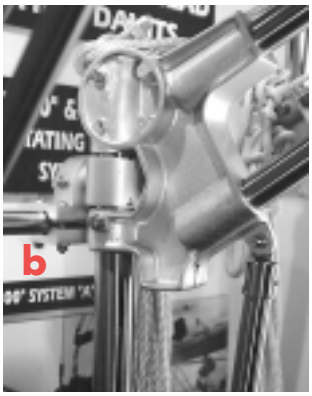
onto the foredeck, bridgedeck or wide swim platform. If the deck can support the load, these systems can be flush mounted rather than placing a standpipe (compression post) through the deck to the keel. Manually operated rotating systems can lift about 81kg (180lb) onto a swim platform, 67.5kg (150lb) up on the foredeck. The higher you lift the more difficult hoisting becomes. Optional electric winches (US$600 each) simplify this task — mechanical hand winches (US$140 each) with a 25:1 purchase, which means 25 cranks for every 2.5cm (1") of lift, aren't practical to manually hoist a dinghy 1.8m (6') or higher.

Dinghies with large motors (30hp plus) often combine a rotating davit on the transom with a cradle mounted on the swim platform.

Swim platform lifts have become popular on large yachts to lift heavy dinghies or PWC. Most are hydraulic powered and not easily owner installed.

Prices for davit systems increase incrementally with the lifting load — the heavier the dinghy, the more expensive the system. Prices, excluding installation, for rail-mount systems range from $790 up to $1,800 per pair depending on the options. Traditional systems start at $649 for davit arms only (pair), then double with the necessary options, up to $3,000 for a complete 337kg (750lb) package. A rotating davit system that lifts a 450kg (1,00lb) dinghy-motor package or two-person PWC averages $5,500 plus another $2,500 for the cradle. Hydraulic swim platforms cost between $12,000 and $20,000 plus installation. Hydraulically operated davits can cost as much as $60,000 plus $10,000 for installation.

Many published prices do not include complete systems. Tie-downs, ratcheted straps, lifting slings, stabilizing



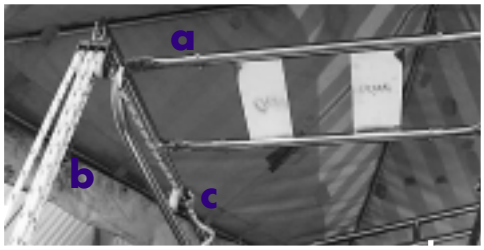
Examples of adjustable rail mounting brackets: (a) Ocean Marine UHMW plastic rail bushing; (b) Atkins & Hoyle cast rail mount with compression strut transfers loads downward onto base (c).

EQUIPMENT

bars, transom strut supports and manual or 12-volt winches are some additional equipment. Boats with weak rails or decks that cannot supply the extra weight require optional support kits. One of the most popular options is a tackle upgrade with purchases ranging from 2:1 to 8:1. With a 4:1 block and tackle you can comfortably hoist a 36kg (80lb) dinghy; add a 9.8hp outboard and you'll likely need a 6:1 tackle. Where the lift is higher than 1.8m (6'), you should consider a power winch system.

Davits are fabricated of stainless-steel pipe, bent to shape and welded, or cast aluminum and anodized as offered by Atkins & Hoyle (actual alloy is Almag 35) and Edson. Bent-pipe davits have a high-gloss finish compared to less attractive, satin-coated cast units, but require frequent cleaning to deter corrosion. As welding changes the molecular structure of the stainless steel, look for small welds, usually formed by TIG welding, compared to the hotter MIG welding method that forms large welds which may corrode. Wall thickness of tubing also varies: .083 tube is more expensive than .065 but has greater weight carrying limits.

Heavy RIB stowed in transom davits system mounted with transom support struts and optional electric winches.



Typical options include (a) horizontal connecting struts, (b) block and tackle, (c) quick-release clam cleat to secure lifting line, (d) ratchet tie-down and (e) quick-removal mounting shoe.

Calculating Loads

Bigger is better when it comes to buying a davit system. It should be able to take the strain of a 600-mile passage, support a rainwater-filled dinghy and in rough weather ensure the dinghy won't break loose and hole the transom.

Strength of a davit system is a function of dinghy weight and boat speed. Davits are rated by breaking load, lifting capacity, test load or safe working load (SWL) which is the preferred rating as it measures the raw lift-and-hold capacity of one davit arm. The faster the boat, the greater the pounding forces. When comparing an express cruiser and trawler with identical dinghies, davit loading is substantially higher on the cruiser.

To determine the SWL, multiply the total load (dinghy plus gear and motor) by 75%, then add a 15% safety factor (allows for water-filled dinghy). Consider this example for

Davits must be set up so the dinghy hangs at gunwale height, any higher and the dinghy will swing. The dinghy tube or gunwale must also stow against the curve ("armpit") of the davits, then tied (ratchet straps preferred) so absolutely motionless. If you have trouble pulling up the dinghy, it's likely you have the wrong block and tackle for the davit, or vice versa.

stern-mount davits: a 3m (10') dinghy and 10hp motor with a total weight of 67.5kg (150lb) times .75 equals 50.6kg (112.5lb). Then multiply by two for a davit system (per pair) carrying capacity of 101kg (225lb) plus 15% safety factor, gives a SWL of 81kg (180lb) for davit pair. For a single crane davit, the SWL equals the total dinghy weight plus 15%.

With dinghy selection and placement completed, you'll need to provide the davit manufacturer with boat year and model, packaged weight, selected davit type, mounting distance between davit arms (if a dual arm system), davit arm height and reach plus desired options. Many builders have a database of designs so they know the boat's basic layout, but customizing and deck add-ons can alter the mounting.

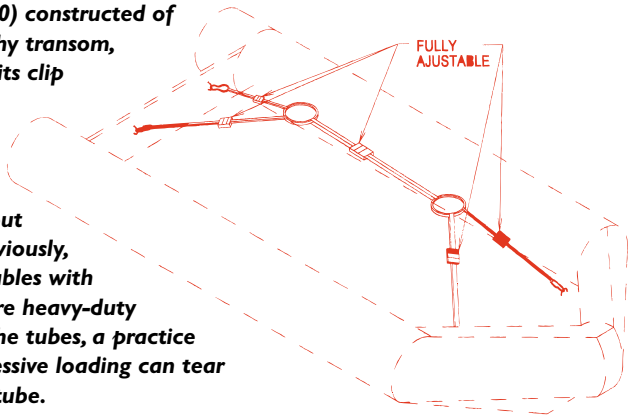
Installation Guide

Since davits put tremendous loads on the hull (or deck) few boatbuilders recommend installing them, especially on the rail or transom. Lifting a 45kg (100lb) package, for example, loads on the mounting base can be as high as 225kg (500lb) with the boat stationary.

As a rule fiberglass boats built before '92 have stronger transoms than newer boats, particularly sailboats with sloped transoms, an area where builders have cut thickness to save weight. Some boats require transom or deck reinforcing as well as optional support kits. Since rail davit systems are limited by the strength of the rail, boats may require reinforcing and optional cable or strut support kits to reduce the load to 1:1. Teak railings almost always require a complex rail-support structure. Large loads may require adding extra layers of fiberglass under mounting brackets, or rail bases for rail davits, together with over-size backing plates at least the dimension of the davit base and preferably as large as space allows.

As all boats and mounts are different refer to the installation instructions supplied with the davit. These "manuals" range from excellent to poor, and some manufacturers offer a toll-free helpline as back-up. Depending on your mechanical ability, installation of a simple rail system takes roughly four hours, longer on curved transoms. For more complex systems, the job may take 40 hours. Power davits are more complicated, especially the wiring, and usually professionally installed.

Note: All prices quoted are in U.S. dollars.



An adjustable bridle ($600) constructed of cable secured to the dinghy transom, bow and/or floor and davits clip onto it. Pick-up points should be 10cm to 20cm (4" to 8") ahead of the transom. This mounts the dinghy in the davits without the motor interfering. Obviously, this won't work on inflatables with roll-up floors which require heavy-duty glue-on ring patches on the tubes, a practice not recommended as secessive loading can tear the patch, damaging the tube.

TIPS WEIGH IN

Before final selection of your davit system, it's recommended you weigh your dinghy. Many times, the actual weight is up to 40% under the published weight.

DIY PROJECTS

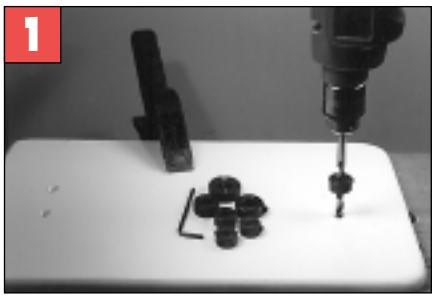
BUILDING WITH STARBOARD

Story and photos by Jan Mundy

King StarBoard is an extremely versatile material. Strong, lightweight, never splits or warps and completely maintenance-free, there are few wooden items on board that can't be replaced with StarBoard. Working with it is easy, certainly no more difficult than wood, using wood fabricating techniques and tools.

Two weak links in building with StarBoard are the lack of offcuts available and the special formulated StarBond glue. The former has been resolved: most plastic suppliers only sell full-size sheets but StarBoard is now available in hobbyist quantities at West Marine and Boat/U.S. As for the StarBond glue, few suppliers carry it and it's expensive: the dispenser costs US$65 (some suppliers rent it for a nominal fee), the 50ml-glue cartridge costs US$25 for only 1 sq.ft. coverage plus more for nozzles. 3M Marine recently launched a glue for polymers only available, unfortunately, in bulk for commercial use. Some builders endorse the use of 3M 5200 adhesive/sealant used in union with screws. This holds well and offers an alternative when you don't have access to StarBond.

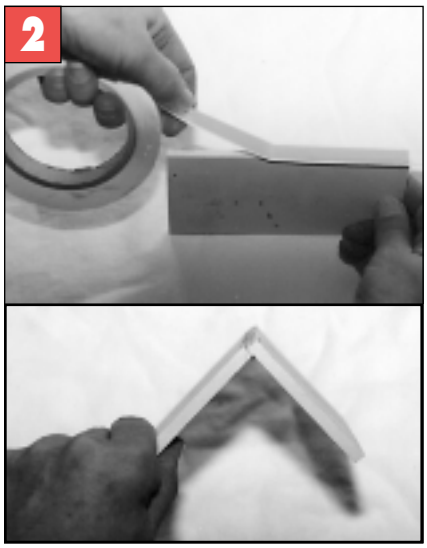
StarBoard behaves differently from other plastic-type materials. To obtain the best results here are some details you need to consider. (Refer to DIY 1996-#4 for complete step-by-step construction techniques.) StarBoard expands and contracts with temperature changes. When measuring items, reduce dimensions by 1.5mm (1/32") per foot of length or width. This material is strong but has limited structural strength and must be supported by a load bearing framework in large spanning applications, such as a swim platform, shelf or seat. A support grid fastened every 38cm (15") is recommended for 12mm (1/2") StarBoard; every 45.7cm (18") for 19mm (3/4"). Reinforcing ribs or pads made of StarBoard, wedged between mounting brackets and the finished piece add the necessary stiffness. Be sure to use drill stops (**Figure 1**) to drill



holes to the exact depth — don't guess. For a professional finish, countersink fastener holes and fill with plugs cut from StarBoard with a plug cutter.

A great aid to temporarily "clamp" StarBoard components (or other "unglueable" material) when assembling or preparing to drill or fasten is Stripfix (**Figure 2**). This pressure sensitive, rubber resin adhesive tape by Vetus is available in 10m (cost less than US$20) or 30m (33' or 98') rolls in widths of 9mm (3/8"), 12mm (1/2") or 22mm (7/8"). Just peel, stick and join pieces together.

If you're a long-time reader of DIY and have read the past three Annual Boat Refit issues, you already know the merits of this UV-stabilized

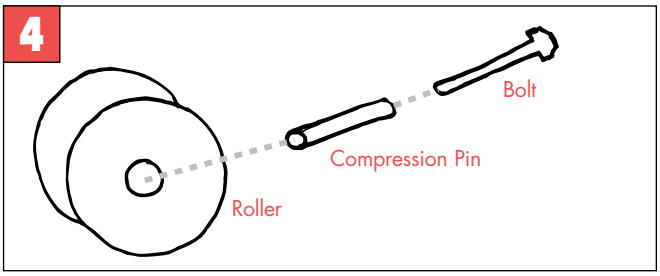


polymer. Past projects include: in 1996-#4, a tool organizer, fishing rod racks, hatch board seat, folding jump seat complete with patterns to scale; in 1997-#4, an outboard bracket, chopping board, tool rack, pulpit seat, boarding step; in 1998-#4, spray deflectors, towel rack and shower grate.

For this issue, we've compiled a new collection of projects: bow anchor roller, propane tank holder, stern rail seat, lightweight chart rack, and brackets for hatch boards. All are cut on a table saw (or circular or

jig saw) and finished with edges rounded on a router with 1/2-round carbide bit; hatch brackets are assembled from separate pieces or from one piece, heated and bent over a form to shape the sides.

Many older boats are not factory-equipped with a proper system for handling ground tackle. Constructed of 2.5cm (1") material, this bow anchor roller (**Figure 3**) is custom-built to match the curve at the stemhead and the anchor stowed in the roller. To make, you'll need to obtain a roller from an anchor manufacturer, a hexhead bolt of the proper length and a short length of aluminum or stainless tube of the same diameter as the roller shaft. Length is determined by the anchor shaft. To determine this measurement, hold the anchor over the bow so it overlaps the deck by 10cm (4") or more, leaving plenty of clearance between the anchor flukes and the hull. An anchor mounted too close to the hull is apt to bounce around in rough seas, very likely damaging the hull. Measure the distance from the stem at the hull to the outermost edge of the anchor shaft. To this add 7.6cm (3"). Most platforms are "V" shaped, although deck contour determines the final shape and length. Add extra if you desire a platform that wraps the sides. Ideally the width should be no less than 12.7cm (5") at the outer end, and of a width at the stem that blends attractively.

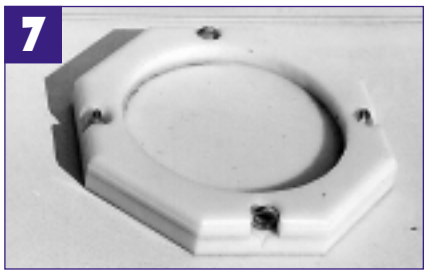


ALISON HOOD

Using your preliminary measurements and proposed shape, make a template from 12mm (1/2") plywood. Cut a hole starting 7.6cm (3") in from the outboard end for the roller and anchor shaft. Allow extra material at the inboard end for temporarily clamping to the deck. Mount template on deck and check fitting of the anchor. Again, be certain there is plenty of hull clearance and enough space in the cutout for the roller and anchor shaft. Complete the template, transferring the desired curve to the inboard end. Cut the StarBoard, round all edges with a router, and then mount the roller with the compression tube inserted through the shaft (**Figure 4**). This tube is especially important as it absorbs the loads and prevents roller or bolt breakage.

Propane tank holder (**Figure 5**) was designed by *DIY* reader Gary Young for his 8.7m (29') Doral Prestancia. Constructed of two layers of 12mm (1/2") StarBoard, it forms a hexagon base for a propane tank mounted on a swim platform. Make a circular template of the tank bottom, adding 12mm (1/2") all around, then

add 5cm (2") to form the outer edge. This can be square shaped (**Figure 6**), circular, octagon as in this project, or whatever looks good. Transfer the pattern to the StarBoard and cut. Use this piece as a pattern for the second layer. Before assembling, make the notches in the top piece for the eye bolts (**Figure 7**). To do this, drill four holes with a hole-saw of a diameter matching the bolt heads, about 12mm (1/2") in from the outer edge. Finish each notch by cutting in from the edge with a jigsaw. Round the top edges of the outer piece with a router. Preassemble the two pieces, lining up the edges, then drill fastener holes for machine screws and holes through



the bottom layer only for eye bolts. Transfer mounting and eye bolt holes to swim platform (or deck). Clean all mating surfaces with solvent, apply 3M 5200 to the two sections and join together. Apply sealant to the swim platform and fastening holes and bolt in place (**Figure 8**). Mount the tank and firmly secure with bungee cord or rubber straps.

Many sailboats never have enough seating for guests. The simple-to-make stern rail seat shown in **Figure 9** is the perfect solution. Take a piece of 6mm (1/4") scrap plywood cut into a rough triangle and lay it over the stern rail. It should overlap the sides by at least 5cm (2"), more if adding a beverage holder. Outline the proposed shape on the wood, curving the inboard side and marking notches for stanchions. Transfer pattern to 12mm (1/2") StarBoard and cut with a jigsaw. Fasten all sides with rail clamps mounted with threaded machine screws or thru-bolts, countersunk and plugged.

Unless you own a 40-footer, where to stow charts is an enigma for many owners. (Not all boats have built-in full-size chart drawers as "Nada," Nigel Calder's new boat.)

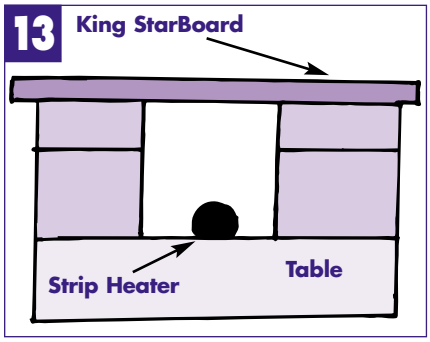
DIY PROJECTS

Often charts are many-times folded then stuffed into drawers or lockers, or tossed on shelves. After a few seasons of such ill treatment, replacement is often the only option. Charts aren't cheap, in fact, some strip charts are outrageously expensive, but being on the water you need them, so why not take care of them. The chart rack shown in **Figure 10** is the ideal solution for boats with limited storage. It's made of King StarLite, a lightweight replacement for

plywood and 33% lighter than King StarBoard. Available in black only, it's fabricated exactly the same. Commonly used as an upholstery backing board, a 6mm (1/4") piece is all that's needed for this project, although it's sold in thickness up to 19mm (3/4"). Also needed is 40cm (16") of 12mm (1/2") PVC tube for spacers and eight machine screws of at least 6cm (2-1/4") or longer depending on desired gap and ceiling thickness. This gives a 5cm (2") gap; purchase longer tube and screws if you want more depth. Overall dimensions depend on the amount of uncluttered ceiling available and large enough to hold a chart folded in half. A location off to one side, away from lights, wiring, deck hardware, etc. probably works best. Cut the StarLite, then to further reduce weight, cut 5cm (2") diameter holes equally spaced with a holesaw. Cut the tube into eight pieces of equal length. Drill the board, then using it as a template, carefully drill the ceiling. Be sure you know what you're drilling through and the proper depth (use drill stops, **Figure 1**). Fasten the board to the ceiling, inserting the PVC spacers. To ensure the charts stay put, you may want to tack on fiddle rails or sides with one end that hinges down.

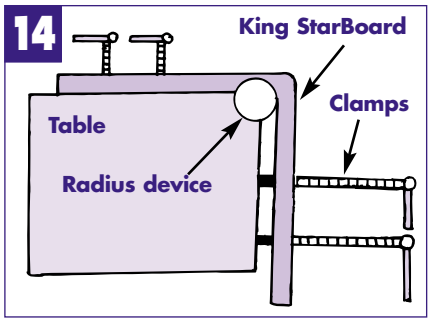
Rarely is there a vacant locker or one big enough to stow cumbersome hatch boards. A good place for them is under a berth cushion, until the berth needs occupying. The two hatch board brackets shown in **Figure 11** for small boards, and **Figure 12** for large ones, tuck out-of-the way on a bulkhead near the companionway. Easy to assemble from strips of 12mm or 19mm (1/2" or 3/4") StarBoard, they are made-to-measure. While you can cut the sides and end-fasten the front supports, this is a good project to try your bending skills.

Stack the hatch boards and measure the maximum depth, then measure the maximum board width. Add an extra 2.5cm (1") to all dimensions. The bracket shown in (**Figure 11**) has a bottom support and uses the bulkhead as the back support; (**Figure 12**) rests on the cabin sole



and mounts to StarBoard backs. My preference is to combine the two: a bottom support to protect the cabin sole and back boards — it's likely the back-less design will eventually deface the bulkhead.

Cut the pieces as required and round the edges using a router. Be sure to cut oversize if you're bending the front to form sides; otherwise, cut the sides, fronts and backs, fasten with screws and 3M 5200 (optional), then mount to the bulkhead. Countersink and plug all fastener holes for a professional appearance.



ALISON HOOD

Skilled fabricators heat StarBoard with a strip heater (**Figure 13**), a device that heats quickly while keeping the rest of the piece cool. It's a worthwhile addition to your workshop if you're an avid user. To use, lay the piece on the heater with the bend line above the heating element. Heat the area from both sides to about 101.6°C (215°F), then transfer the piece to a forming jig. Clamp securely, then slowly bend it to the desired angle. Simple jigs can be made of angled wood, doweling or a pipe clamped in a vise or to a table **(Figure 14)**. Since StarBoard has a memory and will rebound slightly, overbend the piece. For example, the desired bend for the front pieces of these brackets is 90°, so bend the pieces to about 95°. Practice your bending skills on scrap material before graduating to your finished pieces. Wear heavy gloves to protect your hands.

OUTFITTING & UPGRADES

SNUBBER ENHANCES ANCHORING COMFORT

By Paul and Sheryl Shard

An all-chain rode coupled with a versatile anchor like the Bruce or CQR is one of the most reliable anchor-to-rode combinations. For safety and comfort it can't be beat and for this reason, is the one used by most long-term cruisers.

An all-chain rode doesn't chafe and its weight provides better holding by keeping the pull on the anchor more closely parallel to the bottom. It also reduces the shock loading on the anchor as the boat oscillates in gusts. The chain weight creates a sag in the rode between the bow and the anchor, called catenary action. This means the anchor is pulled along the sea floor (which it's designed to do) rather than lifting up as can happen with all-rope rode. The heavy sag also provides a shock absorbing effect since it takes a greater force to

straighten a chain rode.

But in high wind or seas strong enough to straighten the chain, the effect can be jarring, causing a sharp tug at the anchor. This is easily fixed by using an anchor chain snubber — a short length of stretchy rope to absorb the shock of the chain as it straightens out. The snubber also eliminates any noise from the chain in the bow roller as the boat swings, and it takes the load off the windlass, which is normally used just to raise and lower the anchor tackle, not to hold the anchor strain continuously. Making a snubber is easy and it makes a great gift for other boaters.

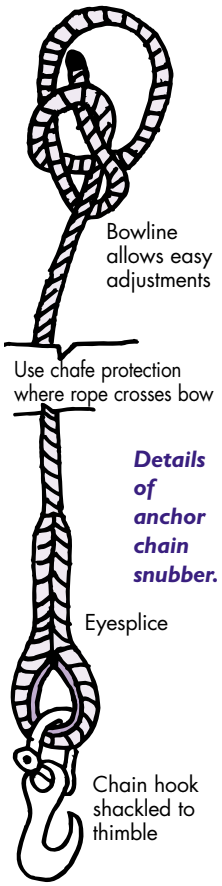
ALISON HOOD

One end of snubber line with eyesplice and thimble to prevent chafe.

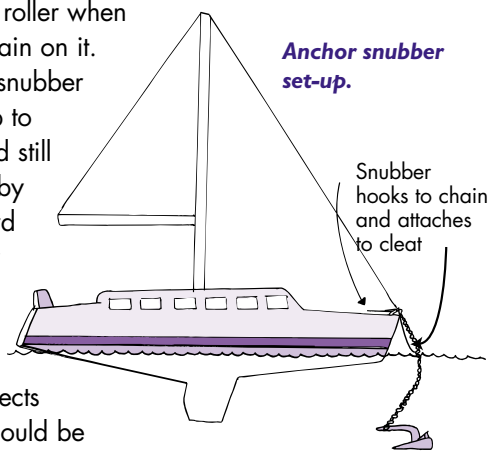
For a successful snubber the line must have good stretch — we use 16mm (5/8") three-strand nylon. Nylon stretches more than polyester and three-strand has more stretch than braid. There must also be a secure attachment to the chain such as a chain hook, which has worked well for us. A proper chain hook has parallel jaws that are made to fit the size of chain; for example, 9mm (3/8") chain requires a 9mm (3/8") chain hook.

Once you've got the pieces, splice a metal thimble into the snubber line using a three-strand back splice and attach the hook with a shackle so there will be no chafe.

To eliminate bow roller chafe, use a .9m (3') piece of braided clear plastic hose seized onto the rode at the inboard end. (Do not seize at both ends since the line in the snubber must be allowed to stretch). To assemble, position the snubber with just a couple of inches of hose extending over the bow roller when there is no strain on it. This way the snubber can stretch up to 61cm (2') and still be protected by the hose guard as the anchor pulls on it.



Details of anchor chain snubber.



Anchor snubber set-up.

The end where the snubber connects to the boat should be

adjustable. Either leave the line and cleat it off or tie a bowline in the end so it drops over a cleat prefit to length. This is better than splicing a loop in the end since you can easily adjust it if the line stretches and replace the chafe guard hose when it wears through.

Setting the Snubber

Once the anchor is down and set, tie the snubber to a cleat, run it forward through the bow roller and drop the chain hook over a chain link. Now gently let out the chain until the snubber takes the load. The hook should sit just at water level. Now let out another 1.5m to 1.8m (5' to 6') of chain so it forms a downward loop. This insures even the strongest gusts won't pull the chain tight and possibly drop the hook off. So long as there is always a loop hanging down, the chain hook will stay put. We use the snubber almost every time we use our anchor and certainly every time we anchor overnight. It's part of a good system of ground tackle and that's cheap insurance.

BOATERS' TOOL BAG

By Vicki de Kleer

Deciding it was time to organize those small tools and other items that are often needed onboard, I purchased an inexpensive nylon weatherproof carrying bag made by Rubbermaid. Using the Sailrite LS-1, I then sewed webbing to the inside, forming loops to store my collection of screwdrivers. Pliers, tapes, wrenches etc. were organized in pouches inside the bag. For easy identification, screwdriver tops were carved using an awl with the appropriate code: star for Phillips heads, straight line for slots, nothing for Robertson (square) heads.

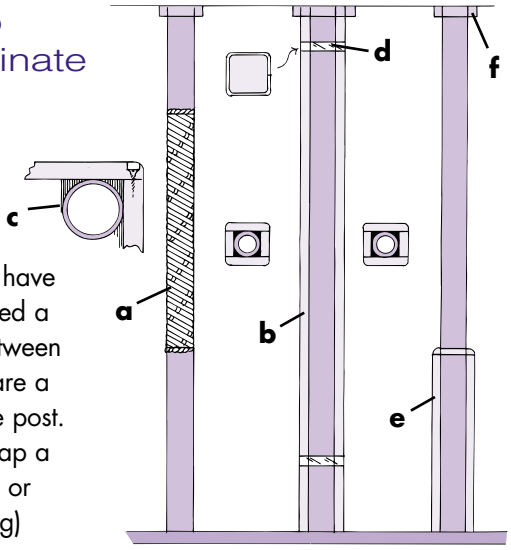
Good Boatkeeping

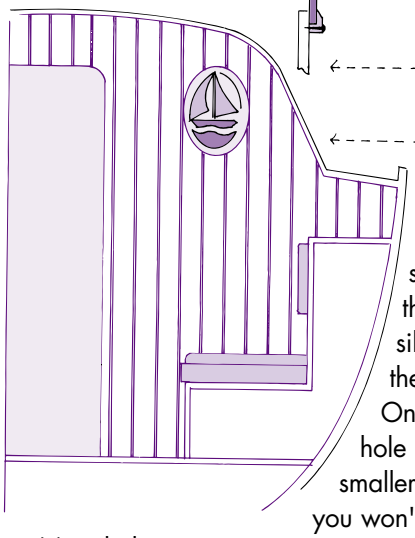
Some nifty ways to dress up and illuminate a boat's interior.

By David and Zora Aiken

EYE CATCHER

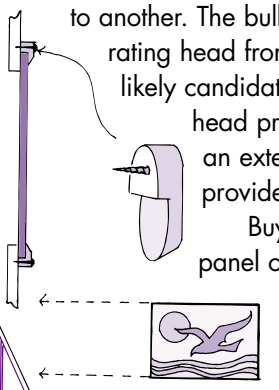
Boats with deck-stepped masts have a mast support (sometimes called a compression post) mounted between the deckhead and keel. Here are a few ways you can dress up the post. (**a**) Using 3mm (1/8") line, wrap a section of the post with a plain or fancy (i.e. French spiral hitching) weave; it becomes a vertical grabrail. Paint the line with enamel so you can easily keep it clean. Cover the post with an attractive wood frame (**b**). The two "inner" wood pieces should be cut to the width of the post's diameter; add the thickness of the wood to the "outer" pieces so all four sides of the frame will fit tightly against the post (**c**) with the connecting screws fastening them together. Add a decorative band (**d**) of 2.5cm (1") flat brass or stainless steel around the wood post near the top and bottom. Put a cabin light near the top of the post; run wiring before attaching the last side piece. (**e**) Add a wood frame around only the bottom section of the post, up to an appropriate height so a removable table can rest on the top. Finish the top of the wood frame with mitered trim pieces; use a router to soften the outer edges. Where the mast step meets the overhead, fit a wooden collar (**f**) around it, neatly varnished to match or contrast interior wood trim.





LIGHT CATCHER

Bring some light — and artistic design — into the salon or stateroom with a decorative interior "port." The idea is to insert an etched- or stained-glass panel into a bulkhead in order to carry light from one boat space to another. The bulkhead separating head from salon is a likely candidate, since the head probably has an exterior port to provide light.



Buy the glass panel or commission an artist to do a personalized design that fits your boat. If you choose the former option, determine a suitable size and shape for the panel by cutting paper silhouettes and taping them to the bulkhead one at a time. Once you have the glass, cut a hole in the bulkhead slightly smaller than the glass. Make sure you won't disrupt any wiring, plumbing or other obstructions before cutting. Sand and finish the cut edges, since they will show. Use mirror clips to mount the glass panel to the back side of the bulkhead. Or, you may prefer to put the glass panel into a picture frame, then screw the frame directly to the bulkhead.

About the authors: David and Zora Aiken are the authors of "Good Boatkeeping" and "Good Cruising" published by International Marine. The Aikens currently live aboard "Atelier," berthed in Grasonville, Maryland.