

Practical Sailor

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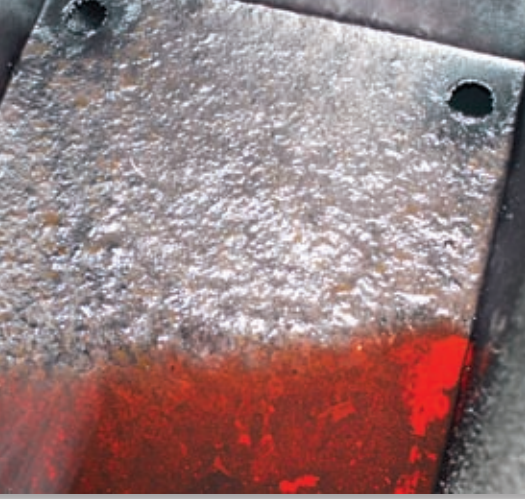
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The Sludge Factor

Some nights, I'm still jolted awake by an image from our cruising days. I'm wedged into the crawl space beneath the bottom of one of *Tosca's* two diesel tanks. My hand grips a crescent wrench that is clamped down on the clogged fuel pickup tube, which—and this was part of our problem—also served as the tank's drain.

Knowing you are about to get drenched in diesel fuel is a singularly unsettling feeling. Despite meticulous pre-filtering, the religious use of anti-biological additives, and many improvements to the 60-year-old ketch's fuel system (including the installation of a fuel-polishing system), I found myself in this position once every couple of years. Part of the problem was our sketchy fuel supply. (My other recurring nightmare is refueling on the island of Obi in Indonesia, which involved

Filter-clogging asphaltine coats the bottom of a diesel tank.

ladling—yes ladling—100 gallons of drum-stored diesel fuel into jerry cans, which were then lugged a mile back to the boat.)

So the article on fuel tank construction and design in this month's issue ("Replacing the Diesel Fuel Tank," page 18) was of particular interest to me. One of the most telling side-notes to that article is that even the manufacturers of plastic tanks readily admit that this material is not the best choice for replacing an existing diesel fuel tank on a cruising sailboat. Here are some of the drawbacks we heard from the makers of these tanks:

- Plastics do "weird" things when exposed to the chemicals in today's fuels.
 - Expansion and flex make it tricky to install a plastic tank. Ideally, they should be supported on all sides.
 - Multiple cleaning ports and baffled chambers that cruisers need on a large tank are not possible.
 - In a fire, plastic melts.
 - Custom ordering a single tank to fit your boat is not an option.
- Most manufacturers don't even sell single orders of their tanks.

From a boatbuilder's perspective, however, plastic tanks offer many advantages. They are light, inexpensive and can be mass-produced in virtually any shape. Fit isn't a

big issue, since the boatbuilder can design space below for an existing tank in production. And when it comes to installing the tank, you can foam it into any corner of the boat without corrosion worries.

A corrosion-free fuel tank is a plus for owners, too, since this is a chief cause of tank failure. But, in our view, the corrosion resistance of a plastic fuel tank isn't worth the hassles mentioned above. With proper material selection, design, and installation, the owner can protect against corrosion in an aluminum tank, which is still the best diesel tank material for the money.

There is far more involved in tank replacement than any single article can cover, so please feel free to write or e-mail any additional questions you may have. This project is probably one of the most trying ones that the owner of an old boat will face, but when done at a time and place of your choosing, it is far more pleasant than suddenly losing your engine in a coral-strewn pass, staring at your reflection in a pool of diesel in the bilge . . . or waiting for the spigot to open for your bi-annual diesel shower. This much I know.

Darrell Nicholson
Editor

On the cover: Close reaching into a long Swedish sunset on the HR342. (Photo by Peter Szamer)

Photo by Steve D'Antonio

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CARD SEARCH

There used to be a product available called CARD. I believe it was short for Collision Avoidance Radar Detector. As I understand it, it picked up the signal of a ship using its radar and had a nifty little display in the shape of a ship to show you what sector the ship was in, relative to you, and a means to interpret its distance away. I cannot find info on the unit anywhere, and since I do not have radar on our boat, I thought it would be a good addition. Do you have any knowledge of it? Have you reviewed it?

John Shugar
Windswept II, 1982 CT 47
St. Mark's River, Fla.

Practical Sailor reviewed Survival Safety's CARD 050 system in the Nov. 1, 1994 issue. The company has since released the CARD 060. We've gotten mixed reviews of this product. Some singlehanders credit it with saving their lives, others complain about its reliability. Contributing PS writer Scott Rosenthal, who reviewed the Nasa AIS (Automatic Identification System) for the March 2007 issue, also had a CARD device installed on his boat. He reports that the alarm has very limited range, and of course, doesn't detect the many ships that seem to be underway without their radar operating. He added that the alarm would go off when any pump on the boat (including the galley faucet pump) turned on, and that it was impossible to run the



'Electrifying Tale' Continues ... In the March 2007 issue's Mailport section, reader Bill Boyeson wrote about his shore-power cord (above) and receptacle that had melted during use. Upon closer inspection of the photos Boyeson sent in, PS editors realized that the cord in the picture has no locking ring. Therein lies the culprit of the "Electrifying Tale." When the locking ring is not present or is not used, the contact made between the plug and the receptacle is compromised. This causes the contacts to arc, which leads to pitting and high resistance, and finally heat generation.

CARD system and radar at the same time because the CARD was easily overwhelmed by the local radar. Corrosion was also a problem. Rosenthal cautioned against placing the CARD antenna near an SSB antenna (as he did), because it can fry the receiving diodes in the CARD antenna.

He eventually replaced the CARD system with the AIS Radar. To find out more about Survival Safety's CARD, visit www.survivalsafety.com online or call 888/475-5364.

HOMELAND SECURITY & AIS

Thanks for the informative report on the low-cost Nasa AIS (Automatic Identification System) receiver (March 2007). The larger issue, of course, is the prospect for not just AIS receivers, but transmitters. These could logically be required on all craft large enough to carry a nuclear weapon, a dirty bomb, a land attack missile, or small,

unmanned aircraft. If the nation is to get serious about defending itself from potential seagoing threats, as it does from aircraft, such an identification system will be essential to permit the authorities to

concentrate on boarding and inspecting only non-compliant craft. It will be interesting to see how the traditionally independent, but always patriotic, recreational boating and commercial fishing communities respond to this emerging need

Gene Porter
Nashua, N.H.

According to U.S. Coast Guard Rear Admiral Joseph Nimmich, the U.S. Coast Guard is initiating a dialogue with recreational boating groups regarding the "small boat threat" to national security. In our interpretation of Rear Admiral Nimmich's well-honed bureaucratise at a recent press conference, a law requiring AIS transmitters on recreational boats (as is required on large commercial vessels) seems much less likely than a standardized national licensing and boat registration program. Nevertheless, we would not be surprised if the manufacturers of these devices were already lobbying hard in Washington to require AIS transmitters on your Walker Bay.

AIS LOGIC?

Why did you report on this obviously low-tech and hardly usable AIS system when there are excel-

lent AIS receivers on the market that interface with long lists of chartplotters and PC nav software to give users useful, readable, and important collision avoidance information?

William Chevalier
Via e-mail

We will soon be testing the devices you describe. Our tester of the Nasa AIS Radar (March 2007), Scott Rosenthal, is a software engineer who knows well the pitfalls of networking. He prefers to keep all of his instruments independent so that a single failure doesn't bring down the whole boat.

The Nasa AIS Radar allows excellent redundancy and—just as important—it consumes far less power than some chartplotter- or laptop computer-dependent AIS systems. This is an important point for the long-distance voyager who doesn't want to waste fuel to replenish wasted amps. The Nasa AIS Radar, at least from Rosenthal's 2,500 miles of experience with it, is extremely useful, readable, and supplies invaluable collision information. Could it be better? Absolutely. But for his needs and budget, it works well.

'CORROSION CRUSADE'

I enjoyed your article on corrosion blockers ("Crusade Against Corrosion," April 2007). It fueled some electrical connection questions that I have been needing to ask.

When crimping wires and fastening electrical connectors, I have always tried to ensure clean areas of contact by spraying with

WD-40 or the like. Sometimes, I even take a toothbrush to the area to get it clean. When done, I spray on some more, like an artist.

If WD-40 or CRC sprays act like blockers, then has my work been counterproductive. Do these and other products act as a dielectric and increase resistance at the connection? This even brings up questions about grease under battery clamps and connections. Is there a preferred crimp, fasten, seal procedure out there? From your test, and other product experiences, is there a single cleaner-corrosion blocker for the saltwater environment that you could recommend or lean toward on electrical connections?

Capt. Ralph Crapps
Jacksonville, Fla.

Stand by, Ralph. Our current project is to test the same products (and perhaps a few others) from our corrosion test for their dielectric properties. Ultimately, we're looking for the best product to protect exposed terminal connections (running lights, circuit panels) without damaging terminal sleeves or insulation.

Most of the products in our test were billed as dielectrics. What they do (or what their manufacturers claim they do) is prevent electrical short circuits via an electrolyte—in our case seawater or salt-laced condensation. However, the film created, in most cases, is sufficiently thin so that when you exert pressure, such as is created when operating a switch or, very likely, when you crimp a connection, the product displaces and allows metal-to-metal connection. The manufactur-

ers warn against using these products around membrane switches, which don't have

enough internal pressure to displace the coating. Also, you should avoid spraying near LCD displays, which are essentially made up of multiple switches whose functioning the coating will impair. Greasing crimp terminals and the wire that will be inserted may help minimize corrosion, but it also makes slippage of an under-crimped terminal more likely.

A much better corrosion abatement approach is to use an appropriately sized tinned copper terminal with a built-in heat-shrink tube over the terminal. The best tubing is made from polyolefin plastic; it's tough and shrinks to one-third of its original size at about 250 degrees F. Such terminals are manufactured by Ancor (www.ancor.com). These also have a built-in adhesive that helps to keep out moisture. Naturally, it's best if the crimping is done with a tool specifically designed for the terminal used.

The use of white lithium grease on battery terminals is an old standby that continues to work well in a marine environment, and there are also non-greasy, dry coatings designed specifically for such protection.

MOUNTING PROBLEMS

Four years ago, we purchased a sailboat with a Magellan Map 410 GPS. The unit works well and serves my needs on the Great Lakes. It has a mounting bracket at the helm that has been bumped a few times. I suspect the UV has made the plastic brittle. I have epoxied it back together before, but now it has to be replaced. Magellan no longer sells replacement mounting brackets. Is there a company that sells after-market universal holders that would work?

I tried to purchase a data cable a couple of years ago, and Magellan



The products we tested as corrosion blockers (April 2007) will now face an evaluation of their dielectric properties. If you're looking for the right product to protect exposed terminals, stay tuned.

Have Portable GPS, Will Charter

My wife and I are avid sailors, but cannot afford our own sailboat, so we charter. When we first began chartering, I purchased a Magellan Nav 6000 handheld GPS Chartplotter, because you never completely know the navigation capabilities of a charter sailboat until you leave the dock. It served us well over the last seven years. In November, a friend purchased an Island Packet Cat, and asked me to help him move it from Destin, Fla., to Port Charlotte, Fla. During the 10-day trip, the limited capabilities and slow processor of the Nav 6000 got me thinking of a replacement. I searched the Internet, but found nothing that improved on the Nav 6000, so I decided to build my own, and came up with the Standard Horizon CP 180i as the basis.

To make it a portable GPS, I purchased some RAM Mounts equipment, and went to our local Ace Hardware Store and purchased a 12-volt extension cord and three stainless steel, 4 mm x 20 mm machine screws, washers, and lock nuts.

I cut off the female end of the extension cord and soldered the two wires to the black (ground) and red (12-volt power) wires of the Standard Horizon supplied power I data cord. I used an multimeter to make sure that I got it right. Also, I pre-positioned shrink wrap of varying sizes so that the final product was waterproof and looked good.

The GPS was \$420 with shipping. The total price for my system was less than \$550. Granted, my system is not truly portable as it requires a 12-volt power outlet. However, I have yet to find a charter boat without one in the cockpit. I always plugged my Magellan Nav 6000 into external power.

Since subscribers like myself are always looking for the most capabilities for the least amount of money, I thought you might be interested in my little project.

Chet and Patty Parham
Port Charlotte, Fla.



The complete assembly installed. Clockwise from top left: The Standard Horizon 180i; the GPS/chartplotter's power supply; and the RAM Mounts equipment.

no longer stocked them. I also have a Garmin GPS at the nav station that is older than the Magellan. Garmin has a full selection of accessories for the older Garmin unit.

Brad Kolpin
CS36T
Lake Huron, Ontario

RAM Mounts (www.rammounts.com) manufactures a variety of mounts for these kinds of devices. They were our top pick in our last handheld holders test (April 1, 2003). We suspect you should be able to find something useful on the website for about \$30 or less. You also may

want to read about one reader's project using RAM mounts, see "Readers' Workbench," above.

ANTENNA TESTING

I have 14 years experience with Morad Electronics, a manufacturer of high-performance, high-durability antennas used by the Alaskan commercial fishing and commercial tugboat industries, military, government, as well as pleasure yachts in the Northwest and Alaska. I have had extensive experience in marine antenna design, testing, and manufacturing.

I wholeheartedly agree with the manufacturers that your test

method was misleading. The proper mounting, use/type of coaxial cable, and environmental conditions can have a greater affect on antenna performance than the antenna itself.

Antenna testing is best done on land in a large field free of powerlines. The antenna is tested horizontal to the ground on a turntable at a specific wavelength above the ground to nullify reflected energy. The antenna is fed with a signal generator and monitored from a distance with a spectrum analyzer. While being monitored, the antenna is rotated 360 degrees. By doing this, the field strength can



Deja vu? One subscriber's recent problems with 3M's blue masking tape mirror those readers wrote us about in 2004, prompting a test of tapes. Our top pick in that test was Intertape's ProMask Blue.

be measured at all angles to the antenna.

Signal strength and radiation pattern can then be plotted and compared to other antennas with the same test.

Quality of materials, physical size of the radiation element, proper impedance matching, dielectric properties, etc., can have a much greater influence on performance than the length of the antenna.

While it is true that for every 3db gain you double the radiation power, doubling the radiation power only increases range minimally.

Another interesting test is of the coaxial cable. Your picture shows the Bird wattmeter connected at the radio output. Measure the output and then move the wattmeter to the antenna end of the coax and measure again. Coax losses are huge. This will convince you of

the need to eliminate excess cable. When I was involved in this type of test, RG213 excelled over any of the RG58 classes. Only use the smaller diameter RG58 types when installation requires it.

David L. Blaine
Morad Electronics
Seattle, Wash.

Thanks, David. We wanted to do a real-world test that mimicked the challenging conditions for radio communication at sea. As we pointed out in the article, environmental variables were unavoidable, but we believe that the methodology ruled out the chance of bad data drastically upsetting the final conclusions. Interestingly, the last time we performed a land test, similar to the one you described, readers and manufacturers criticized the report for not conducting the test at sea. We feel our testers properly balanced the weight of construction details and field performance in making their final determinations.

MASKING TAPE MYSTERY

In the past, I have used 3M's Scotch No. 2090 blue tape on my boat with success. However, the last time I used it, I found that a lot of residue (and some blue paper) would not come off the gelcoat when I removed it (less than 24 hours after application).

When I contacted tape manufacturer 3M, a representative told me that No. 2090 should not be used on gelcoat and that No. 2080

is the tape to use. This is not clear on the 2090's packaging. The label actually reads: "UV and Sunlight Resistant" and "Adhesive does not like raw gelcoat."

The 3M rep attributed the residue to the warm temperature and sunlight affecting the bond. However, I used the tape on both the sunny and the shady sides of the boat, and the temperature was in the 70s.

Please consider reviewing different tapes so PS readers will have accurate information about the different tapes available.

David Thurn
Island Packet 350
Lake Michigan

Mr. Thurn's story is very reminiscent of problems several readers reported in 2004. They too had "gooey, adhesive residue" after removing 3M's 2090. Those reports led editors to investigate and launch their own masking tape test, which was published in the December 2004 issue. The 3M 2090 left some residue after six and 10 days, but it was easily cleaned off. While we did not experience the severe problems our readers had, the 2090 was not the top performer in the test. Intertape's ProMask Blue outperformed 3M's tapes and is less costly (about \$2/roll cheaper according to a general web search). Interestingly, testers—on the advice of several varnish experts—found that black electrical tape works just as well and is the cheapest to boot.

WHERE CREDIT IS DUE



HAIL HARKEN

I have had a Harken No. 1600 midrange snatch block for several years. The eye through which the pin

goes had a piece break off. This allowed the shackle to pop open, and it would not close. I contacted Harken, and per their request, I sent the broken block to the

company. Without any questions, Harken sent me a new block. Great service!

John Helgerson
Windsong II, Seawind 1000
Grenada

PS testers have just begun a test of snatch blocks from an array of makers, including Harken. Stay tuned.

Hallberg-Rassy 342



Though wheel steering is the norm these days, tiller steering is standard on the HR342.

German Frers' design packs distinctive styling, performance punch.

Introduced to the U.S. market last fall, the Hallberg-Rassy 342 is the newest addition to the line from the prolific Swedish builder, which includes eight models ranging from 31 to 62 feet. Like its sister-ships, the 342—which replaced the company's popular HR34, of which over 500 were built during the 15-year production run—sports all the features that make the brand so recognizable: the cockpit windshield, low-profile coach roof, prominent bulwarks, gentle sheer line, rugged rubrail, and, of course, the standard blue-and-white color scheme. In Europe, the boat was well received by the sailing press and the public, and the company took 122 orders within the first seven months after its introduction.

DESIGN

Like all of the Hallberg-Rassys currently in production, the 342 was designed by noted Argentine naval

architect German Frers (who also designed the 34-footer it replaced). It's clear from crunching the numbers that the builder wanted peppier performance than its predecessor. Everything about the new boat is a little bigger: its waterline length is 15 inches longer, the mast is almost 2 feet taller, and it carries 5 square meters more sail area. It all translates into a boat with a displacement/length ratio of 197, which puts it on the light side of moderate. And with a sail area/displacement figure of 20.1, it's clear that Frers was not shy

about designating horsepower.

The sail plan is encapsulated in a 7/8ths fractional set-up that puts the drive emphasis on a larger mainsail complemented by an easily handled, 105-percent overlapping jib. In the case of the 342, it's self-tacking as well. (That said, our test boat's sail power was compromised by a furling main that we'll address below.) The rig is a deck-stepped, double-spreader configuration with slightly swept-back spreaders and a touch of pre-bend to the aluminum spar. There are two keel options, a shoal-draft fin with attached bulb that draws 5 feet, or the standard 6-foot fin with bulb.

The 342 has a fine entry and minimal overhang at the ends. As naval architect Bob Perry has noted, "Frers likes to knock the corners off his transoms at the sheer and has done so for years. This looks good and helps reduce the visual bulk of the transom." As on Perry's Valiant 40,





PRO: Bare lifelines

CON: Jib sheet ankle grabber

PRO: Self-tacking jib

PRO: 2 1/2-inch toerail



CON: Head-knocker dodger

PRO: Opening windscreen

PROS

- Teak deck provides outstanding nonskid, rugged working surface.
- Hard, glass windscreen protects with minimal loss of visibility.
- Wide, 18-inch side decks.
- Tight sheeting angle for genoa.
- Self-tacking working jib.
- Big, well-reinforced mooring cleats.
- Mainsheet sail control at helm.



PRO: Mainsheet control from helm

CONS

- Teak deck picks up dirt and gets hot in the tropics.
- Oh, the joys of keeping that 80 running feet of teak caprail looking like new.
- Optional wheel steering leaves barely enough room for Olive Oil behind the binnacle.
- Mainsheet traveler chops cockpit down in size.
- Working jib sheet is a tripping hazard on foredeck.

the keel and rudder are separated, in the style of contemporary performance cruisers.

As with most Scandinavian designs, the interior layout is very traditional, functional, and straightforward. This boat has sleeping cabins in the ends; a central space that includes the saloon, galley, navigation station, and head—and, each is extremely well executed. The builder does not allow for even slight modifications or customizing.

DECK LAYOUT

Starting forward and working aft, the 342 sports a husky stemhead fitting with double anchor rollers serviced by a Lewmar horizontal windlass adjacent to a deep chain locker. A Seldén Furlex 200S headsail furler handles the self-tending jib, which tacks on a small track mounted on the coach roof just forward of the deck-stepped Seldén mast. There are a couple of large Lewmar deck hatches and a pair of low-profile dorade vents. Our test boat included the optional spinnaker-gear package with the Seldén pole mounted verti-

cally on the mast. One nifty feature is the standard, nearly 8-foot-long boat hook that's stationed in its own mount atop the coach roof.

The side decks are clear and unobstructed and measure 18 inches at their widest point. Together, the 2 1/2-inch bulwarks, the 24-inch-high lifelines, and the teak handholds atop the coach roof offer a nice feeling of security when moving fore and aft along the side deck. The lifeline gate on our test boat was fitted well aft on the transom, between the rails of the stainless-steel stern pulpit, which is ideal for boarding the boat via the swim ladder when on the hook, but not as convenient for everyday amidships comings and goings on a dock or from a launch.

All reefing lines and halyards are led aft through a series of turning blocks at the base of the mast to a pair of Lewmar rope clutches to port and starboard of the companionway. These work in conjunction with twin Lewmar 16C winches for hoisting and reefing sails. With the cockpit dodger raised—it fits nicely atop the standard windshield—working

space is somewhat compromised, but not excessively so. The cockpit is deep and self-bailing, with 6-foot-9-inch cockpit seats for sleeping or stretching out. The primary winches are Lewmar 40 CST self-tailers. A huge starboard cockpit locker is home to the teak cockpit dining table and a series of nifty slots for the companionway slides. The propane locker is aft. All glasswork in the lockers is impeccable, and serves as a reflection of the boat's overall construction quality.

The standard boat is tiller-steered, but our test boat came with a 36-inch Solimar wheel (the quadrant and cables are accessible via a hatch at the aft end of the port quarter berth) with the traveler and mainsheet just forward. A drop-down swim ladder and step is smartly integrated into the boat's transom, and is accessed through a small, removable section aft of the steering station.

Two notes about the wheel set-up: First, there's only a foot of clearance between the wheel and the cockpit seat directly astern of it, which will be too close for comfort for some

helmsmen. Plus, it's a tight squeeze to get around the wheel to trim the mainsheet and traveler, which is necessary to get some purchase on the lines when under load in a breeze. For these reasons, and for better visibility and views of the jib telltales, the cockpit coaming is the more natural position for steering.

Yacht broker Jim Eastland of Eastland Yachts, in Essex, Conn., said he prefers the wheel over the tiller for several reasons. According to Eastland, it's more compatible to a beefy autopilot and it heightens the resale value of a boat that costs over a quarter of a million dollars.

SYSTEMS

The 342 is equipped with a three-cylinder, fresh-water cooled Volvo Penta D1-30 diesel engine with a sail-drive configuration and two-bladed bronze folding propeller. The 44-gallon fuel tank is located under the starboard settee. The dedicated starter battery is rated at 62 Ah while the house bank of dual, flat-plate batteries has a capacity of 225 Ah (up from 124 Ah in the previous HR34). A 115-amp engine alternator handles charging. Engine access and battery storage are behind and below the companionway steps, which are locked down when underway and opened with a special allen-style key. It's a secure system with good, all-around access, however, it could also be compromised if you needed to get at the engine quickly but couldn't find the key.

The pressurized freshwater system is connected to the 71-gallon water tank that's located under the port settee. The compressor for the optional air-conditioning unit is stashed beneath the V-berth. There's a nice, deep, 24-inch sump, at the bottom of which is installed a Jabsco Hydra-air bilge pump. The Mastervolt battery switch is stationed alongside a switch panel for the fuel and water gauges, the voltmeter and the automatic circuit breakers. Valves and transducers are easily accessed under the floorboards. Our

Photo (top) by Peter Szamer, courtesy of Hallberg-Rassy

INTERIOR NOTES: HALLBERG-RASSY 342



The interior of the Hallberg-Rassy 342 shows a good approach to offshore passagemaking with not too many compromises. Details like twist open drawer latches, ample grab rails and fiddles, and two sea berths coincide with a passagemaking purpose. The most apparent trade-off is a tight nav station (right), a necessary evil for having an aft head. The aft cabin (not pictured) is tight, but livable.



test boat was equipped with Raymarine electronics, including the chartplotter and basic ST 60 Tridata (speed, log, and depth) instrumentation; there's plenty of space for additional electronics. The electric fridge utilizes a Danfoss compressor and a well-insulated box with basket and cooling unit.

ACCOMMODATIONS

The 342's interior plan is a traditional layout with a double cabin forward housing a V-berth that measures 6 feet, 8 inches wide at the head, 6 feet, 6 inches long, and 22 inches wide at the foot. There is plenty of storage in the pair of lockers abaft the berth, in shelves and lockers above it, and in a large bin beneath it. Headroom is just over 6 feet. The furniture throughout is fashioned of khaya mahogany with a satin-varnish finish that makes for

a surprisingly light, airy atmosphere (which is reinforced by the 10 opening ports below).

The main saloon features a central dining table with a pair of 6-foot-2-inch settees to port and starboard. The seat backs for these settees can be raised and hung from the cabin-roof for additional storage (though they're not robust enough to be used as berths). The settees below would make excellent sea berths with the backs in the raised position, except for the fact that the chainplates are anchored in stout fiberglass knees precisely where a sailor, in repose, would be lying. Altogether, it's a curious, unsatisfactory arrangement.

The L-shaped galley, to port, is at the foot of the companionway, across from the nav station and the head compartment. The galley is a nice, functional space with the requisite drawers, lockers, and counter

space, and a useful double sink. The forward-facing nav area is snug, but adequate, with excellent storage under the seat.

The head includes a Corian wash basin and countertop, plus a good-sized shower and wet locker, the latter being a nice detail one wouldn't necessarily expect to find on a boat of this size. The holding tank is just aft in the starboard cockpit locker.

The aft cabin, to port, is another fairly tight space, but it serves its purpose as a sleeping station with a berth that measures 5 feet, 10 inches wide at the head, 6 feet, 10 inches long, and 4 feet, 3 inches wide at the foot.

PERFORMANCE

Given the fact that one of the stated design objectives of the 342 was to enliven the sailing performance, it was with no small sense of anticipation that we motored out into the Connecticut River last fall. At 2500

rpm, the yacht slid along nicely at an even 6 knots and was maneuverable, turning easily within a boat length. The sound level of the Volvo engine, which is situated in a well-insulated compartment, was not intrusive, registering 72 decibels in the cockpit, 77 in the galley, and 74 in the main saloon.

As luck would have it, though, the breeze on the river was fitful, and there was a fair bit of current running. However, in about 6-8 knots of wind, the boat made a very respectable 4.8-5.2 knots hard on the wind. Cracked off to a beam reach, at a wind angle of 120 degrees with 8 knots of sustained pressure, it made 4.5 knots. When the breeze came on to about 10 knots, we registered 6.2 knots close-hauled. The boat tacked through about 100 degrees and was quite easy to handle alone, thanks to the self-tacking jib.

The test boat was fitted with a suit of Elvstrom Sobstad "offshore

performance" Dacron sails. The mainsail was set off an in-mast Seldén furler with vertical battens that provided the sail with a bit more roach than many furling mains, though the leech was somewhat scalloped and not ideal. It's worth noting that, while proponents of furling mains subscribe to the notion that they're more manageable than standard mains, it took two people, working in conjunction—one to man the furling line, the other to maintain tension on the outhaul—to strike the main on the 342.

Quibbling aside, the boat had a very light, easy helm; seemed stiff, balanced, and seakindly in the moderate conditions. It offers excellent visibility when peering forward beneath the dodger when seated behind the wheel, and while steering outboard from a perch on the cockpit coaming. There's no reason to doubt the boat would be a solid performer in better wind.

CONSTRUCTION DETAILS

Hallberg-Rassy builds about 175 boats a year in its factory on the island of Orust in Sweden. Of particular note is the monocoque construction technique that requires that all interior components fit through the main companionway.

HULL: The hand-laid fiberglass hull—which is built to CE category A certification—is a straightforward laminate employing isophthalic gelcoat and isophthalic polyester resin. It's insulated above the waterline with Divinycell closed-cell PVC foam. An internal, reinforced grid at floor level increases stiffness and reinforces the hull below the waterline. The hull and deck are mechanically fastened with an interlocking flange at the hull-deck joint that's glassed over with 2½-inch bulwarks finished with a teak caprail, essentially creating a one-piece monocoque structure. Systems, furniture, and tanks all fit through the companionway and are added after the hull and deck are married. An integrated fiberglass rubbing strake that provides protection to the topsides is finished with a brass strip. The interior furniture is all mahogany. Floors are teak with inlaid holly stripes.

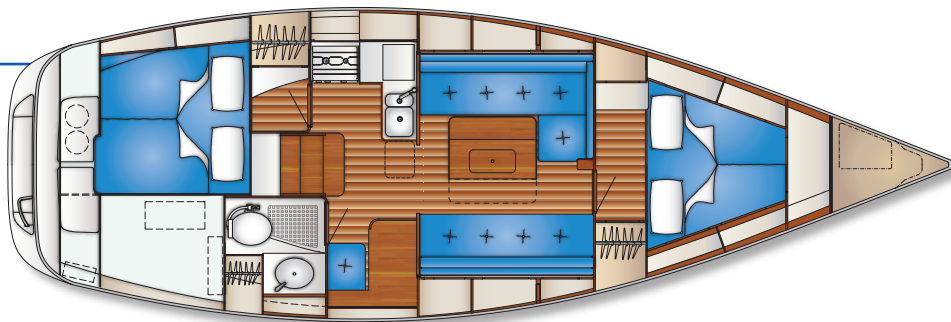
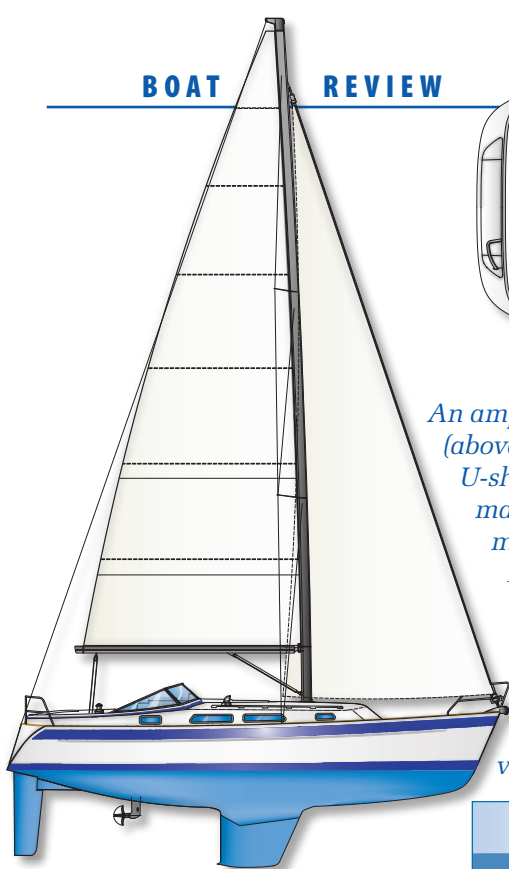


Inboard shroud chainplates are readily accessible for inspection.

DECK: As with the hull, decks are sandwich construction utilizing a Divinycell foam core with backing plates laminated into the deck for hardware installation. Teak side decks are standard. The pulpit and pushpit are securely mounted with a vertical, stainless-steel rod recessed into the bulwark, over which the stanchion is slipped and fastened.

SPARS AND RIGGING: The Seldén aluminum spar is a deck-stepped, 7/8th fractional set-up supported by 1x19 wire rigging with alloy protective tubes over the turnbuckles. The single backstay (no runners) utilizes a Seldén backstay adjuster. A Seldén Rodkicker mechanical boomvang is standard, as is the Seldén Furlex 2005 headsail furling system and Seldén in-mast main furler.

KEEL AND RUDDER: The keel is constructed of externally mounted lead ballast bolted onto a deep internal sump with 12 stainless-steel bolts. The fiberglass rudder is affixed to an aft skeg and fits just below the transom-mounted swim ladder via a stainless-steel rudder shaft that employs a pair of self-aligning bearings to minimize friction.



An ample length-to-beam ratio allows the HR342 to squeeze two staterooms (above) into a 34-foot boat without too many compromises. It lacks a true U-shaped galley, but it does not sacrifice two 6-foot-2-inch sea-berths in the main saloon. The cruiser-friendly fractional sail plan features a powerful main and a manageable jib, with all sheets close at hand for the helmsman. Comparing the HR342 to the Najad 332 (another Orust-built boat) and the Ohio-built Tartan 3400, shows the HR and the Tartan in about the same class in terms of performance ratios. Though handicapped by waterline length, the Najad's narrower, heavier ballasted hull offers the potential for a more seakindly ride. All of the boats could use more tankage, but the HR342 comes closer to the numbers an ocean voyaging couple would likely require.

CONCLUSIONS

It used to be that sailors looking for high quality and offshore potential in a new boat in the mid-30-foot range had plenty of options from which to choose. In the last decade or so, that's no longer been the case. Even sailors new to the sport, it seems, prefer boats upward of 40 feet, and the builders, of course, who wish to maximize their margins on every unit sold, are more than happy to oblige them. The big production builders still offer 35-footers, but for the most part, these are inshore racer/cruisers built and marketed around a specific price point, not as a vessel with long-range capability.

The 342, then, is an anomaly in today's marketplace. Well-built, with a good press of sail, and equipped with first-class systems and hardware, it's a boat that will take its owners, depending on their skills and aspirations, as far as they want to go. The 342 is not necessarily an inexpensive boat when compared to other contemporary 34-footers, but we expect the resale value of this yacht, particularly given its strong debut in the international marketplace, to remain

HALLBERG-RASSY 342 IN CONTEXT			
	HR 342	TARTAN 3400	NAJAD 332
LOA	33' 10"	34' 5"	32' 8"
LWL	29' 10"	30' 5"	26' 8"
Beam	11' 3"	11' 11"	10' 8"
Draft (shoal)	6' 0"	6' 6"	5' 6" / 4' 11"
Displacement	11,684 lbs.	10,800 lbs.	11,660 lbs.
Ballast	4,300 lbs.	3,500 lbs.	4,620 lbs.
Sail area (100%)	594 sq. ft.	620 sq. ft.	505 sq. ft.
Engine	30 hp.	27 hp.	28 hp.
Water	71 gal.	60 gal.	45 gal.
Fuel	44 gal.	25 gal.	24 gal.
SA/D ratio	18.46	20.3	15.7
D/L ratio	197	171	272
Sail-away price*	\$269,000	\$180,000	\$230,000

* Sail-away equipment can vary greatly between manufacturers.

high. It still costs a lot less than 40-footers of similar quality. While, naturally, it won't exhibit the same turn of speed as a boat with a longer waterline, the 342 is a quick and nimble performer given its size and accommodations.

For a couple or young family with extended-cruising plans, the Hallberg-Rassy 342 would be a le-

gitimate option. And, given that it will cost less to buy, maintain, and berth compared to bigger boats, it might even be an excellent one. ▲

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Shedding Light on Survival Gear



The Zodiac Class Ocean survival pack, one of seven reviewed, needs to be supplemented with added gear and water. Some built-in raft features—like the urination tube pictured above—cater to crew well-being.

Winslow Ocean Rescue, Switlik MD-3, Elliot lead the pack.

Our recent test of six-man life rafts (“Elliot Life Raft Rises to the Top,” April 2007) gave us the chance to see what survival gear gets packed into an offshore life raft, and how this equipment varies from one manufacturer to another. Six manufacturers participated in the test: DSB, Elliot, Switlik, Viking, Winslow, and Zodiac.

The manufacturers featured in our life raft evaluation offer several options for survival packs, and in most cases, you can pay more for packages that are superior to those we were sent for review. Some makers also allow you to customize the pack to fit your own specific needs. With this in mind, our ratings focused on the rafts themselves. This evaluation of survival equipment is

primarily a guide to choosing on a life raft kit that is appropriate for your needs. It should also help you determine what contents will be required for a separate abandon-ship bag, or “ditch bag.”

For our life raft test, we asked each maker to equip its raft for an offshore voyager planning a Caribbean cruise and possibly carrying on with a trans-Atlantic crossing.

It was no surprise that some packs were more complete than others. Two manufacturers, Win-

slow and Switlik, included separate ditch bags with the rafts they sent, and the contents were specifically chosen to supplement what was

packed on their respective rafts.

The hierarchy of life raft survival packs ranges from a basic emergency kit (E-type) that the manufacturer

puts together to the international-

ally standardized Safety of Life at Sea (SOLAS) A-package, which is more comprehensive and nearly twice as heavy as the E-type kits. The International Sailing Federation (ISAF) and the International



SAFETY & SURVIVAL



Viking E-Pack

Elliot SOLAS A-Pack

A side-by-side comparison of Viking's E-pack (left) and Eliot's SOLAS A-pack survival kits. SOLAS flares, rations, and a significant water supply can't be stuffed into a small light package. Viking also offers a SOLAS A-pack.

Organization for Standardization (ISO) have their own guidelines for what should be included in the packs, and these kits tend to be less comprehensive than commercial-grade SOLAS A (offshore) and B (coastal) survival packs.

In our view, none of these standardized packages is ideal. (No raft contained a proper radar reflector, a glaring omission in our view.) Even those sailors who have a customized life raft survival kit should be prepared to pack additional gear and supplies in an overboard bag. We will be looking more closely at ditch kits and their contents in a future issue.

The contents of all life raft survival packs can be divided into three categories: vessel gear, crew aids, and signaling equipment. Vessel gear includes items like paddles, a heaving device, a bailer and a drogue—equipment that helps in recovering crew, getting away from a sinking or burning vessel, and keeping the life raft afloat.

Among the vessel gear, we found patching gadgets and material. Some were ultimately useful, and others came with directions that instructed users to “make sure both surfaces are completely dry before applying cement”—not the most realistic expectation.

The essentials packed for crew

well-being included seasickness medication, sunblock, and reflective coveralls that help conserve body heat—similar to emergency “space blankets.”

The most obvious difference among the packs was the amount of drinking water. The Elliot 6-SOLAS had the most water (about 2.38 gallons), while two of our recommended rafts, the DSB 6-ISAF and the Switlik SAR-6 MKII, had none. Anyone who owns a life raft must know how much water it contains and have a plan to augment that supply.

The more diverse your distress signaling ability, the greater your chance of rescue. All of the rafts we tested provided flares, flashlights, and mirrors, but these items are fairly crude compared to what is available today. In the last decade,

The variety of life raft paddles ranged from flat, one-hand paddles to collapsible oars with curved blades. Pictured are the paddles from the rafts we tested (left to right): Switlik SAR, DSB ISAF, Switlik MD-3, Winslow Ocean Rescue, Zodiac Class Ocean, Viking RescYou Pro, and Elliot SOLAS.

call-for-help technology has grown more reliable and smaller in size. The introduction of EPIRBs and their smaller cousins, the 406MHz Personal Locator Beacons (PLB), allow a person to summon a rescue coordination center (RCC) with the push of a button—although a timely response is by no means guaranteed, particularly in remote parts of the world. When you include a portable satellite phone,



PS	GUIDE	LIFE RAFT SURVIVAL GEAR						
		DSB 6-ISAF	ELLIOT 6-SOLAS	SWITLIK MD-3	SWITLIK SAR-6 MKII	VIKING RESCYOU/ RESCYOU PRO (TYPE E)	WINSLOW OCEAN RESCUE	ZODIAC CLASS OCEAN ISAF
RAFT SUPPLIES								
PADDLES		2	2	2	2	2	2	2
BAILER		1	1	1	1	1	1	1
SEA ANCHOR		2	2	2	1	1	2	1
SPONGES		6	2	2	2	1	2	6
REPAIR KIT		1	1	1	1	1	1	1
REPAIR PLUG SET		0	1	0	0	1	0	0
REPAIR CLAMPS		1	0	3	3	0	5	2
RELIEF VALVE STOPPERS		0	2	2	2	0	2	0
PUMP		1	1	1	1	1	1	1
RAFT ID TUBE		0	1	0	1	0	0	0
HEAVING LINE		1	1	1	1	1	1	1
UTILITY KNIFE		1	1	1	1	1	1	1
CREW SUPPLIES								
FIRST-AID KIT		1	1	0 [1*]	1	1	1	1
SIGNAL CARD		1	1	1	1	1	1	1
SEASICKNESS PILLS		60	36	36	36	36	24 [36*]	36
SEASICKNESS BAGS		6	6	6	0	0	6	6
NOTE BOOK		1	1	0	0	0	1	0
EXTRA BATTERIES/BULB		No	Yes	Yes	Yes	Yes	Yes	Yes
MEASURING CUP		0	1	0	0	1	1	1
WATER BAG		0	0	0	1	1	2	1
FISHING KIT		0	1	0	0	1	1	0
RADAR REFLECTOR		0	0	0	0	0	0	0
INSTRUCTIONS/INVENTORY		1	1	1	1	1	1	1
THERMO AID		2	2	0 [2*]	2	0	1	2
WATER PACKS		0	72 x 4.23 oz.	102 oz. [202 oz.*]	0	6 x 16.91 oz.	24 x 4 oz.	1 x 16.91 oz.
RATIONS		0	36 bars	6 bars	0	0	9 bars (1,000 cal.)	0
SAFETY SCISSORS		0	1	0	0	2	0	0
CAN OPENERS		0	3	0	1	1	0	0
SUNSCREEN		0	0	[8 oz.*]	0	0	2 x 6 oz.	3 x 4 oz.
THERMAL GLOVES		0	0	0	0	0	6 pair	0
COMPASS		0	0	0	0	0	1	0
THERMAL BLANKETS		0	0	0	0	0	4	0
TOOLS		0	0	0	0	0	Multi-tool	0
MISC.		0	0	0	0	0	Inflate-a-potty	0
SIGNALING GEAR								
FLARES (ROCKET)		0	4 parachute	0 [2 parachute*]	1 parachute	2 parachute	4 parachute	1 parachute
FLARES (HANDHELD)		3	6	3 [3*]	3	3	6	3
FLARES (SMOKE)		0	2	0	0	0	1	0
FLASH LIGHTS		2	1	2	2	2	1	2
WHISTLE		1	1	1	1	1	2	1
MIRROR		1	1	1	1	1	2	1
RESCUE STREAMER		0	0	0	1	0	1	0
DYE MARKER		0	0	0	0	0	1	0

*in grab bag

WINSLOW ABANDON-SHIP BAG

- | | |
|------------------------|----------------------------|
| ACR 406 MHz EPIRB | 1 extended-life flashlight |
| Icom VHF | 75-foot retaining line |
| Katadyn watermaker | 2 signal paddles |
| 3 USCG meteor flares | 1 magnetic compass |
| 1 signal mirror | 1 fishing kit |
| 1 sea rescue ribbon | 4 spare batteries |
| 1 USCG/SOLAS whistle | 24 (4 oz.) water packets |
| 1 dye marker | 36 anti-seasickness pills |
| 1 USCG handheld smoker | 1 water storage bag |
| 1 utility knife | 1 first-aid kit |
| 1 survival manual | 1 drinking cup |
| 1 repair clamp | 2 sunblocks |
| 2 PRV plugs | 3 nitrile gloves |
| 1 oral inflation tube | 6 rations (1,000 cal.) |



Optional Grab Bag Items

Thirty pounds of safety gear are packed into the Winslow Ocean Rescue life raft. The 20-pound grab bag of optional items (inside square) includes extra parachute flares, a McMurdo 406 MHz EPIRB, a Katadyn watermaker, and a handheld ICOM VHF radio.

a cost-effective, 121.5MHz handheld, aviation VHF transceiver for contacting planes overhead, and a handheld VHF, a life raft seems more like a floating phone booth with 911 on speed dial.

None of the rafts we tested, however, came with an EPIRB, SART (search and rescue transponder), or VHF onboard. Winslow provided an EPIRB in its superb abandon ship kit, but we look forward to the day when EPIRBs are built into the raft. The technology is currently available (U.S. Marines carry satellite-linked PDA's into battle), but putting electronics in wet, harsh conditions takes some serious consideration.

The most common approach today is to include EPIRBs and similar equipment in an abandon ship kit, but it would be even better if this signaling was as automated as the inflation of the raft itself. The night-time drills held during raft testing convinced testers that in the chaos of an emergency, it is easy to overlook the EPIRB or to fail to bring along a handheld sat-phone kept ready at the nav station.

A life raft that comes equipped with an EPIRB and a comprehensive survival pack will, of course, be heavier and more difficult to stow and launch. Another school of thought emphasizes the importance of keeping the raft light and

easy to launch by putting most of the survival equipment in a separate abandon-ship bag. Both arguments have merit, and perhaps a blend of the two philosophies offers the best solution. A belts-and-braces approach would place an EPIRB (and, if the budget allows, a sat-phone) on the boat where it's ready for evacuation, and another EPIRB on the life raft itself. If a single EPIRB is the only option, it belongs on the boat in a dedicated location where it is handy during evacuation.

If a sat-phone is used as part of the normal high-seas communications routine, its operation will become second nature, a big advantage in an emergency. The trick is to stow the unit in a grab case that's waterproof and ready to go, and the phone manufacturers offer such options. In fact, all communication gear such as radios and sat-phones should be kept in a truly waterproof container with extra batteries, sealed

Switlik complements its MD-3 in-raft supplies with a grab bag containing heavy items like water, rations, and additional flares, as well as thermal foil suits, sunblock, and a first-aid kit.

separately. The package should also include a list of phone numbers to reach the U.S. Coast Guard or, if voyaging overseas, the relevant RCCs. It's also important to assign crew ahead of time to essential roles such as the raft launcher, grab-bag steward, Mayday communicator, EPIRB and phone-in-a-box carrier, etc.

A survival situation rarely unfolds as it has been rehearsed. The longer you are on the raft, and the farther you are from a well-equipped RCC, shipping lanes and land, the more your survival depends on things beyond your





Zodiac's ISAF-approved kit was well-packed and fairly comprehensive, but it had only one small bag of water.



DSB provides a limited, compact array of essential items that meets the ISAF requirements, but it includes no water at all.

control. Drinking water immediately enters the equation. Sailors in the Intertropical Convergence Zone (ITCZ) should find enough rainfall, but those elsewhere will face bleaker prospects for catching water. All too often, the rain comes with wind and sea and chop, and spray taints the fresh water running down the canopy into the catchment container. The solution is to bring extra drinking

water aboard the life raft and to have a hand-pumped watermaker in the ditch kit.

IN THE RAFT

The E-pack is a basic kit found in many recreational life rafts, and it's a good start to providing essential equipment for the raft and its crew. This kit is light, usually under 20 pounds, and compact—keeping the raft's bulk and weight to

manageable proportions. However, the limited supplies mean that an abandon-ship bag is essential. Reviewing what we found in the rafts should help you get a feel for what else is needed to augment the supplies. The following are some of the testers' comments regarding essential items found on the rafts. The table on page 14 compares the survival packs found in each raft.

FLARES

Not only is there a difference between brands of handheld and rocket-propelled flares, but there's also a wide gap between the standards for which they are designed. For example, when launched, a SOLAS-grade parachute flare burns longer and brighter than one designed simply to meet the U.S. Coast Guard requirements. Only the Elliot SOLAS raft included smoke canisters, a useful signaling device during daylight hours.

MIRRORS

Using sunlight to gain the attention of nearby ships and aircraft can be effective. The large, highly polished stainless steel mirrors with center-hole targeting features made sense and proved easy to use. Each raft included at least one mirror in its onboard kit.

FLASHLIGHTS

Any life raft flashlight should have a waterproof switch. Since the life raft kits usually contain no more than one set of extra batteries, you'll want to know what size spares to pack in the abandon-ship bag.

When it's time for a raft to be inspected, an owner should ask to be present when it's inflated. This is a great opportunity to see firsthand what's offered in your survival kit.

REPAIR KITS

Clamps are a great means of sealing a puncture and a big improvement over less expensive, screw-type plugs, which are quick to use but

SAFETY & SURVIVAL

make for a less durable repair. Glue-on patch kits can be useful during a spell of hot, calm weather, but in windy, offshore conditions with high humidity and plenty of salt spray, prepping and drying the surface for bonding may be impossible.

WATERMAKERS

Winslow included a hand-pump Katadyn Survivor 6 watermaker in its optional abandon-ship bag. The watermaker can make up to 6 gallons of water a day if continually pumped. This divides out to a quart an hour, and based on a 40-stroke per minute pump regimen, it takes about 9,600 strokes of the pump to make 1 gallon—a demanding commitment, even for those with time and energy to spare. Augmenting this device with Manta Ventures' SeaPack (Chandlery, March 2007), a passive desalinization system that effortlessly converts seawater to a nutrient drink, might provide relief in bad weather when the crew is too sick or busy bailing to pump.

EPIRB

To anyone at sea in a life raft, a 406 EPIRB (preferably GPS-enabled) is worth its weight in gold. Winslow packed one in its grab bag, and the life raft arch tube had a built-in pocket to secure the device. Switlik also offered an EPIRB as an optional item in its grab bag. Sailors on rafts with foil floors should make sure that an activated EPIRB is kept away from the foil. Many EPIRB makers recommend that their unit be deployed in the water and securely tied to the raft. Determine ahead of time how your unit(s) will be used.

DITCH BAG

The brightly colored, positively buoyant abandon-ship bag should have a line on it that is secured to the life raft as soon as the bag goes aboard. Although raft space is limited, essentials such as eye-



Of the three inflation pumps we tested, the Winslow Ocean Rescue pump worked the best. Plugs and clamps are used to make repairs to raft tubes. The plugs (bottom left) are a versatile repair aid in the right hands, but the clamps (bottom right) provide a more durable seal.



DSB 6-ISAF

Zodiac Class Ocean ISAF

glasses, personal medications, the vessel's first-aid kit, and passports (or photocopies of them) are worth taking along. Decide ahead of time on what should be in the ditch kit and keep it in a designated location that's easy to access.

CONCLUSION

Today, the life raft's primary mission is no longer to serve as a means of navigating to safety, but rather a platform from which to signal for help. That's fine if you have the gear needed to make the maritime equivalent of a 911 call. The current approach to life raft survival equipment, however, often leaves the mariner with what amounts to two tin cans and some twine.

So if you are serious about survival, you'll need to give some careful thought to augmenting your life raft with an abandon-ship kit that has an EPIRB. An onboard satellite phone is also an underestimated survival tool, one that can be used not only from the life raft, but also for medical emergencies. A plan to supplement the raft's water supply deserves equal attention.

The gear you have with you can mean the difference between

life and death, and based on our research, none of these rafts come with the ideal built-in inventory. We strongly endorse a supplementary abandon-ship bag that manufacturers such as Switlik and Winslow provide at additional cost.

If we were to isolate three survival packs that stood above the rest, those found in the Winslow Ocean Rescue (the clear leader here), the Switlik MD-3, and the Elliot 6-SOLAS come the closest to meeting our expectations.

A raft and the survival gear it contains can be augmented by the extra gear taken aboard, but equally important are the skills and attitude of the crew. ▲

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VIKING

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WINSLOW

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ZODIAC

410/643-4141, zodiacmarineusa.com

Thick plate stock allowed these iron tanks to endure more than 20 years in a less than ideal installation.

Replacing the Diesel Fuel Tank

Tank longevity rests on material choice and installation details.

It's sad but true: Boats often last longer, much longer, than their diesel fuel tanks.

If that day should come when you find yourself looking at your own reflection in a spreading slick of diesel fuel in your bilge, what choices will you have? Should the replacement tank be an exact duplicate in size, shape, design features, and material as the original?

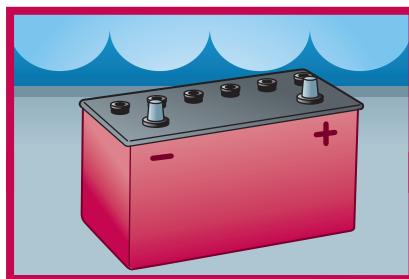
The answer to these questions may depend upon how long the original lasted or what difficulties you faced with that tank while it was in service. Was the tank outdated, or was it a tried-and-true design and material? More importantly, did the design, materials, or installation condemn the tank to an early death? Lastly, a more practical question will be how will you get the old tank out and bring a new one in?

TANK OPTIONS

While diesel fuel does not possess the explosive characteristics of gasoline—diesel's flash point is a relatively safe 130 F, which classifies it as "combustible," compared to gasoline's -45 F, making it "flam-

mable"—it remains a credible fire and environmental hazard. Therefore, the security and integrity of a fuel tank's design, fabrication, and installation are of the highest importance.

Industry guidelines for recreational marine diesel fuel tank installations are limited primarily to those established by the American Boat and Yacht Council (ABYC). An entire chapter within the council's voluntary "Standards and Recommended Practices for Small Craft," H-33, "Diesel Fuel Systems" is dedicated to the diesel fuel system design and installation, including tanks. This guideline spells out such things as the test pressure of a fuel tank, the grades or series



SYSTEMS

of aluminum alloy from which a tank may be manufactured, and the amount of movement that is acceptable in a fuel tank once it has been installed.

While ABYC guidelines are exceptionally detailed, it's important to remember that some items represent the minimum standard and a voluntary one at that. (While the U.S. Coast Guard sets forth a number of mandatory requirements for gasoline-powered vessels, it's mute on the subject of diesel-fuel systems.) In some cases, *PS's* notion of a durable, safe, and long-lasting diesel tank installation differs from that of the ABYC guideline. For example, ABYC section H33.10.5 states that "fuel tanks shall be installed and restrained so the fuel tank does not move at the mounting surface more than one quarter of an inch." We prefer to see no movement.

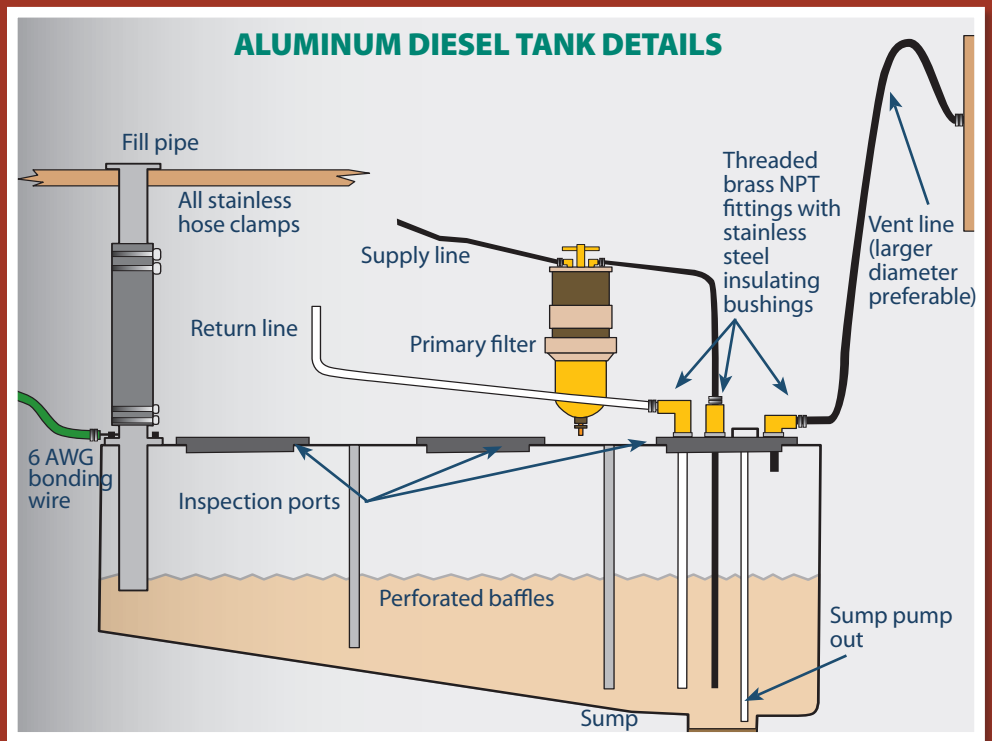
For the most part, however, the ABYC standards on diesel-fuel system and tank installation, if followed, will result in a safe, long-lasting installation.

The ideal tank installation should have, above all else, access. A fuel tank that is permanently buried beneath or behind fiberglass, timber, foam, insulation, or joinery work cannot be inspected for corrosion, chafe, structural damage, or leaks. While it may not be practical to install a fuel tank in such a way that all sides are accessible (the bottom of a fuel tank is almost never accessible), the importance of access cannot be overstated. It's worth noting that ABYC diesel-fuel system guidelines suggest that "consideration should be given to the ease of replacement of the fuel tank." This may be considered a tall order, particularly on modern cruising vessels where a premium is placed on accommodation spaces and installation of accessories.

TANK DESIGN

Section H-33 (“Diesel Fuel Systems”) of the American Boat and Yacht Council’s “Standards and Recommended Practices for Small Craft” covers almost every detail regarding diesel fuel tank design:

- **Fill pipes:** Located so that no fuel can enter boat when fuel flows at 5 gallons per minute.
- **Copper-based alloy fittings:** Separated from an aluminum tank by means of 300-series stainless steel inserts.
- **Baffles:** Should not prevent flow along bottom of the tank or trap vapor at the top.
- **Fasteners:** 300-series stainless steel hardware shall be used to secure senders, inspection port cover plates, fittings.
- **Leak check:** System leak tested at no less than 3 psi.



Each baffled compartment should have its own access plate. A sump in the bottom of the tank traps contamination for easier removal.

An additional feature of the ideal tank would include baffles. These are nothing more than vertical, and sometimes horizontal, walls or barriers within the tank. It’s difficult to determine if a tank is baffled by looking at its exterior. Perforations or limber holes within the baffles allow fuel to move slowly from one chamber to the next. Depending upon the tank’s shape, it’s considered desirable and beneficial to install baffling on most tanks larger than about 30 gallons, or 30 inches long.

Baffles do two things: First, they reduce the movement of the fuel within the tank, which under some circumstances can upset the stability of the vessel as well as aerating the fuel. In the latter case, if this aerated fuel passes to the engine, it could lead to performance problems or an outright shutdown. Second, baffles are a means of internally stiffening and strengthening the tank. For larger or irregularly shaped tanks, this may be a necessity.

Because contamination within diesel fuel tanks is a virtual certainty, inspection or clean-out ports are a prerequisite for PS’s ideal tank. Although it’s preferable for them to

be mounted on the top of the tank, ports may be side-mounted if necessary. The addition of these ports during tank construction adds very little to the bottom line. While it can be done, installing inspection ports after the tank has entered service is considerably more complex, time-consuming, and costly. It’s important that an inspection port be installed into every baffled chamber since you won’t be able to clean any chambers that don’t have inspection ports. A 6-foot-long, 60-gallon, rectangular fuel tank might have two vertical baffles, creating three chambers.

Even if some or all of the ports will not be easily accessible once the tank is installed, it’s still worth installing them. If the tank becomes contaminated, it could be moved or even removed for cleaning. Otherwise you might be faced with the unpleasant and potentially costly task of installing inspection ports later in some far-flung locale.

The pickup (supply) and return tubes on the ideal tank should be removable rather than permanently installed. To reduce aeration of the fuel, the return lines, as well as

the fuel pickup lines, should be attached to tubes that extend to the bottom of the tank. The pickup tubes are prone to clogging with debris, so it’s important that they be removable as well as accessible. In the past, pickup lines were often fitted with screens, but it’s better to have any debris travel to the primary fuel filter where it can be easily serviced rather than accumulating at the end of the pickup tube, which would require more time and effort to remove and clean. To avoid chafe and obstruction of fuel flow, it’s important that the pickup tubes not make contact with the bottom of the tank. Ideally, the bottom of the tube should be placed approximately a half-inch from the lowest portion of the tank bottom.

Some thought should be given to securing the tank. How will the tank be installed so that it cannot move, even a fraction of an inch, once it enters service, while avoiding chafe or corrosion damage?

Many original equipment tank installations use bracing, cribbing, or surrounding joinery work to keep the tank in place. The drawback to this, for metallic tanks, is the



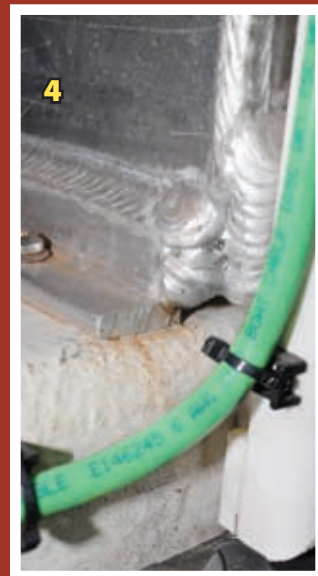
1



2



3



4

1. *Stainless-steel bushings insulate copper-alloy (brass, bronze) fittings from tank. 2.* *Non-hydroscopic material (preferably adhered to tank itself) isolates tank from wood. 3.* *Install inspection plates into every baffled chamber. 4.* *Leave at least a 1/4-inch air gap between bottom of tank and its shelf.*

propensity for this material to hold water, which can lead to corrosion. If you have the option of designing a new tank, it may be worth considering the addition of mounting flanges. These rugged angle sections are welded directly to the tank during its manufacture. The flanges allow you to fasten the tank—preferably using substantial through-bolts rather than screws—to a shelf that is integral with the vessel. This approach may take some thought and design modifications to the mounting location, but it will pay dividends. The tank can then be securely installed with minimal contact between the tank and any surrounding structure or material, reducing the potential for corrosion, chafe, and movement.

Finally, consideration must be given to plumbing fittings and their attachments. Plumbing fittings—including pickup tubes, returns, vents, and fills—come in two varieties: those that are permanently attached to the tank body and those that are threaded in place. Permanent fittings have the advantages of being cheaper (usually) and being less prone to leakage. However, permanent fittings can't be replaced if the size is wrong or if they are damaged. If they are accidentally stepped on, for instance, they will sometimes

deform or even crack at the welded interface with the tank.

Threaded, removable fittings, on the other hand, offer the advantage of being easily modified to accommodate different size hoses and they are less prone to damage. Removable fittings can also be disassembled for inspection and cleaning.

Threaded, removable plumbing fittings, along with any hardware that makes contact with a metallic tank, must be galvanically compatible with the tank material. Thus, copper-alloy plumbing fittings such as brass and bronze should not be allowed to make direct contact with aluminum tanks. An “insulating” bushing, typically 300 series stainless steel, must be installed between the tank and the copper-alloy fitting. Alternatively, the plumbing fittings themselves may be made of 300 series stainless steel. These are probably worth the extra expense, replacements may be difficult to obtain in out-of-the-way places.

In some cases, even if these incompatible alloys are properly isolated, corrosion may still occur. If water leaks onto a copper-alloy plumbing fitting—or any other hardware for that matter—and then onto an aluminum tank, it will carry with it salts of copper. These will land on and imbed themselves

into the aluminum, where they will begin a slow but almost unstoppable galvanic corrosion process. Therefore, it's important that even properly isolated fuel tank alloys be kept as dry as anything can be kept aboard a sailing vessel.

TANK MATERIAL OPTIONS

In our quest for the ideal fuel tank, *PS* considered a number of common marine fuel tank materials. The primary materials used for fuel tanks are aluminum, polyethylene, fiberglass, occasionally steel or iron, and now stainless steel, roughly in that order of popularity.

ALUMINUM

Aluminum is first on the list for several good reasons. It is *PS*'s replacement tank material choice for most installations. It is easy to work with, readily available, comparatively inexpensive, light, strong, and corrosion resistant, although far from corrosion-proof.

There are some prerequisites when selecting aluminum for fuel tank fabrication. The alloy used must be 5052, 5083, or 5086 series and a minimum of .09 inches thick. This gauge is ABYC approved, however, 1/8-inch (.125 inches) is preferable, and 1/4-inch (.25 inches) should be considered for “extreme” appli-



1. Direct contact between wood cribbing and the tank invites corrosion. **2.** Stick-on foam insulation traps moisture. **3.** Uncoated mild steel will corrode quickly. **4.** Placing a tank where bilge water sits accelerates corrosion.

cations, such as bilge installations or where maximum durability and longevity is sought. Every fraction of an inch of wall thickness may buy a failing installation years of life.

If aluminum possesses so many good attributes, why use anything else? Unfortunately, as many boat owners will attest, aluminum is anything but indestructible. One of its primary foibles is its susceptibility to some corrosion, particularly pitting, galvanic, and poultice.

Pitting is caused by upsetting the corrosion-resistant film formed on the surface of aluminum, sometimes due to variations in available oxygen. Once it takes a foothold, the pit grows deeper, which creates a more powerful cell, accelerating the next form of corrosion, which is galvanic. Galvanic corrosion is the interaction between dissimilar metals in the presence of an electrolyte. In aluminum tanks, this process may take place between a copper-alloy fitting (brass or bronze) and seawater, or between a pitted aluminum surface and seawater. You must ensure that all metals that are in contact with the tank are compatible with aluminum.

Poultice corrosion results when aluminum remains in constant contact with a wet surface, such as wood, carpeting, insulation,

or stagnant water. If allowed to make contact, these demons are the harbingers of an early death for any aluminum tank. The result is prodigious amounts of white, gooey aluminum hydroxide. (It looks like freezer-burned vanilla ice cream.) This will quickly compromise the tank surface.

The best defense against this scenario is careful attention to installation details. No hygroscopic material should be allowed to make continuous contact with an aluminum tank, period. A proper aluminum tank installation calls for 1/4-inch by 2-inch strips of non-hygroscopic material, such as neoprene or high-density plastic (Starboard for instance), spaced two inches apart and placed between the tank bottom and the shelf on which it is mounted. This will prevent the tank from resting in water, and enables air to circulate beneath the tank, while allowing condensation to evaporate. Additionally, the installer must be sure to bed or glue the insulating material to the bottom of the tank. If this is not done, water or condensation will find its way between it and the tank, and corrosion will set in. Any other mounting arrangements, such as cribs or beams, must include this insulating material.

STEEL, MILD OR LOW CARBON

Low-carbon or mild steel was once a popular material for fuel tank fabrication. In spite of its rust-prone tendencies, a steel tank is quite strong and comparatively inexpensive. If uncoated, it develops light surface rust at first, which usually becomes more pronounced over time. Steel usually rusts from the surface in, retaining its basic shape while getting smaller. In the hopes of extending the lives of steel tanks, many boat builders swathed them in fiberglass. This is a short-lived prevention for rust that is wisely prohibited by ABYC guidelines. Interior corrosion can attack any metal tank, but this can be kept at bay with a well-designed and maintained system, one with a sump that is routinely checked for water.

STAINLESS STEEL

Another ferrous material that is worthy of mention is stainless steel. Until a few years ago, this material was not permitted by ABYC guidelines unless the tank was limited to a relatively small size of 20 gallons and used the unusual and costly shape of a cylinder with domed heads. The concern with stainless steel is its potential for weld embrittlement. The area adjacent to welds, because of the heat to which they've



Permanently welded fittings (left, top of photo) limit your options should the welding crack. Black iron tanks (below) are strong and cheap, but prone to corrosion. A deck leak at the fill pipe attacked this tank.



been exposed, can become hardened, and thus brittle. If the tank flexes, as many tanks do throughout their service lives, then there is the chance that this less-flexible material may develop cracks, particularly in a damp, salty environment. The attitude toward stainless steel diesel tanks, however, has changed somewhat, and today's ABYC guidelines do provide reasonable standards for stainless steel fuel tank fabrication. While weld embrittlement may still occur, it's less common with today's modern welding techniques and thicker plate stock. Stainless is also susceptible to crevice corrosion (akin to aluminum's poultice corrosion), which occurs when stainless steel is exposed to oxygen depleted water for extended periods, so precautions are needed to prevent its constant contact with stagnant, oxygen-depleted water.

In order to meet ABYC guidelines, stainless steel tanks must be a minimum of .075 inches thick and utilize 316L or 317L low-carbon alloy. (The "L" suffix denotes low carbon and is a prerequisite for any stainless steel that is to be welded.) If low-carbon stainless steel is not used, carbide precipitation, a scenario where the area adjacent to the weld becomes

"chromium impoverished," may occur, causing stainless to corrode much like ordinary steel.

ABYC's general approval of stainless steel for larger fuel tank installations is relatively recent, so there aren't many compliant stainless steel fuel tanks in service. It is, however, an acceptable material, albeit exceptionally expensive, particularly with the recent increases in the cost of stainless steel (See "Keep a Close Watch on Marine Metal," February 2007).

POLYETHYLENE

One material, which has been gaining steadily in popularity for fuel tank fabrication, is cross-linked polyethylene. Hunter and Beneteau use polyethylene fuel tanks in their boats, and it is commonly used on gasoline-powered powerboats. It is virtually indestructible, corrosion-proof, strong, light, and comparatively inexpensive. Its drawbacks include that it is impractical for custom fabrication—most manufacturers require multiple tanks be made, anywhere from five to 100 units—although hundreds of shapes and sizes are available. Additionally, because the tanks are roto-molded, full internal baffles are not possible.

(Partial baffles in the form of "speed bump-like" shapes along the tank sides or bottom as well as tubes between tank walls can be included in the tank mold.)

Chafe is another issue poly tanks must contend with, but so must all tanks. Careful attention must be paid to poly tank installations due to their propensity for hydrocarbon expansion. Poly tanks will expand or grow in all directions by approximately 2 percent when first exposed to fuel. (It is possible for a 60-inch-long tank to grow as much as 1.2 inches.) Once the tank has expanded, it stabilizes for the remainder of its life. Additionally, all poly tanks must be fully supported across the entire bottom of the tank (good advice for any tank installation), meaning they must rest entirely on a shelf. Plumbing fitting installation may also become a weak link in these tanks. As the tank bulges—and larger tanks will bulge—the threads can begin to deform, which could lead to leakage around plumbing fittings. Perhaps the greatest drawback of poly tanks is their inability to support inspection ports. Because of the hydrocarbon expansion issue as well as their flexibility, leak-free inspection ports are difficult, if not impossible, to install. Although these tanks are well-suited to small, and thus often very wet, gasoline-powered runabouts and center consoles, the inability to clean out these tanks thoroughly makes them questionable for diesel applications. One note of caution: If used for this purpose, plastic fuel tanks must be fabricated from cross-linked polyethylene, or XPE, not linear polyethylene, or LPE.

FIBERGLASS

The final tank material, and probably the most unsung, is fiberglass. Fiberglass was, before the advent of polyethylene, the only non-metallic alternative. It is strong and corrosion-proof. Care must be taken to use the proper resin (vinylester or

DIESEL TANK COMPARISON				
TANK MATERIAL	ALUMINUM (SERIES 5052, 5086)	POLYETHYLENE	STAINLESS STEEL	FIBERGLASS
LONG-TERM DURABILITY	GOOD: Rugged, suffers minimal expansion, easily fabricated, but more subject to corrosion.	FAIR: Won't corrode, but tank is prone to chafe, flex, and expansion.	GOOD: Long lasting if installed properly, but not immune to corrosion.	EXCELLENT: A well-made custom fiberglass tank should last the life of the boat.
EASE OF FABRICATION	GOOD: An experienced welder can fabricate a rugged tank, but care is needed at fittings to prevent corrosion.	POOR: Cannot be custom fabricated.	GOOD: An experienced welder can fabricate a durable tank. Welds require special attention.	FAIR: Requires strict adherence to standards for constructing a fiberglass fuel tank.
EASE OF INSTALLATION	FAIR: Special care required to prevent corrosion.	FAIR: Must allow for tank expansion. Perfect fit may be impossible.	FAIR: Special care required to prevent corrosion.	GOOD: Needs no extreme measures to protect against corrosion.
EASE OF MAINTENANCE	GOOD: Provided installation and tank construction is sound.	POOR: Cannot be fitted with cleaning ports.	GOOD: if construction and installation is sound.	EXCELLENT: No need to monitor for corrosion.
COMMENTS	The best value for most cruisers, corrosion the chief concern.	Last choice, but the cheapest option for a corrosion-free tank.	Much more expensive than aluminum, but less prone to corrosion.	Expensive, long-lasting choice, if done right.

epoxy), and meticulous lamination technique is a prerequisite. These tanks lend themselves well to the do-it-yourself project, provided the person has some experience with fiber-reinforced plastic (FRP) lamination, because odd shapes and sizes can be custom fabricated. They should not be made integral to the hull unless the vessel was originally designed and constructed for this type of installation, otherwise you will risk delamination during severe wracking, as in the case of a grounding or collision.

The preferred installation methods are the same as other tanks, flanges, shelves, and cribs. Certain shapes can be tabbed in place, provided these secondary bonds are done properly. They are immune to corrosion, so isolation from moisture, bilge water, and hygroscopic materials isn't important. A number of production boatbuilders (Cabo Rico has used non-integral FRP tanks for many years with good results) have switched from steel or aluminum to fiberglass for fuel and other tank construction.

The only physical shortcoming of fiberglass is its susceptibility to damage as a result of exposure to certain fuel additives such as etha-

mol. The boating press has been rife with stories in the last two years about the effects of gasoline containing ethanol (sometimes referred to as gasohol), usually in a 10-percent concentration. When used in fiberglass tanks, this has caused serious damage to the tanks as well as engines. The good news is that diesel isn't yet spiked with alcohol, although we can't entirely rule out the possibility. (E-diesel, a mixture of diesel fuel and ethanol, is still in the experimental stage.)

CONCLUSION

Given our criteria for the best tank at a reasonable price, *PS's* ideal tank material for most applications is aluminum. Custom aluminum tank fabrication is reasonably priced, and it has a very long track record, so the behavior and weaknesses are well understood. If cost is no object, a well-made fiberglass tank will serve well in areas that will inevitably see water, but finding a qualified builder can be difficult. The higher expense of a stainless-steel tank might also be a good choice for certain applications, but its track record with diesel is limited. If you do opt to have a tank custom fabricated (this

would include aluminum, stainless steel or fiberglass), it's critical that the fabrication be undertaken by a professional, dedicated tank builder and not just a machine or fiberglass repair shop. Fiberglass shops will often build what you specify, even if it is flawed or violates ABYC guidelines for fuel tanks. A dedicated fuel tank fabrication shop will often advise you if your design goes against convention. For off-the-shelf aluminum, stainless, or poly tanks, simply purchasing from a reputable manufacturer of these products will often, but not always, produce good results. Shop carefully and let features and quality be the watchwords that are weighed against economy. ⚠

CONTACTS

BEST FABRICATORS (Aluminum, stainless), 800/788-4577, bestfab.com

FLORIDA MARINE TANKS (Aluminum, stainless), 305/620-9030 floridamarinetanks.com

LUTHER'S WELDING (Aluminum, steel alloy, stainless), 401/253-5550, lutherswelding.com

TEMPO PRODUCTS CO. (Crosslinked polyethylene), 800/321-6301, tempoproducts.com

Bustin' Barnacles Without Resorting to Harsh Chemicals

You'd think that people who spend so much time testing bottom paint wouldn't have a barnacle problem, but we do ... a big one. Our home waters of Sarasota, Fla., are paradise for barnacles. After 18 months (seven of them in Rhode Island), the Interlux Micron Extra on the hull of one of our test boats, a 21-foot Parker powerboat, finally surrendered to the little bug-gers along the waterline.

In our last barnacle-remover test (May 1, 2004), two products stood out. The most effective was Star brite Zebra Mussel and Barnacle Remover. The Star brite's active ingredient is hydrochloric acid, an acid that produces a sharp, acrid odor, and can irritate the respiratory system. We also recommended Marsolve, which uses a less potent aqueous organic salt (hydrogen chloride) mix. Marsolve was more pleasant to work with, but not quite as effective.

This time we tried a solution with the promising name of Barnacle Buster from Trac Ecological, a company that specializes in making environmentally friendly cleaners and descalers for marine plumbing and engine-cooling systems. (One of their newest products is designed for cleaning head plumbing.) Barnacle Buster's active ingredient is phosphoric acid, a common cleaning acid. (Several products in our May 2006 rust-stain remover test used phosphoric acid.) It comes in the ready-to-use, diluted Barnacle Buster (\$23 per gallon),

which has about 20 percent active ingredient, and the Buster Concentrate (\$69 per gallon), which has about 85 percent active ingredient.

Like the Marsolve, Barnacle Buster's primary purpose is to remove scale and marine growth from cooling passages. Both are biodegradable and can be harmlessly flushed directly into the water at any dilution, the manufacturers claim. Both products are relatively mild acids, although gloves and eye protection are still recommended.

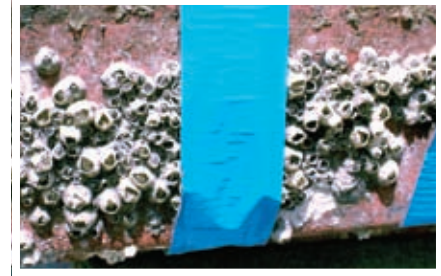
The adjacent photos document our comparison between Barnacle Buster and Star brite. (With the former, we used a 4:1 ratio of water to concentrate). The foamy Star brite was quicker to break down the shells. Although the Barnacle Buster didn't attack the adhesive as we'd been told it would, it also did the job, it just took a little longer. For both, we used a plastic putty knife to lightly release the shells after application. Neither completely removed all traces of the barnacles' tenacious ring bases until after a second application.

We have not yet tested Barnacle Buster's descaling ability, but trusted sources tell us they have had good experience with it cleaning air-conditioning and refrigeration plumbing. (The company sells a portable flushing device for this purpose.)

Trac Ecological warns users that Barnacle Buster will dissolve zincs, so if you are cleaning a heat exchanger or raw water cooling system, replace your good zincs with some bad ones before flushing the system. And protect a galvanized trailer, if you are working over it.

Bottom line: Same as Marsolve. We recommend the product for those who'd rather not use a scraper or work

Trac Ecological Barnacle Buster **Star brite Zebra Mussel and Barnacle Remover**



2:29 p.m. (Untreated)



2:35 p.m. (First application)



2:43 p.m. (After a light scraping, rinsing, drying)

Elapsed-time photos show the first results. One application wasn't enough for either Trac Ecological Barnacle Buster (on left) or Star brite Zebra Mussel and Barnacle Remover. Light scraping and a second application was required.

with strong acids. It will also appeal to those who have cooling passages to flush. The concentrate is useful since it lets you adjust the potency according to the job. However, if getting barnacles from your hull is your highest priority, and you're comfortable working with acids, the Star brite is a better choice. ▲



The Buster Concentrate (far left) can be mixed at more potent ratios for faster cleaning.

CONTACT
TRAC ECOLOGICAL,
 757/619-3614, trac-online.com



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The experiences of other sailors can often be your best gear guide. Coastal and long-distance cruisers Joe and Lee Minick offer the lowdown on the gear aboard their Mason 43, *Southern Cross* (above).

From ground tackle to electronics, here's what worked and what didn't.

By JOE MINICK

Everyone faced with the task of fitting out a boat for cruising deals with the same hard questions: What do I really need, and what equipment will do the job reliably? There is no easy answer, no single source of information or reference to provide clear-cut answers. Choices are often guided by a hodgepodge of information derived from other people's experiences, manufacturers' claims, personal goals, intuition, and even random selection when all else fails.

We relied on other people's experiences when we equipped *Southern Cross*, our Mason 43. We paid particular attention not only to their choices in equipment, but how they used it, what was needed to maintain it, and—most importantly—whether it fit our perceived needs. Now, several years later, it's painfully obvious that misconceptions about what is really needed lie at the root of many problems with equipment, although

there are still poorly designed pieces of gear that should be avoided.

ANCHORING

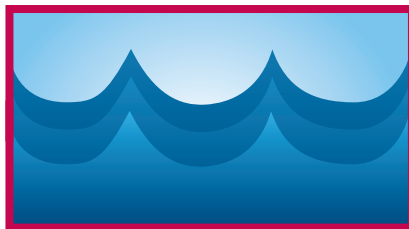
A cruising boat lives as much by its ground tackle as it does its sailing rig. The average cruising boat spends about five days inshore for every day under sail, and given today's marina prices, a lot of those inshore days will be spent at anchor.

Decisions here are fairly simple: You want the biggest, strongest anchor you can carry on the bow, backed up with the longest, heaviest chain you can stow, and a reliable windlass that can pick up the

entire length of ground tackle when it's hanging vertically from the bow roller. The windlass should have a workable backup in case of power or motor failure, and the bow roller should be well thought-out and heavily built.

We got this one right. *Southern Cross* tips the scales at a little over 32,000 pounds, and her primary anchor is a 60-pound CQR backed up with 300 feet of galvanized 3/8-inch chain. Half-inch chain would be even better, but it's just too heavy for *Southern Cross*' bow.

I set the anchor with a minimum scope of 5 to 1, and really prefer 6 to 1, if there is room. Reaching the desired scope before attempting to set it with the engine seems to work the best, and easing it into the bottom with a bit of reverse before testing the set with more power eliminates a lot of problems. In deep water, I have occasionally used less scope when no more chain was available and have successfully anchored in nearly 100



OCEAN TESTED

GLOBAL CRUISERS

Joe Minick, currently the electronics editor for *PassageMaker* magazine, also served as electronics editor for *Cruising World* and is a contributing editor for *Sail*, *Practical Sailor*, and *Naviga*, a Turkish publication. He and his wife, Lee, have been sailing together for more than 40 years. They have refitted three boats and cruised both U.S. coasts and the Bahamas. Most recently, they chose a Mason 43, a moderate displacement,

cutter-rigged sloop, as their long-distance cruiser. In 2002, after five years of refitting and sea trials, they moved aboard *Southern Cross* and left Annapolis, Md., for Europe. Their Atlantic crossing included calls to Bermuda and the Azores before making landfall in Ireland. They went on to cruise the waters of Scotland, Ireland, and the English Chan-



nel before crossing the Bay of Biscay and entering the Mediterranean, where they have sailed as far as Port Said, Egypt, and the western Black Sea.

feet of water with the full 300 feet of chain out. I would avoid this sort of anchorage, if you can. For a snubber, we use 5/8-inch, braided nylon secured to the chain with a camel hitch—really a rolling hitch with more wraps in each section—and to date, it has never let us down. The snubber is led over the roller with the chain, and the shallower the water, the more length I use, often ending up with 15 feet or more out in 8- to 10-foot depths.

We have used the CQR in all kinds of bottoms—weed, sand, mud, and even some rocky patches—with almost total success. On several occasions, it held in winds upward of 50 knots for several days. But like most plow anchors, over a period of time, it may slowly move or plow a bit in really soft mud. With the large selection of anchors on the market, it's important to be aware that there is a significant difference in strength between the drop-forged steel of anchors like the CQR and the weaker, welded-steel-plate anchors.

ELECTRICAL SYSTEM

Another one we got right. We run almost everything from what I hoped would be a bulletproof 12-volt DC platform. The combination of a Freedom 2000 inverter/charger and a Link 2000-R monitor (both sold under the Xantrex name) controlling both the engine alternator and the Freedom's output to our Lifeline AGM batteries has been rock-solid for years. The first set of Lifeline AGM batteries lasted

well over eight years, and I think I inadvertently shortened their life a bit by using too high of a voltage during the equalizing phase of charging. We run virtually everything from this platform, including fairly high-draw items like a big 1/3-horsepower refrigeration compressor motor and a watermaker. The Link system has survived several near misses with lightning strikes and lots of pounding with RF from the SSB, and it never misses a beat. The Link 2000-R and inverter/chargers are readily available, but the marine version of the Freedom inverter/charger can be used with both 50 and 60 Hz AC power. This is a feature that we depend on heavily in European waters where our shore power transformer supplies 120 volts at 50 Hz power to the boat whenever we plug in at a marina.

Allowing the Link 2000-R to regulate engine alternator output has several advantages, but also a potential weakness. Failure of the Link system with its interdependent alternator regulator would mean complete loss of alternator charging capability. The Freedom inverter/charger

can be run independently if the Link system fails, but the alternator regulator cannot.

As a backup, we installed a stand-alone, three-stage regulator on the panel beside the Link system regulator. The plan, in case of failure, was to move the leads from the Link regulator to the backup regulator and be charging again in short order. Aside from occasionally connecting it to see if it still works, the backup regulator has been decorating the compartment wall for eight years and has never been needed.

SGC 2000 SSB TRANSCEIVER

I really blew this one. Our nav station is too small to support a full-size marine SSB transceiver, so we decided to go with a SGC 2000 with a small control head mounted at the chart table and the main chassis tucked away in a locker. While this solved the space problem, the SGC 2000 created its own problems. Before we left for our voyage, it failed twice. Although

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This 60-pound CQR, along with 300 feet of 3/8-inch chain, has served the Minicks well in a variety of bottoms, from mud to rock.





The Minicks' electrical system includes a Xantrex Freedom Marine 2000 inverter/charger (top) and a Xantrex Link 2000-R monitor (bottom). The Freedom's marine version can be used with 50 and 60 HZ AC power—a big plus for those cruising in Europe.



The Freedom's marine version can be used with 50 and 60 HZ AC power—a big plus for those cruising in Europe.

SGC repaired it under warranty each time, this wasn't what I had in mind for a piece of cruising equipment.

After I diligently removed all the components, I gave the SGC 2000 to a fellow cruiser who was determined to give it a try. In another year or so, it had failed again and he gave up on it. Ultimately, we both installed an Icom 710RT.

ICOM 710 TRANSCEIVER

The Icom 710 is available as a single unit or in the RT version, which comes with a separate control head to allow remote mounting of the main chassis. Our 710 RT version has been totally reliable for many years, and performance has been excellent. We depend heavily on this radio, combined with a Pactor Modem for e-mail, weather fax, news, and communications.

The radio itself is only half of the equation, though. A proper antenna like the insulated backstay we use is fairly easy to set up, but a good ground plane is another matter. We have had good results with the tuner mounted in the lazarette, a few feet from the

backstay, and a 4-inch-wide strip of copper embedded in the hull around the waterline for a ground plane. A lot has been written about creating a good SSB antenna ground plane, but getting a good Pactor modem installation is another issue entirely. These gadgets are very sensitive to RF noise and require good filtering to work right. You can spend a few days tinkering with filter capacitors and chokes, or you can purchase a pre-assembled cable setup complete with filtering from HF Radio's (www.hfradio.com) Don Melcher. He is knowledgeable and has a selection of suitable SSB transceivers and Pactor modems, or he can help you set up an existing transceiver with a modem. When I plugged together our new HF Radio setup, we successfully sent e-mail from the first attempt and have continued to do so for many years now.

NASA NAVTEX RECEIVER

Although Navtex is available in North America, U.S. boaters don't often use it. However, in many parts of the world this may be the only source of weather and bulletins in English. A Navtex receiver listens on one of two different frequencies, 518 and 490 kHz. Transmissions on 518 kHz are in English, but the 490 kHz frequency is used by individual countries for local weather and is frequently transmitted in the local language. This isn't all bad. In the UK, for example, the shipping forecast is always available on the higher frequency, but a local

weather forecast for small craft, also in English, is broadcast on 490 kHz, so having the ability to receive both frequencies can be useful.

Navtex transmissions encompass areas where you might easily be 100 miles or more from the transmitter, and at these low frequencies, a sensitive receiver is a must. I originally installed a Nasa Target Pro-Plus Navtex receiver and had continual difficulties with receiving stations at any great distance. After consulting with the folks at Nasa, the antenna was relocated several times and a ground added. However, we still couldn't receive anything from more than a few miles away. In the end, it went the way of all things unproductive and found a new home.

My next attempt was a Furuno NX-300 Navtex receiver. The difference was immediately apparent. It's so sensitive that while anchored in Turkey, we were getting messages from the Suez Canal area to the other side of Greece. Fortunately, Navtex receivers allow you to select which stations you are interested in. The Furuno receiver takes this a step further. If you connect a GPS signal, it automatically selects stations within a preset distance, if desired. This is a nice feature, in our opinion.

With the little, mushroom-shaped antenna mounted on the stern pulpit, perhaps closer than it should be to other metal, and no special ground, it still works well. The NX-300 can receive only one frequency at a time (as selected by the user). A few Navtex receivers incorporate dual-channel capability and can receive both frequencies at the same time, but the reliability and long-range reception of the NX-300 made it a winner for the *Southern Cross* crew. ▲



In some places, Navtex is the only source for local weather info in English.

The Minicks weren't happy with the Nasa Navtex (top), which they said had poor range. They replaced it with a Furuno NX-300 (bottom), which they said offers better reception, more features, and better reliability.



CONTACTS

- FURUNO**, furuno.com
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- XANTREX**, 604/422-8595
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Weather Instruments

To evaluate the handheld weather meters' accuracy in measuring wind speed, testers set up a wind tunnel (at left) to control the wind level.

The Kestrel 4000 and the Skymaster weather meters best meet sailors' needs.

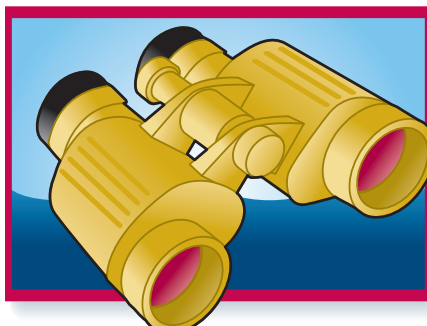
Time was, maybe 30 years ago, weather information was relatively hard to come by, unless you happened to be on the bridge of a ship equipped with HF radios or within range of the coastal forecasts. Today, it's streamed at us 24/7 over every medium imaginable—pay a fee, get weather updates over your cell phone.

In recent years, developments in microelectronics and programmable chips have brought atmospheric measurement capability literally into the palm of your hand. Devices range from the simplest anemometer to complete weather stations with special applications for everyone from hikers to aviators to hunters. While none of these products is geared specifically to the sailor—we're well recognized as a small market of tightwads—many have the basic measurements sailors find most

useful: wind, temperature, and barometric pressure.

Most 30-foot-plus boats have wind instruments mounted at the masthead, where they give a more reliable reading than a handheld device. Still, we are always interested in what the wind is doing, and some of us no doubt can find clever ways to put these handheld devices to use (to improve sail trim, for example).

Temperature by itself isn't very



PERSONAL GEAR

helpful, but coupled with humidity, and perhaps barometric pressure, it can give you a clue as to where the front is and whether to expect fog or rain.

Barometric pressure is essential information for sailors, and any device that can tell you current pressure and its history over the previous few hours is of real value.

WHAT WE TESTED

PS contacted the major manufacturers and requested a selection of weather tools. Our dozen test devices ranged from the simple—delivering wind information only or wind and temperature—to the complex, instruments that can record data, such as humidity and barometric pressure, over time. One device will even tell you if the moment is propitious for taking your rifle ashore for a spot of deer hunting.

From JDC, we tested the Skywatch Atmos, Meteos, Xplorer2, Xplorer4, and Geos 11. From Kestrel, we tested the 1000, 3500, and 4000 Weather Tracker. Speedtech sent us the Skymate, Skymaster (winner of our last test, "Handheld Weather Stations," in the July 15, 2002, issue), and Eco Edge.

What did testers deem important? Big, easy-to-read numbers on the screen. Unimportant? Decimals. This was particularly apparent when trying to compare several devices' wind speed, side by side. The numbers, apart from never agreeing between instruments, change too often. (Do we really need to know if it's 11.8 or 12.2 knots, or is 12 close enough?) What testers found most frustrating were the tiny LCD characters that were hard to read and tended to hide in the shadow of the screen's frame.

We've grouped them roughly from the most simple to the most complex. We rated them after evaluating the functions offered, the price, user-interface, intuitiveness, and how useful the device is for sailors.

PS VALUE GUIDE **HANDHELD WEATHER INSTRUMENTS**

MAKER / MODEL	Price / Price source	Warranty	Single-hand operation	Screen readability	Instructions quality	Floats	Usefulness (1-4, 4 is most useful) & Testers notes
SKYWATCH EOLE	\$65 / altimeters.net	1 year	No	Excellent	Good	N/A	1 — Functional, limited
SKYWATCH METEOS	\$72 / amazon.com	1 year	No	Excellent	Good	N/A	2 — Functional, limited
SKYWATCH ATMOS	\$111 / ambientweather.com	1 year	No	Excellent	Good	N/A	2 — Functional, limited
SKYWATCH XPLOERER2 \$	\$52 / ambientweather.com	1 year	Yes	Good	Fair	No	2 — Functional, limited
SKYWATCH XPLOERER4	\$115 / ambientweather.com	1 year	Yes	Good	Fair	No	3 — Functional, limited
SKYWATCH GEOS 11	\$375 / ambientweather.com	1 year	No	Good	Fair	No	2 — Functional, useful
KESTREL 1000	\$89 / nkhome.com	2 years	Yes	Excellent	Good	Yes	1 — Advanced, too complex
KESTREL 3500 ✓	\$250 / nkhome.com	2 years	Yes	Excellent	Good	Yes	3 — Functional, useful
KESTREL 4000 ★	\$329 / nkhome.com	2 years	Yes	Good	Good	Yes	4 — Advanced, useful
SPEEDTECH SKYMATE	\$90 / ahoycaptain.com	1 year	No	Good	Good	Yes	1 — Advanced, useful
SPEEDTECH SKYMASTER ✓	\$171 / ambientweather.com	1 year	No	Good	Good	Yes	3 — Functional, useful
SPEEDTECH ECO EDGE	\$130 / modernoutpost.com	1 year	Yes	Good	Good	N/A	2 — Different, of some use

★ Best Choice **\$ Budget Buy** **✓ Recommended**

All 12 of the weather instruments tested can be operated with gloved hands. All also passed the drop test; in fact, the Skywatch Geos 11 measured low wind speeds better after being dropped. Other than the Kestrel 4000, which requires two AAA batteries, all the devices use No. 2032 Lithium button cells for power. The “Usefulness” rating is based on the functions offered, the price, user interface, and how well the device suits the mariner’s needs.

KESTREL 1000

The simplest of the simple, the Kestrel 1000 gives wind speed plus maximum gust and the average speed since it was turned on.

A slip-on plastic sheath protects the device when it’s not in use—no accidental turn-ons—and a lanyard that passes through the sheath keeps the two parts connected. While this arrangement isn’t quite as handy as the flip cover on other test devices, such as the Speedtech Skymate, it ensures the same degree of protection.

The three control buttons—on/off, scroll right, scroll left—are easily operable by a gloved hand. Big, easy-to-read numbers and a “hold” mode that

allows you to move to shelter to read the screen, make the Kestrel 1000 a useful basic instrument. The battery cover opens with a coin and has an O-ring seal. We found the 1000 priced at \$89.

Bottom Line: The 1000 is handy and rugged, if all you need are wind readings.

SPEEDTECH SKYMATE

Similar in size and feel to the Kestrel 1000, the Skymate SM-18 gives wind speed; maximum gust; averages over 3, 5, and 13 seconds; temperature; and windchill.

The flip cover is practical and has positive grips that enable it to be opened with gloved hands. Simple, two-button operation and large LCD characters make it easy to use and easy to read. A tripod mount is provided; it’s not much use with the unidirectional

propeller anemometer, but it could be for monitoring temperature.

The Skymate’s battery is accessed with a coin and sealed with an O-ring.

Bottom Line: The Speedtech Skymate is a quality instrument. We found it for \$90, just \$1 more than the Kestrel 1000.

SKYWATCH EOLE

Three of the Skywatch models tested had a cup-style anemometer rather than propeller-style anemometer. They were all similar in outward appearance, clunky at first impression. But once we took them in hand, they fit well, allowing a firm grip on the foam-clad body with fingers clear of the screen. Removing the cover from the wind cups is a little tricky—more so if you try to follow the instructions—as is the battery “drawer.” We dropped the battery on the floor during the first attempt. The drawer fits only one way, but the battery



Kestrel 1000



Speedtech Skymate



Skywatch Eole

CHART A	TEMPERATURE TEST				
	TEMP 1	TEMP 2	TEMP 3	TEMP 4	TEMP 5
SKYWATCH ATMOS	33 F	40	49	58	71
SKYWATCH METEOS	33	43	52	60	73
SKYWATCH XPLORER2	31.2	43.7	51	59	69.6
SKYWATCH XPLORER4	31.2	42.2	50.9	58.8	69.8
SKYWATCH GEOS 11	30.9	42.5	51.1	59	70.2
KESTREL 3500	33	41.7	51	59.8	71.1
KESTREL 4000	32.5	42.1	51.2	59.6	71.2
SPEEDTECH SKYMATE	32.6	41.6	51.5	59.2	70.1
SPEEDTECH SKYMASTER	26.2	39.2	49.6	57.8	69.1
SPEEDTECH ECO EDGE	31.4	40.8	50.5	60	70.1
RANGE	7%	11%	6%	4%	6%

All temperatures are expressed in degrees Fahrenheit.

The range is the difference between the highest and lowest temps, expressed as a percentage. The range was the highest—and the devices' readings varied the most—at lower temperatures. However, most of the devices' performances fall within the manufacturers' claims for accuracy.

CHART B	BAROMETRIC PRESSURE TEST					
	BARO 1	BARO 2	BARO 3	BARO 4	BARO 5	BARO 6
SKYWATCH XPLORER4	1009.3	1006.8	1006.0	1006.4	1016.8	1017.5
SKYWATCH GEOS 11	1010.2	1007.7	1006.8	1007.1	1017.7	1018.3
KESTREL 3500	1008.8	1006.3	1005.2	1005.5	1015.9	1016.5
KESTREL 4000	NA *		1004	1004	1015	1015
SPEEDTECH SKYMASTER	1014	1011	1010	1010	1019	1021
SPEEDTECH ECO-EDGE	1008	1005	1004	1004	1015	1016
RANGE	5.2	8.0	4.8	4.5	4.0	6.0

All barometric pressure readings expressed in millibars, but were taken using kilopascals (kPa). (1 kPa = 10 mb)
* These readings omitted because they were taken at a preset, not an actual, reference for QNH.

All of the barometric readings tally closely if they are zeroed out. Remember, a barometer needs to be calibrated against a known value and compensated for elevation.

CHART C	WIND SPEED TEST				
	SPEED 1	SPEED 2	SPEED 3	SPEED 4	SPEED 5
SKYWATCH EOLE	2.1 / 2.3	2.8 / 3.1	4.2	7.8 / 8	9.5
SKYWATCH ATMOS	2	2	4	8	10
SKYWATCH METEOS	1.7 / 2.1	2.4 / 2.8	3.9 / 4.2	8.1 / 8.5	9.5 / 9.9
SKYWATCH XPLORER2	3.5	4.4	6.7	11	13.2
SKYWATCH XPLORER4	3.2	4.3	6.3	11.2	13
SKYWATCH GEOS 11	N/R	N/R	N/R	7.6	10.3
KESTREL 1000	3.5	4.3	5.9	9.6	11.2
KESTREL 3500	3.6	4.3	5.8	10	11.6
KESTREL 4000	3.5	4.2	6	9.9	11.2
SPEEDTECH SKYMATE	3.6 / 3.8	4.1 / 4.3	6 / 6.2	9.5 / 9.7	10.8
SPEEDTECH SKYMASTER	3.3	4.2	6.2	10.4	12.2
HIGH / LOW AVERAGE	3.7 / 1.9	4.4 / 2	6.7 / 4	11.2 / 7.6	13.2 / 9.5

Speeds are measured in knots. Where two speeds are given, the reading flipped constantly between the two numbers listed.

The Skywatch models showed consistently lower wind speeds. To see whether this was a result of the test setup, we compared the Atmos and the Kestrel 3500 outdoors. There, the measurements were more in sync. The Xplorer models seemed more enthusiastic than the others at higher wind speeds, so we pitted the Xplorer 2 against the Kestrel 3500. The Xplorer continued to show higher readings. The Skywatch Geos, which has a small prop-style impeller, didn't begin registering until Speed 4, when it showed readings closer to those of the Eole.

Measuring Schtik

The handheld weather instrument test had four main evaluation points: usefulness, ease of use, ergonomics, accuracy/consistency. To determine usefulness, testers considered the data each device provided and how well it met the needs of mariners. For ease of use, testers looked for the most accessible format that was easy to manipulate. To rate ergonomics, testers weighed how each device felt in the hand, whether it gripped well, and whether it felt robust enough for marine duty. Consistency was determined by how each instrument compared to the others in terms of accuracy.

The first three areas have a strong subjective element. Someone who uses a lot of gadgets might find all of these instruments intuitive. A less techy individual might want fewer functions and more buttons with which to scroll between them. Mariners have specific needs with regard to weather readings. Sailors heading out for a day or an afternoon can probably get what they need from the media and the NOAA VHF broadcasts. Those with longer-range plans want to be able to follow trends so as to make informed prognostications for what might be coming their way in a day or two.

If these readings are to be made at sea, the instrument needs to be rugged, easy to use with one hand while holding onto the boat with the other, and offer a clear display. Gloves inhibit dexterity, so to be useful in cold weather, the instrument's buttons need to be accessible for gloved hands and not too close together.

Because we did not have access to the Bureau of Standards calibrated comparators for the consistency test, we simply placed the instruments in controlled environments and observed how their readings compared. Standing outdoors with two wind gauges in one hand and a notebook in the other proved pointless. Wind strength and direction is so variable even in an open field that readings were never constant enough for us to make fair comparisons, so we resorted to the lab approach. Using a length of pipe and a fan, we created a small draft generator. By controlling the fan with a rheostat, we could reproduce—with reasonable consistency—a range of steady "winds," and by clamping the devices at a fixed distance from the nozzle, we could take "same conditions" measurements with them. (See results, Chart C at left.)

To track temperature (Chart A), humidity, and barometric readings (Chart B), we simply moved the instruments between a heated office, a basement, and an outdoor shed, leaving them each place long enough to acclimate. The one calibration we were able to reach was the melting point of ice. We set the Xplorer2, which was rated as waterproof, in ice water that had reached an equilibrium. The number thus obtained was close enough to the temperature in the frigid shed to serve as a standard for comparing the other devices.



All three Speedtech products offer clear, easy-to-read measurements. The only drawback, however, is the Skymaster's function indicators; they are hard to see on the screen.

can be installed in the drawer the wrong way, although no damage will result from this. No gasket around the drawer means the device is not water-resistant.

The cup-style anemometer is easier to use than the propeller-style because you don't have to point it at the eye of the wind for an accurate reading. It also makes the 1/4 x 20 threaded camera-tripod adapter a practical extra.

All three models have large, easy-to-read LCD displays and simple button sequences for setting and selecting display information.

Eole is the basic model, providing wind speed (the operator can set the units), maximum gust, and average over 30 seconds. Large, digital numbers are accompanied by a Beaufort scale bar graph.

Skywatch
Meteos

Bottom Line: Skywatch Eole doesn't offer a lot for the mariner.



SKYWATCH METEOS

The Meteos shows current wind (in digits and as a vertical Beaufort bar graph), wind average (since the device was turned on or reset), and maximum gust. At the

same time, it provides current temperature, minimum temp, maximum temp, and wind chill. It will scroll through the temperature functions

or you can select the one you want to monitor. The Meteos also has a tiny compass in the cap, but to use it, you have to move the cap away from the magnetic influence of the device itself.

Bottom Line: Meteos, while not a salty tool, delivers basic wind and temperature data for the budget-minded and can be mounted on a tripod or post.

SKYWATCH ATMOS

The Atmos has all the features of the Meteos plus a hygrometer and wet bulb, so it also provides relative humidity (without needing to be calibrated) and dew point.

Bottom Line: For the price (\$72), and for not being waterproof, Atmos doesn't offer the sought-after data, like barometric pressure.



Skywatch
Atmos

SKYWATCH XPLORER2

A very different design from the Eole and its siblings, the Xplorer series (1 through 4) uses a small propeller-type impeller for wind measurements and, in models 2 and up, an internal temperature sensor that abuts the metal backplate on the plastic case.

We tested the Xplorer2 and Xplorer4. These devices are small. They are hard to grip without touching the temperature-sensing backplate. Each comes with a lanyard, but would best be carried in a rucksack pocket where a bump won't accidentally turn it on.

The Xplorer2 has a two-line display that shows wind plus maximum wind measurements, wind plus temperature, or wind plus wind chill. The numbers are clear, but our testers found the small mode characters hard to see, especially in poor light. On this device, with its few function

Skywatch
Xplorer2



not a big problem. It has a backlight for use after dark.

Battery life in normal use should be long, but don't expect to change the battery on the fly: You'll need a tiny Phillips screwdriver for the six easy-to-loose screws securing the backplate to get to the battery.

You can dip the device into water to measure temperature—it's rated to withstand short-term immersion to a depth of 1 meter.

Bottom Line: For its size and price, Xplorer2 is a good choice for the data it offers. At \$52, it's our Budget Buy.

SKYWATCH XPLORER4

Xplorer4 is the top of the Skywatch's Xplorer range of products. It comes loaded with functions, excluding the "wet bulb" series that includes humidity. Identical in looks to the Xplorer2, the Xplorer4 shares the handling drawbacks. Simply holding it by its plastic case during use affects the thermometer dramatically. All of its functions are accessed by a single button, so you have to learn to press it for varying lengths of time to find what you're looking for.

The two-line screen—large characters on the top line, smaller on the second—displays several combinations of functions. Among them are wind speed and temperature, or wind speed and barometer, barometer trend, or altitude trend over time. The choices are aimed at the outdoorsmen from hikers to hang-gliders, so many of them are superfluous for boaters. The compass is of minor utility.

In our testers' opinions, the small characters for units and mode are hard to read, except in the best lighting, or with the battery-eating backlight on. Testers were impressed by the amount of information Skywatch packed into such a compact



Skywatch
Xplorer4

PERSONAL GEAR

device, but accessing the info demanded too much fancy fingerwork.

A note about the devices with altitude: Altitude is calculated by barometric pressure. Assuming barometric pressure changes slowly, you can determine changes in altitude without recalibrating the barometer during an outing. If you need accurate elevation, as when flying, you have to know the difference between QNH (absolute or sea-level barometric pressure, the numbers on a surface synopsis map and given out by weather stations) and QFE (pressure at field elevation—where you plan to land). Mariners operate at sea level, so we're interested in QNH. The Xplorer4 manual isn't too clear on how to set the device so that's what you get.

Bottom Line: Testers found the feature-laden Xplorer4 to be not rugged enough and a little difficult to use with its single button. Be careful not to drop it because the anemometer is vulnerable.

SKYWATCH GEOS 11

This is the Xplorer series on steroids. It packs functions too numerous to list into a solid case that fits the hand well and stays there, thanks to serious grips. The only seemingly vulnerable part is the tiny wind impeller, and as luck would have it, that's the end upon which it landed in during the drop test. Whatever bug the anemometer had before (see Wind Test results in Chart C of "How We Tested," p. 31), the drop appeared to cure it.

Geos 11 has three buttons, one of which is dedicated to the backlight while the others let you scroll through the four blocks of data on the screen and page through the multitude of modes available for each block.

The primary display numbers are large and clear, but the sub-mode icons at the side are tiny. It seems a case of trying to get too much into too small a space, and much emphasis is

placed on altitude.

Testers found that when working in cold weather, it was difficult to get the temperature-related numbers to settle down, because the metal case responded too quickly to the warm hand holding it.

Skywatch Geos 11

Bottom Line: Skywatch Geos is a comprehensive tool for the crowd that likes to climb mountains and jump off them on flimsy flying machines. It's not really as useful for mariners, and at \$375, it was the most expensive device tested. Still, it looks pretty cool, feels cool, and a real gadget freak could make it sing tunes.

SPEEDTECH ECO EDGE

The Eco Edge is the only device we tested that has no wind sensor. It also has no wet bulb. It has a specific application, and if you hunt deer, or simply want to know when they're active, this is for you. (Speedtech also makes an Angler's Edge, which includes tidal information, but not temperature.) The default screen on the Eco Edge shows a bar graph predicting deer activity, so you have to scroll to find the barograph. It has a clear LCD display that shows a weather forecast icon (sunny, cloudy, rainy), the moon's phase, and the locations of the sun and the moon—useful perhaps for predicting tides. Scrolling through the modes gives time, date, year, barometric pressure, sunrise, sunset, and altitude. It also has a time function that lets you see

predictions for the future (limited to heavenly body and wildlife activity).

The bar graph shows 16 hours of barometric history in four-hour blocks. You can see whether the trend is up or down, but the rate of change is not terribly clear. The Eco Edge has a severe-weather alarm that is activated if the barometric pressure changes by 6 millibars over a three-hour period.

Bottom Line: The device is light, compact, fits easily into the hand, and isn't overly sensitive to body heat—but in our opinion, it's better suited for Grizzly Adams than Salty Joe.

Speedtech Eco Edge

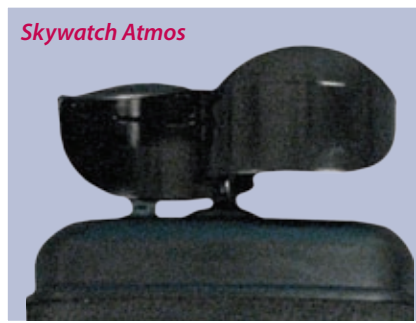
SPEEDTECH SKYMASTER

Slightly larger the Skymate, the Skymaster SM-28 has a barometer and wet bulb. It also measures humidity, dew point, and heat stress index.

It's handy and rugged. The information is easy to read, except for the tiny characters that indicate what function is being displayed; these hide in the screen frame's shadow.

The barometer and temperature screens also show bar graphs of past trends, but these are small and hard

Speedtech Skymaster



Skywatch Atmos



Kestrel 1000

Testers found the cup-style anemometer of the Skywatch Atmos, Eole, and Meteos easier to use than the propeller-style found on other test products, such as the Kestrels. The cups do not have to be pointed directly into the wind to take wind measurements.



The Kestrel 4000 comes with a docking station, enabling users to log their data on a PC. We did not review this feature as the 4000 was the only test unit that offers it.

to decipher. Once familiar with the sequence, though, we found this a useful tool.

The Skymaster has a severe-weather alarm, which is disabled when the device is in altitude mode.

Bottom Line: The Skymaster provides useful information in a tough package, but the display is a potential drawback. Still, at \$171, we'd recommend it as a quality product.

KESTREL 3500

In size and appearance, the Kestrel 3500 is indistinguishable from its simple sibling, the 1000. But it has a bevy of sailor-friendly functions accessed by two two-way buttons. (It has a separate on/off button.) As you scroll from one to the next, a screen describing the next function flashes.

As with most of these small devices, holding it in your hand affects the temp reading (and those calculated from it), but you can keep your hand far enough away from the sensor to limit the effect.

The 3500 has a wet-bulb sensor, so in addition to wind, temperature, and wind chill, it gives wet bulb temperature, relative humidity, heat stress index, and dew point. The barometer function comes with altitude, and a clock is included. The device has no recording function. We found the 3500 for \$250.

Bottom Line: We like and recommend this instrument because of its handiness, ease of scrolling through functions, and clarity of the display.



Kestrel 3500

connected to a PC, so you can back up the National Weather Service with logged data. We did not review the PC logging function as no other test device had this feature (and we only had a Mac available). We did find the basic use of the 4000 quite straightforward for a device with so many features.

It has a dedicated on/off switch. And even though the LCD display was slightly hard to read under some lighting conditions (though the backlight—another dedicated button—takes good care of that), the sequence of screens is logical and can be accessed in two directions.

The 4000 has a tripod mount in the docking station. You can set it up as a weather station and feed data to the computer. However, the prop-style anemometer is unidirectional, so it limits the value of wind readings.

We particularly liked the graphic records for barometer, temperature, etc. We'll leave it to the PC lovers to try the advanced features.

Bottom Line: For the uses we put it to, the 4000 was easy to use and not hampered by complicated extras. It gets the nod as *PS's* Best Choice for those undeterred by its \$329 price tag. The optional PC interface adds value for the serious weather tracker.

CONCLUSION

Having a personal weather station adds a little extra zest to the daily routine—it's something else against which to match our wits when figuring out what the sky is trying to tell us. Finding the one that works best

KESTREL 4000
Even though it appears similar to the lower-order Kestrels, the 4000 is the Big Daddy. It comes with a docking station that can be con-

for mariners is a bit of a trick.

We would happily pay a dollar or two more for a few added buttons to make some of these devices easier to use. A problem with gadgets in general is that it takes time to get used to them. Fiddling with them at the store display doesn't give the full picture, as we found out by living with a collection of them for a few weeks. You really need a firm idea of what you're looking for in terms of functions, hand (as cordage manufacturers would say), durability, and price.

One thing to keep in mind is that all these devices have to be outdoors to provide relevant information (except for barometric pressure).

None is designed to completely fulfill the sailor's weather-observation needs. Still, given the variety of instruments available, we ought to be able to find something to meet our wants and our means.

Based on testers' assessments, we'd select the Kestrel 4000 as the Best Choice for a sailor who's not concerned with price and wants a reliable product that offers valuable info.

We would recommend the Kestrel 3500 as it provides much of the information the sailor needs in an easy-to-read format, and the Skymaster for those with sharper eyes.

The *PS* Budget Buy is the Skywatch Xplorer2, which fits easily into a pocket and can be used to measure water temperature. The Geos 11 is technically superb, but it's not a mariner's tool. ▲



Kestrel 4000

CONTACTS

NEILSEN-KELLERMAN
(Kestrel products)
610/447-1555, nkhome.com

SPEEDTECH INSTRUMENTS
(Speedtech products)
703/430-8055, speedtech.com

JDC ELECTRONIC USA
(Skywatch products)
608/498-4021, jdcusa.com

12-volt Fridge/ Freezers



All of the units did a good job of holding cold temps. After 12 hours, the Norcold MRFT 60 was the coldest: -2 F.

Keeping it cool: Engel MT-35 and Norcold MRFT 60 lead the way.

There are three solid reasons why compressor-driven, portable refrigerators and freezers have displaced and overwhelmed all other competitors in every arena where they are used: They are quiet, efficient, and effective. They've also proven to be long-lasting and low-maintenance. The major downside is the high cost. However, if you need the capabilities of one of these units, there essentially is no alternative. Your best bet is to pick a unit that fits your needs and budget. In the April 2007 issue, we covered thermoelectric coolers. This time around, *PS* takes a look at portable, compressor-driven units that can serve as either a refrigerator or a freezer.

WHAT WE TESTED

We found four units with at least a 34-quart capacity. From Engel, we received the MT-35F, and from Norcold, the MRFT 40 and MRFT 60. Japanese manufacturer Sawafuji Electric Co. builds all three. Waeco's CF-40 Cool-

matic rounds out the field.

All of these plug into cigarette lighter outlets, a convenient but trouble-prone connection to have on a boat. Replacing the fridge plug with a marine-grade plug and socket is an option, but we recommend hard-wiring the fridge to the boat's 12-volt system. In any case, it is important that the socket's wire size and the socket or connection are rated to carry the current these devices require. They should be sized so that there is no more than a 3 percent voltage drop in the circuit.

Both the Engel MT-35F and the Norcold MRFT 40 lighter plugs have thermal fuses designed to blow at temperatures higher than 160 degrees F or if there is an electrical short. The Waeco and Norcold MRFT 60 have common, fused lighter plugs. Regardless of the plug fuses, we recommend making sure the lighter sockets is also fused or protected with a properly sized circuit breaker.

HOW WE TESTED

Tests were conducted simultaneously on all four units indoors, where we regulated the ambient temperature to 76 degrees F using air-conditioning. During initial testing, each unit was set to its coldest temperature level. We wanted to see how fast they'd cool and how cold they would get. It was important to know if these units were really capable of achieving and maintaining freezing temperatures.

For power, we used our robust Astron VS-70M power supply regulated to 12.8 volts DC and the manufacturer-supplied DC cable for each unit. Testers monitored the output voltage using a Sperry DM-4100A digital meter. (We did not test the units using AC power.) DC-amp-draw measurements were taken with a Fluke 336 clamp-on ammeter. We took several measurements over the following three hours as the boxes cooled. Noise levels were measured in decibels using a Radio Shack sound level meter held 6 inches from

PS VALUE GUIDE	12-VOLT PORTABLE FRIDGE / FREEZERS			
Maker	\$ ENGEL	NORCOLD	★ NORCOLD	WAECO
Model	MT-35F	MRFT 40	MRFT 60	CF-40
Price	\$649	\$799	\$999	\$730
Price source	eco-fridge.com	pplmotorhomes.com	pplmotorhomes.com	westmarine.com
Stated capacity (quarts)	34	40	60	39
Cost per quart of capacity	\$19.08	\$19.97	\$16.65	\$18.72
Exterior dimensions (LxWxH inches)	25 x 14.25 x 16	25.5 x 14.25 x 20	31.5 x 20.5 x 17.5	23 x 14 x 17.5
Empty weight (pounds)	46	51	67	35
Warranty (years)	2	2	2	2
Waterproof	No	No	No	No
Compressor type	Swing	Swing	Swing	Reciprocating
TESTING				
Amp draw (amps)	2.0	2.0	3.1	2.9
Noise 6" from fan (decibels)	<50	<50	<50	<50
Ambient temperature	76 F	76 F	76 F	76 F
Box temperature at 1 hour	9 F	13 F	20 F	9 F
Box temperature at 2 hour; 1 gal. water inserted	2 F	0 F	-1 F	-2 F
Box temperature after 3 hours with water	30 F	26 F	12 F	26 F
Box temperature after 12-hour overnight run	7 F	8 F	-2 F	8 F
Box temperature 5 hours after power cutoff	47 F	45 F	43 F	47 F
Warmest regular temperature	46 F	48 F	46 F	-4 F
★ Best Choice \$ Budget Buy			Note: All have top-mounted lids.	

the compressor end.

Temperature measurements were taken using a digital Fluke 116 multimeter with a thermocouple temperature attachment. The sensor, a long, thin wire with the temperature probe at the end, was placed into the box as near as possible to the center. (We only opened the lid enough to get the wire inside, usually no more than a 1/16 of an inch.) Once we had the reading, we opened the lid/door for a second and read the Taylor 5924 analog refrigerator/freezer thermometer we had placed inside each unit as backup. As long as the readings were comparable, we recorded the digital reading. All were. Past experience testing other types of coolers, refrigerators, and freezers led us to take temperature readings at one hour and again at two hours. After each two-hour reading, we opened the lid and placed a one-gallon plastic jug filled with 100-degree water into the

box. Three hours later, we took another temperature reading to see how well the boxes had done cooling with the water jug inside. Once each one of these temperature readings was completed and recorded, we let the coolers run unattended for 12 hours. We measured the temperatures again, then shut off the electrical power. Five hours later, we recorded another reading to see how well the boxes were insulated. The next day, after letting each unit return to room temperature, we cranked them up again—but this time, testers set them to the warmest temperature level. After they ran overnight, we checked and recorded the temperature each box was maintaining.

We wanted to see how well each cooler held food and drinks, so we packed each with the following:

- (2) six-packs of canned soda
- (1) six-pack of bottled beer
- (1) ½ gallon of lemonade

AMENITIES

- (1) ½ gallon of ice tea
- (1) ½ pound sliced turkey breast
- (1) 1½ pound boneless ham
- (2) ½ pound blocks of cheese

In the final analysis, we picked winners based on performance, construction quality, warranty, power usage, price, and load capabilities.

ENGEL MT-35F

Engel is the worldwide brand name and distributor of a full line of portable fridge/freezers that range from 14- to 84-quart capacity. Engel refrigeration products, which are built by the Sawafuji Electric Co. in Japan, have been known for their quality since production started in 1962.

Our test model, the MT-35F, has a 34-quart capacity and its exterior is constructed of powder-coated and galvanized steel.

The Engel is designed to sit flat and open from the top. Its locking lid is removable for better access to the interior. Carry handles bolt onto the case sides, but we did not install them. The interior of the Engel is constructed of bright white, high-impact plastic for easy cleaning. A metal basket fits snugly inside and provides a means to hold or remove contents.

In our testing, we found the box temperature could be set between approximately 0 and 50 degrees F, making the unit useful as either a refrigerator or freezer.

The Engel held our full list of food and drink as well as three 1-pound packages of burger meat.

Bottom Line: A top performer with an efficient compressor and low price. We rated it the *PS* Budget Buy.

NORCOLD MRFT 40

The 40-quart Norcold is nearly identical to the Engel MT-35F. Both share a 25½-inch x 14¼-inch footprint, but the Norcold is about 4 inches taller and uses the extra height to achieve increased capacity. Both are built in the Sawafuji factory, use the same compressor, and are constructed from powder-coated and galvanized steel outside, with high-impact plastic inside. The lid, lid lock, handles,



Engel MT-35F



Norcold MRFT 40



Norcold MRFT 60



Waeco Coolmatic CF-40

The 60-quart Norcold ingested our groceries and still had a full storage basket to spare. The 34-quart Engel is much smaller, but still managed to comfortably hold the items, as did the 40-quart Waeco and Norcold.

and interior basket are the same, too, but the Norcold basket is a bit taller.

The Norcold performed well in testing and can be set to operate from 0 to 50 degrees.

We had no problem loading all of our groceries into the 40-quart Norcold. It had so much extra room, we were able to load 12 one-pound packs of burger meat, too.

Bottom Line: A top performer.

NORCOLD MRFT 60

At 67 pounds, the bulky Norcold shouldn't be considered easily portable. Moving this big unit is a two-person job. It is another product of the Sawafuji Electric Co. and shares all the characteristics and features of the Engel and Norcold 40-quart. Everything is upsized here, with a larger compressor and interior.

The MRFT 60's top-mounted lid swings opens to the side and uses a chain stop instead of the rubber bumpers found on the smaller boxes. Two locks hold the lid closed tight.

This unit performed exceptionally well, taking a little longer to initially cool the bigger space, but it chewed up the hot water fast and remained colder than any other unit.

Divided into two equal-sized sections by a pair of metal baskets, the cavernous 60-quart Norcold swallowed up our provisions using only one basket. The other basket was empty and waiting for more stuff.

Bottom Line: This brute will hold a ton of provisions, and it performed superbly.

WAECO COOLMATIC CF-40

Waeco is a worldwide manufacturer and distributor of a wide variety of refrigeration systems. The Coolmatic unit we tested is constructed using a couple of different types of durable plastic. Even though its mechanical components are metal, its plastic exterior gives it excellent protection against corrosion.

The Coolmatic sits flat and opens from the top. The lid locks with two plastic latches and can be removed. It did not seem to shut as tightly as the other units we tested, in our opinion. Carry handles bolt onto the case sides, but as with the other units, we did not install them. A light is fitted to the interior; it switches on when the lid is open.

Though the Coolmatic generally performed as well as the others, it uses a less-efficient compressor, and in our test used significantly more power than the comparably sized Engel MT-35 and Norcold MRFT 40. Also, the temperature range setting did not seem to perform as advertised. When we set it to maintain a warm temperature, it shot right down to below zero.

The interior of the Coolmatic is divided into two sections, a main section with a metal basket, and a smaller, warmer section. We were

able to load everything on our grocery list into the main section of the freezer, though it was a tight fit and filled the basket to capacity. We managed to pack four one-pound packages of burger meat into the small section that remained.

Bottom Line: In our test, the Waeco's Danfoss compressor was not as power-efficient as the best units tested. But we like the unit's completely plastic exterior and its price.

CONCLUSIONS

The compressor system used in the Engel and Norcold fridge/freezers proved to be far more efficient than the Danfoss reciprocating compressor used in the Waeco. In our tests, the Waeco's amp draw was nearly 50 percent higher than a comparably sized Norcold unit. When coupled with the top-shelf construction and materials of the Engel and Norcold units, we'd opt for one of these every time.

When shopping for a portable fridge/freezer, first find the right size, then buy whichever you can find at a cheaper price, Engel or Norcold. You may find only an Engel available in the size you seek as they market several more sizes than Norcold. ▲

CONTACTS

ENGEL, 561/743-7419, i-m-d.com

NORCOLD, 800/543-1219,

norcold.com

WAECO USA INC., 860/664-4911,

waecousa.com



In 2003, testers coated this boat's hull with three hull restorers: Poli Glow (bow), Vertglas (amidships), and New Glass 2 (aft and stern). Poli Glow's sheen (above) and water-beading action (inset right) are still visible on the boat's bow.

Shining Star: Poli Glow Hull Restorer

After three years baking in the Florida sun, it is still working.

Some *Practical Sailor* readers take meticulous care of their boats, faithfully cleaning and waxing their hulls to keep them in boat-show condition. But for most of us, life gets in the way, and the hull may be neglected for a season—or three. In fact, the gelcoat may be so far gone that even a good wax (we recommend Collinite 885, see Nov. 15, 2004 issue) might have a tough time bringing it back.

Enter the hull restorer. These products contain resins of higher molecular weight, which provide a harder and more durable film than what can be achieved with wax. Hull

restorers contain water-based emulsions of acrylic or acrylic/urethane resins. The resins are tiny droplets suspended in water. When applied, the water evaporates and the droplets flow together to form clear films. These emulsions dry rapidly and require multiple coats.

In late 2003, we applied three hull restorers to our Neptune 212 (see above) test boat. We divided the hull into three sections, and each restorer was applied to the same section on both sides of the hull. Poli Glow was applied to the bow. Vertglas was used on the hull sides, amidships. And we coated the aft

hull sides with New Glass 2.

We realize that different areas of the boat may have endured more of a beating from the sun than others. For instance, the flared sections of the bow are somewhat more protected from the sun than the flat sections of the hull sides. But in the last three years, every inch of the hull has endured its fair share of sun and weather, so we feel the test results are useful.

WHAT WE FOUND

We never expected any of the products to last for three years. They are supposed to be re-applied after one or two seasons. But we were pleasantly surprised when we inspected the boat this fall, discovering that one section—the bow—was still “shiny.” The Poli Glow’s acrylic sheen is still clinging to the gelcoat. It looks good.

The other sections, those coated with Vertglas and New Glass 2, need some help. The Vertglas sections are spotty. The clear coating has come off on some parts, and the parts where it remains have no

PS VALUE GUIDE HULL RESTORERS			
PRODUCT	★ POLI GLOW	VERTGLAS	NEW GLASS 2
PRICE	\$60	\$67	\$53
PRICE SOURCE	poliglowproducts.com	lovetmarine.com	newglass2.com
CONTENTS	32 oz. Poli Glow, 7" applicator, 32 oz. Poli Prep, scrubby pad, gloves	16 oz. oxidation remover, 8 oz. boat wash, 16 oz. color restorer/sealer, 8 oz. sealer remover, 4" applicator, manual	32 oz. New Glass 2, 5" applicator, 32 oz. PreTreat cleaner, scrub pad, vinyl gloves
RATING	Excellent	Good	Fair
★ Best Choice			

visible shine. It appears that most of the New Glass 2 is gone as the stern sections are dull.

Vertglas and Poli Glow hull restorers have not changed since our 2003 test. They use the same formulas and their kits come with the same applicators. However, there have been big changes over at New Glass 2, according to new owner Thom Goff. The acrylic solids—the stuff that makes the hull shiny—have been upped by 10 percent; the applicator and the labeling and directions have been improved; and the company now offers a cleanser (Pre-Treat) to prep the area that will be restored. Pre-Treat can also remove previous acrylic coatings. Vertglas and Poli Glow also provide cleaner/removers.

CONCLUSIONS

Manufacturers of all three hull restorers make it clear that surface preparation is essential to their product's success. This means that if you miss a streak of dirt or grease,

that blemish will become trapped under the hull restorer. Fortunately, our tester did an excellent job cleaning the hull before application, so there is no spotting on the test boat.

Recommending Poli Glow is a no-brainer. It's still hanging around after baking in the Florida sun for three years. And as we reported in 2003, it comes with a wide variety of applicators, clear directions, and an effective cleanser. But the apparent improvements over at New Glass 2 call for another test.

We'll take them all off and re-apply new versions of all three to the same hull sections. ▲

CONTACTS

POLI GLOW, 800/922-5013,
poliglowproducts.com

VERTGLAS (Lovett Marine),
800/673-5976, lovettmarine.com

NEW GLASS 2, 800/785-7675,
newglass2.com

Meet Jelly, the New PS Test Boat



We recently added a new member to our test boat fleet, Jelly, a 1974 Catalina 22 in need of much TLC. Among her ailments are a cracked centerboard box, questionable rigging, and spots where only a semblance of gelcoat remains. Our first project was dropping the boat's swing keel using a sled (above) to access the keel pivot pin and keel hanger castings (inset), which were precariously attached. Each casting is typically held in place by two bolts. One casting was missing a bolt and another had been sheared off. The bolts on the other casting were sheared off when we tried to remove them during our triage. Thankfully, the keel was supported and didn't just fall off. Stay tuned for more on this and other Jelly projects.

Practical Sailor

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Practical Sailor

First Aid for Lead Lesions

Mars Metal offers fix-it tips for a common keel problem.

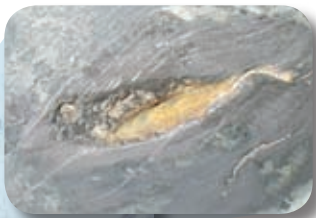
I have a 1997 Alerion Express 28 that has a lead keel, and in the course of fairing it this winter, I discovered a defect (see pictures below). It's like a rusty lesion, about three-eighths of an inch deep. I keep attacking it with a wire brush in an electric drill, but the "rust" seems to just go deeper and deeper. What is this, and what should I do about it?



PS ADVISOR

Joe Guidos
Variable, Alerion Express 28
Milford, Conn.

Keel voids of this size are quite common, and it's one reason why you don't see bare lead at boat shows or in the dealer's lot. Casting imperfections and partial, localized collapse of the sand mold cause these voids and much worse.



When voids form around the support for the keel bolts, bad things happen.

Narrow, high-aspect keels tolerate this far less, and it's one of the reasons carbon or high-modulus steel fins and ballast bulbs now rule in that realm.

We forwarded this reader's question on to the folks at Alerion, who then passed it on to Mars Metal, a Canadian-based metal manufacturer and one of the most prominent manufacturers of lead keels. Here's what they suggested.

"Advise the customer to excavate as far as he can into the keel, ideally getting under the 'scar tissue.' Thoroughly clean the area with solvent to remove any dusty residue. Mix a small amount of Interprotect 2000e epoxy barrier coat and wire brush it as deeply into the excavated area as possible and allow to set up. Fill the void with a two-part epoxy fairing compound and al-

.....
Keel voids are a common problem with lead keels. To repair one requires a good bit of elbow grease.



ON THE HORIZON
SURVIVAL SUITS
USED BOAT: BALBOA 26
FLEXIBLE WATER TANKS
SIRIUS vs. XM WEATHER
REMOTE VHF MICS

low it to cure. Sand the area smooth and fair with the keel. Then fair the body (might get away with one application...maybe more). Spot-prime the repaired area with five or six coats of Interprotect 2000 to get good barrier coat coverage, and then finish fairing the keel. It's very important that multiple coats of the barrier coat be applied to the affected area and the entire repaired keel surface. The more paint, the better the long-term protection. Five, six, or even seven good, thick, roller-applied coats of the barrier paint are great." Finish with a compatible antifouling paint.

STINKY BILGE CONTINUED

Further investigation into ways to rid bilges of residual diesel fuel fumes ("PS Advisor," April 2007) yielded yet another option. This option is faster, and doesn't require cleansers or chemicals: Use a hot-water pressure washer. The hot water emulsifies any fuel residue and the elevated temperature raises diesel's vapor pressure. Caution should be used when doing this, if there are enough fumes, they could reach an ignitable state, however, it's difficult for this to occur unless there is free-standing fuel pooled in the bilge. (Diesel fuel doesn't produce enough fumes to be flammable until about 140 degrees F, depending on the type of fuel.) The high volume of water vapor that is in the air during the washing process makes any ignition unlikely. The boat should be force-ventilated during the process. ▲