GOOD OLD BOAT

THE SAILING MAGAZINE FOR THE *REST* OF US!

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GOOD OLD BOAT

THE SAILING MAGAZINE FOR THE *REST* OF US!

CONTENTS

MARCH/APRIL 2010

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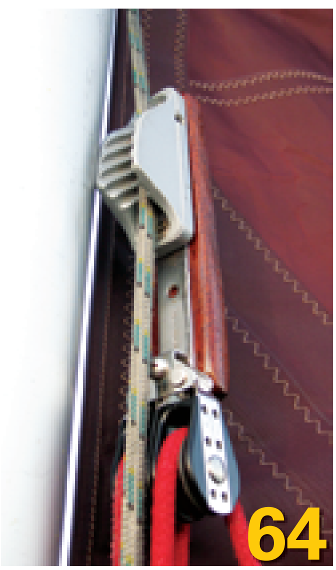
CONTENTS



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About the cover . . .

Professional photographer and good old boater, Paul Rezendes took this shot in Westport Harbor, Westport, Massachusetts. He calls it "Sailboats in evening light." See more of Paul's work at <www.paulrezendes.com>.

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See you at the boat show!

JACK PAYNE

Good Old Boat *is heading west*

by Karen Larson

Spring calls for a new tradition. Next month, your editors and members of the loyal crew will head toward California and the Strictly Sail show in Oakland with a truckload of magazines. Although we've visited a number of times, this will be our first time exhibiting at this show.

The reason for waiting so long is logistics. With our very small staff, Jerry and I haven't been able to take three weeks away from the office at the time that the Oakland show is held; our publishing schedule had us busy creating the next issue for you. But during the past year, the two of us have been working ourselves out of our jobs, at least the daily grind parts, so we could attend more shows, sail on more lakes, and smell more roses while we still have our good health.

If we did it right, we kept all the fun parts of our jobs and gave away the more humdrum parts. This summer, we'll test our ability to disappear without being missed by cruising on Lake Superior (for an article about our favorite cruising grounds, turn to page 24) for 10 to 12 weeks. While out there, we'll be out of touch with reality in more ways than one. There are no cell towers, WiFi connections, or televisions along most of Lake Superior's coastline. We call it wilderness cruising for good reason. We'll send occasional updates on a blog anytime we discover civilization, but we'll be out of touch for most day-to-day decisions. That won't be a problem. A very capable crew is prepared to carry on in our stead.

But even before that, we'll drive the good old truck to Oakland for the show (scheduled April 15 to 18), enjoy meeting readers on the Left Coast, and appreciate the balmy spring weather with gusto.

We've learned over the last four years as exhibitors in the Annapolis show that boat shows are great fun. Some of our readers volunteer to help staff the booth, so we get to know them a little bit as we work side by side giving away free sample copies of *Good Old Boat* to the passing throng. If you're an extrovert, if you'd like to spend a couple of hours in our booth, and if you can see the attraction in getting into the show for free, send an email to Karla Sandness: karla@goodoldboat.com. The two-hour volunteer time slots fill up fast. If you don't have time to come volunteer, we hope you'll stop by anyway to renew your subscription or just say hello.

The above photo, taken at our first Annapolis show back in 2006, captures the enthusiasm and energy that radiates from our booth most of the time. The crew on that occasion included Michael Facius, Karla Sandness, Brenda Payne (who was volunteering with her husband, Jack), Patty Facius, Jerry Powlas, and Karen Larson. Many thanks to Brenda for bringing this photo and many good memories to our booth when she stopped by last fall.

We look forward to seeing you in Oakland!

No heroics, GOB caps, solar

Oops, slipped!

I just got the new edition — looks great. Several very interesting boats to learn about. I liked your "No heroics" piece. Years ago, when we had our little Ranger 26, *Seaborne*, my wife and I were sailing over to Angel Island in San Francisco Bay and we arrived about dusk. Martha leapt for the dock over too much open water and fell between the boat and the dock. Fortunately, it ended comically with her swimming furiously trying to pull the boat into place! Also fortunately, we had some dry clothes for her to put on before we spent the night at a buoy in Ayala Cove. Ever since then, our mantra has been no jumping; just step down onto the dock. So your piece really rang a bell.

– **Jamie Harris,** Lafayette, Calif.

Hear, hear!

Excellent editorial ("No heroics," January 2010). I think that applies to more than just age (I'm 63 and feel as you do). We've always been somewhat more dependent on ourselves on the water than the landlubbers are, so your wise advice applies to a broader population than just us oldsters.

– **Len Lipton,** Norwalk, Conn.

Sailing an old boat while getting older (ugh)

I just renewed for another year since, of all the sailing magazines I read, *Good Old Boat* is the only one that I keep.

Karen's editorial on her age-related adjustments was excellent for people who do not want to give up sailing. Other than what Karen has done, we (my wife, Joan, and I) have taken it a step further. We found that our relatively new mainsail was somewhat difficult to lower and furl and that our genoa was sometimes difficult to sheet in. We contacted several sailmakers regarding a roller-furling main that is on a furler behind the mast. We were advised by very knowledgeable folks that we could either have a boom that furls or an in-mast furler, but that we would lose 15 percent efficiency in our mainsail. I told the sailmakers that I would be *gaining* 85 percent efficiency because I was not using the main much.

While reading your great magazine, I saw ads by Somerset Sails and CDI furlers. I called Martin Padilla, who owns Somerset Sails, and he advised that the way I wanted the sail to furl in back of the mast was possible and that he could make one. He stated that I would lose about 15 percent efficiency and I told him of my 85 percent gain in usage. He then told me to call Tom Livingston, who is an engineer and owner of CDI, to explain what I wanted. I called Tom at CDI, and he explained that he has the same system on his Irwin 37 and that it works fine. He advised that his furling system should work on my boat, and I should contact Somerset Sails to order the sail and furler. Tom stated that he would provide any advice and expertise that I might need.

Martin recommended a white furling cover, which I should have ordered, but I was worried that the fibers would break down too fast in the Florida sun. I had been successful with blue Sunbrella as a furler cover in the past, so I asked him to install the blue. I'll probably return the sail in the summer to have a white Sunbrella cover put on. I also asked Martin to make my 135 percent genoa ready for use. The two sails have been on the boat for three years and are used all the time. The main is easy to raise and lower; reefing may take 30 seconds to get it to where it is sailing comfortably. The new genoa is easily controlled and I feel that I have extended my ability to sail my Pearson 39 for many more years. It is a very good feeling to get on my boat, power out to Tampa Bay, and put up both sails with confidence. Many thanks to Martin Padilla and Tom Livingston for extending my sailing.

– **Roger Maxwell,** Apollo Beach, Fla.

Oh dear, we've created a monster!

I just got your latest magazine (January 2010). Chris Roberts has certainly raised the bar on good old boat restoration with his comfortable, stylish, and elegant treatment of *Sinfonietta*. Let the games begin.

– **Joe van Benten,** Chestnut Hill, Mass.

Good Old Boat cap in a bucket

Many other sailing magazines publish photos of their magazine covers in exotic places. In our ongoing effort to stand apart from the herd, *Good Old Boat* is proud to bring you, instead, a photo of one of our caps in an exotic place. Mark Haveman sent this shot from Cane Garden Bay Beach, Tortola, British Virgin Islands. In a reversal of that T-shirt that states: "Grandma went to the BVI and all I got was this lousy T-shirt," allow us a moment of self-pity when we realize that Mark went to the BVI and all he took along was a Good Old Boat cap.

– **Editors**

So sorry, Mr. Payne

You've probably picked up on this typo already, but the designer of the Columbia 9.6 referred to in the comparison article on page 56 of the November 2009 issue was Alan Payne.

An Australian naval architect, Alan Payne (1921-1995) was known for his America's Cup designs, ocean racers of the sixties, and seakindly cruising boats. His Tasman Seabird, Koonya, and other designs are still revered for their combination of seaworthiness, speed, and comfort.

– **Petrea Heathwood,** Beaudesert, Queensland, Australia

You are so very right. That was our error and it got past several of us in the proofing process. – **Editors**

lights, and lazy-jacks

Solar lights

I was just reading through my latest issue and decided to share something that I found to be helpful. I own a 1986 Catalina 25 and like to spend as many nights as possible "on the hook" in the Chesapeake Bay.

Running the anchor light all night long almost always killed my single battery. Without having any means of charging other than to plug in at the slip, I found the $4 solar lights at a local Wal-Mart to be a good alternative. I placed two on the bow, two midships, and four aft. The first season, they remained lit the entire night. We'll see how long their rechargeable AA batteries last.

While this probably doesn't meet the lighting requirements, you would be hard pressed to miss me with all those solar lights. It's perhaps not the most elegant solution, but it's inexpensive and practical.

– **Steve Bufe,** Middle River, Md.

Homing in on Griffolyn

In your November 2009 article, "Preparing to Cruise" by Dan Ahart, there is a material called Griffolyn, fabricated by Reef Industries. Dan mentions that this material is excellent for sunshades. I went to the Griffolyn website and was able to get to their product lists. I could not determine which of the hundreds of Griffolyn products was the one Dan referenced. Once I know which product he recommends, I can take it from there.

I am interested in following up on this to determine if Griffolyn would be a suitable material to use on my good old boat *Aweigh*, a 1972 Pearson 39.

– **Frank Giambattista,** Ft. Lauderdale, Fla.

Dan Ahart has the answer

Try this website for Griffolyn: <www.reefindustries.com/division.php?div=1>.

You may want to give them a call and discuss your plans with them. They can cut any size and shape you want and put in grommets where you want them or you can buy a roll of the material and cut and sew your own tarps. Let me know if I can help in any other way. Best regards.

– **Dan Ahart,** Valley Mills, Texas

Lazy-jacks

Greetings, I am one issue behind. I have been too busy buying a good old boat to keep up. My wife and I are now the happy owners of a Bristol 32, which, as fine as it is, does not have lazy-jacks, a situation I mean to change. As I was trying to catch up on my reading this week, I was therefore drawn to the article in the September 2009 issue, "Lazy-Jacks 101." It is a helpful review, but I do have a question for Don Launer. What classifies as a very large boat? He states, "The three-leg lazy-jack system is usually seen only on very large boats." When I turn the page, I see a Tartan 33 with what looks like a four-leg system. My question is, how do I judge what is appropriate for our boat before I get to know her well?

– **Dean Ungard, Huntsville,** Ontario, Canada

Don Launer replies

On my 32-foot schooner I use lazy-jacks on the jib, foresail, and mainsail. Of course my mainsail is smaller than it would be on a sloop of similar length. If you find that the simple lazy-jack system does not contain the sail well enough, it's not too hard to convert it into the more complicated system.

On the Bristol 32, I would use the two-leg system. In the article, the illustrations showing the mainsail flaked down evenly represent a pie-in-the-sky wish. Actually, the sail crumples down and is not contained as prettily as that. Nevertheless, the lazy-jacks keep it from falling down on people's heads or, worse yet, getting underfoot.

My sail-furling is also enhanced by a shock cord that runs the length of the boom on one side, through a few stainless-steel eye straps. On the other side of the boom are stainless-steel hooks, spaced halfway between the eye straps. As soon as the sail has been contained by the lazy-jacks, I flip the shock cord over the sail and hook it to the hooks on the other side of the boom. (***Note:*** *See an article on this concept in the November 2008 issue. –**Eds**.*) But each sailor has his own preferred method of furling.

– **Don Launer,** Forked River, N.J.

Fred Goguen sent this photo of his favorite wintertime aids to navigation. He made these bookends for his wife, Cheri, one Christmas. "Up here in Maine," he says, "when it's 10 below, nothing beats sitting back and reading your latest issue."

Jerry Powlas replies too

Our boat is 30 feet on deck and has a displacement of about 8,500 pounds. It is one of the many masthead sloops of her era. She has a small main and a large foretriangle. The boom is 11.5 feet long and the main hoist is 34 feet. With 429 square feet of working sail area, it would be an unnecessary complication to add lazy-jacks. We just drop the main and let it fall where it will.

Early each season we do a "harbor fold," in which we slowly lower the main and flake it on the boom with one of us at the mast and one at the boom end. Once it's nicely flaked, we mark the loops of the folds at each end with a red pen for port and a green pen for starboard. The red marks fade over the course of a season and the green will fade over the course of several, so we renew the marking at least once a year. (*See an article on this in the November 2006 issue.*)

Each time we lower the sail, if we can, we help the flake by putting all the loops on the proper side based on the color. After a few weeks, a new sail will become "trained." An old sail, once trained, will almost always fall with the loops on the proper side. Then, since the sail is so small, we just tidy up when we can. The complication of lazy-jacks would just get in the way.

The lesson for me is "first do no harm." Keep it simple. If you don't need it, don't put it on.

Larger rigs with longer booms eventually will need something, but lazy-jacks are just a trade of one set of problems for another. There will be an article coming soon on lazy-jacks and a homemade "stackpack."

– **Jerry Powlas,** Technical Editor

Under the weather down under

This osprey was a constant visitor to our masthead during the recent floods in Australia. We thought the warmth of the light might be drying out his little feet.

With normal seasonal rainfalls, we don't get floods, but when exacerbated by a major rain system — typically a trough diagonally across Australia, especially if it contains a number of mini-storm cells that feed already full rivers and creeks — it makes for rapid flooding. The result is a flood that may be as high as 20-plus meters (66 feet) in the headwaters reducing to half to 1 meter (18 inches

to 3 feet) at the mouth. The strong outflow can last a couple of weeks before normal tidal flow resumes. During the continuous flood outflow, the main threat to any vessel is the collection of water hyacinth around an anchor or mooring cable that, if allowed to accumulate, will drag a vessel under. To a vessel alongside, the same accumulation between her and the dock can overwhelm warps and springs and carry her away. As to the bar, it usually deepens during a flood but the strong continuous outflow against a swell denies the benefit of a calming influence of a rising tide.

I hope your weather is better than ours. A perfect sailing day is rare right now, particularly on the New South Wales coast, as a lot of the rivers and ports have bar crossings. We live in hope!

– **Patricia Lucas,** Point Clare, New South Wales, Australia

Thanks for the present

Thanks for the holiday present. I love your magazine. I am new to boating. I always wanted a boat and I took the plunge and bought a 1973 O'Day 22 . . . one of the best things I have done in my life. My wife gave me your magazine as a Christmas present last year and it is the only magazine I read cover-to-cover. Keep up the great work. Thanks.

– **Mike English,** Gloucester, Mass.

Wes Nance is the March Editor's Choice photo winner with this shot of his family on their first ever sail on *Day Dreamer*, a 1979 O'Day 25. Wes and his father-in-law, John Kunkel, resurrected the boat after it had been abandoned in a yard in Rochester, N.Y. Wes says, "If you look closely, I couldn't even get the main all the way up. We had a couple of jammed sheaves, but we weren't going to let that stop us." Send your sailboat photos to jstearns@goodoldboat.com and we'll post them on our website. If we publish yours here, we'll send you a Good Old Boat T-shirt or cap.

Send questions and comments to *Good Old Boat*, 7340 Niagara Ln N, Maple Grove, MN 55311-2655, or by email to jerry@goodoldboat.com.

LM 28

A small Danish motorsailer for all-weather cruising

by Milo Feinberg

Safina's pilothouse design allows her owner, Larry Rosen, to stretch the seasons on Maine's Penobscot Bay.

Larry Rosen dreamed of owning a boat that sailed well, was suitable for extended cruising, and that he could comfortably live aboard. He wanted to be able to invite friends to join him for a week or two of pleasant cruising. After some research, Larry bought an LM 28, sight unseen, from a seller in Minnesota, who had found the boat too large for the small lake he had moved to.

Every boat is designed around priorities and compromises, and the LM 28 meets several requirements often thought of as essential: comfort, seaworthiness, good sailing capabilities, excellent accommodations for its size, and the ability to motor comfortably and efficiently so you can get where you need to go on schedule.

It was these characteristics that first attracted Larry to the LM 28. When he first launched *Safina* on Chesapeake Bay (where he kept her until trucking her to Maine) he watched with some trepidation as she came off the trailer. To his relief, Larry found the boat "was just as the magazines had described it — a lovely sailing boat with brilliant design features."

An evolving business

The LM 28 was designed by Danish designer Bent Jull Anderson and built by LM Glasfiber in Kolding, Denmark. LM Glasfiber started as a small company manufacturing wooden furniture under the name Lunderskov Mobelfabrik (Lunderskov Furniture Factory.) In the early 1950s, LM shifted its focus to the use of fiberglass and subsequently changed its name to LM Glasfiber. In 1972, the company began manufacturing a line of small motorsailers ranging from 24 to 32 feet. The LM 28 was the last of five models that LM would build; its nine-year production run ended in 1991. Although the focus of the company had shifted to fiberglass, its woodworking legacy is evident in the LM 28; few production boats have as many clever and well-thought-out details in their joinery.

After 1991, LM Glasfiber shifted gears once again and, having left the boating industry, became the world's largest manufacturer of wind turbines.

Design

Pilothouse boats are not easy to design, especially under 30 feet where so many elements compete for attention. The LM 28 is surprisingly attractive, with a gentle sheer, raked bow, and counter transom. It was offered in two configurations: with a deep fin keel drawing 4 feet 6 inches or with twin bilge keels drawing 3 feet 8 inches. The rudder is located quite far aft and is mounted on a partial skeg.

Displacement is moderate; the displacement/LWL ratio is 265, which is actually a bit on the light side for a motorsailer. The sail area/displacement ratio of 13.3 indicates a sail plan that is small yet, in a breeze, capable of moving the boat without auxiliary power.

Construction

The LM 28's hull is solid hand-laid fiberglass, and is certainly a little overbuilt. In some places it is over an inch thick, a fact brought to Larry's attention when he was installing a depth sounder. The deck is fiberglass cored with end-grain balsa, which reduces weight and increases stiffness, making the deck less likely to flex when you walk on it. The balsa core is replaced with plywood where deck hardware is fitted and in high stress areas. The deck is bonded to the hull using bolts and chopped-strand mat, and bulkheads are bolted to tabs that are bonded directly to the hull.

The LM 28 has iron ballast encapsulated in the keel and covered inside the hull with a partial pan. In fact, the

The anchor well is easy to access and keeps the anchor stored out of the way when not in use.

The cleverly designed table makes the cockpit a comfortable place to eat and relax and folds away to open up the space when sailing.

builder made extensive use of fiberglass liners. Wood trim is well-fitted mahogany ply with a matte finish and interior glass surfaces are painted. Altogether, the LM 28 is a solid and rugged little boat.

The pilothouse

The first thing that strikes you about the LM 28 is the pilothouse. It is small, which minimizes its aesthetic and structural impact, and just large enough to house a chart table and a helm station. The front, sides, and even the aft bulkhead of the pilothouse consist almost entirely of glazing (although two 8-inch wide supports make the cabintop sturdy and are thoughtfully positioned to minimize visual obstruction). This makes the pilothouse a warm, sunny, and pleasant place to while away many miles, while also allowing a virtually unobstructed view of the water ahead through the pilothouse from the cockpit.

On the port side, the pilothouse has a chart table that opens up into a galley with a two-burner stove and a sink with hot and cold pressure water. Larry likes this arrangement because it allows him to cook and navigate while still being within easy reach of the helm, which is on the starboard side of the pilothouse (the refrigerator is under the helm seat). A sliding hatch on the pilothouse cabintop directly above the helm seat allows the helmsman to stand up with his head through the skylight for a better view when docking. It also enables the helmsman to easily see the rig and sails while steering from inside the pilothouse. A companionway-style hatch shuts off the pilothouse from the rest of the interior during inclement weather.

Cockpit and deck

The pilothouse is right in front of the cockpit. It provides shelter for the crew in the cockpit — no dodger necessary — and its expansive glass gives the helmsman excellent visibility forward and excellent protection from the weather.

A removable tiller is used for steering the boat from the cockpit. When the the tiller is in use, the pilothouse wheel can be disconnected from the rudder by disengaging a simple locking mechanism. This eliminates the friction and effort required to turn the wheel and makes for a lighter and more sensitive helm while sailing.

Instead of dropboards, the cockpit is sealed off from the pilothouse by this innovative door that pulls up from a pocket in the bulkhead where it is stowed out of the way, at left. Larry installed extra custom handholds to give him more security when going forward, at right. Note the sliding hatch over the helm seat and the cockpit awning folded away just behind the pilothouse.

The saloon is a comfortable place to unwind after a long day on the water, at left. *Safina*'s 28-hp Volvo Penta diesel engine is mounted beneath the cockpit sole. The spacious engine room and large hatch allow the engine to be easily inspected and maintained, at right.

A canvas awning can be folded out to enclose the entire cockpit, to substantially expand the living space when at anchor or to provide shelter in heavy weather. Larry had his awning built with roll-up windows and netting, so he can set the awning and keep the bugs out but still enjoy a breeze flowing through. With the awning and the pilothouse, the difference between "down below," and "on deck" is significantly blurred.

The cockpit has copious amounts of storage — in cockpit lockers and in the open space underneath the deck. A clever fold-up table allows comfortable al fresco dining and, coupled with the awning, makes the cockpit a wonderful place to spend time in pretty much any weather or port.

Larry installed several substantial handrails on the roof of the pilothouse to provide security for anyone moving around on deck in rough weather. The original handrail was so small and skimpy he felt he was literally hanging on by his fingertips.

Forward, an anchor well makes dealing with the ground tackle quick, easy, and convenient.

The rig

The aluminum mast is stepped on deck and has a single set of spreaders. The genoa sheets are trimmed aft by the cockpit, and the mainsheet is led to the top of the pilothouse. This system works well, especially in heavy weather, as all the sheets can be accessed from under the awning. The jib is fitted with roller furling, and the mainsail is contained by a Dutchman sail-handling system.

Larry inherited the boat's present reefing system from the previous owner, and it's a bit odd: two lines are spliced into one and then led aft to the cockpit. When the time comes for a new mainsail, Larry thinks he will probably set it up with regular old-fashioned lazy-jacks and two-line reefing.

LM 28

Designer: Bent Jull Anderson
LOA: 29 feet 4 inches
LOD: 28 feet 8 inches
LWL: 24 feet 7 inches
Beam: 9 feet 6 inches
Draft (fin keel): 4 feet 5 inches
Draft (bilge keels): 3 feet 8 inches
Displacement: 8,810 pounds
Ballast: 3,415 pounds
Sail area: 354 square feet
Disp./LWL ratio: 265
Sail area/disp. ratio: 13.3
Fuel: 31 gallons
Water: 31 gallons

As mentioned earlier, the rig on the LM 28 is small for the average cruising boat. This limits performance in light winds, but in those conditions the boat would most often be motoring. In heavy weather, the small rig makes the boat easy to handle, adding to the comfort of the crew.

Accommodations

Forward of the pilothouse, the layout is conventional and practical. Aft near the pilothouse, and perfectly positioned for quick access from the pilothouse and cockpit, are the head to port and a large hanging locker to starboard. The head is well thought out, with many small shelves for storing toiletry items and cleaning products, and has a sink that pulls out from behind the toilet on tracks. Details like the hanging locker, which is an ideal place to stow foul weather gear, make it easy to forget that the LM is only a 28-foot boat.

Farther forward, the saloon has full-length settees facing each other. The port settee can extend all the way out to the table to make a double berth without impeding access to the forward cabin.

All the way forward is a V-berth. The LM 28 can comfortably sleep four or five people but, like all 28 footers, it is best suited for just two.

The boat has an impressive amount of storage space. In addition to the lockers in and around the cockpit, it has a large lazarette. It also has storage under the pilothouse sole, under the galley, under the settees in the saloon, in attractive shelves built just under the deck in the saloon and above the V-berth, and in a locker forward between the V-berth and the anchor locker. A cruising boat has a tendency to pick up all sorts of small, unexpected items, and on the LM 28 there is plenty of space to store them. The storage capabilities make it well suited, despite its size, for someone living aboard.

A distinguishing feature of the LM 28 is the high quality of the joinerwork throughout the vessel. The cockpit table, chart table/galley, clever locking systems for doors and access panels, and cleverly designed lockers for holding dishes and glassware secure in even the worst conditions, remind us that the LM builders started out as furniture makers. One particularly clever solution is that for closing the companionway. Instead of the usual hinged doors or loose teak dropboards, a single companionway dropboard stows in a slot in the aft pilothouse bulkhead. It pulls up from under the sill when needed and is completely out of the way when not in use.

> **“A distinguishing feature of the LM 28 is the high quality of joinerwork throughout the vessel.”**

Under way

As a motorsailer, the LM 28 relies heavily on its engine. The diesel engine on *Safina* is a Volvo Penta 28-hp sail drive located under the cockpit. Larry likes the sail-drive setup because its horizontal propeller shaft improves efficiency and maneuverability for docking, especially when reversing. (One magazine review says the fin-keel version handles better than the bilge-keel version, which doesn't back up well.)

This engine drives the boat at a top speed of 6.5 knots and enables it to cruise between 5.5 and 6 knots at 2,000 to 2,200 rpm. At this speed, the LM 28 has a range under power of about 300 miles. This relatively small range reminds us that this boat is, though a motorsailer, still very much about sailing. This is evident in its relatively deep fin keel and separate rudder. While the LM 28 won't blow your socks off with blistering upwind performance, it easily tacks through 90 degrees, has a comfortable and light helm, and makes easy work of a chop. The small sail plan makes it easy to handle in heavier winds, and is a reminder that though it sails very well, the LM 28 is designed to sail and motor at the same time.

Conclusion

Larry is an anthropologist who has spent much of his professional life in the Arab world. In Arabic, *safina* means “light dancing on the surface of the water.” Having cruised in her all around Penobscot Bay and the coast of Maine, Larry says *Safina* has lived up to her name.

L. Francis Herreshoff believed that the term “motorsailer” carried too many negative connotations. He never viewed his Marco Polo design (a 55-foot motorsailer rigged as a three-masted schooner) as a motorsailer but saw it simply as a capable and seaworthy boat for any type of cruising. Cruising is not a sailing- or motoring-specific activity; it is the covering of many happy miles on the water. By the same token, the LM 28 is a good choice for someone looking for a rugged small boat on which to spend time on the water.

Today, a serviceable example of the LM 28 could probably be bought for around $50,000.

Milo Feinberg recently graduated from Westlawn Institute of Marine Technology's Elements of Technical Boat Design Program. He is a freshman at MIT and plans to major in mechanical engineering with a concentration in ocean engineering. Milo has spent many summers sailing in Castine, Maine, where his family sails an Edey & Duff Stone Horse. He had the good fortune to race with Olin Stephens.

The port side of the pilothouse is both nav station, at left, and galley, at right. When it's the cook's turn to use this space, the leaves of the chart table open to reveal a sink with hot and cold running water and a stove.

All about keels

PART ONE

How they shape up to perform their many roles

by Robert Perry

When people discuss yacht design you often hear the phrase, "Well, it's all a compromise." That sounds defeatist to me. But if there is one area where most yacht design is certainly a compromise, it is in the design of the keel. In this issue and the next, we'll take a look at the factors that go into designing a keel for the modern sailing yacht. We will consider the extreme ends of keel technology, but for the most part I'll address keel design that affects the typical good old boats built in the last 40 years. I'll touch on the technical issues, but I'll focus on the more pragmatic aspects of keel design.

The keel has several jobs to do. It must:

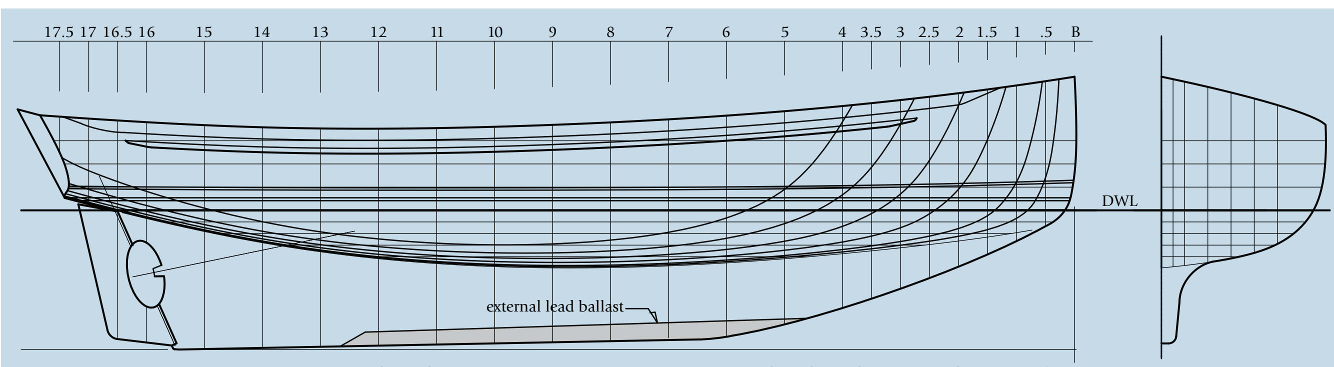
- Balance the boat's fore-and-aft trim by allowing correct ballast placement
- Provide lift to give the boat forward drive when on the wind
- Balance the forces of the sail plan and rig for easy control by the helm
- Provide a good, low home for the ballast, to ensure stability

Cruisers could add to this list the requirement that the keel needs to be of a shape to allow the boat to rest on the keel during haulouts. You can also view the keel as a protecting body that will guard the rudder, prop, and shaft from impact and help the boat deflect things like lines, logs, and rocks. I would also add that the typical good old boat keel must accommodate restrictions in draft depending upon the area were the boat is sailed.

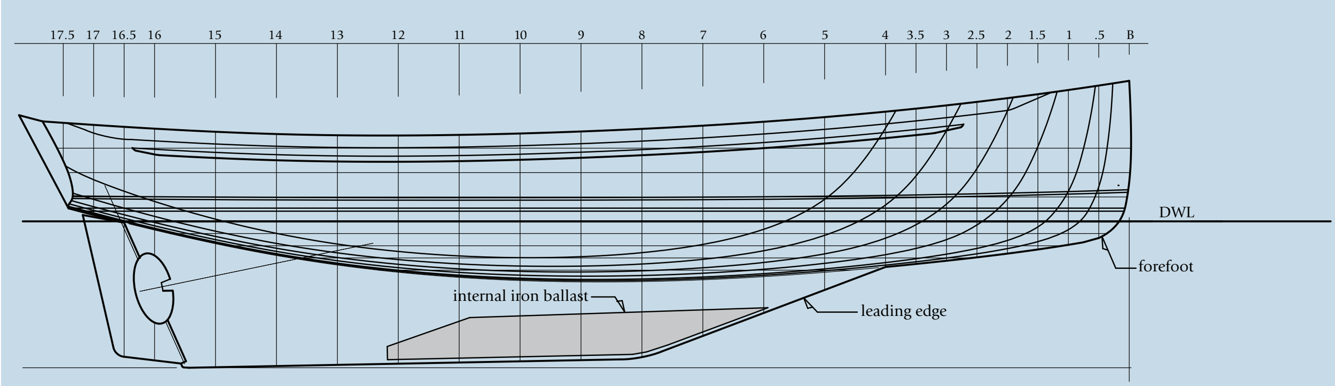
Defining the full keel

We are all in agreement on what a "full keel" is. For me, the full keel starts at the forefoot and terminates at the rudder gudgeon aft. We can get into arguments over what a "modified full keel" is. If the rudder is attached to the trailing edge of the keel, I think you're looking at some form of full keel, and just how "modified" it is will be a subjective call. For convenience, let's say that any keel with a leading edge pulled aft enough so you can see a distinct forefoot before the keel starts, and then terminates at the rudder gudgeon, is a "modified full keel" of some degree. I may use the terms "fin" and "keel" interchangeably.

In a sailboat, the keel has to provide the volume for the ballast. In some radical, high-performance, daggerboard boats today, that's all the keel does. The daggerboards take care of the lift job. Many older boats have the ballast inside the keel fin, and I call those boats "internally ballasted boats." If you attach the keel to the hull with bolts, I call those boats "externally ballasted boats." As we will see, there are advantages to both approaches.



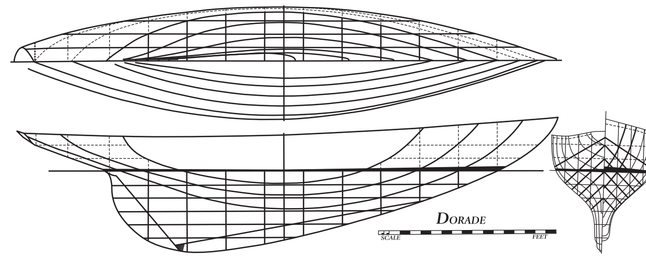
A typical 45-foot full-keel hull showing no distinct forefoot forward of the keel's leading edge.



The same 45-foot hull with a slightly modified full keel and a distinct forefoot forward of the keel's leading edge.

by Robert Perry

VOYAGER, PETER KARLSONS 1962 ALBERG 35



***Dorade*, above, carrying a refined classic full keel, won the 1931 Transatlantic Race to launch her designer, Olin Stephens, on a spectacular career. Because the Alberg 35's hull has a distinct forefoot, its keel can be described as a modified full keel, at left.**

Naming the parts

Let's start with some keel-design nomenclature. (***Note:** For graphical illustrations of these terms see Bob's article in the September 2009 issue of* Good Old Boat. ***–Eds.***) The depth of the keel from the bottom of the hull to the bottom of the keel is called "span." The horizontal fore-and-aft length of the keel at any point on the keel is called the "chord." To describe foil shapes, the chord is broken down into percentages from the leading edge. The athwartships width of the keel is called the "thickness." The "root" is the top of the keel where it meets the hull. The "tip" is the bottom of the keel. Leading and trailing edges are self-explanatory. When you view the keel in profile, I call the shape of the keel the "planform." If we're dealing with a fin keel, the fairing in of the leading and trailing edges to the hull are called the "fillets." In sectional view, the fairing in of the fin to the hull, usually a radius, is called the "tuck" and sometimes the "garboards." Most designers use a line connecting the quarter chords — say 25 percent aft of the leading edge — to measure sweep, but for the sake of this article, sweep will be the leading-edge angle, as measured from vertical.

Aspect ratio is a term I will use a lot. A keel with a long chord and a short span — typical of many modern shoal-draft models — would have a low aspect ratio. If the keel has a long span and a short chord, the keel would have a higher aspect ratio. The epitome of the low-aspect-ratio keel would probably be a full-keel boat like a Westsail 32, where there is almost no distinction between where the hull ends and the keel begins. The most dramatic examples of high-aspect ratio keels would be modern racing boats like Transpac 52s with very deep fins with short chord lengths.

Aspect ratio and performance

From my perspective, there is little argument that the most effective keels in terms of performance have the highest aspect ratios. But draft is important to the cruising sailor, so we don't always have the option of designing keels to an optimal aspect ratio. While the boat with the high-aspect-ratio fin may be a rocket to weather, if it can't get from the slip to the bay due to shallow water, the potential performance advantage of the deep keel is a moot point.

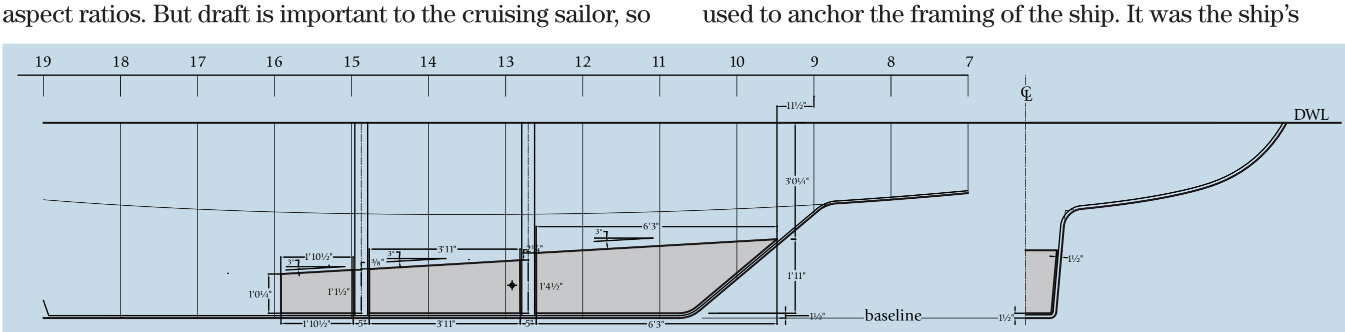
Let's use a 40-footer for example. A 40-footer drawing 6 feet would be considered a moderate-draft boat. I would consider anything less than 6-foot draft to be some degree of shoal draft; I'd call anything over a 6-foot draft to be some degree of deep draft. If the boat weighs 20,000 pounds, we're going to need about 34 percent of that displacement for ballast. With all the stuff cruisers put on their boats today, the old goal of 40 percent ballast-to-displacement ratio is only achievable in boats with displacement-to-length ratios above 280, unless you go very exotic on the build materials or eliminate the interior layout and copious tankage.

Our 40-footer needs about 6,800 pounds of ballast, and the choice of either lead or cast iron for the ballast will play a major role in the shaping of the keel. Lead weighs about 700 pounds per cubic foot. Cast iron weighs about 450 pounds per cubic foot. That works out to 9.7 cubic feet for lead ballast and about 15.1 cubic feet for iron ballast. The keel designed for internal iron will require far more volume to house the ballast than the keel designed for internal lead.

You can ask the builder to use lead instead of iron for a lower ballast vertical center of gravity (VCG). But if the keel was designed for lead, you cannot substitute iron unless you are dealing with a large and voluminous fin.

The ship's backbone

We'll start with what we call a full keel. For years, mariners sailed the oceans upwind and down in ships that had no salient fin. The keel was a long, straight, heavy timber used to anchor the framing of the ship. It was the ship's



The arrangement of the internal ballast in the low-aspect-ratio fin keel on the Stevens 53. The lead ballast is installed in three pieces.

"backbone." Ballast was internal. I still marvel that these vessels, usually square rigged, went to weather at all.

Over time, driven by the performance requirements of small workboats, the keel became more and more distinct from the hull and the "wineglass" section emerged as the dominant shape. The keel was dropped below the canoe-profile "fairbody" of the hull and faired into the hull sections with full garboards. Lots of examples of this shape can still be seen today. One we are all familiar with is the venerable Westsail 32. You could also consider one of my favorites, the Alberg 35, as a modified-full-keel example of this type. The long, full keel usually has a slight angle to the bottom of the keel in profile, with the forward end higher than the aftmost point of the keel. I call this the "drag angle." There is little doubt that the true full-keel boat will take grounding with the least amount of potential damage to the hull. The problem is that the lowest point of the keel, at the aft end, is almost always where the rudder gudgeon is placed, so that fitting is vulnerable. You can remedy this by putting a slight kink, say 10 degrees, in the bottom profile of the keel to raise the gudgeon fitting up above the lowest point of the keel, as L. Francis Herreshoff did when designing *Landfall*.

Effects of the leading edge

Unfortunately, the keels of most full-keel boats and many modified-full-keel boats do not have good foil shapes. Many have very blunt, even flat, leading edges. In plan view, these keels often have no taper at all until just before the rudder stock. This works. Star class boats and Snipes, along with other classes, use flat-plate keels with no foil whatsoever. They sail fine, but today we recognize that choosing the correct foil results in the best performance. Also consider that a full-keel boat carries a lot of its displacement in the keel. Most full-keel boats will have displacement-to-length (D/L) ratios well above 300 and many are over 400. Today, with materials being expensive, there is a lot of pressure to reduce displacement.

With the quest for speed, displacement and wetted surface began to shrink. The leading edge of the keel crept aft and the trailing edge of the keel with its attached rudder crept forward. These are the modified-full-keel designs. Sometimes the trailing edge stayed aft for better steering control and helm balance, while the leading edge moved aft. You can see this shape in my own Tashiba series. It works well. If you want to see extreme examples of the shrinking full keel, take a look at boats like the 30-Square-Meter class from Scandinavia or the famous 12-Meter class used in the America's Cup for many years. The 12-Meter class is a good example, because it tracks the evolution of keel profiles well. The problem with these extreme, modified-full-keel boats was that, as the rudder moved forward, steering and tracking suffered. These boats could be monsters to drive when hard-pressed off the wind.

Rudder placement

The rudder belongs as far aft as practicable. Full-keel and modified-full-keel boats often have a propeller aperture cut partially into the hull and partially into the rudder blade. This compromises the shape and effectiveness of the rudder and makes for boats that are a challenge to back up under power.

A centerboard or daggerboard can help offset the upwind shortcomings of the shoal-draft, low-aspect-ratio keel. But, for a centerboard or daggerboard to be efficient, it too needs aspect ratio. Boards come with their own maintenance challenges, not to mention the drag of a slot cut into the bottom of the boat.

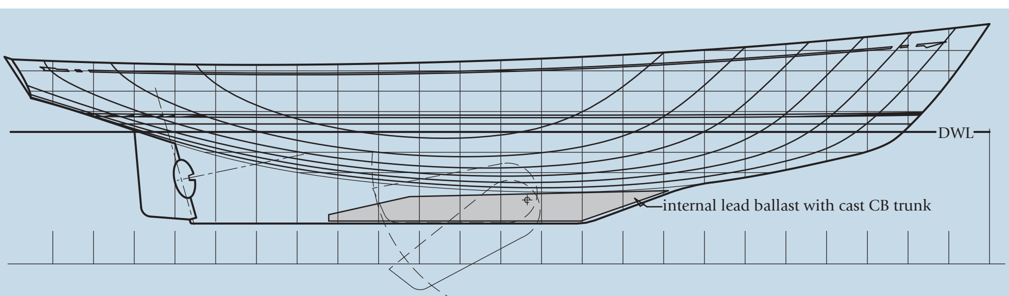
The daggerboard is preferable in that case as its slot only has to be the chord of the board with some working tolerance for clearance. The centerboard slot has to be as long as the entire span of the board. Boards also have to work in the turbulent flow at the tip of the keel and this cuts into their effective span. But they do work. The English Southerly series has a center-board that is all ballast, and I think this is a very good solution to performance in a shoal-draft boat. Boats with vertically lifting keels, like my own *Icon*, work great but present some accommodation compromises due to the keel trunk. Complex hydraulics to control the lifting keel add expense to the build.

Vintage fin keels

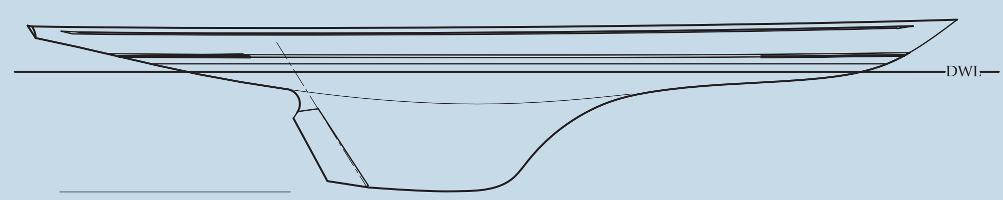
Nathaniel Herreshoff designed a number of fin-keeled boats with both spade and skeg-hung rudders well aft of the fin keel. I know L. Francis Herreshoff did too. See his famous Marco Polo design or his *Wasp* with its canting fin/bulb keel and spade rudder. Bill Lapworth and Ben Seaborn began using fin keels on their ocean racing boats starting in the late 1950s. Lapworth's Cal 40 was dominant in the early and mid-1960s. But it was not until the late 1960s that most designers adopted fin-keel configurations exclusively for boats with speed as a focus. The venerable 12-Meter class slowly evolved into designs with distinct fin keels (see Ben Lexcen's *Australia II*) and spade rudders well aft. Today, the keel debate rages on. For most, it's a matter of priorities. There are conditions that favor a full keel just as there are conditions that favor fin keels. Between the two types, there is a world of keel shapes and geometries.

Internal and external ballast

Consider fin keels in two distinct types: internally ballasted and externally ballasted. With internal ballast, the keel is a monocoque part of the hull and the ballast is inserted into the "keel envelope." This has some problems. If you are building a boat in a one-piece mold, the keel shape will have to be such that it can be pulled out of the mold. But the mold itself is more



A circa 1962 hull with a shoal-draft modified full keel and centerboard.



This is an example of an extreme modified full keel as seen on the Scandinavian Square Meter classes circa 1937. At this degree of modification, it is close to becoming a fin keel.

likely to be in two pieces joined on the centerline for the hull lamination process. With a one-piece mold, the foil distribution of the fin will be restricted. The keel must be wider at the root than it is at the tip or it will get stuck in the mold.

Even with a two-piece mold, the designer has to take into consideration that humans are going to lay up the boat. As the keel tapers toward the trailing edge, it becomes difficult to get your hands down into the keel to laminate. Any kind of bulb-type shape near the tip will also increase the ergonomic challenge. Pragmatic construction considerations can play a big part in the design of the keel. You often hear the term "encapsulated keel" or "encapsulated ballast." I would assume this means internal ballast glassed or capped in place with glass-reinforced plastic (GRP).

Placement of the keel

The longitudinal center of gravity (LCG) of the ballast inside the keel must offset the center of gravity of the rest of the boat so the boat floats on its lines. The LCG of the boat without the ballast is usually well aft, so the LCG of the ballast has to be forward in order to get the total center of gravity in fore-and-aft alignment with the boat's center of buoyancy.

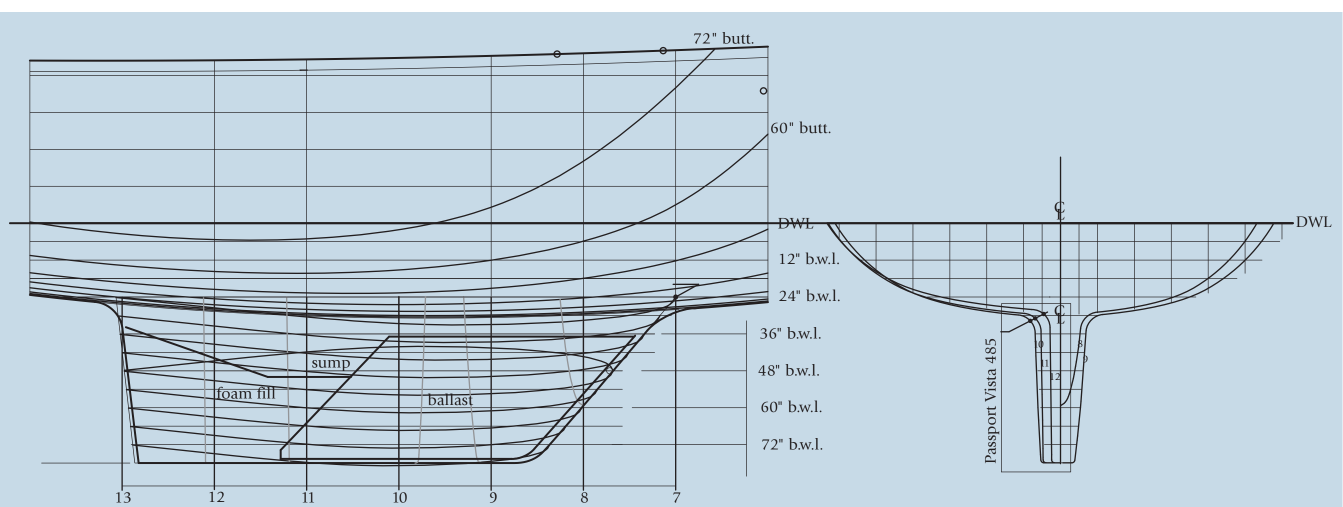
So, for trim, the ballast generally wants to be forward. But to balance the forces on the rig, especially when the boat is hard-pressed and heeled over, the keel needs to be well aft. This is a conflict faced in almost all sailboat designs.

The solution is a long fin where the ballast will occupy only the forward portion of the fin. The designer can also design the ballast slug to have a sloping top so the ballast is much higher forward, pulling the LCG forward. In many cases, moving the ballast slug forward in the fin means there will be a void in the keel aft of the ballast. I like to fill that void with foam and then glass over it to limit the depth of the keel sump. It's just not practical to have a deep and narrow keel sump. It's hard to reach down there and retrieve your wrench. Internal ballast requires that the designer choose a foil thickness that allows for a thick GRP keel skin and a reasonable working tolerance in order to slide the ballast slug down into the keel envelope. This additional thickness will increase the frontal area of the fin and that's not good. With careful manipulation of the keel planform, foil thickness, foil choice, and the ballast-slug configuration, the designer can design a suitable internally ballasted keel.

All but one of the boats I designed that were built in Taiwan, starting in the mid 1970s, were single-piece hulls laid up by hand in two-piece molds with internally fitted ballast. Most used cast-iron ballast with the ballast going in as a one-piece slug. Cast iron was cheaper than lead. Internal ballast meant the builder did not have to bolt the keel onto the hull. I have heard the stories about BBs in the keel and other weird substitutions for a single iron slug, but I've never see it. The Taiwan builders and marketers liked internal ballast because it removed all the concerns that come with having to bolt the keel onto the hull.

Robert Perry is the principal of Robert H. Perry Yacht Designers in Seattle, Washington. In a career spanning nearly 40 years, he has designed a wide variety of sailboats, many of which now fall into the category of "sought-after good old boat."

In the next issue, in "All about keels, Part 2," Bob Perry will continue this discussion with a focus on keel shapes.



A moderate-aspect-ratio keel with internal ballast on a 48-foot cruising hull.

The legendary Olson 30

JOHN RIISE/LATITUDE 38

Polar Bear, an Olson 30, and her owner, Eric Thomas, approach Hanalei Bay, Kauai, Hawaii, on their way to a first-in-class finish in the 2008 Singlehanded TransPacific Race.

Fast and furious ultra-light fun

by Karen Larson

Eric Thomas doesn't swagger. It's not his style. Even though he has won an amazing collection of sailing honors with his good old boat, an Olson 30 named *Polar Bear*, he doesn't brag. Eric and *Polar Bear* placed first in class and fourth overall in the singlehanded portion of the 2002 Port Huron-to-Mackinac Island Race. They won boat-for-boat and on corrected time in the singlehanded section of the Trans Superior Race in 2005 and 2007. They placed second in class and third overall in the singlehanded Chicago Mackinac Race in 2006. And they did it again (first in class and second overall) in the 2008 Singlehanded TransPac race from San Francisco to Hawaii's Hanalei Bay in Kauai sponsored by San Francisco's Singlehanded Sailing Society.

But bragging and swaggering aren't part of this sailor. Eric knows who he is and what he can do. It isn't important whether those with whom he comes in contact know about his sailing credentials. When he's not involved in major racing events (which, really, is most of the time), Eric lives and breathes boats as the yard supervisor and service advisor with Barker's Island Marina in Superior, Wisconsin. And he's active in local Wednesday-night fleet racing when the water isn't frozen.

The son of a sailor, Eric grew up aboard racing and cruising sailboats while his parents, Nelson and Margaret Thomas, and two older siblings sailed first a New Horizon 26 and then a Santana 27 in as many races as possible on Lake Erie and southern Lake Huron.

Far-flung starts

The family of five delivered and trailed boats to some even more far-flung starting lines (think: Key West Race Week) and home again. Sailing (and racing, in particular) has always meant "family time" for the Thomas family. It still does. His Wednesday-night crew is made up mostly of family members, and the family comes together in amazing ways to make sure that Eric and his boat make the starting line for those big events, whether that help comes in the form of delivery assistance, making repairs, or baking monster cookies.

Good Old Boat isn't normally about sailboat racing. It's about good old cruising sailboats. While some of our good old boats lead double lives and do get up and race from time to time, few do it as actively as *Polar Bear*. Just one look around the extremely Spartan accommodations aboard this Olson 30 will convince you that this is no cruising sailboat. But Eric lived aboard for about a month during the summer of 2008 (even if he was racing across the Pacific during the two weeks sandwiched in the middle of that time period). If you're of the opinion that cruising means nothing more than "glorified camping aboard," you might make an Olson 30 work for you. It offers a roof over your head (no standing headroom, I'm afraid) and amenities such as galley, bunks, head, and stove.

High-performance cruising

Did I mention that it goes like the wind? You could drive your fellow sailors crazy when you put the spinnaker up and manage speeds in the mid-teens. Call it "high-performance cruising," if you will.

In 2009, I found listings for five of the original 255 or so Olson 30s built between 1978 and 1984. These days, they range in price between $9,000 and $18,000. Add "affordable" to the list of attributes. Most important, however, is the strong class enthusiasm and support for racers around North America from the Chesapeake to San Francisco and from the Great Lakes to the Southeast.

A final attribute is that this keelboat is trailerable. It takes a crane to lift her onto the trailer, since this is no keel/centerboard sloop, but once there she's lightweight, displacing 3,750 pounds in racing trim, and narrow, with a beam of 9 feet 4 inches. Eric says the boat on the trailer stands 12 feet tall (the draft is 5 feet 2 inches) and the unstepped mast extends 40 feet. Not a daysailer, perhaps, but you *can* take her cross-country when you want to.

The Olson 30 was designed in 1978 by George Olson, of Santa Cruz, California. He was a surfer who decided to design an ultra-light-displacement boat (ULDB) while sailing on Bill Lee's *Merlin*, one of the early ULDBs of that time. George was part of the crew bringing the 68-foot *Merlin* home to Santa Cruz from Honolulu following the 1977 TransPac. You might say George designed this 30-footer with the TransPac in mind. It was clearly designed as a 30-foot ULDB capable of offshore racing. Eric says there has been an Olson 30 in nearly every singlehanded TransPac since that time. And he adds, "They have yet to come up with a new one to replace the Olson 30. There are sport boats, like the Melges 24, but these were not built for offshore sailing."

Purposefully built

Polar Bear, hull #140, built in 1981, is fairly representative of her sisters. Eric did not strip this boat out to make it competitive. It began life as a stripped-out raceboat. Once the cruiser in you recovers from the surprise of the no-nonsense accommodations below, Eric will regale you with her construction highlights. The Olson 30 was designed by a surfer and built by surfers. As a result, the fiberglass work is a level above that seen on most good old boats. Eric shows that you can put your hand inside a locker anywhere and find good, finished glasswork. No nasty splinters lurk just out of sight. The hull-to-deck joint is similarly well done. Ditto for the stanchions, the joint between the sole and any furniture within, the glassed-in bilge drain, and so forth. All was done by a team of people who cared.

"Historically," Eric points out, "There have been no delamination issues in these hulls." Like many sailboats of this era, the Olson 30s were constructed with balsa core in the hull and the horizontal surfaces of the deck. The difference is that the Olson's laminates were vacuum-bagged. The laminate is built up of roving, with mat used adjacent to the core as a bonding layer. Some areas were further reinforced with additional woven roving. As on other good old boats, localized wet-core issues around long-neglected deck hardware at the mast partners and turning blocks are issues of concern with this fleet.

"Eric did not strip this boat out to make it competitive. It began life as a stripped-out raceboat."

Ankle-level cables

Eric is quick to point out the crossbar that spans the cabin just aft of the mast and ties the sides together. That and the ankle-level cables that tie the base of the mast to the chainplates create a spider web that makes it hard to access the bow from the main cabin. But not to worry. You should keep the bow light anyway. Light? Even set up as a club-racer sailed by a crew of as many as nine, *Polar Bear* has absolutely nothing stowed in the V-berth, a standard practice with the Olson 30s to prevent submarining as they race down-wave at high speed. Port and starboard pipe berths are tucked under the cockpit, quarter-berth fashion, and there's room for heavy stowage between them under the cockpit sole. On his passage to Hawaii, that's where Eric kept his water supply and extra sails.

The central cabin contains two simple birch-plywood benches that provide seats and could be where one does cooking or dishwashing. That probably is their intended purpose. These boats came with a two-burner gimbaled Origo stovetop but, during his solo races, Eric cooks on a small mast-hung

Structural integrity trumps all in the Olson's "bare essentials only" interior.

The Olson 30 is minimally furnished. Crew quarters are a quarter berth each side of the cockpit, above left, with a hull-mounted seabag for gear. Some stowage for sails is provided forward of the mast bulkhead, above right. When he's at sea, Eric cooks on a single-burner stove suspended at the mast, below left. The mast, repaired with a sleeve just before the start of the race, below right, survived the TransPac passage.

propane burner. In the bare interior, the teak-and-holly sole seems like overkill. But it's a nice feature. Pacific Boats, the manufacturer, even added four small seabags to the kit. The bags were hung from mounts to keep them off the furniture. Eric still has the original bags and mounts. There's a Porta Potti tucked under a lid in the bow and plenty of space for gear. That pretty much covers it. Who could want anything more?

Extensive modifications

Eric did. Since he bought *Polar Bear* in 1997, his modifications have included the installation of new ports and hatches, an addition to the cabinetry to make two stowage areas more secure, the removal of six of the eight self-tailing winches sprinkled about the deck, and a beefing up of the chainplates. For his solo adventures, he ran the reefing lines to the cockpit and added a baby stay, solar panels, SSB, jacklines, a sat phone, EPIRB, a ditch bag with an emergency desalinator, and backup autopilots for the backup autopilots (he carried four in all). He also had to carry anchoring gear because he'd anchor in a bouncy bay once he reached Hawaii, and an outboard and fuel because he'd have to deliver the boat to Honolulu for the trip home aboard a ship. That last stretch to Honolulu after the race was the worst part of the whole trip, and made it possible to forgive the outboard for the unnecessary weight it contributed during the race.

Polar Bear carried two Dacron mainsails with two reefs: a lightweight main and one made of heavy material with very stout battens. She also carried 3DL headsails: a 155 percent genoa and a 100 percent jib. Her spinnaker collection included two ¾-ounce kites, one ½-ounce kite, and a ¾-ounce asymmetrical reaching spinnaker. Eric also had these sails stowed below the cockpit sole: a 40 percent storm jib, a storm trysail, a heavy-air 80 percent jib, another spare spinnaker, and a lightweight Kevlar racing main.

Crack in the mast

Eric made one more modification at the eleventh hour. Once he and *Polar Bear* were launched in Alameda, California, and preparing for the race, Eric noticed a crack where the mast wiring exits the mast at the overhead. Buying a section of mast for emergency overnight delivery, getting that sleeve delivered to the correct marina, and installing it with the tools he had aboard make a great sea story, and Eric tells it well. A similar saga ensued when he decided that the boltrope in the mainsail really should be replaced and reinforced. This was done in a day.

He tells of the inspector, a five-time veteran of the TransPac, who cleared his boat to join the race. He took one look at Eric's smallish solar panel and asked, "So, you plan to hand-steer?"

Eric, an innocent from the Great Lakes who expected nothing but sun while crossing the deep blue sea, had another think coming. "There will be nothing but clouds for 1,500 miles offshore," the inspector said. Eric (the man with four autopilots, remember?) had no intention of hand-steering. In fact, he steered, on average, only about an hour in 24. "The next day," he says, "I went right out and added a third more area to my solar panels. On the race, I needed about 60 amp hours per day. My solar collectors kept up with that."

That siren call

Eric heard the TransPac's siren call for years before hauling his boat halfway across the continent and then sailing it halfway across the Pacific. In the summer of 2007, after having a "wonderful time" in the solo Trans Superior, Eric, who says he'd "been keeping an eye on that race for 10 to 20 years," told Sarah, his high-school sweetheart and wife of 15 years, "I think I want to do the Hawaii race." Knowing him as well as she does, Sarah was unfazed. It took much of the next several months to apply for acceptance in the race, to lay plans for the complicated delivery dance required any time a vessel goes on a one-way trip, and to arrange for time off, since there is a six-week commitment from the moment you drive your boat down the driveway until the day you return to your job. "Half the game is getting to the start," Eric admits.

The TransPac committee not only chooses who can participate in the race, it also requires and makes sure with a final inspection that certain equipment (such as an EPIRB) be carried aboard, along with 30 days' worth of food and 21 gallons of water for the passage that generally takes two to three weeks.

Once the big day arrives in mid-July, the fleet of 20 to 30 boats of all sizes — from a 54-foot multihull to a Cal 20 in the 2008 race — begins with four separate starts for what amounts to five fleet classifications. The "course" is a 2,120-nautical mile Pacific Ocean crossing in generally following winds between 22 and 25 knots punctuated with frequent squalls.

South until the butter melts

"You generally sail upwind to the Golden Gate Bridge," Eric says. "Then it's heavy-air reaching. You tack once to the gate, reach for three days (sail south until the butter melts), and jibe once as you turn dead downwind." Actually Eric says he jibed "probably a half-dozen times during the whole trip." He generally had the spinnaker up during the day and took it down overnight when he caught a couple of hours of sleep. "A big part of the performance is getting up and pushing the boat hard," he says.

"A typical day meant getting up early in the morning, launching the spinnaker and sailing hard until mid-afternoon . . ."

Working *Polar Bear* hard for 14 days, Eric occasionally saw speeds as high as 17.9 knots with the spinnaker, averaged 8 to 10 knots most of the time, and ticked off 190-mile days, although the wind near California, and again near Hawaii, was light, making for a frustrating first few and last few days.

A typical day meant getting up early in the morning, launching the spinnaker and sailing hard until mid-afternoon (taking the helm only when a squall hit), snatching catnaps during the afternoon with a lookout every 20 minutes or so, making dinner, continuing to sail hard until call-in time to report his whereabouts to the race organizers and family, and finally taking the spinnaker down and taking more catnaps between midnight and 5 a.m. Eric figures he slept 4 to 5 hours a day and lost about 20 pounds on MREs, beefstick and crackers, and those marvelous monster cookies.

Slumped athwartships

This was no luxury cruise. He never actually crawled into one of the two pipe berths (it might take too much time to get out); instead, he slumped athwartships in the forward end of one of the berths with his feet at the companionway landing and a harness already buckled up. One of his log entries says:

"Just finished roll call, lost a little gained a little, just sailing. Many people have had some sort of breakdown or scare at this point (***Note:** One of the racers lost a mast and another lost a rudder on the way to Hawaii, while a third, very experienced, sailor lost his boat on the return trip. –**Eds***). Some are starting to be more conservative, realizing how far from anywhere they are and the consequences that has. I was

A typical skipper's-eye view on the TransPac shows *Polar Bear* plowing a fast furrow across an endless blue ocean.

LADONNA BUBAK/LATITUDE 38

***Polar Bear*'s cockpit is all business, above left. Eric even removed winches to save weight (the filled bolt holes are still visible). Eric waves for the camera at the start of the 2008 Singlehanded TransPac, which took place in typical San Francisco Bay conditions, above right.**

doing all those calculations in my head a few days ago and it really gets you down. Not that they are bad, they are real. So one has to calculate the risks in all actions. I always wear my harness; I sleep in the damn thing. I am clipped on whenever I am out of the cabin. My big worry has been the rig and the fact that losing it would make this a really long downwind race, *Black Feathers* (the Cal 20) would eat me for lunch! Luckily the wind blows toward Hawaii and one would eventually get there. Enough rambling. Time to tighten the tiller-head fitting on the rudder post, it's starting to work loose. Got to get done before dark and do a general scout around the deck before nightfall to remember where the halyards are and straighten up for the coming squalls. We have 622 miles to go."

A psychological journey

Eric notes that this sort of voyage is not so much a physical journey as it is a psychological one. He says participants generally get blue for the first several days as they disconnect from their land-based lives. The actual crossing is pleasant and could be endless, as far as he's concerned. But there's also a seemingly endless period of time toward the finish during which most participants get caught up in anticipating the approaching landfall. These final days drag on also.

And there's another psychological demon to slay: gear fear. Eric learned of this from other competitors and firsthand. "I was obsessed during the first few days with the backstay. My brother-in-law had broken his mast the day I left." Watching that spinnaker pull the boat ahead at 17.9 knots with the boom resting on the shrouds filled him with dread, Eric says. He notes that the spreaders are in line on the Olson 30 so the backstay is the only thing preventing the mast from being pulled forward. As the guy back home at the marina repair shop who sees many equipment failures, Eric began imagining the worst-case scenario. "I ran another halyard and shackle back to the transom. Then the wind filled in and I got busy. After that, I was calm as a cat," he says.

"Before he knew it, he'd raced into Hanalei Bay where Sarah was waiting for him under the tree."

Before he knew it, he'd raced into Hanalei Bay where, in the tradition in this race, Sarah was waiting for him under the tree with the rest of the race committee and anxious family members. He'd made the crossing in 14 days, 1 hour, 53 minutes, and 27 seconds, averaging better than 6 knots for the entire trip in spite of calms at the beginning and end of the journey. *Polar Bear* was the second boat to arrive. The next week is generally spent under the tree swapping tales of each participant's experiences while waiting for the rest of the fleet to arrive.

Eric has no illusions about who gets credit for a race well run.

"The Olson 30 performs really well in light air, but it's also very efficient in heavy air," he says. "People say they're light and go really well downwind. But they also go upwind." *Polar Bear* was the perfect choice for an experienced round-the-buoys racer who occasionally heads out on a long single-handed racing adventure.

"This boat rewards you for good sail trim," Eric says. "It does not forgive you for bad sail trim. It really is a wonderful boat . . . a lot of fun to sail."

Karen Larson and her husband, Jerry Powlas, the founders of Good Old Boat, *have been sailing their C&C 30 on Lake Superior for nearly 20 years. They also have a C&C Mega 30 project boat in the backyard. With it they are learning some important do-it-yourself truths and don't welcome questions about how soon it will be ready.*

Resources

Olson 30 class
<www.olson30.org>

San Francisco's Singlehanded Sailing Society TransPac
<www.sfbaysss.org/index.html>

Logs of the 2008 Singlehanded TransPac participants
<www.sfbaysss.org/TransPac/transpac2008/race_tracker/log.html>

Comparing a trio of ULDBs

Three boats built expressly for speed and fun

by Ted Brewer

George Olson designed one of the first successful ultra-light-displacement boats (ULDBs), the one-off 24-footer *Grendel*, in 1970. In 1972, in partnership with Roger Moore, George modified *Grendel*'s extreme design with increased beam and produced the Moore 24, still with an extremely low displacement/LWL ratio of only 89. The Moore 24s proved to be sporty and fast and the little yachts race as a class in several areas even today. In 1977, while on a delivery run from Hawaii aboard Bill Lee's very quick and successful 68-foot ULDB, *Merlin*, which had just sailed a record-setting win in the Transpac race, George began to dream about a new 30-foot design. The first of many Olson 30s was launched in 1978.

Bill Lee had come out a few years earlier with the Santa Cruz 27 which, with ultra-light displacement and generous sail area, was considered to be an extremely radical boat in 1974. She was also extremely fast off the wind, capable of surfing, and a proven serious contender in such events as the 225-mile Santa Cruz-to-Santa Barbara Race and the Swiftsure Race. Indeed, several of the 27s have sailed in singlehanded races to Hawaii.

The new Olson 30, sporting a displacement/LWL ratio of only 78 and spreading about 80 square feet more sail on just 300 pounds greater displacement, was even more radical than the Santa Cruz 27. Her 9-foot 3-inch beam also provides slightly greater form stability than the 8-foot beam of the Santa Cruz and the Mega 30, and there is no question of her surfing ability when the wind is free. The Olson 30 is capable of exhilarating speeds when surfing, as well as spectacular crashes when things go wrong! The 30s have proven surprisingly seaworthy, though, and hardy souls have sailed them in the Bermuda Race, numerous Transpacs, and a race across the Atlantic.

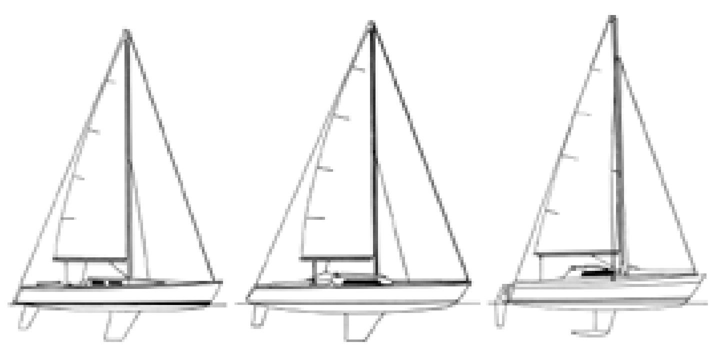
Top trailersailer

The third boat in this review, the C&C Mega 30, was never designed as a serious racer but, rather, as a top-performing trailersailer with a retractable cast-iron ballast fin. The Mega's ULDB hull and very generous sail area ensure that she will not be a slouch off the wind, especially in light air. Still, I expect the Olson 30 and SC 27 would walk away from her when the conditions favor their surfing capabilities. The Mega's displacement and modest beam may prevent her from surfing in less-than-optimum conditions, but her narrow beam combined with a long waterline and slightly huskier displacement could give her a bit of an edge over the other two in punching to windward through a stiff chop when it breezes up.

Where the other two boats have just sitting headroom, the Mega has standing headroom, and she can creep into those delightful shoal gunkholes and harbors simply by retracting her fin. Both the Mega and the Santa Cruz are legally trailerable without a special permit but will require a husky truck to sail them down the highways. Only the Mega, however, is launchable without a crane.

These three ULDBs are going to appeal to different classes of sailors. The Mega 30 will be the choice of the cruising man who wants a fast and fun boat to sail and to race occasionally but who is also looking for a bit more cruising comfort combined with trailerability. The Santa Cruz 27 and Olson 30 are definitely the boats for the serious racing sailors. They have proven to be very competitive in club and distance races, as well as MORC and PHRF events. If one-design racing is your thing, the Santa Cruz is more centered in Southern California, and that may limit her appeal. The Olson 30, on the other hand, has fleets in the Great Lakes, the Chesapeake, the Southeast, California, and the Pacific Northwest and will give true one-design aficionados all the serious competition and sport that they can handle.

Ted Brewer is a contributing editor with Good Old Boat. *He is one of North America's best-known yacht designers and has designed scores of good old boats.*



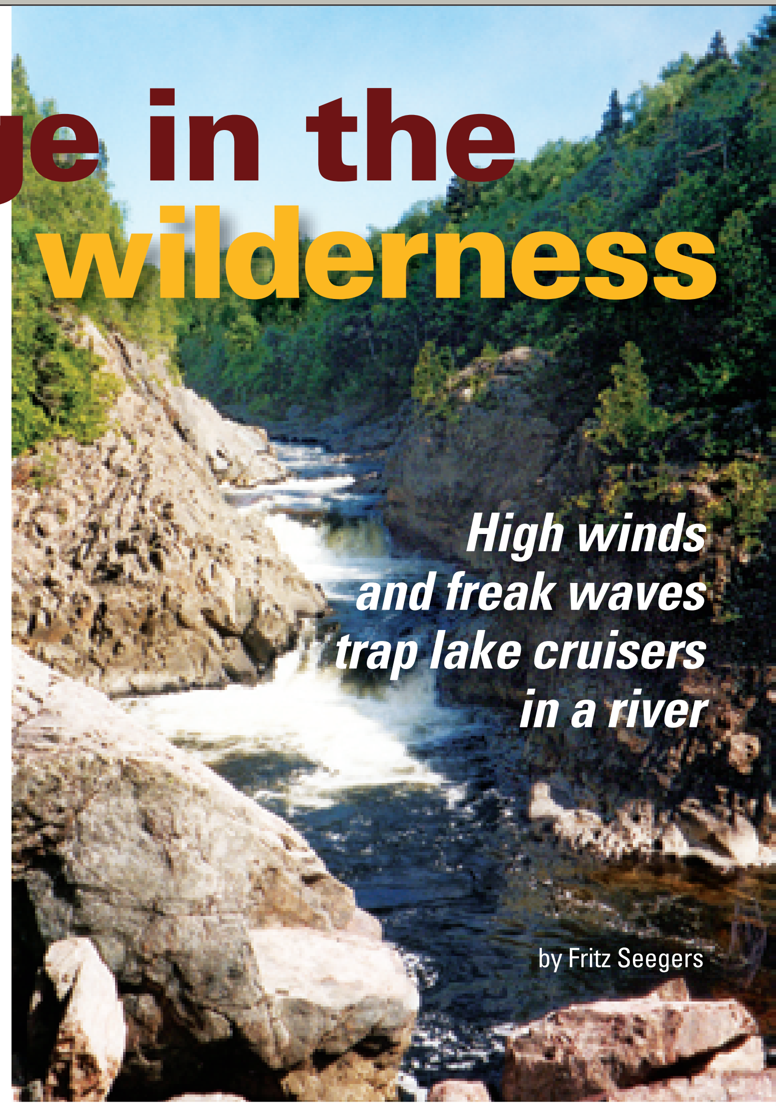
Olson 30 — **Santa Cruz 27** — **Mega 30**

	Olson 30	Santa Cruz 27	Mega 30
LOA	30' 0"	27' 0"	29' 11"
LWL	27' 5"	24' 0"	27' 4"
Beam	9' 3"	8' 0"	8' 0"
Draft	5' 1"	4' 6"	2' 0"/5' 2"
Displ.	3,600 lb	3,300 lb*	4,500 lb
Ballast	1,800 lb	1,600 lb*	2,250 lb
LOA/LWL	1.09	1.13	1.09
Beam/LWL	0.337	0.333	0.293
Disp./LWL	78	107	98
Bal./Disp.	0.50	0.48	0.50†
Sail area	380 sq ft	301 sq ft	421 sq ft
SA/Disp.	25.9	21.7	24.7
Capsize no.	2.4	2.15	1.92
Comfort ratio	10.1	12.8	15.6
Year introduced	1978	1974	1977
Designer	George Olson	Bill Lee	Peter Barrett/ C&C

*Hulls #24 onward, according to the Santa Cruz 27 Association

†The Mega's iron ballast is not as dense as lead but the large bulb lowers the VCG of the casting. I would rate it as being about as effective as 50 percent lead ballast.

Under siege in the wilderness



High winds and freak waves trap lake cruisers in a river

by Fritz Seegers

Two artist friends and I spent more than a week in June 2003 sailing my traditional 27-foot cutter along Lake Superior's eastern shore north of the town of Wawa. The next city of any size, Marathon, is more than 100 miles away. Phyllis, Ladd, and I hadn't seen another person for days as we gunkholed and explored the endless bays and islands that fringe this vast wilderness.

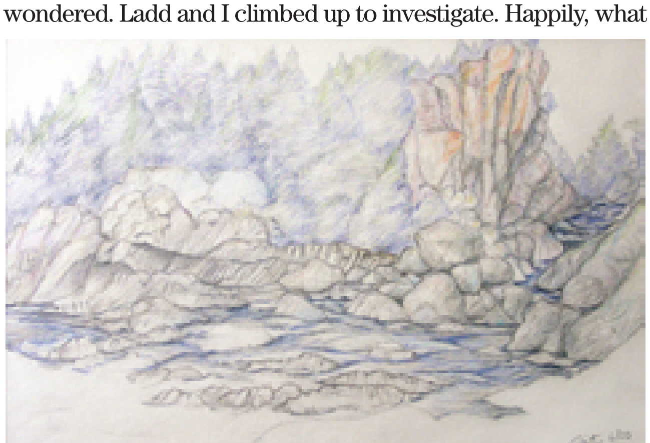
Little has changed in this area since the voyageurs paddled through centuries ago. VHF radios, weather forecasts, and cell phones are of little use as the nearest road is more than 50 miles away. Even the charts for this area are of such scale that they provide very little detail. We used every available means of dead reckoning, GPS, and Bonnie Dahl's cruising guide, *The Superior Way*, which describes all of Lake Superior's anchorages, bays, islands, and harbors.

One day was perfectly clear, accompanied by a mild offshore breeze that blew us easily to the mouth of the Pukaskwa River (pronounced puck-a-saw) by early afternoon. We cleared the 6- to 8-foot shoal at the river's entrance on flat water with just 3 feet to spare as Phyllis guided us past rocks and shoals from the bow. We anchored up the river near the falls — one anchor off the bow and another off the stern — facing downstream toward the lake.

Gifts of nature

We visited the falls and found a perfect swimming hole above the falls surrounded by automobile-sized boulders baked by the afternoon sun. The water was 70 degrees, compared to the 43-degree water in Lake Superior. We gladly splashed about, as we had not had the opportunity to bathe for several days. As evening approached, we wandered downstream past the boat to explore and sketch Superior's shore. A bald eagle soared above us over the cliffs south of the river.

We were disgusted to discover what looked like large plastic sheets hanging over the edge of a cave on the cliffs. "Can't even *this* area be spared from human trash?" we wondered. Ladd and I climbed up to investigate. Happily, what appeared to be plastic turned out to be tons of ice remaining from the previous winter. We could have all the ice we needed that day in late June to replenish the supply in our icebox.



FRITZ SEEGERS

As we made our way back to the boat, a river otter swam by toward the falls, motivating Ladd to set off with his fishing gear. Before he left, he confidently asked us what kind of fish we would like for dinner. Phyllis and I challenged him to bring us a rainbow trout. In less than an hour, Ladd reappeared with a two fine trout! We celebrated far into the night with the first fresh food in days, Chardonnay, and a deadly game of Scrabble. All of this, under the warm glow of oil lamps in the nocturnal silence of Ontario's paradise, brought the day to a perfect end. "Yes," Phyllis concluded, "life couldn't get better than this."

Nature less benign

Not usually a morning person, I awoke just as the first sunlight peered into the port above me. I had an uneasy feeling just before a huge wave roared by. Was this washing up the river from the lake? Perplexed, I peered out and saw that the river was now *several* feet lower than the day before. Low-water rocks and brambles lined the banks.

This had to be a seiche. This phenomenon is similar to a tide, but its timing is unpredictable because it's caused by changes in weather conditions rather than the passage of the moon. Then another wave violently rocked the boat, knocking Phyllis and Ladd out of their bunks. I went up to the bow to check the anchor. All was well, but I felt apprehensive as I peered into the haze over the lake. Superior's surf was building, making a deafening roar. Happily, the surf was not affecting the river . . . yet.

Ladd joined me on the bow. We were discussing the seiche when a crash of thunder sent us dashing back to the cockpit. A sudden gust heeled the boat 20 degrees, testing our anchor. Then a blinding torrent of rain, hail, and wind hammered us. Visibility dropped to zero. The only way we could sense our position was by gazing sideways at the spruce trees at the shore bending over like giant bows. Phyllis frantically battened down everything inside. Then, all of us felt the boat slip backward. Our forward anchor was dragging.

Storm strategy

I remembered facing another hurricane-force squall years earlier in another harbor. As my boat slipped helplessly astern, a sailor companion showed me a strategy that saved my boat on that day. Now, I fired up the engine and cautiously inched the throttle forward. I coached Ladd to pay out a little more line for the aft anchor and to then go forward to make sure we weren't running over the bow rode. I held the stern line tight as I tried to steer into the wind. I had to power the boat just enough to weather with all of the twisting and turning while not tangling either line in the prop, a tricky proposition when you can't see forward and with very little leeway behind. Motoring had to work; we had no other option.

In due course, the squall abated and we sat unharmed in the river's waters, now murky from the runoff. We felt we had better revise our anchoring strategy in case there was another blow, so we mustered every sheet, dockline, and rope we could. We attached them to the anchor rodes, extending them so they reached opposite sides of the river, where we wrapped them around boulders and trees on shore. For the remainder of the day, we listened to and watched the cacophony of thunder and lightning as storm fronts raced to the north and south of us. The wind and waves built out of the southwest to a full gale on the lake, dashing any hope we had of leaving our river anchorage. Thankfully, our mooring lines held as our boat wiggled back and forth in the middle of the river.

We retired early that very dark night, fearful of being aroused at any moment. I slept like a fireman with my clothes on and my rain gear within easy reach.

Free at last

By the end of the fourth day, just hours before dusk, the seas diminished enough for us to make our escape. The setting sun shone through the clouds and it sleeted intermittently as we slid over the reef, leaving Pukaskwa River behind. We motored three miles north to Pointe La Canadienne, where we anchored in a large bay and went ashore to cook dinner over a campfire. As darkness loomed, northern lights appeared, stealing our attention while the fire thoroughly burned our dinner. The mishap hardly mattered as we reflected on our remarkable odyssey.

Although it was by then day 11 since leaving Wawa, we still had not seen another soul and had never missed civilization. We felt like children drunk with self-confidence, yet humble over our vulnerability. This wilderness is beautiful and compelling but fraught with unpredictable dangers. We wondered about the incredible resourcefulness of the ancient people who passed through here before us.

That night the gods were very quiet, the water became like glass, and we slept very soundly indeed.

Fritz Seegers is a Good Old Boat *illustrator who also has documented lakes Michigan, Huron, and Superior in his illustrations while sailing in his hand-crafted boat,* Alwihta. *He has done illustrations for International Marine/McGraw Hill that have appeared in publications by Don Casey, Nigel Calder, David Burch, Dan Spurr, and Beth Leonard. His website is <www.fritzseegers.com>.*

"This wilderness is beautiful and compelling but fraught with unpredictable dangers."

Propellers 101

Basic insights into how they work

by Don Launer

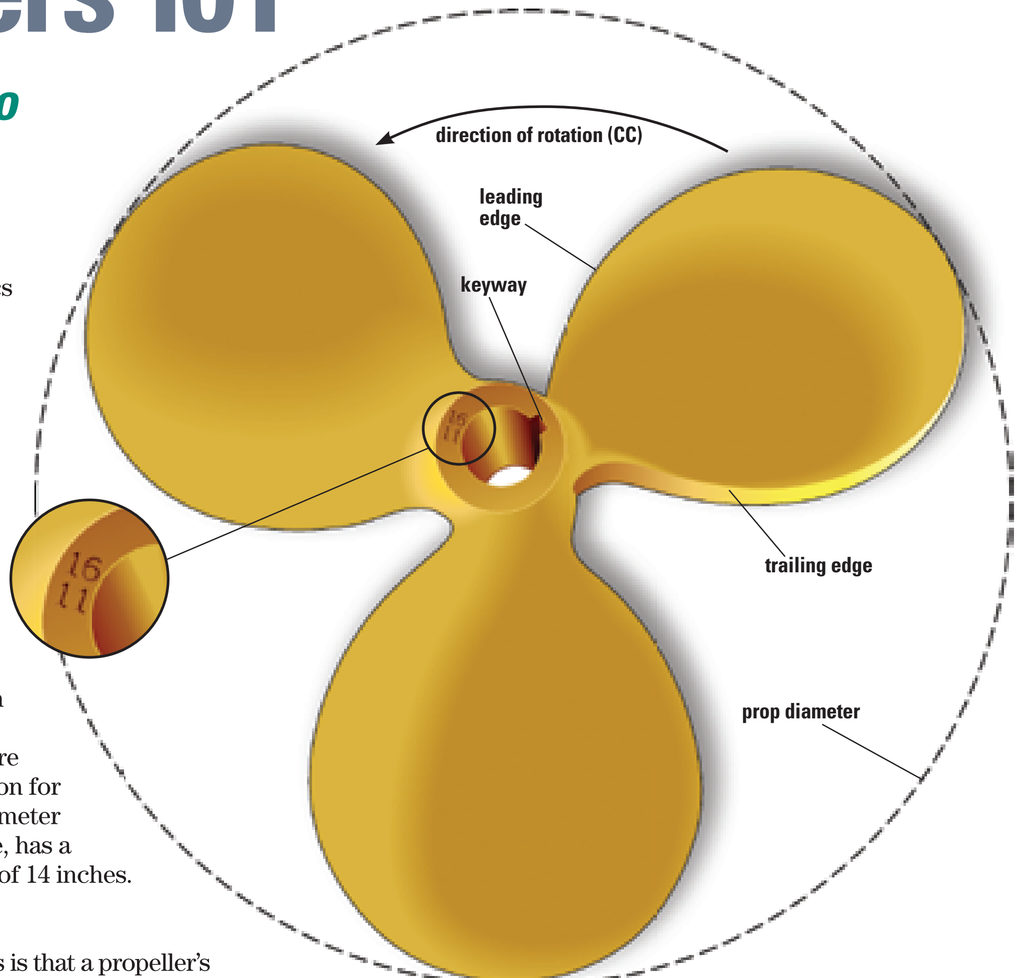
Much complicated mathematics lies behind the deceptively simple appearance of a boat's propeller, but it can be described and specified with a few simple numbers and terms.

Diameter and pitch

The diameter of a propeller is the diameter of the circle described by the tips of its blades when it rotates.

The pitch of a propeller is the theoretical distance it would screw its way through a solid with each complete revolution.

In the U.S., these dimensions are stated in inches, and the convention for specifying a propeller lists the diameter first. A 16 x 14 propeller, therefore, has a diameter of 16 inches and a pitch of 14 inches.



Viewed from astern, this propeller rotates counterclockwise with the engine in forward gear, making it a left-handed prop. The numbers stamped on the hub indicate that it has a diameter of 16 inches and a pitch of 11 inches.

LAYOUT AND ILLUSTRATIONS BY TED TOLLEFSON

Number of blades

This is obvious. What's not obvious is that a propeller's efficiency decreases as the number of blades increases. Although a two-bladed prop is more efficient, the two blades enter the disturbed water flowing either side of the boat's keel at the same time. On full-keeled boats, this often causes vibration or humming in parts of the boat. A prop with more blades provides smoother propulsion with less vibration.

A three-bladed prop is a good compromise for an auxiliary cruising sailboat with a full keel, since each of the blades enters this disturbed water at a different time. However, the three-bladed propeller will induce more drag under sail, whereas the two-bladed prop, when stopped and aligned vertically — at least on a full-keeled boat — is hidden by the keel, reducing its drag.

Shaft size

This is the diameter of the propeller shaft, exclusive of the tapered end to which the propeller is fitted.

Key and keyway

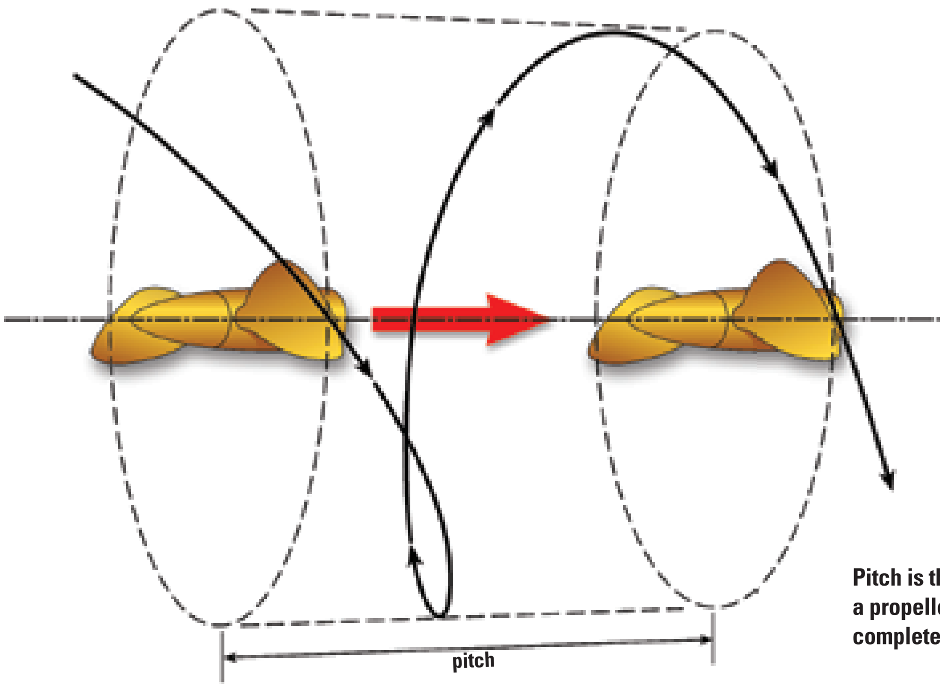
The keyway is a slot machined into the propeller shaft and into the hub of the propeller. A key fitted into the keyway prevents the propeller from turning on the shaft. This key usually has a square cross-section. In the U.S., the side of that square is designated in inches, so a ¼-inch key is used in a ¼-inch keyway.

Rotation

The direction in which a propeller rotates depends on the particular engine and transmission. If, with the engine in forward gear, the prop rotates clockwise when viewed from the stern, it is described as right-handed. If, with the engine in forward gear, the prop turns counterclockwise when viewed from the stern, it's left-handed. On a boat fitted with twin shafts and props, the props will generally rotate in opposite directions, so one prop will be a right-handed prop and other a left-handed prop. Because of their opposite pitches, the props cannot be interchanged.

Thickness

Ideally, propeller blades should be as thin as possible, since more power is wasted turning a thicker blade. As an example, because stainless steel is about five times stronger than aluminum, a prop made of stainless steel can have thinner blades than one made of aluminum, and will therefore be more efficient.

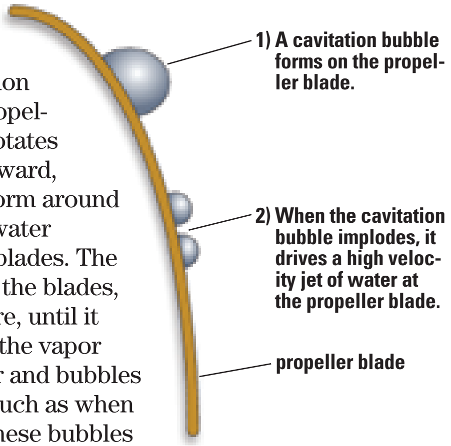


Pitch is the theoretical distance a propeller would travel in one complete revolution.

Slip
When propelling a boat, a propeller, because it's working in a fluid and not a solid, actually moves forward a lesser distance per revolution than its manufactured pitch. Thus a prop listed as having a 14-inch pitch, may only move the boat forward 7 inches for each revolution. The difference between the theoretical pitch and the actual forward movement is termed slip. Many factors contribute to slip, including hull resistance, wind and wave conditions, and the weight of the boat.

Thrust
The propeller propels the boat forward by generating thrust, which in the U.S. is measured in pounds. The propeller on the typical auxiliary creates thrust in the neighborhood of 8 pounds per square inch (psi) of blade area. The power used by the propeller's blades to create thrust is provided by the engine. A typical propeller only converts about 50 percent of the engine's power into thrust.

Cavitation
Cavitation is an unwanted phenomenon that accompanies propellers. As a propeller rotates and drives a boat forward, low-pressure areas form around the propeller as the water accelerates past the blades. The faster the rotation of the blades, the lower the pressure, until it becomes lower than the vapor pressure of the water and bubbles of gas are formed (much as when water boils). When these bubbles subsequently collapse under the higher pressure of the surrounding water, they do so violently, creating high-pressure implosions and microscopic high temperatures (thousands of degrees). When the bubbles implode on the surface of a propeller they create explosive noise. What's more, these implosions and instantaneous microscopic high temperatures also cause pitting of the propeller's surface. This pitting is higher on propellers made of softer metals. Cavitational pitting can dramatically shorten a propeller's efficiency and life.



Propeller variants
Folding or feathering propellers and variable-pitch propellers address the problem of drag when sailing. Racing sailors often choose folding props because they are thought to cause the lowest drag. Their drawback is that they do not work in reverse as well as other designs. Feathering propellers create a little more drag than folding propellers but have excellent thrust in reverse. Variable-pitch propellers have about the same drag as feathering propellers but adjust their pitch automatically to maximize efficiency. These propellers have been found to maintain higher efficiency over a wide range of boat speed and engine loading.

Propeller selection
Choosing a propeller's specifications is a complicated process. In general, you want to start with the largest diameter that will allow adequate clearance between the blade tips and the hull or aperture, use the smallest number of blades that will do the job, and choose the pitch last. *(**Note:** See articles in* Good Old Boat *by Aussie Bray, March 2003, and Rebecca Burg, March 2008. **–Eds.**)* You can also find guidance in selecting a prop in books and through programs on the Internet.

Don Launer, a Good Old Boat *contributing editor, has held a USCG captain's license for more than 20 years and has sailed the East Coast from Canada to the Caribbean. He built his two-masted schooner,* Delphinus, *from a bare hull. His newest book is* The Galley: How Things Work.

Discover the current

Learn to make safer, faster passages

After spending a few days in Jacksonville, Florida, we planned to head out the St. Johns River and then turn south into the Intracoastal Waterway (ICW). We knew that once we made the turn, we'd have to decide whether to stop at one of the few available anchorages in that area or continue on a further 20 miles to the next anchorage. Our preference was to go on to the more distant anchorage because it was likely to have fewer, if any, boats in it. However, heading there carried with it the chance that nightfall and a weather front would catch us traveling through a stretch of the ICW bordered by shallow water and often heavy with traffic. Our decision hinged on whether the current would help us or hinder us.

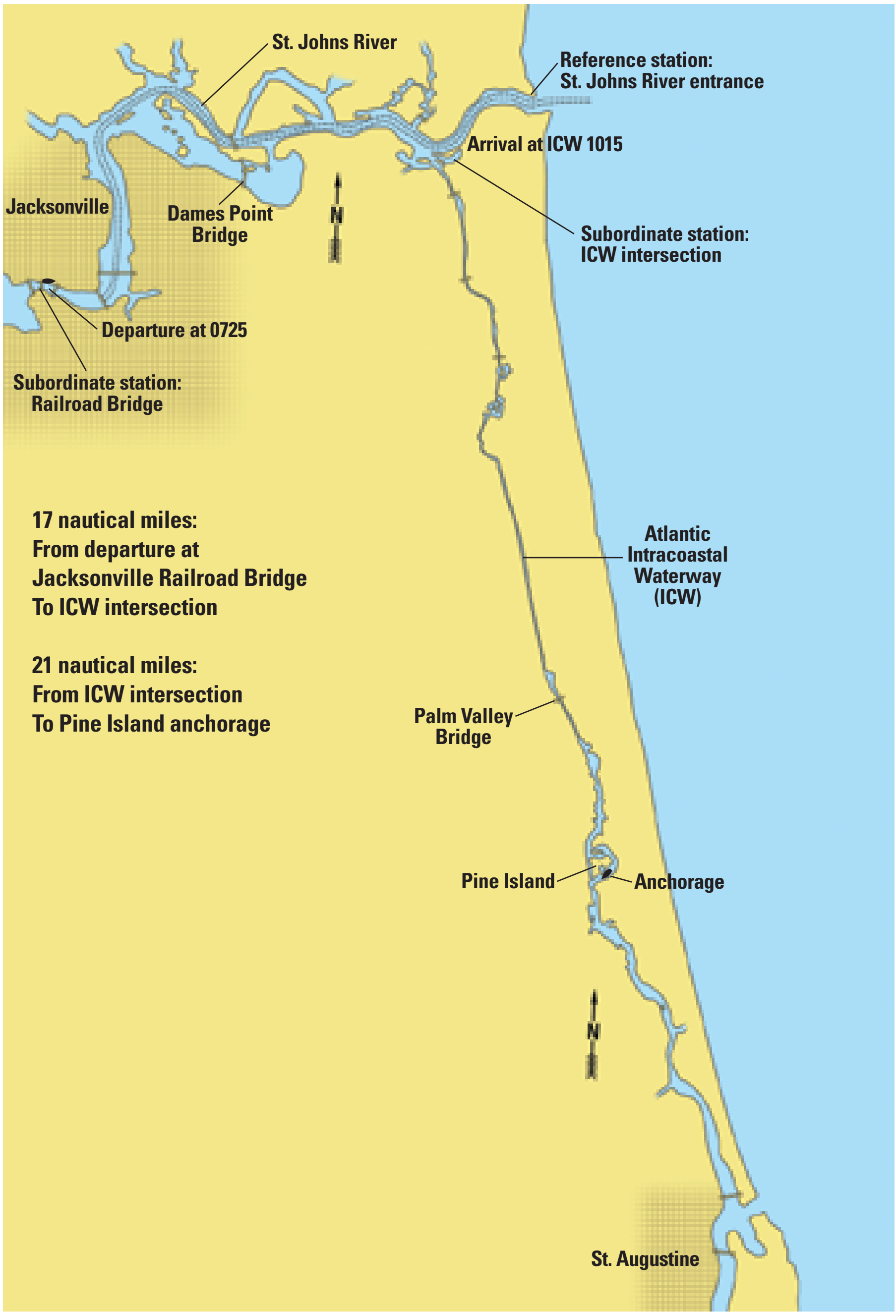
Reviewing the information for tidal currents in the area, we determined that the currents should be favorable for most of the trip. Sure enough, as we departed Jacksonville, an ebb current gave us a boost down the St. Johns River. As predicted, a flood current commenced once we reached the ICW, boosting our speed when we turned south into it. Our progress was as expected and we made it to the more distant anchorage with plenty of daylight to spare.

Tide and current data

Our source for information about tidal currents — the horizontal movement of tidal flow — was the current tables published by NOAA; in this case, the *2008 Current Tables: Atlantic Coast of North America*.

NOAA also provides data on tides — the vertical movement of water. The relevant publication in this case would have been the *2008 Tide Tables: East Coast of North and South America (including Greenland)*. Having both publications on board is helpful and at times necessary, since the data from one publication often cannot be deduced directly from the other. For example, the times when tidal current is least generally do not coincide with either high or low tide and, in fact, can differ by up to several hours.

To time our departure from Jacksonville with a favorable current, we looked in the current tables for our reference station, the St. Johns River entrance. We determined that, on

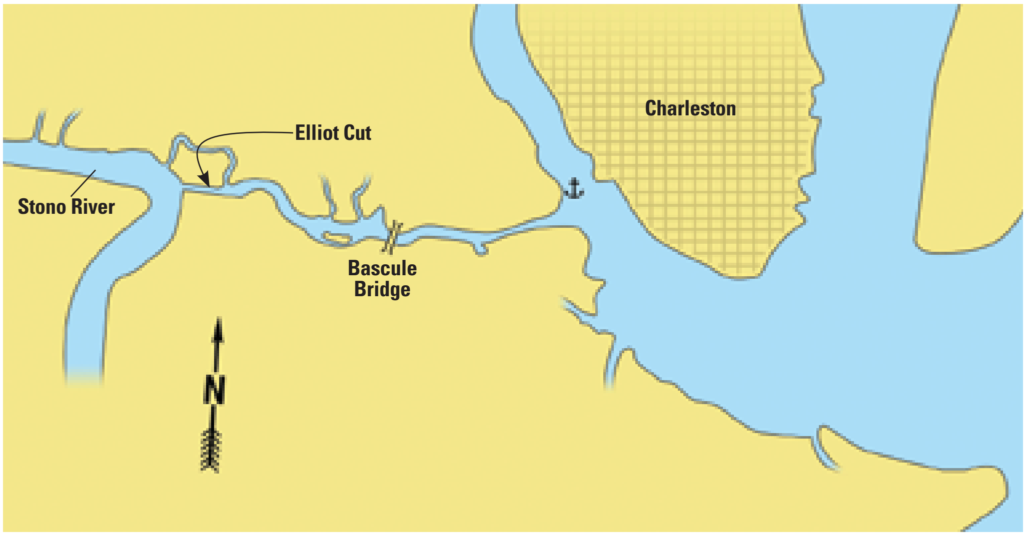


ILLUSTRATIONS BY FRITZ SEEGERS

When Jill and Rudy Sechez made the trip from Jacksonville to Pine Island, they used the current tables to determine the departure time that would give them a favorable current all the way.

tables

by Jill Sechez



Tidal currents can run fast in narrow Elliot Cut, but a timely departure from Charleston ensured a trouble-free passage.

our departure date of March 28, 2008, the time of slack before ebb would be 0234. We then looked up the time differential for the subordinate station closest to our departure location, which was the railroad bridge in downtown Jacksonville. We simply added this difference, which was 2 hours, 59 minutes, to the time at the reference station. We wanted a morning departure, so we were pleased to see that slack before ebb would occur at 0533.

To determine the time of slack before flood at our next subordinate station, the ICW intersection, we added the time difference of 27 minutes to the time of 0930 listed for our reference station. The result was 0957, and this became our target time for arriving at the intersection.

We calculated that, at 6 knots (our usual speed of 5 knots plus 1 knot of current), it would take us just under three hours to cover the 16.75 miles to the ICW intersection, so we departed at 0725. We reached the intersection at 1015 and entered the ICW on a flood current. This was a good thing, since the current tables showed that at Pablo Creek Bridge, located within the first 2.5 miles of the ICW, the current averages 5.2 knots at maximum ebb. Ultimately, we arrived at our anchorage, 20 miles farther on, at 1415.

Go with the flow

When we left Charleston, South Carolina, heading south on the ICW, we knew we would have to negotiate Elliott Cut. Tidal currents in this narrow passage can exceed 3 knots, especially if the wind, weather, and moon conspire together. We had previously passed through this cut against a stronger-than-normal current. Because we were barely able to make headway, had marginal steerage, and had no opportunity to turn around while in the cut, we preferred not to repeat the experience, particularly since tows also transit this very narrow waterway.

continued on page 31

The layout of the tables

The current tables are published for each year, in two volumes, *Atlantic Coast of North America* and *Pacific Coast of North America and Asia*. Both are divided into sections called tables. Instructions on their use and on how to perform the relatively simple calculations are included.

Table 1 gives, in calendar format, for various locations called "reference stations," the predicted times for slack water, the predicted times and speeds of maximum current, the direction (set) of flood and ebb currents, and the phases of the moon.

Table 2 lists, in tabular format, additional locations, called "subordinate stations," along with their latitude and longitude and the predicted times, speeds, and direction for maximum and minimum currents, at both flood and ebb.

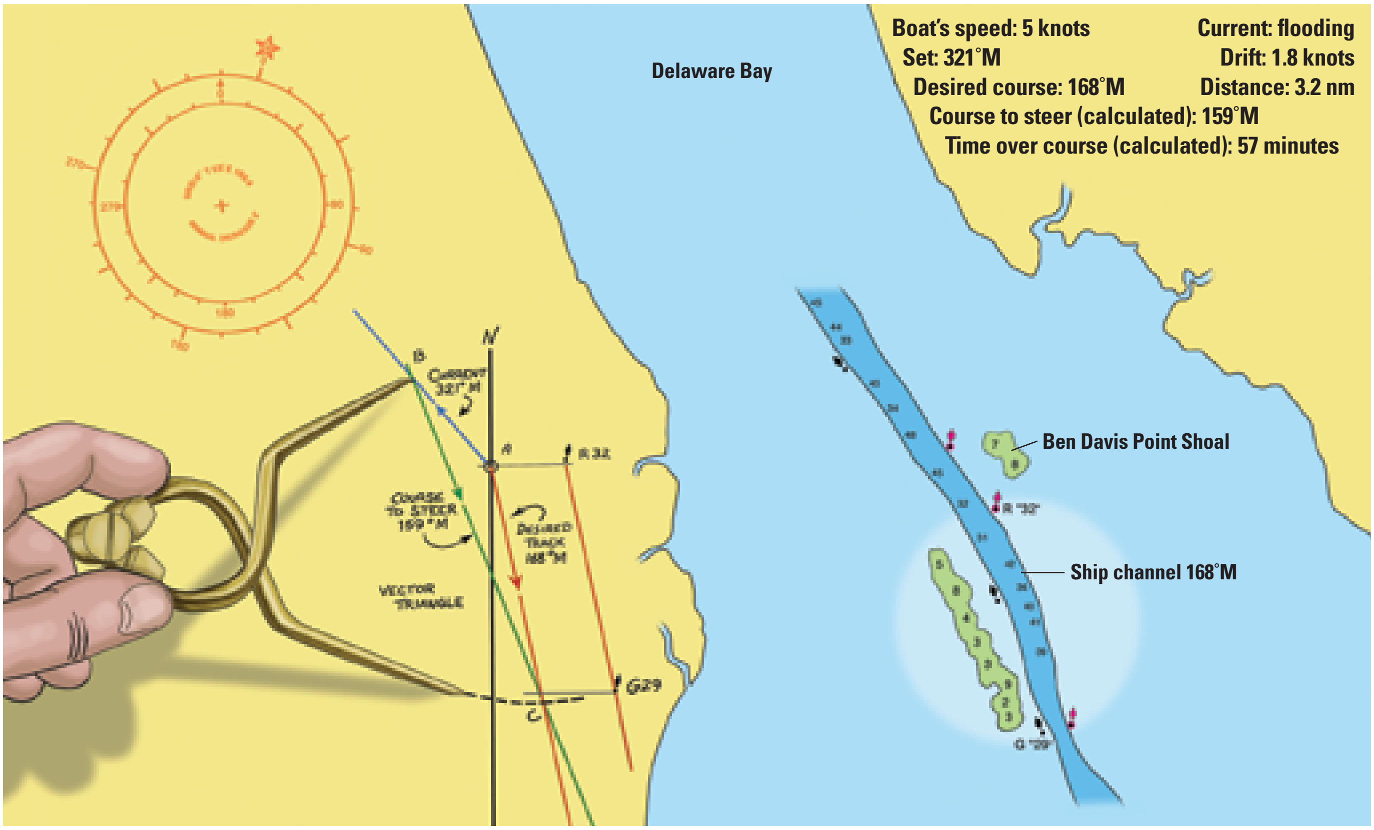
Table 3 is a chart for determining the speed of the current at times other than those given in Tables 1 or 2.

Table 4 indicates the time frames when the speed of the current, on either side of slack water, does not exceed 0.5 knots.

Table 5, found only in the *Atlantic Coast of North America*, lists offshore stations where rotary tidal currents occur. In the absence of restricting barriers, some currents flow in a continually changing direction, traveling around the compass, seldom achieving slack; these currents are called rotary tidal currents. This table lists their speed and direction in hourly increments.

Information pertaining to specific currents, wind-driven currents, and combination currents, along with current diagrams for specific locations, and a glossary of terms, is found in the pages following the tables. (Information for ocean currents and tidal currents in locales not listed in the current tables may be sought in publications such as pilot charts, pilot chart atlases, sailing directions, coast pilots, or some nautical almanacs.)

Standard Time is used throughout the publication. When Daylight Saving Time (DST) is in effect, the difference (one hour) must be added to the times in the tables. (Information for determining whether an area is affected by DST can be found in the *Nautical Almanac* or the *Nautical Almanac — Commercial Edition*). Also note: when depths are listed, these are the depths at which the data was obtained, not the depth of the water.



Sailing southward on Delaware Bay against the flood tide, you could encounter a current that sets against you and across your desired course. For example, the current tables might indicate that, near Ben Davis Point Shoal, on the reach of the channel between R 32 and G 29, the current will set at 321 degrees magnetic (321˚M) and the drift will be 1.8 knots. Your boat can make 5 knots through the water. You can determine the compass heading you need to steer to stay in the channel by constructing a vector diagram of the problem.

1. Start at point "A." Use the chart's compass rose and your parallel rule to draw your desired track line. In this case, 168˚M.
2. From point "A" again, draw a line at 321˚M to represent the set of the current.
3. Mark point "B" 1.8 nautical miles (nm) from "A" to represent the drift over a one-hour period.
4. Set your dividers to 5 nm (the distance your boat travels through the water in 1 hour at 5 knots). Place one point of the dividers on point "B" and swing them so the other point falls on your desired track. Mark this point "C."
5. The line "BC" represents the course to steer (159˚M as taken from the compass rose).
6. The length of AC is the speed you will make good over the bottom. It scales as 3.35 knots.
7. The distance from R 32 to G 29 measured from the chart is 3.2 nm.
8. The time it will take you to cover that distance is 3.2 ÷ 3.35 = .955 hours. Multiply this by 60 to get minutes (.955 x 60 = 57 minutes).

How to obtain the tables

The *Current Tables* and *Tide Tables* are published by Lighthouse Press, a division of ProStar Publications, but the data used in them is generated and updated by National Oceanic and Atmospheric Administration/National Ocean Service (NOAA/NOS) and has not been altered or abridged. These publications can be ordered online from ProStar at: <www.prostarpublications.com> or by calling 800-481-6277. They are also available through authorized chart agents and from some chandleries and bookstores. Corrections or updates to the current tables are issued in the Notice to Mariners or in the Local Notice to Mariners.

Tidal current (and tide) information is also available from NOAA on the Internet at <www.tidesandcurrents.noaa.gov>. Various software programs for current (and tidal) information are available from some chandleries, chart agents, and by searching on the Internet for terms such as "tidal current software."

Current (and tide) information for a limited number of estuaries, is available through a system called PORTS (Physical Oceanographic Real Time Systems). PORTS information is available online at <www.tidesandcurrents.noaa.gov>. This information is also accessible by phone; the phone numbers (too numerous to list here) are listed in the current tables and on the PORTS website.

Current tables are often available in cruising guides, almanacs (*Reed's Nautical Almanac* being one popular publication), and in privately produced tables. Although the data in these publications is most likely from NOAA, it may be abridged or abbreviated. Before using them, review the tables to ensure they contain the information you need.

Continued from page 29

So, this time, prior to weighing anchor, we consulted the current tables. We established the times when the current in the cut would be at its weakest, timed our arrival accordingly, and had a stress-free passage.

> **“Regardless of the form in which you choose to use them, current tables are a valuable addition to the ship’s library.”**

Informed is fore-armed

Knowledge of a current’s set and drift can also be helpful in determining when to arrive at or depart from a dock or berth (will the current overwhelm the boat or the helmsman’s competence?), when plotting or piloting (will the boat actually go where you think it will?), and during periods of low visibility, through tricky corridors, or when traveling close to hazards (can an “incident” be avoided?).

Confused seas often develop when the current and wind oppose one another. While such conditions can make a passage merely difficult, sometimes they can become treacherous. One day, when planning for a day of sailing offshore in 15-knot winds, we consulted the current tables and determined there would be a 2- to 3-knot current in the inlet setting against the wind. We postponed making the trip by boat and instead drove out to the inlet, where we saw 4-foot seas breaking in the inlet and for a considerable distance out to sea. These conditions would not have been conducive to a pleasant sail.

In some circumstances, the danger could be even greater. For instance, when a vessel is approaching an inlet from offshore, the first inkling that there might be danger could tingle in the captain’s brain when he correlates data from the current tables with the wind conditions. A strong wind blowing contrary to a fast current creates conditions in which broaching, pitchpoling, or being knocked down are all possibilities. In such a situation, the wiser course of action might be to divert to another inlet or even stay offshore until conditions improve.

The current tables do not always provide the whole answer, as predictions are sometimes complicated by other factors. In coastal areas where the inlets are interconnected, it may be impossible to predict the set of the current for every mile. Other factors can also cause conditions to be other than predicted. These include currents entering from rivers, creeks, or other bodies of water, wind conditions, weather patterns, phases of the moon, or distance from the reference station. Any prediction made from the tables should be used with caution until shown to be without error.

Current sailing

“Current sailing” is a technique defined in *The American Practical Navigator* as “the process of allowing for current when predicting the track to be made good or of determining the effect of a current on the direction of motion of a vessel.”

In some settings, particularly when crossing larger bodies of water, you can plan your current sailing by using data from the current tables to plot a vector diagram on the chart.

For example, if traveling south on the Delaware Bay on a flood tide, as you near Ben Davis Point Shoal, your boat’s course would be affected by a current which could, depending on the time and day, be setting in a northwesterly direction at 1.8 knots or more. To make a safe passage, or at least an incident-free one, you would need to take into account this information, which is provided by the current tables. (See illustration on facing page.)

Today, even with electronic navigation, the need still exists to have this information on board. If darkness, fog, or other vision-limiting factors should come into play and, in addition, an electrical component were to fail, it would be important to have a source of data for set and drift, as well as the knowledge of how to use them.

Although current tables are available electronically, in our experience, the printed versions are more than adequate and provide inexpensive and readily available information at the nav station. Since they’re portable, they can easily be taken elsewhere, even to other boats. Regardless of the form in which you choose to use them, current tables are a valuable addition to the ship’s library. You will find them useful when traveling the ICW, sailing on rivers subject to tidal flow, and making coastal passages.

Jill Sechez and her husband, Rudy, have lived aboard and cruised for 13 years, beginning with a 36-foot wooden cutter they built and currently with a 34-foot sail-assisted wooden troller they designed and built. As they cruise, they enjoy writing and assisting others with their boat-repair projects.

Definitions

Those who want to avoid being dubbed “lubbers” will need to use the proper terms associated with currents and tides since, to an old sea dog, using a term like “slack tide” is as dreadful as saying “knots per hour.” The following terms and their definitions are taken from *The American Practical Navigator* (commonly known as Bowditch), *Dutton’s Navigation and Piloting* or from the current tables.

Currents

Drift – speed of a current

Set – direction toward which the current is flowing

Flood current or flood tide – tidal current moving toward the shore or up a tidal river or estuary

Ebb current or ebb tide – tidal current moving away from shore or down a tidal stream or estuary

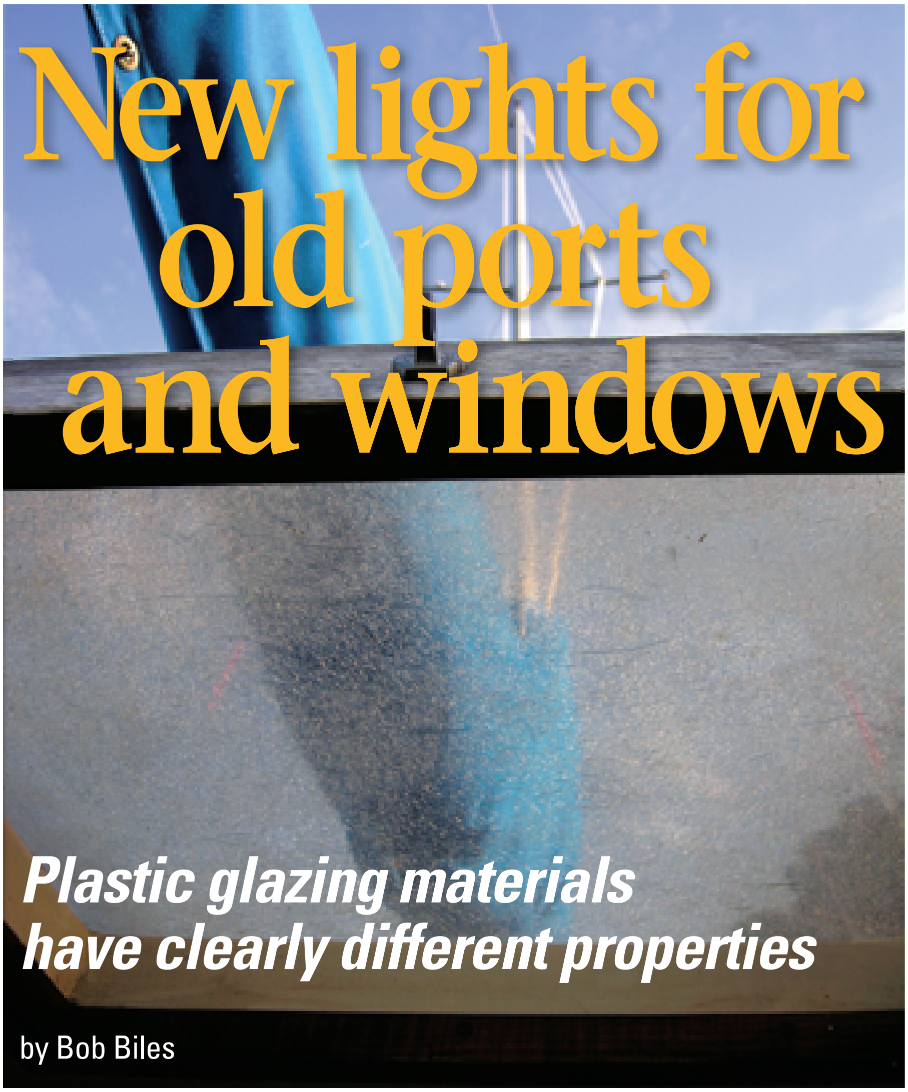
Slack water or slack current – the state of a tidal current when its speed is zero

Tides

High tide or high water – the maximum height of the water achieved by a rising tide

Low tide or low water – the lowest height of the water achieved by a falling tide

Stand – the state of the tide, at high or low water, when there is no discernible change in height



This badly crazed acrylic companionway slider is past due for replacement. With crazing this deep, not only is the clarity gone but the acrylic is now quite brittle.

New lights for old ports and windows

Plastic glazing materials have clearly different properties

by Bob Biles

For decades, most recreational boats have been built with hatches, windscreens, and ports made of rigid transparent plastics. Clear plastics have replaced glass because of their toughness, cost, ease of fabrication, and durability. Despite these great qualities, there comes a time when any good old boat needs to have some not-so-good old plastic replaced.

The two transparent plastics most commonly used on boats are acrylics and polycarbonates. Acrylics, known commercially by familiar trade names like Plexiglas and Lucite, have a longer history in the marine industry than polycarbonates, which are sold under trade names such as Lexan and Makrolon.

Both types of plastic come in a wide variety of formulations and tints. Each is available in a range of thicknesses with those in typical use on boats being from 0.06 inch to 1 inch.

Acrylics and polycarbonates are very different plastics. Whether you're replacing old parts or planning a new project to make your boat even better, understanding their relative strengths and faults will help you determine the better choice for the job.

Physical properties

Clarity – Both acrylic and polycarbonate are available in clear and a range of transparent tints. Either plastic has visible-light transmission values that approach or exceed 90 percent, which is comparable to glass. Clarity is most often affected over time in both plastics by surface abrasion (scratching or scuffing) or prolonged exposure to the ultraviolet radiation in sunlight.

For many years, acrylic was the preferred material in marine applications because polycarbonate, in its natural form, is much less resistant to UV. Old acrylic too long exposed to the sun usually develops crazing that goes right through the plastic, but this could take decades to happen. Overexposed polycarbonate takes on a yellowish cast and the surface becomes hazy. In subtropical climes, this could happen in a year or two. Chemists went to work and developed additives and surface coatings for special grades of polycarbonate that increased UV resistance so it's now comparable to that of acrylic.

Still, most grades of polycarbonate do not have the surface hardness of acrylic. That means polycarbonate is easier to scratch and mar. It also means it's harder to polish out blemishes in polycarbonate to restore original clarity. In addition, there is the possibility of eventually wearing away the UV-protective coating.

Mechanical properties

There are three ways to compare the mechanical properties of different materials:

1. Determine the force required to make each material fail in tension, compression, or flexing.
2. Measure how materials react physically when a steady force is applied to them.
3. Observe how they react when a sudden force or impact is applied.

The average tensile, compressive, and flexural strengths of acrylic and polycarbonate are similar, with acrylic slightly stronger in tension and flex. Polycarbonate edges out acrylic in compressive strength. Even though there is not generally a great difference in their ultimate strengths, polycarbonate is known as a "tougher" material than acrylic.

A modulus is a ratio of the stress or force applied on an object to the amount that object is strained or deformed before it breaks. A material with a lower tensile modulus (also known as a modulus of elasticity) will stretch more before failure under the same stress than one with a higher modulus. Likewise, the more a material bends or squeezes before it fails, the lower its flexural or compressive modulus. Polycarbonate has significantly lower tensile and flexural moduli than acrylic and will deform more for a given force than acrylic — it is far more elastic than acrylic. Acrylic, on the other hand, with its higher tensile strength and modulus values, can be brittle in service. For a roughly equivalent ultimate strength, polycarbonate's ability to withstand a significantly higher percentage of deformation without failure than acrylic is one reason for its reputed toughness.

Impact strength is a measure of the ability to resist breaking from a sudden and localized stress. Perhaps the biggest mechanical advantage polycarbonate has over acrylic is its impact strength.

Standard impact strength tests are performed with samples that are either notched (a V-cut the width of the sample) or not. An Izod impact test subjects the material to a local impact with a measured force in the area of the notch. Materials that fail with low impact forces are called notch-sensitive. A notch-sensitive brittle material will often fail under impact in the vicinity of localized stresses, such as around screw or bolt attachment points. Acrylic is known as a notch-sensitive material; polycarbonate is not. Other impact tests use plain (non-notched) samples. All those tests demonstrate that polycarbonate shows a resistance to localized impact that is many times higher than that of available grades of acrylic.

Choosing a plastic

A general understanding of the properties of each material is a starting point to plan your project. Consider two common boat jobs: replacement of portlight lenses and companionway dropboards.

Portlight lens replacement – Many production boats are built with fixed cabin portlights made with acrylic lenses that will eventually need replacement. If in 20 years a portlight has crazed but not broken, it has given good service — the boatbuilder has done a workmanlike job of engineering and installation. A typical installation has the lens held in place with a caulk or rubber seal, sandwiched between metal frames which are, in turn, fastened to the cabin trunk. This installation allows the lens to float, which isolates it from stresses on the boat and absorbs some of the energy of local impacts. The flexible continuous seal provides no notches or stress points from which cracks could easily form if the lens is strained. The relatively high flexural modulus of acrylic can help prevent the lens from flexing enough to pop out of its frame if hit. Unless the service requirements of the boat will change (planning a trip around the Horn), there are three advantages to replacing the original lens with acrylic:

1. You know what its service life will be.
2. There should be no need to re-engineer the installation to accommodate the different mechanical properties of a different material.
3. Acrylic generally costs less than polycarbonate.

Companionway boards replacement – A common custom modification to older boats is replacement of the old wooden dropboards in the companionway.

Dropboards can lead a hard life. They are often kicked, sat upon, stood upon, and even casually dumped into the cockpit locker. Few closed cabins suffer from too much light, especially on rainy days. A transparent plastic might be a good substitute for the old wooden boards. When you consider how to design and install new boards, polycarbonate merits consideration because of its ability to tolerate the abuse you expect to give it.

Over time, stress crazing has developed along the edge of this acrylic windscreen. It is most likely the result of overheating during fabrication caused by incorrect cutting or polishing.

General tips for working with plastics

- Leave the mask (paper or plastic) on while fabricating to avoid damage to the finish, but remove it as soon as possible after installation. Paper mask can be especially hard to remove after prolonged exposure to sunlight or moisture. After a couple of hours of peeling and scraping, you might even think of starting over if you made this mistake.
- Use the parts you are replacing as patterns for the new ones. Trace the outline on the mask of the new material and saw approximately ⅛ inch outside the line. Then attach the old to the new with double-stick tape and use a bearing-tipped router bit to cut to the finish line.
- For curved surfaces, both plastics can be "cold bent" in the same way as a piece of plywood. For acrylic, the rule of thumb is that the bend radius not be much tighter than 200 times the thickness of the plastic. Polycarbonate can be cold bent to a much tighter radius.
- When cut or sanded, plastics create a nuisance dust according to most MSD sheets. Check with your supplier and wear a dust mask.

An acrylic port mounted in the center of a now sun-fogged non-UV-protected polycarbonate window provides a good comparison of how the two types of plastic withstand weathering.

Getting your hands dirty

Tools – Use the right tools. When working on clear plastics, use saw blades and drill and router bits designed specifically for working with plastics. Blades and bits designed for rapid aggressive cutting can cause chipping or cracking. On the other hand, very fine tools can overheat the plastic in the cutting area which can lead to cracking and crazing later on when exposed to weather.

Cutting – Pay special attention to how you support the material as you cut. Secure your piece to a stable bench before cutting, then cut as close to the clamps as your tool will allow. Vibration or excessive bending can make things go bad quickly. It is also important to control the rate of cut. Polycarbonate is less sensitive to the speed of the tool through the material. With acrylic, too fine a blade or too slow a feed will result in the material re-welding behind the blade. Localized stress from this overheating can also cause crazing after the part has been installed. The same considerations apply to the use of router bits. Cut edges may be finished by removing tool marks with progressively finer sandpaper, then buffing with a white polishing compound.

Drilling – Drilling polycarbonate presents no special problems with standard drill bits, but acrylic may crack in the area where the bit breaks through the back side of the material. An alternative is to drill a small pilot hole through the material and finish with the final drill size, drilling with care from both sides. In any plastic, the hole should be slightly larger than the diameter of the fastener, and it's a good idea to chamfer both sides of the hole for stress relief.

Fastening – The standard DIY installation procedures for your new part usually involve either mechanical fasteners or bonding (sealing, caulking). Mechanical fasteners should hold, not clamp, plastic to other things. Over-tightened screws and bolts are a common cause of failure when installing plastic parts. They can create local deformation or cracking at the fastener location because the plastic part will not have the same structural or thermal properties as the structure it is fastened to. Tighten the fastener down snug to the surface; resist the temptation to crank it down hard.

Where you are bonding or sealing parts, understand that acrylic and polycarbonate have variable resistances to solvents. Be aware of the contents of both the adhesive (or sealant) used to install the part and the cleaners you clean up with afterward. Many adhesives and solvents used in and around boats can damage plastics. This information is not hard to come by. Talk to your supplier. Read the container. Check the Internet. *(**Note:** A good article on the subject of solvents and their uses appeared in* Good Old Boat's *November 2004 issue. **–Eds.**)*

Conclusion

In planning any project for clear plastics, be aware as a buyer. There are many grades of each of these materials for sale. Not all grades of polycarbonate have good UV-resistance and some grades of acrylic are tougher than others. Not just any grade of either plastic will necessarily be suitable for your application. Do your own research and work with an established supplier to make sure that your money and time are well spent. A basic understanding of the properties of these plastics and a little planning of your project will give you the pride of seeing your old boat shine.

Bob Biles has been sailing around Florida and the Bahamas for 45 years. He currently sails on Florida's Gulf Coast. Bob applied 25 years of experience in commercial plastics to create Seaworthy Goods, a company that designs, manufactures, and sells products to improve sailors' time afloat, see <www.seaworthygoods.com>.

More online . . . For more information on polishing acrylic and polycarbonates, go to <www.goodoldboat.com/reader_services/more_online/polishing_plastics.php>.

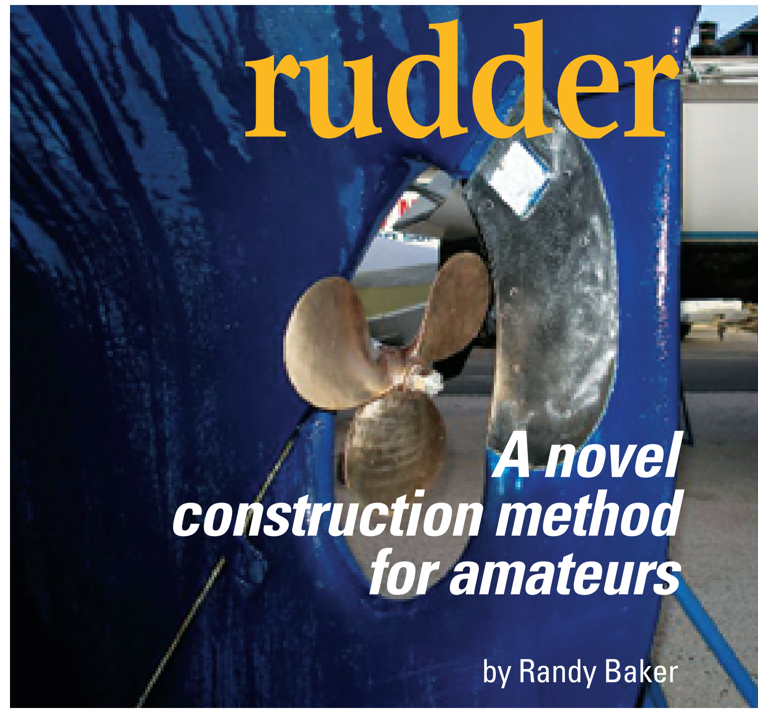
Resources

Mechanical properties of acrylics and polycarbonates
Check the technical sections or look for technical product downloads.
<www.theplasticsshop.co.uk>
<www.eplastics.com>
<www.professionalplastics.com/plastic-sheets>
<www.ebooksquad.com>

Fabrication tips and techniques
Check for technical and fabrication information in the sheet products section, search for the plastic name, or do a Google search with the kind of plastic and the phrase "how to fabricate" in quotes.
<www.cyro.com>
<www.piedmontplastics.com>
<www.ebooksquad.com>

YouTube
Videos showing fabrication, from amateur to professional.
<www.youtube.com>

The inside-out rudder



A novel construction method for amateurs

by Randy Baker

Corrosion concerns led Randy to fit the stainless-steel structural web onto the outside of his new rudder.

Few parts of a boat are more vital than the rudder. If you lose the use of your rudder, you have no easy means of steering . . . always a serious prospect. If the failure should occur at a critical moment — while sailing near a lee shore, for instance — the consequences could be catastrophic.

After hearing three firsthand accounts of rudder failures within just a few months, we resolved to make sure ours was in shipshape condition before we began more extensive cruising. We had some cause for concern. During a previous haulout, we had noticed pitting on the stock. We couldn't fully investigate at the time without dropping the rudder. That would have meant digging a deep hole in the ground, among other difficulties. With *Caribee* hauled out once again and well into a major refit, it was time to address the problem.

All three sailors who recounted their rudder failures to us said they had lost steering because welds between the stainless-steel stock and tabs within the rudder had broken. The stock still turned as designed, but the rudder didn't turn with it, or turned insufficiently to be effective.

Conditions within the laminate of an immersed rudder are ideal for generating crevice corrosion in stainless steel. Because stagnant, oxygen-deprived salt water is much more conducive to corrosion than seawater that is able to circulate freely, this is one of the most common types of failure.

The apparent corrosion of our stock, along with osmosis problems and water saturation, convinced us that a new rudder was the best solution. After a lot of head scratching, questioning, and research, I came up with a design for a rudder that has no embedded metal. The construction method is "inside out," in the style of an airplane wing or foil. This is the opposite of the more common molded method.

I believe this method is easier for a one-off construction, especially for unskilled builders. It's certainly easier to get the stock aligned properly, a critical factor. Depending on the rudder type, a small degree of misalignment may result in binding. This may not be evident in a molded rudder until the construction is mostly complete . . . a bit too late. With the inside-out approach, you can check alignment frequently and make simple adjustments at various stages to fix any problems as they show up. This is an intuitive project that takes shape as you go, so it's easy to make alterations before mistakes become serious.

Except for the welding and machining of the metal parts, any reasonably handy person with a working knowledge of epoxy and fiberglass construction techniques should be able to pull off this project, using a few simple tools. The only power tools required are a jigsaw and small grinder/sander, though a palm sander or random-orbit sander can be useful. The concept is well suited to keel- or skeg-hung rudders.

Frame design and construction

Unless you're a welder and machinist, you'll have to contract out the fabrication of the stock and attachment plate, just as you would with other construction methods. What you want is a stock the size of the existing one with two cheek plates welded to it. The plates will sandwich the fiberglass portion of the rudder between them. There will be no metal, except bolts, embedded within the rudder. The connection will be through-bolted with several hefty bolts. These should have flat heads countersunk into one cheek plate with threads tapped into the other so you'll wind up with smooth surfaces that won't create drag. The cheek plates themselves will be recessed flush with the fiberglass surface, producing a low-drag, hydrodynamically-smooth whole.

If your rudder is very thin in relation to the stock size, it may be necessary to flare the thickness of the rudder out slightly in the area of the cheek plates, then taper it down to normal size as you move some distance away from the plates. In our case, the plates had to be beveled on their forward edges because they were incorporated into the leading edge of the rudder.

Once you have designed the metal components, take the plans to a machinist. The best readily available material for the metal parts is probably

The cheek plates, at left, will be bolted to the rudder blade. They will transfer the rudder load to the rudder stock, at right, to which they are connected by substantial welds.

grade 316L stainless steel (sometimes called marine-grade stainless steel), which is more resistant to chloride corrosion than 304 or most other grades. The "L" means that the carbon content is below 0.03 percent, which reduces the sensitization effect caused by the high heat of welding. In the presence of air or oxygen-rich water, this alloy is highly corrosion-resistant. Even so, it's a good idea to have a ¼-inch hole drilled and tapped into each plate for attaching zincs. Try to find a supplier you can trust to give you the correct material, because you won't be able to identify 316L stainless steel just by looking. Look for a machine shop that is used to welding stainless steel.

The size and thickness of the plates should be appropriate for the size and type of the rudder and the expected loads. A little common sense goes a long way and some overkill never hurts, at least up to a point. In general, the less secondary support a rudder has, the stronger the cheek plates should be. Spade rudders need the strongest connection to the stock. For our moderately heavy 32-foot offshore boat with a keel-hung rudder, we used ⅜-inch plates of about 100 square inches each. Nine ⅜-inch bolts squeezed them to the rudder. I feel sure this was overkill, but it gives us confidence.

Rudder backbone

The next step is to build the "backbone" of the rudder. This is made from a flat panel of fiberglass laminate that is the shape of the profile of the original rudder and establishes the shape of the new one. If you want to change the shape or size of the rudder, you can do it now, but be cautious about making such changes without seeking expert advice, preferably from the boat's designer.

You'll be laying up a panel of fiberglass using mat, roving, biaxial cloth, or a combination of these, saturated with resin. It's OK to use polyester resin for this step and for the ribs and stringers that will determine the rudder's shape. If you use mat in the layup, don't use epoxy resin unless it's special matting designed for use with epoxy. You should use epoxy for most of the remaining steps because of its superior bonding and water-exclusion properties.

Wax a piece of plastic laminate (like the kind you see on kitchen countertops) a little bigger than the profile size of your rudder. Use mold-release wax or a few coats of car wax. (You can also use lightweight plastic sheeting over a solid surface such as a concrete floor.) In order to have extra material for making narrow ribs and stringers, make the sheet about 50 percent larger than the rudder.

Lay the plastic laminate on a very flat surface. Spread out your first layer of cloth on the plastic and saturate it well with catalyzed resin, working out any air bubbles with a ribbed metal roller (often referred to as an air roller) or plastic spreader. Use only enough resin to saturate the fabric. Before the resin has cured, add the next layer, and so on

"A little common sense goes a long way and some overkill never hurts, at least up to a point."

until the panel is the desired thickness. The finished panel of fiberglass should be about 3⁄16-inch thick for a moderately sized rudder. After it cures, you'll be able to peel it away easily from the waxed plastic. It will be very flexible and floppy at this stage.

Next, lay your existing rudder over the panel of fiberglass and carefully trace the shape onto the panel with a marker or pencil. Draw a second line ¼ inch inside the traced line to allow for the extra size the outer layer of fiberglass skin will add to the finished rudder. Take a jigsaw and carefully cut along your inner line. What you have now is a flat panel the shape and size of your rudder upon which you will begin to build the foil shape using ribs cut from the excess material.

Creating the sectional shape

Take careful measurements of the thickness of the old rudder at closely spaced intervals (about 6 inches apart) in a grid pattern. You can drill small holes in the rudder and measure the bit penetration or lay the rudder flat on the floor and use a straightedge set parallel to the floor. If you use a straightedge, mark the spot where each measurement is taken. Write the measurements beside the drill holes or marks. Divide the measurements in half. Subtract half the thickness of the backbone plus another 3⁄16 inch to allow for the outside skin of the new rudder. Transfer the corrected measurements as accurately as possible to the backbone, writing them down on spots that match the same stations on the old rudder. You may also want to chart them on a scale drawing. Double-check everything.

With a jigsaw, cut ribs from the remaining fiberglass sheeting, using the thickness measurements you pulled off the old rudder to determine their size and shape. Space the ribs about 12 inches apart, or more closely if you wish. The more closely spaced they are, the more precisely you will be able to define the shape of the rudder. For now, hold off on adding the first few ribs in the area where the cheek plates attach so you can first reinforce the backbone with a few layers of fiberglass, a point I will address later. This is all easier to do than it sounds, and any irregularities in shape will be obvious.

In the interest of speed, and ease of adjustment if needed, tack the ribs in place with hot glue or dabs of quick epoxy. After you've fitted the horizontal ribs, glue in some vertical stringers, cut from the same fiberglass panel. These will stiffen the backbone and give you additional reference points when building up the core material later.

After you've tacked the ribs and stringers in place, check the thickness and shape again. Make sure you've allowed for any fittings the rudder may require. It's very easy to make adjustments at this stage.

Sight down the tops of the ribs and view the structure from various angles to ensure that it looks true. If you need to reduce the height of some of the ribs or stringers, a small angle grinder fitted with a coarse-grit sanding disc makes quick work of the job.

The rudder's backbone is a fiberglass sheet, above left, that is bigger than Cheryl, above right.

Using excess material from the same sheet, Randy cut ribs, at left, and stringers, at right, that he used to define the sectional shape of the rudder and connect the skins to the backbone.


With foam strips fitted between the ribs and stringers, the rudder really begins to take shape, at left. At the top of the rudder, Randy built up the backbone with solid laminate to ensure a strong connection to the rudder stock's attachment plates.

Once you're satisfied, mix a small batch of epoxy resin and silica powder to a consistency somewhere between mayonnaise and peanut butter. Wipe all the joints with acetone or lacquer thinner and sand lightly. Run a small curved fillet of the mixture down both sides of every joint between the ribs, stringers, and backbone, including the rib-to-stringer joints. Use a Popsicle stick or latex-gloved finger to give a small radius to the fillet. Before the fillets cure, lay some narrow strips of glass cloth over them, overlapping the edges of the fillets by a half-inch or so. Then wet out the strips with epoxy resin. Once the epoxy has cured, the structure will be quite rigid.

Flip the frame over and place the ribbed side down. Support it with small blocks of wood to keep the backbone perfectly flat. It's important to make sure it's flat and straight. If the rudder isn't symmetrical, it will tend to pull to one side when the boat is under way. Repeat the procedure on this side.

When you've finished, the structure will be light in weight but very rigid and have the unmistakable appearance of a rudder. If you like, you can add stringers to more accurately define the shape and provide extra reference points for the build-out to follow. While any stringers you add at this stage will stiffen the structure, much of the rigidity will come from the fiberglass skin that goes on last. You now have a rudder in skeletal form, which has to be fleshed out.

Putting meat on the bones

The next phase is the build-out of the core. Before you begin, make certain that you have allowed for any fittings or supports that will be needed in the finished rudder. In our case, this meant an intermediate bearing, as well as a socket to accept the small bronze pintle of the rudder shoe. I also planned for a small hole near the trailing edge, with the idea that it could be an aid to emergency steering if the stock, stock connection, or tillerhead failed. I reasoned that my keel-hung rudder would still be supported by the intermediate and bottom bearings and a line attached to the trailing edge of the rudder would allow the boat to be steered in some fashion, perhaps by blocks set to the ends of a lashed-down spinnaker pole.

Once you're satisfied that everything is in order, start adding material to the frame. Fill in all the spaces between the ribs and stringers, bringing the core flush with their tops.

At the upper end, where the plates will be attached, the material should be solid fiberglass to ensure strength and prevent compression of the laminate when the plates are bolted on. In our case, I had already attached all the ribs below the plate attachment point, so any fiberglass material I added to the backbone below that point was not continuous but was in segments separated by the ribs. It would have been somewhat stronger if I had bonded a few continuous layers of glass to the backbone in the upper portion and placed the ribs on top of those layers. That's the reason I recommend that you temporarily hold off on installing the upper ribs.

A word from the technical editor

The guy who had to make the final call regarding the suitability of this article for publication for good old boaters was Good Old Boat *founder and technical editor, Jerry Powlas. He concluded:*

I chose to publish this article because the design is innovative and I think the task is well within the capabilities of many of our readers. Author Randy Baker writes that the the outer skin imparts much of the rudder's strength. That may be so, but I think the ribs are also very important to the structure. If you build a rudder like this, don't skimp on the scantlings. A little extra glass is much better than not quite enough. The same would be true for rib thickness and spacing.

The real test is that Randy has had his rudder in satisfactory service since 2004 and reports that he has had no problems. He recently wrote to tell us *Caribee* was in Pago Pago, American Samoa, when the tsunami struck. The first incoming wave shoved *Caribee* back across her mooring pennant and buoy at about a 90 degree angle, causing her to heel about 45 degrees. The pennant and mooring ball passed under the hull, and the force deflected the rudder to port, breaking a ¼-inch nylon restraining line on the tiller. When Randy later dove to inspect the hull and rudder, he found the rudder undamaged.

If you decide to reinforce the upper part of the backbone this way, add the upper two or three ribs after you've completed that reinforcement. Much of the rudder's strength will come from the fiberglass skin, but it's a good idea to build up and strengthen the backbone in this area just to be conservative.

You can use any kind of strong glass cloth that is compatible with epoxy resin. I recommend biaxial or even triaxial fabric, made up of multiple layers of unidirectional rovings stitched together in different orientations. It takes fewer layers of such fabric to produce a laminate with multidirectional strength than with unidirectional fabric. This offsets its higher cost to some degree.

Test-fitting the stock

When you've built up the stock attachment end a bit with fiberglass, do a test fitting to see how the rudder fits between the cheek plates. Make sure the frame is centered and aligned between the plates and is straight on the pivot axis. Then take measurements of how much space remains between the laminate and the plates. Add more fiberglass until it's close, then do another fitting. If the laminate is too high in isolated spots, grind it down with a coarse sanding disk.

Once the laminate is touching the cheek plates in a few spots, trowel in some epoxy/glass-fiber (or silica) paste. Wax the cheek plates and clamp them onto the rudder. After the mixture has cured, remove the rudder and check the result. It should only require one or two more additions of the paste to make the joint perfect. Don't use microballoons in this area because they have little compressive strength. Short glass fibers (you can shred some cloth with scissors to make them) mixed with epoxy are best, but an epoxy/silica mixture is OK if the voids you're filling are relatively small and shallow.

Filling in with foam

As you move away from the plate-attachment area, gradually use less glass and more foam to build up the core, transitioning to all foam about halfway along the length of the frame. The resulting ratio of fiberglass to foam should impart something close to neutral buoyancy in the finished rudder. Any other load-bearing areas should also be reinforced with glass.

"It's important to overlap layers of glass fabric at the leading and trailing edges to add strength."

Use structural foam for the core. Airex or Core-Cell, two brands sometimes used in cored-hull boat construction, or a similar product will work well. Glue the blocks of foam to the backbone, ribs, and stringers with epoxy, filling gaps with an epoxy/microballoon paste. During this build-out phase, the ribs and stringers act as guides. You'll know you have gone far enough when the surface of the core is flush with the tops of the ribs and stringers. If some of the foam blocks are a little too high, it's easy to sand off the excess. Finish by troweling on a thick paste of the same microballoon mixture, which will cure to a sort of foam that sands easily.

Once you've built all the fillers out to the height of the ribs, take a longboard and sand off any high spots, making the surface fair. You can buy a longboard at a boatyard chandlery or auto-body-repair supply outlet, but it's easy to make your own from a piece of

After building up the rudder's core with foam and fiberglass, Randy applied a microballoon paste, above left, which he then sanded with a longboard to eliminate any unevenness, above right.

Randy used epoxy resin and biaxial fiberglass fabric for the rudder's structural skins, wrapping the fabric around the edges for strength, at left. Once the glasswork was complete, he applied a layer of microballoon paste that he would sand to give the rudder its final smooth shape, at right.

¼-inch plywood. The board should be 4 or 5 inches wide and around 30 inches long. On one side, screw a small wood block at each end to serve as handles. Buy some 36-grit bulk sandpaper and cut it into strips the size of your longboard. Glue it to the plywood with a spray adhesive such as 3M Super 77.

Start sanding the surface in long, smooth motions until any high spots fall away. You will find the microballoon material is easy to sand.You will be left with a relatively fair surface that has some obvious low spots. Mix another batch of epoxy/microballoon paste and spread a thin layer over the surface. After it cures, repeat the longboard fairing process. Some sanding with hand-held sandpaper and/or a palm sander will probably be needed on areas where the curves are too sharp for the long-board. It may take one more application before the surface seems nearly perfect.

The structural skin

Next, apply the structural skin. Use as many layers of cloth as needed to form a skin about 3⁄16-inch thick. (Make a small test panel to see how many you'll need.) While it's possible to use woven roving, stitched biaxial or other multi-directional long-strand glass fabric is a much better choice.

To make sure the rudder is clean and grease free, I like to wipe down surfaces with an acetone-soaked rag before coating.

Coat one side of the rudder with epoxy resin. Lay a piece of precut fabric over the wetted surface, allowing the edges of the fabric to overhang the edges of the rudder by an inch or so. Wet out the cloth, working from the center out. Pour a little resin onto the cloth and spread it toward the edges with a plastic spreader. Remove any bubbles with a metal air roller. Use just enough resin to saturate the cloth. You can cut off the overhanging edges with an angle grinder or rasp after the epoxy has cured, but it's easier to trim away the excess with a razor knife when it's tack-free but still pliable.

Turn the rudder over and repeat, this time wrapping the edges of the glass cloth around the leading and trailing edges of the rudder, overlapping the first layer's edge by 2 or 3 inches. Flip the rudder back over, alternating sides and overlapping edges until the skin is thick enough.

It's important to overlap layers of glass fabric at the leading and trailing edges to add strength and prevent any tendency toward splitting under stress. If you're not sure you have enough overlap in these areas, or if you have difficulty getting the edges to wrap around without leaving voids under them, you can always add a strip of fabric along the edges, overlapping each side of the rudder by a few inches.

After the skin has cured, sand the entire surface as smooth as you can get it without removing too much material. Use the longboard or float an angle grinder fitted with a sanding disc lightly over the surface.

Mix another batch of microballoon paste and spread a thin layer over the surface. It's a good idea to do this with the rudder clamped or bolted to the cheek plates. That way, you can use some of the mixture to fill in any gaps between the plates and the fiberglass surface, making a perfectly smooth joint. Remove the rudder and sand the

***Caribee*'s new rudder, barrier coated, primed, and installed, awaits the the final touch: antifouling paint.**

Ted Brewer comments

When asked about the suitability of Randy's design and construction, Ted Brewer had this to say:

That is a reasonable fix but it may be far too complex for the average owner to carry out without profes-sional help. Certainly it is way beyond any skills I have acquired over the years. While it solves the problem of crevice corrosion inside the rudder, it does not solve the problem of crevice corrosion in the fastenings or inside the rudder port, which can pit the stock itself.

Unfortunately, little was known about crevice corro-sion in the 1960s and '70s when builders and designers began substituting cheaper stainless steel for the silicon and manganese bronze that we had always used for prop shafts and rudder stocks, castings, keel bolts, and other structural fittings. Later, when we did learn of stain-less steel's problems, the builders were reluctant to pay more for bronze since it would increase the price of their product when compared with the competition. Instead, they all chose to continue with stainless steel and pass the problems on to the owner somewhere down the road. They still do.

The answer, of course, is to use proper silicon bronze for the rudder stock. In the long run, after a rudder failure, it might be simpler and even less costly to carefully remove the old shell, take out the corroded stainless-steel stock and plates, replace that metal with silicon bronze, and re-use the old shell. At least then you would never have to worry about crevice corrosion again.

cured surface fair with the longboard. The purpose of this step is to fill small dimples and imperfections and ensure that the surface is smooth and fair in preparation for the barrier coat.

> **“This rudder has performed flawlessly for five years and nearly 10,000 miles of offshore sailing.”**

Keeping the water out

While a rudder built in this way won’t be too susceptible to water damage, it’s still a good idea to keep the inside dry, mainly to protect the foam from deterioration and to retard osmosis. The best way to seal out water is to cover the whole thing with a specialized epoxy barrier coat. Pay special attention to any areas where the skin is pierced by fittings or holes.

My favorite coating is West System epoxy mixed with their Barrier Coat Additive #422. This is easy to mix and apply with a roller. Four to six coats should be plenty. Once you’ve started applying the barrier coat, don’t allow any layer to fully cure before applying the next coat. If a coat does cure, you must clean it with soapy water or a solvent and sand it well before applying additional coats. This rule applies to all epoxy work: a chemical bond is always stronger than a mechanical one, so try to apply epoxy layers wet-on-wet for the strongest bonds. If you’re not familiar with the use of epoxy products and construction techniques, you can obtain excellent technical manuals from Gougeon Brothers and System Three.

The finished surface will be dark metallic gray in color and very shiny. If the barrier coat was carefully applied, it will also be smooth and free from runs or sags. The rudder is now complete, except for coating with anti-fouling bottom paint. Bottom paint doesn’t stick well to epoxy, so a primer is called for. Ideally, a two-component epoxy-based primer would be painted directly on the last layer of barrier coat before it is fully cured.

In practice, it may be hard to apply so many coats wet-on-wet because of the cure time involved. If the barrier coat has cured, before applying the primer, wash it well with soapy water or wipe it down with a solvent, then sand it to a dull finish.

Roll on two or three coats of a good two-part epoxy primer, preferably adhering to the wet-on-wet rule. We used Amercoat 385, which is certified for use above or below the waterline. This is an excellent product for any application that calls for a high-build epoxy primer. If the bottom paint you plan to use specifies a proprietary primer, apply that over the epoxy primer. It’s also acceptable to skip the epoxy primer and apply the specified primer directly to the barrier coat. Otherwise, most bottom paints should adhere well when applied directly to well-sanded epoxy primer.

Project summary

We spent about two weeks building our rudder, not counting time spent working out the design, dealing with the machine shop, and applying antifouling paint. Much of that time, we were waiting for epoxy to cure, so it was possible to work on other projects simultaneously. I did most of the work myself, but my wife, Cheryl, took a break from her endeavors to help out when I needed an extra pair of hands.

We think it was well worth the effort. The total cost, not counting our labor or boatyard lay days, was around $475 in 2004 in Trinidad. It would have been a bit more if we hadn’t had access to some scrap biaxial fabric and structural foam. This was considerably less than the lowest price that we were quoted for a molded rudder.

We now have a new rudder we can trust without having to wonder about any unseen corrosion. It’s very easy to inspect the welds; they can even be inspected with a mask and snorkel while the boat is in the water. Dropping the rudder is dead easy. We just unscrew the nine bolts from the cheek plates, remove the intermediate bearing strap, and tilt the rudder back while lifting it off the bottom pintle. To then inspect the portion of the stock that’s encased within the tube, and thus still subject to crevice corrosion, we simply remove the tiller head and the whole weldment slides down and out. We no longer have to dig a hole. We carry a set of replacement bolts, so we can easily and inexpensively replace any bolt that becomes corroded. So far, we have seen no sign of corrosion in either the bolts or the stock.

Caribee displaces 14,000 pounds. Her rudder is 76 inches long, 24 inches wide at the widest point, and has a maximum thickness of about 3 inches. The backbone, ribs, stringers, and skin of the rudder were all built to a thickness of 3/16 inch. The top one-quarter of the rudder’s length is solid fiberglass, gradually transitioning to a foam core about halfway along its length. The skin is made of biaxial glass fabric, with overlapping layers at the leading and trailing edges. The ribs were spaced about a foot apart. The stock is 1 3/8 inch in diameter and the cheek plates are about 100 square inches each in surface area and 3/8-inch thick. Both sides of the stock/plate junction are welded with a continuous bead. The plates are through-bolted to the fiberglass rudder with nine 3/8-inch bolts. All metal except for the bolts is 316L stainless steel. The bolt material is undetermined (dictated by availability) but probably 304 stainless steel, which warrants frequent inspection.

I’m not a structural engineer but I feel certain this rudder is stronger than the original one it replaced. It has performed flawlessly for five years and nearly 10,000 miles of offshore sailing, some of that in heavy following seas. If you’re planning to replace your rudder, consider building your own using this method. Lower cost may be the least important of the benefits you’ll enjoy.

Randy Baker and his wife, Cheryl, have been living aboard and cruising Caribee, *their 1968 Nicholson 32 sloop, since 1992. They transited the Panama Canal in 2008 and are spending the South Pacific cyclone season of 2009/2010 in the Kingdom of Tonga.*

Resources

Gougeon Brothers
<www.westsystem.com>

System Three
<www.systemthree.com/reslibrary/m_index.asp>

Amercoat 385
Certified for use above or below waterline
<www.coatingswest.com>

Making your own

The first cut

PART TWO

Gearing up to build a catamaran at home

by Dave Martin

"Completion is sometimes more important than perfection."

Dave built an extension on his garage, at left, then purchased a pile of high-quality marine plywood, above, to cut into dozens of components for the Tiki 30, below.

In the last issue, Dave Martin wrote about the chain of decisions that led to his building a catamaran in his garage. In this, the second of two articles, he examines the "time factor" and explains why he chose to build it in plywood.

In the spring of 2008, I purchased the building plans for a James Wharram Tiki 30 catamaran. There were many facets to the process by which I chose this design but, in the end, I basically wanted a strong, relatively inexpensive boat that I could build in about a year.

I focused on building time because, more than a lack of money, lack of time is often the reason a home project founders. It's a huge commitment, and puts building a boat into the same category as running a small business. If I don't show up regularly, remain focused, and make sacrifices, the project will fail. When distractions come along, I must set them aside, just like at a real job. For me, progress is addictive.

Each designer whose boats I researched provided estimated building hours for completing the project. Bear in mind that the actual hours taken will vary, depending on an individual builder's experience, the type of tools available, work-space constraints, and the level of finish desired. However, these estimated hours do help define the time commitment relative to each design and the building methods employed.

My Tiki 30 takes an estimated 1,000 hours of building time. From experience, I'm confident that I can maintain an average of 20 hours per week without getting burned out or feeling as though I'm missing out on other activities. Organization is important. Before I begin any task, I ensure that all the materials are on hand so I don't waste valuable hours running around town or waiting for the UPS truck to bring supplies.

Just like finding the money to buy materials, finding the time to build takes careful budgeting. Consider a 35-foot boat that will take an estimated 3,000 hours to build. This equals a year-and-a-half of dedicated 40-hour weeks. If weekends and the occasional evening are the only time available, 20 hours a week is realistic. The build time is now three years . . . and that excludes any allowance for "free" time. This type of scrutiny might tarnish a little the romance associated with building a boat yourself, but your success relies

All the plywood parts for one hull, some already saturated with epoxy, await assembly.

on a firm understanding of the huge time commitment needed to see the project to completion.

To stay motivated, I try to complete something each day. A step forward, no matter how minor, is progress. On days when I'm not able to devote much time to the boat, I set micro goals that are realistic. During the tedious moments of sanding and other repetitive tasks — when it seems the boat will never be finished — I step outside, take a breath of clean air and think about the tangible date of completion. Anticipating the finished boat keeps my energy flowing.

Calculating costs

Designers' websites typically post enough information to interest a home builder but never give enough detail to allow you to figure all the costs involved in completing the job. To get to where you can calculate the bottom line, it's essential to purchase study plans at nominal cost. These include a materials list. Actual building plans can cost many thousands of dollars, so it's wise to find out what's involved before committing.

Study plans are an essential step for other calculations in addition to project costs. Armed with accurate information, you'll find it easier to compare the various designs and building methods. For example, after evaluating several boats, I was surprised to learn that a 35-foot catamaran requires roughly three times the materials of a 30-footer. As a general rule, that also means it will take three times longer to build.

Calculating costs for hull materials, rigging, sails, and systems is straightforward. But remember to include peripheral items such as fillers, brushes, rollers, solvents, fasteners, tape, sandpaper, primers, and paint. Also include tools, workshop improvements, and heat. A prudent builder will tack on a 20-percent waste factor for materials to ensure there are no financial surprises or shortages.

Watching weight

Another poignant consideration when choosing a catamaran design is knowing how much weight the boat can carry. Catamaran designers provide two figures for displacement. The first is the boat's "empty" weight: the weight of the hulls, mast, rigging, and engine. The second and most important figure is often called the maximum load limit: the allowance for people, personal gear, systems, provisions, and liquids. It all adds up quickly, making it important to calculate the weight of everything you plan to have on board.

If you want a well-appointed interior with loads of trim and complicated systems with multiple batteries, inverters, watermaker, water heater, and refrigeration, the extra weight will cut into the maximum load limit. This will drastically reduce the boat's ability to carry essential cruising gear and provisions. A longer boat will usually support more weight, but it's not necessarily that simple; sometimes two boats of the same length will have different load limits because of their hull shapes.

Monohulls have more leeway with regard to overloading. Although weight is essential to increase a catamaran's ability to resist a wind-induced capsize, an overburdened cat quickly loses performance. Safety and comfort are also compromised if the narrow hulls are hogged down below their designed waterlines.

Choosing a design is an exhilarating exercise, but it becomes an economic balancing act that demands careful thought and a clear vision of the final product.

Material choices

A home builder has many established building methods and a variety of materials to choose from. Each has advantages for the amateur builder relative to time, cost, and maintenance. Ignoring science, I believe building materials and methods must also be evaluated on a scale of enjoyment. The boat is going to dominate my life for thousands of hours. If I dread the daily labor, chances increase that I'll rush the project and end up with an inferior product, or even abandon it.

One option for the home builder is to use a core material, such as Core-Cell, Klegecell, or end-grain balsa wood, and

Using copper wire, Dave stitches the plywood components together prior to gluing them.

Flat plywood takes on curves in the lower part of a hull, top left, to be joined by the upper hull, top right. Sole boards and deck beams tie everything together, above.

sheathe it inside and out with fiberglass fabrics and resin. Cored hulls are moderately lightweight, extremely stiff, require little long-term maintenance, and typically have higher resale values than non-cored hulls. Cores also provide insulating values that help deaden sound and provide resistance to interior condensation. Unlike balsa, synthetic core materials will not absorb moisture or rot if water infiltrates.

However, a cored hull will be labor intensive and expensive to build because of the need for temporary molds and jigs. These take time to make and use an abundance of wood.

Cored laminates have structural drawbacks in that repeated stress cycling can cause the cores to shear and cored hulls are prone to severe laminate failures after a collision.

But the biggest disadvantage to constructing a boat using laminates is the serious impact that these materials can have on the health of the home builder. In almost every stage, the air in the workshop is charged with harmful toxins, particulate matter, and odors.

Cutting fiberglass cloth with scissors is simple, but it creates millions of tiny glass shards that float in the air and stick to every surface. These are impossible to vacuum away and can permanently contaminate a workspace. Wetting out fiberglass cloth with resin is labor-intensive, tedious, messy, and will dominate the majority of construction.

Sanding cured resins and cloths is infinitely itchy and will coat the inside of a workspace with a fine layer of toxic fiberglass dust. Hundreds of hours of grinding and cutting will introduce these particles into every recess. An exhaust fan helps, but it simply moves the material outdoors where it flies with the wind and pollutes the yard. Elaborate vacuum systems, air exchangers, and dustless grinders can help cut down on the fumes and debris but these systems are not cheap. On top of all this, styrene-based resins reek. Polyester resin is pungent and vinylester resin makes polyester smell like roses.

When I evaluated the possibility of using laminate construction, I thought back over the years I have spent in shops where fiberglass boats were under construction. Each day, I had to put on a paper suit and respirator and tape gloves over my hands. Even with all this preparation, my clothes and hair would become saturated by fumes, my car stank, and I had to strip off my clothes before entering the house at the end of a workday.

With these wonderful memories, it didn't take me long to reject fiberglass construction. Despite the advantages, I wanted to enjoy the entire process of construction and absorb the magic that comes from a hull that is taking shape. For me, this is as fulfilling as using the boat later on.

The plywood option

Plywood construction offers perhaps the quickest and least expensive way to build a boat. I chose the stitch-and-glue method to build my Tiki 30. Compared to cored laminates, plywood has superior point-loading characteristics, which makes it more durable in a collision. Delamination problems are subsequently less severe.

Other techniques suitable for constructing a catamaran of wood include strip plank and cold molding. Both methods produce fine hulls but they require more skill, more expensive materials, and more time. Just like cored hulls, they require the construction of elaborate and precise frame molds.

Unfortunately, plywood-built boats have a bad reputation. This is mainly a result of poor building techniques employed prior to the advent of epoxy resin. Early plywood boats utilized polyester resin, which does not bond very well with wood in a moist environment. This leads to delamination, water infiltration, and rot.

A modern plywood boat would more accurately be termed a plywood/epoxy boat. This is because every surface, even the interior, is completely saturated with at least two coats of epoxy resin. Most of the plywood is coated with epoxy before it's even fitted into place. This is done to ensure that there will be absolutely no raw wood exposed anywhere.

Epoxy stabilizes the wood by sealing off the air, thereby preventing the wood from absorbing excessive moisture. To provide abrasion resistance, the external surfaces of the hull are sheathed with a layer or two of relatively lightweight fiberglass cloth. Although we are back to the fiberglassing argument, the level of cutting and grinding is minimal. A properly built and faired plywood hull will be indistinguishable from its fiberglass cousins and will last decades when properly cared for.

Quality counts

Any well-built boat starts out as a pile of top-notch materials. Don't underestimate the value of good-quality plywood; it will enhance longevity and increase resale value. I did extensive research before purchasing my raw materials.

Expensive marine-grade plywoods use waterproof, boil-proof (WPB) glue and often have a fungicidal additive to resist rot. The surface veneers, where all the bonding takes place, are thicker. The internal plies are all of the same species to ensure stability. Some degree of moisture is natural in wood, and different species might contract and expand at different rates, creating internal stresses. Using a single species in the manufacture of the plywood is therefore important.

High-grade marine plywood sheets are also guaranteed to contain no internal voids, fillers, or plugs. Voids in a sheet create weak spots, which could undermine the overall structural integrity of the hull. Since catamarans are built with an eye to lighter scantlings, each piece of the boat must be of the utmost quality.

"Since catamarans are built with an eye to lighter scantlings, each piece of the boat must be of the utmost quality."

A coat of fiberglass cloth and epoxy will toughen the hulls' exteriors, above. Two hulls take over the driveway, below.

On my boat, I used Lloyd's-registered okoume plywood (also known as gaboon). It is lightweight, has a tight grain, and finishes well when left bright. This is a huge timesaver for interior finishes. Other quality grades of ply, although heavier, are sapele and meranti. Marine-grade fir plywood is adequate, but the surface is very difficult to sand completely smooth and is not attractive for natural interior finishes. Over time, the grain of fir plywood can even leave print-through and be visible in exterior paint despite being covered with fiberglass cloth.

On my Tiki 30, the cost of the plywood is roughly one-seventh the price of the finished boat. Yet plywood accounts for 90 percent of the structural integrity. Trying to save a few hundred dollars at the outset will not pay off in the long run.

The other 10 percent of hull integrity is derived from wooden stringers and bracing. Sitka spruce has long been the gold standard of weight versus strength but it's expensive. Instead, I chose to use clear, vertical-grained fir, which is equally as tough and was within my budget. Its disadvantage is that it weighs 18 percent more. I calculated that using fir instead of Sitka spruce would add around 100 pounds to the boat but would provide an $800 savings. So it was a tradeoff: I combined heavier,

Nearly complete, the Martins' Tiki 30 goes for a dry sail in the Maine woods.

> I fantasized about building a dedicated workshop until I calculated it would cost more than the boat.

less-expensive fir with lighter-weight more expensive okoume plywood and, the way I see it, came out even.

Finding quality wood to build with can pose a problem in some regions. Construction lumberyards and home-oriented hardware stores seldom carry an adequate selection of boatbuilding-quality stock. I found many companies on the Internet that sell and ship quality lumber and plywood, but the freight costs must be considered. Here in coastal Maine, all species of lumber and marine plywood are readily available. I bought 24-foot long, kiln-dried, rough-sawn fir boards and was able to save quite a bit of money by milling the wood myself.

Workspace and tools

Anyone who plans to build a boat would naturally want a large, dedicated workshop with plenty of space to build both hulls at the same time and still have room for floor tools, gluing tables, and workbenches. I fantasized about building a dedicated workshop like that until I calculated it would cost more than the boat.

That's when I happily cleaned out our garage and added a 10-foot temporary extension over the door. There is just space enough to build one hull at a time. Before I started, I precut all the major hull pieces and stringer stock and did all the major glue-ups while I had plenty of room.

For this project, I purchased an average-quality table saw and a 12-inch portable surface planer. These two tools are invaluable for milling stringer stock to exact design specifications. Electric hand tools that I consider mandatory are a jigsaw, router, palm sander, drill, power plane, and an 8-inch disc grinder. Power tools create better work, allay frustration, and save time. Time — there is never enough to go around.

Postscript to completion.

I began writing this two-part article in January 2009 when I deemed the boat to be about about 75-percent completed. The sub-zero temperatures outside my shop had made it too expensive to heat it adequately, so I gave myself a 4-month "vacation'" from the project. I had logged 1,000 hours of construction time between June and December 2008. Both hulls were built and faired, the beams were roughed together, the mast was finished, and the tillers were laminated. I figured I'd "git'er done'" in a total of 1,500 hours. That left me dreaming of a launch date in August 2009.

Wrong! In the end, I logged 2,000 hours. I underestimated the time required to fit the beams into place, sew all the trampolines, and complete the rigging. I also came up against a major "time-versus-cosmetics" decision at the painting phase. I could have painted the hulls quickly and saved six weeks of laborious sanding. That amount of time saved would have represented launching "on time" but would have been a sorry conclusion to the enjoyment I'd derived from creating a boat from a stack of wood and a barrel of resin. I did not want to rush, just for the sake of meeting my arbitrary "deadline." I was also not interested in a late fall launch and a hasty shakedown.

We will launch the Tiki in the Spring of 2010, with fair winds at our backs and an entire summer season to look forward to.

Dave Martin is a contributing editor with Good Old Boat. *He and his wife, Jaja, and family live in Bremen, Maine, in a solar-electric house they built themselves. Dave is currently building a 25-foot Phil Bolger sharpie schooner (using plywood and epoxy) for Pemaquid Marine and Boatworks in New Harbor, Maine.*

Resources

Noah's Marine Supply
A helpful site for evaluating all the different building materials <www.noahsmarine.com> (Click on "old website" at the bottom of the menu bar to access the specs for different materials.)

Plywood specs
<www.boulterplywood.com>

Wood specific gravity table
<www.csgnetwork.com/specific gravwdtable.html>

Working outdoors with expensive and sensitive paint was trying, but the Doughertys proved themselves up to the challenge and were able to transform *Splendora*'s bruised and dull topsides, below, into a gleaming triumph, at left.

LPU blues: Painting *Splendora*

Rolling and tipping their way to glory

by Chuck Dougherty

Next time you're down at the marina, take a close look at the hulls of your neighbors' boats. You don't have to look very far to see rub marks, gelcoat faded from years of UV exposure, or the telltale signs of less-than-friendly encounters between their topsides and pilings and docks.

If your boat meets that description, chances are you've thought about having it repainted, as we did when we hauled our sailboat, a 34-foot Sea Sprite, for a bottom job. A boat that looks a little tired in the water usually looks a lot worse on the hard, and *Splendora* was no exception. Her scratched and badly faded flag-blue Awlgrip finish was overdue for cosmetic work.

We were surprised to learn that a professional spray paint job would cost between $3,500 and $6,500, depending on which contractor or yard did the work. Apparently, linear polyurethane (LPU) paints, such as Awlgrip and Imron, are the BMWs of the paint world. They are without equal in gloss, depth, and durability. They are also notoriously expensive, labor intensive, and unforgiving. Even the pros sometimes get inconsistent results; hence the big price tag. Since the price tag was too big for a couple of retired folks, we decided to do it ourselves.

There's a lot of information on the Internet about LPU paint. It's an exotic technology involving cross-linked molecules, solvent flash-off, accelerators, and organic-vapor hazards, including a cyanide compound that becomes airborne when the product is sprayed. Spray painting is not an option for the do-it-yourselfer. The roll-and-tip application method is much safer and, theoretically at least, easier to do.

The journey begins

The small-town hardware store near our marina sells marine supplies at competitive prices. The old-timers in the paint department seemed to know a lot more about house paints than boat paint, but we all learned together as we waded though the wholesale catalogs and placed the call to the supplier. Three days and $130 later (including hazmat shipping fees), we had a quart of flag-blue Awlgrip topcoat, a quart of converter, and a quart of brushing reducer.

Our plan was to paint one side at a time. (The transom had been professionally redone when we bought the boat five years earlier.) We started the prep work, which is especially important when using LPU paints. The product goes on very thin, no more than one or two mils for each coat, so any imperfections will show through. Also, the surface must be 100-percent free of wax and alkyd-based paints or other contaminants, as they will affect adhesion and performance of the paint. Removing these can be quite a task. The

Weeks of hard work resulted in a perfect paint job, at left, and a boat as lovely as her surroundings, below.

lesson here is to *never* wax your boat if you think you might paint it in the future.

We carefully repaired the dings and scratches with polyester filler, touching up with epoxy primer, and did the final sanding with 220-grit paper. After five days' work, the hull was now a clean, smooth, powdery blue. Our fellow boaters were impressed and asked a lot of how-to and what's-next questions. The yard manager, well-known for his disdain for do-it-yourselfers, was not impressed. "What the *heck* are you *doing*?" he boomed. From atop our ladders, we responded as best we could through our brand-new 3M organic-vapor respirators, but he was already walking away. "That's one of the prettiest boats in the marina, and you're *ruining* it," he added over his shoulder. Everyone else avoided making any further eye contact.

Theory vs. real world

In theory, application of LPU paint is a fairly straightforward process. It's a two-part plastic topcoat with a tinted base and a catalyst (converter). A third component, reducer, is used to thin the mixture. After mixing these and letting them react for a few minutes, you pour a small amount into a roller tray.

In the roll-and-tip method, you roll the paint on the hull in a W-pattern in an area of about two roller widths, then roll the same area vertically to ensure uniform coverage. Next, you tip the freshly rolled paint with a high-quality brush to smooth out the stippled surface and bubbles left by the roller. This must be done very quickly and exactly right because the plasticized surface skins over in about 60 seconds — and there's no going back to fix mistakes.

There's a nice demonstration of this technique in a streaming video at Yachtpaint.com. It shows a powerboat being painted with Interlux Perfection, a consumer-grade LPU that's much more forgiving than Awlgrip or Imron. Be sure to notice how easily and smoothly the paint is going on and how one man is doing both the rolling and tipping without even raising a sweat. He looks as if he's enjoying the task. Note that he's working on a scaffold inside a large, well-lit, air-conditioned building. Finally, see the completed project in all its shiny and flawless glory, a finish that rivals even the best spray jobs.

It's an impressive demonstration, but application of commercial-grade LPU paint in the Great Outdoors (the boatyard) involves a complex set of variables that must be controlled. Everything in the equation has to be perfect. The optimum conditions: a warm (68 to 75° F) overcast day with low humidity, zero chance of rain, and no wind. Morning is better than afternoon, so the paint can cure before the evening dew ruins it. The paint has to have the exact viscosity for the heat and humidity prevailing at the moment it's applied, so the amount of reducer has to be exactly right. Too much reducer and the thin paint will fall off the vertical surface in the form of sags and curtains. Too little reducer and the roller and brush strokes won't level out.

Also, the temperature of the surface being painted has to be lower than 83 degrees. This is a problem, because a 70-degree hull can zoom to 130 degrees 15 minutes after being exposed to direct sunlight. The reducer flashes off in seconds. If this happens in the middle of a painting session, just throw away the rest of that very expensive paint you've mixed and go home. Wind presents a similar obstacle; even a light breeze will suck the reducer out of the painted surface faster than you can tip it.

The Blue People

The finish quality of the first few layers of paint is not that critical because the emphasis is on creating film thickness and depth. Some folks just roll and sand each coat, saving the tipping until the finish coat. But we treated each application as a final coat because we needed all the practice we could get. My wife, Sarah, and I spent the next four weeks rolling, tipping, and sanding. After three coats on each side, we had achieved progressively better, but still less-than-satisfactory, results.

At the marina, we became known as The Blue People, a reflection of the vast amounts of blue paint and dust in our clothing and tools, on our hands and faces, and in our outlook on life in general. Things were not going well. There was a certain degree of weird unpredictability about the whole project.

On a particularly dry and hot day, the static electricity from sanding was so intense that we had to wash the hull three times to remove all the paint dust. A few days later, we had the Attack of the Leafhoppers, when a great swarm of *Cicadellidae* descended on the freshly-painted hull. These tiny insects are nearly invisible, but they can plow amazingly long and visible furrows in the paint before finally succumbing to the solvents. Very impressive indeed. Imagine *Homo sapiens* trying to wade through a couple of hundred yards of highly toxic mud.

We discussed the project between ourselves and with anyone else who

would listen, to the point of obsession. Our boating pals were sympathetic, but we could see their eyes glaze over when we went into the details. One person who did listen was Ted, the U.S. Paint technical representative, who was very patient and provided a lot of helpful advice.

"It sounds like you're making progress," he concluded at the end of a long phone call, "You're doing everything right; all that's needed is some decent painting weather."

A perfect morning

By then, it was mid-October and we were running out of time. On a beautiful cool, dry, and partly cloudy morning, we mixed up the paint and said a short prayer to the Awlgrip god. We thought about offering up a small sacrifice, but it was the yard manager's day off.

After doing the first few feet on the port side, we knew we were going to make it. The lessons learned from previous sessions were serving us well. We had extra reducer in a restaurant hot-sauce squeeze bottle so we could quickly add small amounts to the mix as the temperature rose. The roller tray was on a stable, easily movable platform (one of the marina dock carts). Sarah had become expert in judging paint viscosity and in rolling the exact amount of paint needed for each strip. To solve the problem of brushes loading up, I had five, 3-inch Purdys ($16 each) at the ready and I'd mastered

> **"We now have a boat that's a guaranteed head-turner in any marina or anchorage."**

the art of making the long, very light, top-to-bottom strokes that work best in the tipping process. Most important, we had learned to work as a team, shoulder-to-shoulder, with minimum wasted effort and few mistakes. Fifty-five minutes later, we finished at the stern, stepped back, and looked at our work. We'd nailed it.

A couple of weeks later, we finished the starboard side and repainted the boot and cove stripes. The whole yard crew (and the marina's owner) turned out when we splashed *Splendora* once more in early November.

The balance sheet

Our boating friends ask us if the project was worth doing. We'd wasted a lot of expensive materials in our attempts to get it right and it cost us many sleepless nights, as it was one of the most difficult and frustrating things we'd ever done. We'd also missed the best fall cruising season in recent years on the Chesapeake.

On the positive side, the total cost of the project was under $1,000, including yard storage fees, and we now have a boat that's a guaranteed head-turner in any marina or anchorage. "Yes," they ask, "but would you do it all over again?"

Now that, my friends, is a completely different question indeed.

Chuck and Sarah Dougherty live in Virginia and cruise the Rappahannock River and Chesapeake Bay on Splendora, *their 1983 Sea Sprite 34.*

The rest of the story

After finishing the job, Chuck put together a detailed how-to tech sheet in case he and Sarah ever want to undertake this job again (although *that* sounds unlikely!). He will make this document available to any fellow sailors interested in improving their boats' dull topsides the do-it-yourself way. Once you have contemplated this document, you may think a yard bill is very reasonable. Don't say Chuck didn't tell you so. Contact him via email: oakhillmax@va.metrocast.net.

Going solo on short

Stay safe and sane when sailing singlehanded

by Richard Smith

My friend Dorothy's brother was visiting from Ohio. She said he was a fellow sailor and invited me over for dinner. Her brother turned out to be Robert Manry, who'd just crossed the Atlantic in his now legendary *Tinkerbelle* — at 13½ feet, the smallest boat to have done so at that time, which was 1965.

As he described the crossing, I began to think differently about my little home-built 18-footer. Suddenly she was bigger than I'd thought and capable of great adventure. It was a good evening all around. I was left with the notion that true adventure on a small boat requires, at least in part, sailing alone.

Robert Manry sailed by preference with his family but also found single-handing an essential part of his love of sailing. Singlehander Bill Howell put it another way. He wrote, "If you love adventure, whatever you do is much more adventurous if you do it alone."

Accounts of singlehanded ocean crossings are among the most exciting and inspiring in the literature of the sea. It is well to read and re-read the voyages of Francis Chichester, John Guzzwell, Kenichi Horie, Ellen MacArthur, and so many others. From Joshua Slocum's epic *Sailing Alone Around the World* to Robert Manry's *Tinkerbelle*, the great singlehanders never fail to inspire.

But the difference between reading about sailing alone and actually doing it is like the difference between reading about making love and actually doing it. Setting off in a small boat without anyone else on board is an inherently dangerous act whether the aim is to cross an ocean or spend a week or two seeking night-time anchorages closer to home. Neither should be undertaken lightly.

Stay connected

The main thing for the singlehander is to stay on board. Stay in the cockpit unless it's absolutely necessary to go forward. Substantial toerails are important safety features, as are stout lifelines. Jacklines should be rigged as close to the centerline of the boat as possible and used with short tethers made fast to D-rings in a harness type PFD so, if you fall, there's a better chance you'll land on deck. The jacklines on my Ericson Cuising 31 are made from rigging wire with swaged thimbles at the ends that connect to well-backed eyebolts. The forward ends are shackled and the cockpit ends are lashed so they can be cut loose in an emergency with others on board. If all else fails and you suddenly find yourself staring at the boot stripe, there should be a ladder or other means of getting back on board.

"Non-skid" decks can be notoriously slippery, especially as they get wet. Replace your deck shoes when they lose their grip or become hardened with age. Thinner and more supple soles allow for a better feel of the deck. Look where you're going and think about every step you take. Move about very carefully with "one hand for yourself and one hand for the boat." If you must move quickly, remember *festina lente* — make haste slowly.

Be aware

It's important to know where your boat is and where it's likely to be in the next few minutes. If you sail with a GPS, be sure you know how to use it without taking your eyes off the shore any more than necessary. Make sure you can back it up with conventional piloting methods in the case of battery or other equipment failure. Develop a good sense of how close you are to things — including the bottom — by sight alone. Learn to judge distances and heights. Keep paper charts in the cockpit along with your instruments, hand-bearing compass, cruising guides, tide tables, and log book. Organize other necessities such as sunblock and glasses where they're handy to the helm.

Toerails and reliable deck shoes help you stay aboard, at right. A ladder reachable by a swimmer is a last line of protection, above.

Be alert

Keep a good and constant lookout, especially in limited visibility. When you have your hands full tacking, dealing with backed jibs, and clearing lash ups of one kind or another, your eyes can easily be diverted. Make sure your boat and its equipment present as few obstacles to good visibility as possible. Many potential hazards can lurk behind Lifeslings and horseshoe buoys, barbecues, outboard motors, inflatables hauled up against the transom rail, fenders, and opaque sections of a dodger. Rain on plastic windows and side curtains can obscure crab-trap buoys, deadheads, kelp beds, and a host of hazards. While keeping tabs on immediate dangers, also remember to keep a 360-degree watch on such things as speeding powerboats hard on their GPS tracks and supertankers that come up out of nowhere.

An autopilot is something of a mixed blessing to the singlehanded sailor sailing close to shore. It can be a good extra hand, especially toward the end of a difficult day spent tacking through rambunctious water, but overuse can encourage spending too much time away from the helm. Keeping your hands on the wheel or tiller focuses your attention, keeping you in better touch with the boat, where she's going, and how she feels.

Have proven methods

Devise a good method of making sail and stick to it. Some singlehanders swear by lazy-jacks. Whether you do or not, make sure that all is clear aloft and that you know what's happening at the other end of the line you're hauling. There's no one else to spot an open snapshackle or a halyard about to foul a spreader.

Consider leaving a mooring under power with the main halyard attached and all but one sail tie cast off. Getting the main up with as little fuss as possible means you can get your eyes back on the water quickly.

Plan and practice a simple and foolproof way of getting two reefs in

With only one pair of eyes aboard, you need a clear view of your surroundings. Cockpit clutter is not your friend, at left. A headsail with a high-cut clew will let you see what's ahead, below, and binoculars will help you identify it, at bottom.

the main. When you get the first inkling that it might be well to reef, do so. Don't wait, getting more and more anxious, rationalizing away those dark scudding clouds and whitecaps off to windward in the hope that things will get better. If the morning breeze is building, consider tying in a reef before leaving that snug anchorage.

The roller-furling jib or genoa is a boon to many singlehanders. You can reduce sail quickly with just a few turns, and furling from the cockpit is a safe and convenient way to clear the foredeck prior to anchoring. A headsail with a high-cut foot, well off the deck, can provide an uninterrupted view of the horizon and will not go amiss. If you plan to use a spinnaker, make sure your skills and energy are up to the care and feeding of it. Think of everything that can go wrong with a full crew. Now multiply it by four if you're on your own.

Be prepared

Keep a sharp boat knife with marlinspike and shackle key on a lanyard in your pocket at all times. Some solo sailors also keep a knife in its sheath lashed or duct-taped to the binnacle or tiller for emergency use.

Be equipped

In addition to the electrical bilge pump, mount a good manual pump near the helm where it can be operated with one hand while steering.

Keep a good non-collapsible boathook within reach and have it weighted so it floats in an upright position and high enough to be grabbed from the deck or cockpit. Devise a good way of picking up buoys by yourself and practice in all conditions.

Keep a pair of binoculars handy. They should be light, feel good, and be easy to use with one hand. Sailing close to shore, I use binoculars for bringing

> "Sailing alone is aided and abetted by a general curiosity about the water and the creatures who live in and on it."

up points and bays on a distant shoreline, identifying aids to navigation, and looking for ripples around the bases of buoys for indications of current speed and direction. I look for glassy patches and signs of wind signaled by cat's-paws, the heel of other boats, the drift of chimney smoke, and movement in the tops of tall firs.

Binoculars also get a workout when I spot a bird I don't know, seals, porpoises, or whale spouts. Sailing alone is aided and abetted by a general curiosity about the water and the creatures who live in and on it.

Be neat

Whether you run halyards and other running rigging back to the cockpit or keep them secured up forward (there are advantages and disadvantages both ways), try to keep the deck and cockpit well organized. Avoid a jumble of lines. Coil halyards and secure them after each use.

The solo sailor also has to consider what happens when crossing a turbulent pass in 20-knot winds that blow counter to a strong current or when approached by a large, fast-moving powerboat. These events can cause turmoil down below. Nothing in the cabin should be affected by anything less than a knockdown. The last thing you want is to slip and slide in spilled olive oil or Simple Green at the foot of the companionway ladder.

Sometimes, the simplest of meals is all it takes to crown a day of solo sailing, at right.

Be warm, fed, and watered

To cut down on trips to the cabin, I keep an assortment of sweaters and jackets, hats and gloves, foul weather gear, and such in a small hammock rigged between stanchions. As well as carrying a carton of water bottles in a cockpit locker, I also like to keep a thermos of hot tea or coffee in an insulated bag with sandwiches, fruit, and other snacks hung over the binnacle.

Meals are apt to be simple affairs when you're on your own. Some of my

Under way, a string hammock provides a handy repository for extra layers of clothing.

solo-sailing friends seek restaurants at the end of a long day on the water. One friend, a former climber who frequently sails alone, takes freeze-dried foods on his cruises and boils up soups in bags. There are evenings when I'm not up to much more than dropping an egg in the punched-out hole of a piece of fried bread. But I've also spent wet and happy days at anchor making Irish soda bread in a pressure cooker and getting together a gourmet meal inspired by my dog-eared shipboard copy of *Joy of Cooking*.

Occupy the mind

Loneliness stalks the singlehanded sailor and must be dealt with before the adventure can truly begin. It's important to occupy yourself with interesting pursuits when you're on your own and there's no one else to help take the edge off your splendid isolation. Sailing a small boat is its own reward, but the safe and exciting enjoyment of cruising singlehanded close to shore is an acquired art. The trick is to busy yourself with things you enjoy doing.

Keeping the cell phone turned off for a few days is a good start. I try not to call home until the cruise takes over and solitary contentment begins to replace loneliness . . . about three days and three nights.

Reading a good book is the lone sailor's traditional way of avoiding the dreaded *ennui*. You'll have access to the radio, DVDs, BlackBerries, cyber gaming, and all the rest, but try to avoid replicating the comfortable world you've just left.

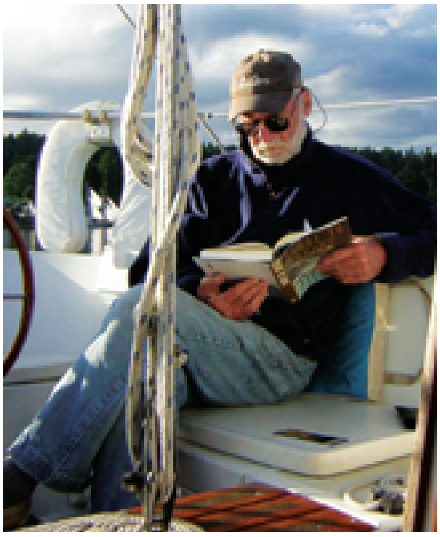
A good rowing dinghy is essential to my good humor when singlehanding. I like to start the day by rowing along the shore. My newfound enjoyment of bird watching comes almost entirely from cruising singlehanded, watching crows mobbing a lone eagle, and following a great blue heron along the water's edge, admiring its short takeoffs and smooth landings as it squawks the squawk of the ancient pterodactyl.

I throw in a couple of boat cushions before casting off in the dinghy and use one for kneeling as I climb back on board. Boarding and landing from the dinghy are among the more hazardous activities for the solo sailor. Do them with great care and respect and always wear a PFD that gives you freedom of movement to row and moor in comfort and safety.

I tow the dinghy except when crossing wide straits, when I expect heavy weather, or when undertaking a particularly long or arduous passage.

It's difficult for many would-be singlehanders to enjoy the solitary nature of sailing without a crew. But after a couple of days, if you discover the knack, a sense of independence and self-reliance begins to assert itself and the world is set to rights. You've moved your boat more or less where you wanted, had an unexpected adventure or two, and suffered your own company to no bad effect.

Richard Smith is a contributing editor with Good Old Boat*. He has built a wide variety of boats and sailed them in waters near Detroit, Seattle, and Liverpool, England, for about 40 years. These days, when not messing about with his fleet of five dinghies, he sails an Ericson Cruising 31 with his wife, Beth, in Puget Sound. But when Beth can't make it and the wind and waves beckon, Richard often sails alone.*

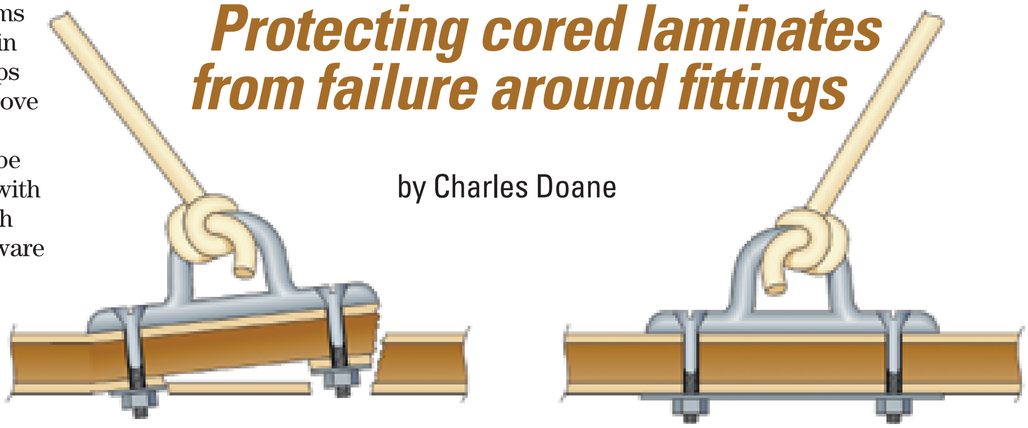


Solitary does not mean lonely, especially with a good book to read and a dinghy in which to explore the anchorage. With no one to see you if you slip, boarding from the dinghy is not to be taken lightly, far right.

Hardware on soft decks

Protecting cored laminates from failure around fittings

by Charles Doane



Inadequate backing under highly loaded hardware can lead to failure of the deck laminate, at left. Substantial backing plates prevent this by distributing the loads, at right.

ILLUSTRATIONS BY TED TOLLEFSON

Though most older fiberglass boats have hulls of solid laminate, their decks normally are built of two thin skins of fiberglass enveloping a different material. This "sandwich" construction has big structural advantages. Cored laminate is much lighter and stiffer than solid laminate.

As early as the 1950s, builders realized this was a better way to build a deck, as the extra stiffness makes it unnecessary to support it with beams underneath. Further, weight saved in a high part of a boat's structure helps lower its center of gravity and improve its sailing performance.

Two important provisos should be respected, however, when dealing with cored deck laminates, both of which affect the installation of deck hardware such as winches, cleats, pad-eyes, genoa tracks, travelers, stanchion bases, and the like.

First, the core should not be crushed when hardware fasteners are dogged down or when the hardware is loaded while in use.

Second, the core should not be exposed to moisture, as is very apt to happen when water sloshing about on deck creeps down fastener holes.

Core materials

By far the most common deck-core material found in older boats is balsa wood. Originally, the balsa was installed as planks, with the grain oriented lengthwise. By the early 1960s, builders had discovered that an end-grain orientation, where the grain is perpendicular to the deck, works much better. End-grain balsa is stiffer, resists water migration better, and is less compressible. Still, balsa is a soft, absorbent wood that needs some protection when used as a core material, however it's oriented.

This is particularly important because of the way end-grain balsa core is manufactured. The wood is cut into squares (usually about 2 inches on a side) and attached to a scrim, which allows the core to conform to curved surfaces. Unless this core material is laid up very carefully so all the kerfs (the gaps between the blocks) are completely filled with resin, the kerfs become highways within the core along which water can travel very quickly.

A few older boats were built with plywood-core decks. Plywood is much heavier than balsa but it is much less compressible. It's not very moisture resistant, however, and because the plys are cut with the grain running lengthwise, water migrates easily through it.

The common practice when building decks today is to replace the core under hardware with an incompressible water-resistant material, such as high-density closed-cell foam or solid laminate. In the early days of glass boatbuilding, the assumption seems to have been that a core would not be crushed if nuts and bolts were not dogged down too hard, nor would it become saturated with water if the hardware was well bedded in sealant. This was wishful thinking. Heavily loaded hardware will crush a core even if its fasteners are only finger-tight, and even the best sealant, liberally applied, will break down over time, allowing moisture to sneak past it.

Core concerns

The state of health of a deck's core should be a primary concern of anyone who owns or acquires an older fiberglass boat. In the worst of cases, where the entire core is saturated and much of the deck has delaminated, major surgery is required. One of the laminate skins must be cut away and all of the wet core removed. Then a new core must be bonded in place and skinned over with a new layer of glass. Doing this sort of work yourself takes an enormous amount of time; paying others to do it will likely cost you dearly.

More commonly, you'll find a deck core that's saturated in just a few spots. These problems are more easily addressed. The affected area can be ventilated by drilling a series of holes through the outer laminate skin. The core can then be dried out with a shop vac and heat gun or flushed with acetone (which will wick away moisture then quickly evaporate itself). Once dry, the core can be rebonded to its skin with the injection of thickened epoxy into the holes in the laminate. Or if the core is too wet or rotten to save, you can cut the skin away just in the affected area and replace that one bit of core.

Once you've cured your wet-core problems (or if you are lucky enough to own an older boat that already has a dry deck), you want to be sure it stays dry. If you are lazy, you can try to do this the same way the builder did by simply rebedding each piece of deck hardware with a liberal dose of sealant. If you are conscientious, however, you need to treat every fastener hole for

“All loaded hardware should be supported beneath the deck by substantial backing plates.”

every piece of hardware so the core in the area of the hole is sealed against moisture intrusion and protected against compression.

Decompress the core

One way to secure your core is to drill out a grossly oversized hole for each fastener, fill each hole with a plug of epoxy paste, wait for the epoxy to cure, then redrill a proper-sized hole through each plug (see diagram A). The plugs in this case seal off the core, protecting it against moisture that might work its way past the hardware’s bedding of sealant. They also act as compression posts to prevent the deck and core from being squashed together.

Another way is to drill a proper-sized hole for each fastener, ream out the core around the perimeter of the holes with a bent nail or router, then fill the cavity so created with epoxy paste. Again, the epoxy seals the core and resists compression loads (diagram B).

Yet another alternative, rarely seen, is to drill just slightly over-sized holes, seal them with epoxy resin, then insert metal compression tubes to bear compression loads (diagram C).

Note that if your boat’s deck has a plywood core, you need not worry about the compression loads. Each fastener hole, however, should still be sealed against moisture with epoxy resin.

Spread the load

The discussion above assumes we are dealing with heavily loaded deck hardware secured with threaded through-bolts with nuts on the end. Traditionally, this is the only reasonable option.

In addition to being through-bolted, all loaded hardware should be supported beneath the deck by substantial backing plates that have generous margins extending beyond the hardware above. This helps spread loads over a much larger area. In the past, builders did not always install backing plates under deck hardware, believing large fender washers would be sufficient to keep fasteners from ripping through decks. This, alas, is a fallacy (still adhered to, I’m afraid, by some contemporary builders) as the point loads imposed on fasteners can be very large. For example, I’ve seen a cleat secured with fender washers torn clean out of a deck (my own, regrettably) by the common shock loads imposed when a passing boat wake causes a docked boat to jerk hard on its docklines.

In most cases, again, it is up to the boatowner to address deficiencies after the fact. If you are going to the trouble of sealing off fastener holes, it is usually only a little more effort to install backing plates as well.

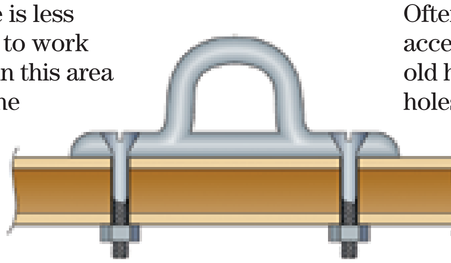
Metal plates are best. Stainless steel, bronze, or aluminum all work well. Aluminum is the easiest to work with, as it is relatively soft and can be shaped and drilled with hand tools. Plywood is also acceptable, if large fender washers are installed. It’s a good idea, too, to seal the edges of plywood backing plates, including hole perimeters, with epoxy resin. StarBoard, which is both stiff and water-resistant, is another excellent alternative.

One area that sometimes presents difficulties when installing backing plates is along a deck’s perimeter. There is less room to work with in this area and the surface of the underside of the deck may be very uneven and irregular, depending on how it’s joined to the hull.

You must resist the temptation to just punt and rely on fender washers here. Stanchion bases in particular, because they are often subject to abusive side loads when crew grab on to stanchions while boarding, need lots of support. If full-sized backing plates will not fit along the edge of the deck, it’s better to use long metal strips, rather than washers, to back hardware. Also, it’s worth the trouble to make the underdeck surface flush and square by adding spacers or bosses as needed. This ensures that loads are evenly distributed.

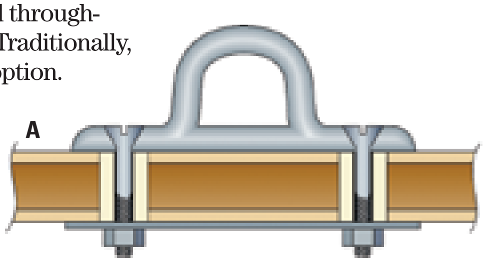
Coping with liners

Some production boats (old and new) have comprehensive one-piece deck liners covering all the overhead area in the cabin space (see diagrams on next page). The problem with such liners is that they restrict access to fasteners on the underside of the deck. Some thoughtful builders went to the trouble, when installing the liner, to cut small access hatches with removable covers so fasteners can be reached easily. Often, however, you will need to cut access holes yourself so you can remove old hardware to rebed it, treat fastener holes, and install backing plates.



Hardware installed with no backing plate at all and the core not sealed is a recipe for certain trouble, at left.

A



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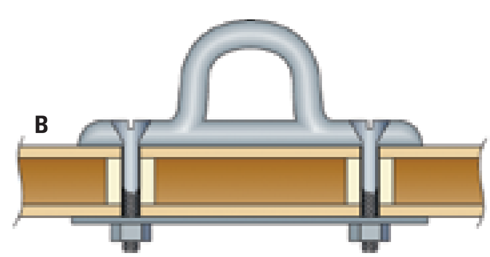

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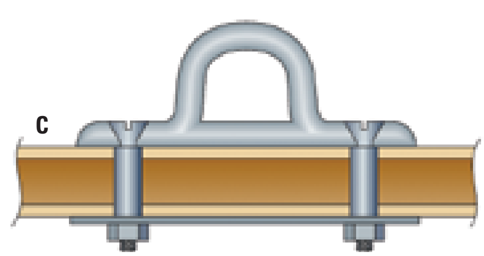
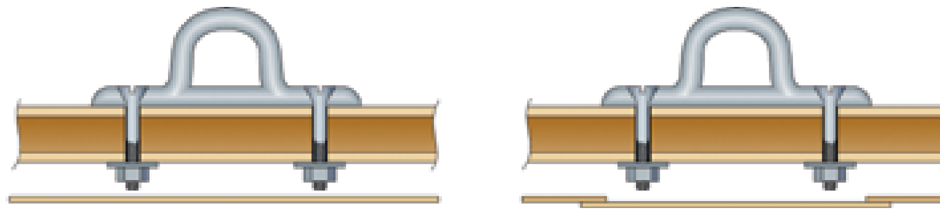
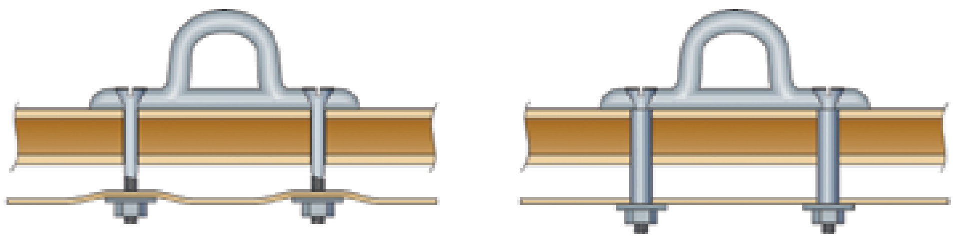


The core can be sealed against water and protected from compression loads in several ways.



A deck liner might conceal fasteners, above left, unless access hatches are fitted, above right. A liner should not bear loads, below left. Compression tubes are a partial solution, below right.



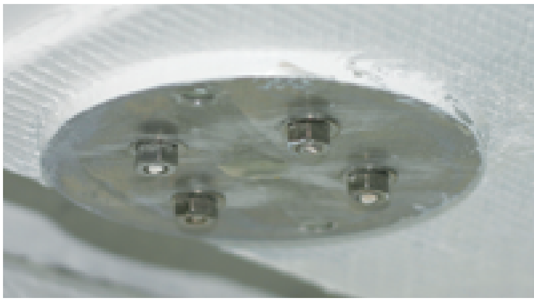
Alternatively, fasteners may penetrate the liner, spanning the gap between the liner and deck. In such a case, the liner should not be bearing any load. A backing plate should be installed between the deck and the liner, bridging the gap between them and carrying the load on the fasteners.

Ultimately, it is much more convenient if there is no deck liner. On some boats you'll find instead a series of removable overhead panels covering the underside of the deck. These are often held in place by pieces of trim that are relatively simple to remove. They may be secured with Velcro strips. Removable panels provide much easier access to under-deck fasteners and should be preferred if you have any choice in the matter.

The optimal arrangement, really, is to have no liner and no overhead paneling at all. A few boats were actually built this way, and some enthusiastic owners go so far as to permanently remove liners and panels to save weight and improve access. To be sure, this is cosmetically inferior, as all your deck-hardware fasteners are exposed to view. But you will be intimately familiar with their status (leaks, for example, will be much easier to spot) and will more likely go to the trouble to treat them properly. The bottom line is very simple: the fewer obstacles there are between you and your deck-hardware fasteners, the healthier your deck will be.

Charlie Doane is the author of The Modern Cruising Sailboat, *published by International Marine/McGraw-Hill. He blogs about cruising sailboats at <www.wavetrain.net> and sails a Tanton 39 cutter and lives in New Hampshire.*

Better backing blocks



Valuable tips for upgrading deck hardware

by Jerry Powlas

I have not spent a lot of time crawling around the hidden spaces of high-end luxury yachts, but the vast majority of the fiberglass production boats I've looked at have pathetic backing blocks that often fail to do the intended job. I am proposing a much higher standard for backing blocks than what has been the normal practice for the builders of most good old boats. The trouble with this plan is that it may be too high a standard to be affordable in a production boat built to a price today.

In the case of your boat, however, the choice is yours. You have the advantage of years of field-testing on your own boat. You can look at your backing blocks and decide just how far you should go toward upgrading them. If your boat has leaks and damaged core, you obviously will have to do something. If you have bent bolts, washers, and even bent metal backing blocks, you may want to go further in upgrading. On the other hand, you can decide that all this bent stuff has served for 20 or 30 years and is good enough.

Likewise, if you have fasteners protruding into the accommodation space, you can leave them, put acorn nuts on them so they are more attractive but still deadly, or go a little further and make really high-end backing blocks as described here.

Preserve the core

Sealing the deck and preventing it from being crushed is fundamental to installing any deck hardware. If you skip this step, as many builders did, you will likely regret it. Drill oversized holes twice the size of the bolts or screws and fill them with filled epoxy. Then re-drill the fastener holes through the epoxy. Now the core is sealed and cannot be crushed. This is slow work, but absolutely necessary.

A fastener bends when the surfaces under the head and under the nut are not parallel. Screws and bolts were not intended for this kind of fastening. Each thread on a screw or bolt is a stress concentrator and a bent bolt has already been taken to a stress level beyond its elastic limit. It is difficult or impossible to reuse bent bolts.

The way to make the top and bottom surfaces parallel is to tap threads in the backing plate and pull it up to the underside of the deck with filled epoxy between the plate and the deck. Take care to pull the plate up evenly. Spray the bolts with non-stick food spray before installation so you can remove them once the epoxy has cured. This is easier with wooden backing blocks but it will work well enough with aluminum plates if they're at least ¼-inch thick.

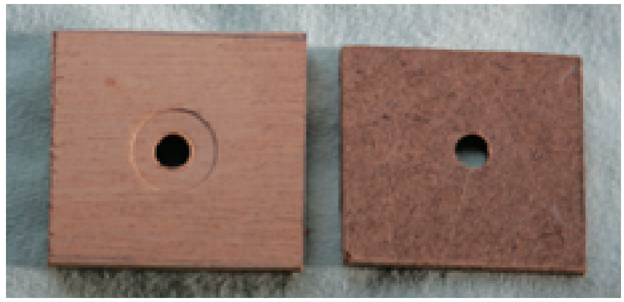
After the epoxy cures, it's tempting to just put nuts and washers on the bolts, but it's better to back the bolts out and drill clearance holes through the plates. There are several reasons for this extra step. First, when you put nuts on and tighten them, they tend to loosen the screws in the backing plate threads. Second, the bolts function better if the tension from tightening the nut is distributed across the entire clamped span. And third, there is less tendency to break the bolt from over-tightening if you drill out the threads in the backing plate. Don't ask me how I know.

Aluminum plates

There are several choices for backing plate material. On my project boat, the trailerable Mega 30, I used ¼-inch aluminum plates above and below the deck when I mounted the bow pulpit and mooring cleat. I also added a layer of ¼-inch marine plywood to the foredeck above and below the fiberglass skins. There was clear damage from the mast hammering on the bow pulpit while towing, the original mooring cleats were too small for the mooring lines I had in mind, and the deck was too thin to hold a serious cleat. Thick aluminum was a good choice for these areas. Minimum thickness for aluminum plates is probably ¼ inch. Thinner plates will be bent and crushed.

Perhaps a better backing-plate material is marine-grade plywood. Better yet

This bow pulpit base has ¼-inch aluminum plates above and below the deck, top photos. The genoa track is above the cabin, so the nuts are recessed to protect the crew, above.



Plywood crushes under pressure but Masonite doesn't, at left. Masonite sandwiched between two layers of plywood makes a sturdy backing plate with cosmetic appeal, at right.

is marine-grade plywood faced with Masonite. It is better if the plywood is a harder wood, like sapele. Okume is probably a bit too soft. No wood, including plywood, has sufficient crush-resistance across the grain. Wood is like a bunch of soda straws glued together. It has good tensile strength along the axis of the straws, but it has very poor compression strength to resist clamping forces cross-grain.

Try an experiment in your shop. Clamp up a piece of good plywood with a ¼-inch bolt, nut, and washers. Note that the washers crush into the wood, cutting the fibers. Now make another sample with a thin layer of Masonite on one side. The washer will not cut into the Masonite. Cross-grain, the Masonite has significantly better crush-resistance. If you make your backing blocks from a sheet of marine plywood to which you have glued a layer of Masonite, you'll have a block that will not crush. If the wood does not crush, the washers will not bend and distort, and the nuts will have a proper bearing surface when under load.

Masonite sandwich

You can go one more step and make a sheet with a layer of marine plywood, a layer of Masonite, and then a layer of marine plywood over the Masonite. When you are making your backing blocks for accommodation spaces where the crew may come in contact with the blocks, drill into the backing block with a Forstner bit just deep enough to expose the Masonite. You'll then have a good crush-resistant surface for the washer and a wooden shield for the end of the bolt and nut formed by the outer casing of plywood. Naturally, you'll have to cut each screw or bolt to length so it doesn't protrude beyond the layer of protecting plywood.

In his book, *Boat Strength*, Dave Gerr says backing blocks should have 1.4 times the area of the fittings they're backing. I have no quarrel with this, but I try to make my backing blocks much larger. If a fitting measures 2 x 4 inches, I double both numbers so the block is more like 4 x 8 inches. This will result in an area about four times larger than the base of the fitting. I often taper the edges of the block at 45 degrees or run it through a roundover bit to make the sides of the block less of a hazard to bump into. This takes away from the strength of the block. The way I see it, area may not be the figure of merit in all cases. In some situations the perimeter of the backing block may be what matters. Where that might be the case, doubling the length and width of the fitting makes a block perimeter that is only twice the perimeter of the fitting. If you follow either rule, there will be places where large blocks such as these simply won't fit. Winches are often mounted on coamings that won't take such large blocks. In those cases, I do what I can and take some solace in the inherent strength of the coaming and the structure often built into it for holding winches.

Deck pads

I never see any mention of putting pads between the deck and the fitting, but there is sometimes good reason to do this. If you mount a fitting onto a surface that has aggressive non-skid, you're setting it on a bunch of peaks which may be crushed when the fitting is tightened. Putting a softer plywood or Masonite pad under the fitting will let the non-skid dig into the pad while providing a flat surface for the fitting.

Such top pads can be made to serve two other purposes.

First, some fittings, such as winches, need drains added at the bottom or they'll fill with water. You can solve this problem with washers under the winch base, but a better way is to make a pad with drain-channel grooves cut into it. Some winches have drain channels cut into them, but others do not.

Second, it's bad practice to mount a flat fitting on a curved surface. This is a common problem where winches are to be mounted on the top of a cabin trunk. The surfaces available are often curved in two planes and, if a winch is mounted directly to the cabin trunk, both the winch and the mounting surface will be distorted when the bolts are tightened. This problem can be solved by setting a flat pad on the curved surface in a mush of filled epoxy.

Installed properly, a deck or hull fitting should be held by bolts that are not bent and washers that are not bent nor have dug into the underside of the laminate. The cored deck around the fasteners should be filled with epoxy slugs that prevent crushing and preclude the seeping of water into the core if the sealant should fail. The backing blocks should be large and strong enough for the fitting to be loaded to the point of failure without the deck or hull structure failing too. If you work to this standard, you will probably have backing blocks that are of a higher quality than those found in some very high-end boats.

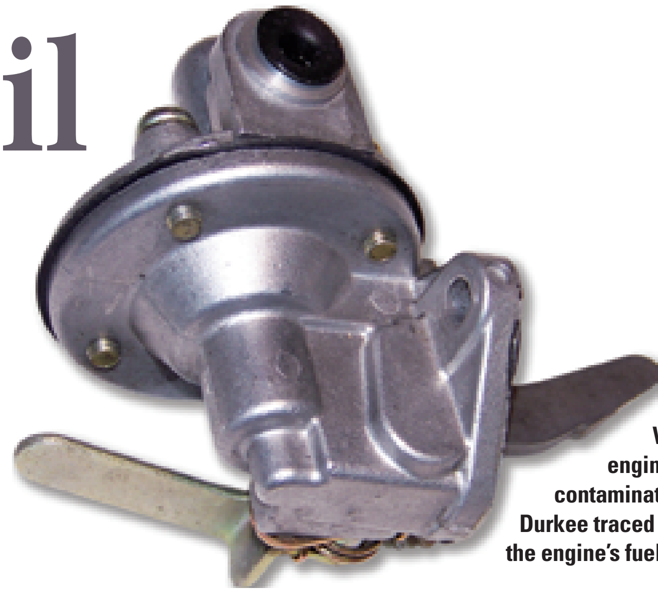
Jerry Powlas had careers in the U.S. Navy and as an engineer before he met and married Karen Larson. Together, they founded Good Old Boat. *They now have two boats, one for sailing and one for practicing their restoration skills.*

A deck pad set in epoxy mush will provide a flat surface in an area where the deck surface is uneven or curved.

Engine oil mystery

Biodiesel fuel is the chief suspect

by Durkee Richards



When his boat's engine oil became contaminated with fuel, Durkee traced the source to the engine's fuel lift pump.

After a six-year trial, discussed at some length in the July 2005 issue of *Good Old Boat*, I have decided to suspend using biodiesel blends in our 1996-vintage Yanmar 3GM30F diesel engine. Twice during this time, I have experienced significant fuel contamination in the engine oil due to leakage in the mechanical fuel pump (sometimes called the lift pump). The pump I just replaced had been in use for only two years and 370 engine hours.

My initial diagnosis of fuel contamination in the oil, back in 2007, was based on three factors:

- A steadily increasing level of engine oil on the dipstick (the engine appeared to be "making oil")
- A drop in oil pressure, especially at idle with a warm engine
- Laboratory analysis of the engine oil

For historical reasons, I use Blackstone Laboratories in Fort Wayne, Indiana. It measured a fuel concentration of 5.5 percent in the oil sample I took just before changing the lift pump for the first time. I did not submit an oil sample before changing the lift pump for the second time since I was confident the lab would again report a significant level of fuel in the oil. I *will* send in an oil sample after about 30 engine hours with the new lift pump, just to be sure that the fuel contamination problem has been solved now that I am using straight fossil diesel.

When I first experienced fuel contamination in the engine, I discussed the problem with the local Yanmar dealer, Shoreline Marine, in Port Townsend, Washington. He confirmed my suspicion that the most likely source of fuel contamination was the lift pump. He went on to say that the other two possible sources were the high-pressure injection pump or leakage past the piston rings. The latter was rare and usually associated with tired engines having noticeable blow-by or a bad injector. Fuel leakage from the high-pressure pump was also relatively rare. Since the lift pump was the most likely source, and was also the cheapest fix by far, it was a good starting point. Changing the lift pump did fix the problem — at least for a couple of years.

In July 2009, while cruising in remote regions along the coast of British Columbia, my wife and I again saw signs of fuel contamination in the engine oil. We managed the problem by replacing two quarts of oil every 30 hours or so until getting safely home. This kept the contamination problem sufficiently in check to avoid damage to the engine. I again suspected the lift pump but was puzzled as to why it would be leaking after so little usage. When I replaced the lift pump for the first time, I knew that the original pump would have been designed before bio-fuels were even a consideration. However, I had hoped that by 2007, Yanmar would have reviewed the design and construction of any replacement components to assure compatibility with biodiesel blends.

Tracing the cause

Once back in our home slip, I removed the suspect lift pump and tested it using a method described in my Seloc Marine Yanmar manual (see "Pump test," below). The test confirmed leakage past the diaphragm. I asked the Yanmar dealer about the expected life for the lift pump on a Yanmar 3GM30. He confirmed that these pumps normally have a long service life and that my experience was very unusual. The only exceptional factor that he or I could identify was my use of biodiesel blends.

After replacing the lift pump, I disassembled the old one. These pumps would look familiar to anyone who worked on automobile engines in their formative years.

The diaphragm on the failed pump looked normal to my eyes. However,

Pump test

After removing the lift pump from the engine, you can test it by operating it manually to pump air. The steps are to:

- Immerse the pump body in kerosene so only the fuel inlet port is above the liquid.
- Close off the fuel exit port with a finger while working the activating lever.
- Look for bubbles coming out from the body of the pump around the lever (such as from the underside of the diaphragm).

Bubbles coming from the body of the pump indicate leakage past the diaphragm. In normal use, this would mean fuel was able to dribble into the engine's oil sump.

> “The longer-term benefits that I anticipated included a cleaner fuel system and reduced engine wear.”

there is a metal disk visible at the center of the diaphragm where a connection is made to a spring and then to the activating lever on the backside of the diaphragm. This connection must be well sealed, mechanically or adhesively, to prevent fuel from leaking past it and into the engine oil. I suspect that the leakage in the failed pump was occurring at this point, but have no way to confirm it. My concern about biodiesel causing or accelerating leakage past this seal is circumstantial and rests on the fact that biodiesel is a stronger solvent than fossil diesel.

How it all began

I began using biodiesel blends, usually 20- to 30-percent biodiesel, for reasons I’ll discuss shortly. (See also my article on biodiesel fuels in the July 2005 issue.) By conventional usage, a B20 blend means 20-percent biodiesel with the balance being #2 diesel. Early on, B20 seems to have become the most widely used blend.

It is not convenient for boaters on the Olympic Peninsula, where we sail, to use biodiesel. No nearby fuel docks sell biodiesel or biodiesel blends. (Unlike some states, Washington has no mandate for adding small amounts of biodiesel to the existing sources of diesel.) Initially, I purchased straight biodiesel in 5-gallon jugs from a chandlery in the area and added enough to the fuel tank to make a 20- to 30-percent blend. Later, I used the B99 pump at a heating-oil company. Before starting out on an extended cruise, I would have a full tank with at least a 30-percent blend. After a few refills en route with conventional diesel, this would dilute down to just a few percent biodiesel.

My primary short-term motivation was to reduce or eliminate the characteristic diesel-engine exhaust odor because some members of my family are very sensitive to petrochemical fumes. Using blends with at least 20-percent biodiesel did have the desired effect. We also saw a dramatic drop in the sooty mustache on the transom, which was a visible confirmation of the reduction in particulate emissions associated with using biodiesel blends.

The longer-term benefits I anticipated included a cleaner fuel system and reduced engine wear. A cleaner fuel system is expected because biodiesel will dissolve away the deposits left by fossil diesel on the walls of fuel tanks and fuel lines. This will initially cause reduced fuel filter life when switching over to biodiesel as old deposits are cleared out. I did initially experience shorter filter life after switching to biodiesel blends. I also experienced one fuel-line failure after the switch. However, when I subsequently had to remove the fuel tank to clean its compartment (see my article in the November 2009 issue, “Aftermath of a fire on board”), I found the interior of the fuel tank to be pristine — completely free of any deposits.

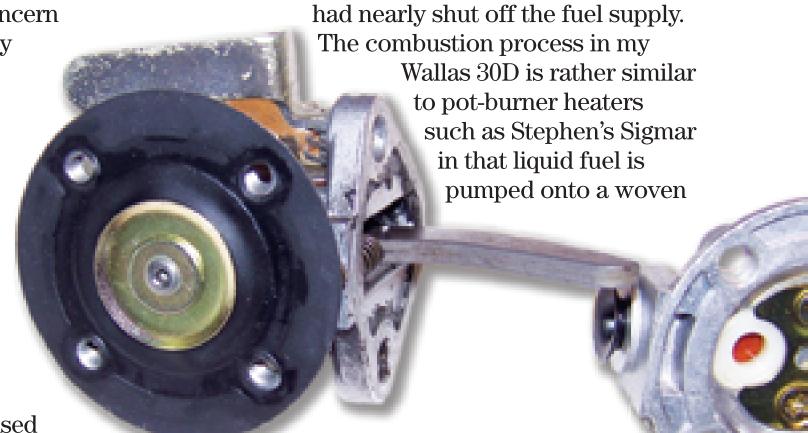
The lubricity factor

Most recreational sailors will never be able to conclusively say whether or not our engines have suffered from the known loss of diesel-fuel lubricity that occurred with the change to low-sulfur fuels or whether or not we correspondingly benefited from the restored fuel lubricity that comes with biodiesel use. Because of my concern about fuel lubricity now that I have stopped using biodiesel, I have started using a fuel additive sold by Stanadyne. I have confidence in this product because Stanadyne is a major supplier of the high-pressure injection pumps used on large diesel engines in trucks and buses. It was among the first companies to notice the increased field-failure rates for these components after the switch to low-sulfur fuel. This fuel additive was part of its effort to prevent premature failure of its products when used with low-sulfur diesel.

Biodiesel and cabin heaters

I want to close with a cautionary note about the use of biodiesel blends in small marine heaters or furnaces. While biodiesel does burn cleanly and well in diesel engines and large fuel-oil furnaces (such as home or commercial heating furnaces), it does not work well in all the different types of diesel heaters commonly used aboard boats. Stephen Hulsizer wrote in the November 2005 issue “Mail buoy” about his experience using biodiesel in a Faball/Balmar/Sigmar bulkhead-mounted heater. (***Note:*** *An active conversation among readers about biodiesel continued in the magazine and newsletter until August 2006.* ***–Eds.***) In this style of heater, liquid fuel is pumped into the bottom of a pot-like combustion chamber where it evaporates and mixes with combustion air. Stephen found that, after switching to B20, his heater “would fill with hard carbon deposits after only one night of use . . .”

Shortly after reading his letter, I had to service our boat’s Wallas 30D furnace. Surrounding the fuel-injection tube I found a hard carbon cake that had nearly shut off the fuel supply. The combustion process in my Wallas 30D is rather similar to pot-burner heaters such as Stephen’s Sigmar in that liquid fuel is pumped onto a woven



It seems that biodiesel penetrated the seal between the fuel side and the engine side of the fuel pump’s diaphragm.

ceramic-fiber mat where it evaporates before being mixed with fan-forced combustion air. Our Wallas is fed from a day tank. After cleaning the furnace, I switched over to filling its day tank with kerosene or #2 diesel.

Subsequent discussions with Espar and Webasto dealers raised concerns about using biodiesel blends in these heaters. I understood from the Webasto dealer that, in their products, liquid fuel is pumped into a mesh to promote rapid evaporation before subsequent mixing with combustion air. He noted that using biodiesel blends caused rapid carbon buildup on this mesh and on a nearby ignition detector.

Ben Hempstead ("Mail buoy," July 2006) reported a good experience using B20 in his Espar Hydronic D10W. It had performed well for more than 300 hours over a four-year period. He also noted that this diesel heater uses a "spray-injection system."

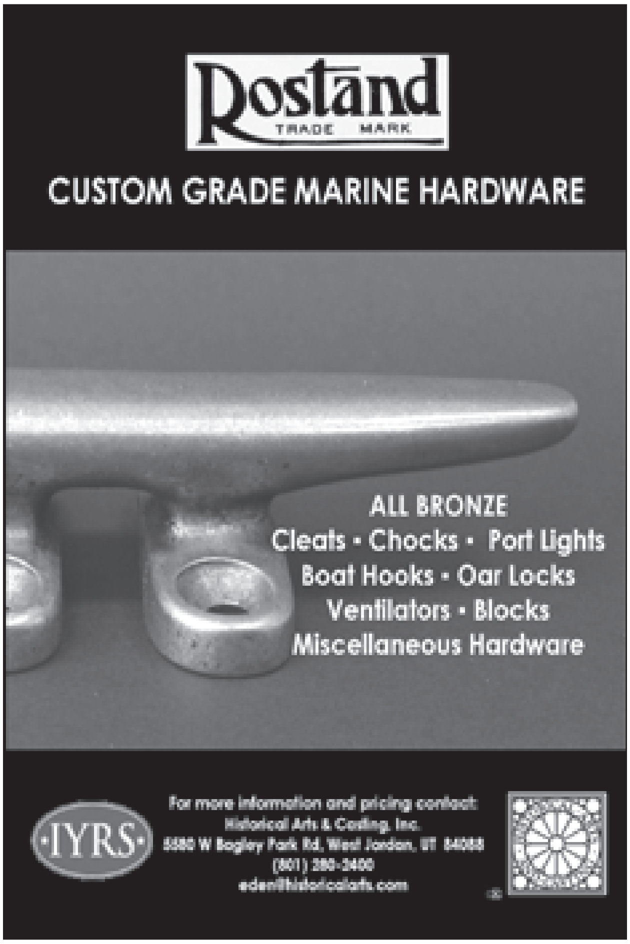
My view on burning biodiesel is that complete combustion occurs when it is finely atomized, as by the injectors in a diesel engine, or delivered in the somewhat coarser spray patterns in large furnaces. However, at the other end of the spectrum, burning the vapor over a pool of liquid tends to generate substantial carbon deposits. Pot burners (such as Sigmar and Dickinson), my Wallas 30D, and Webasto cabin heaters operate at this end of the spectrum.

"Discussions with Espar and Webasto dealers raised concerns about using biodiesel blends in these heaters."

The Espar heaters may inject fuel in sufficiently fine droplet sizes to be compatible with biodiesel. However, this may vary with the size of the burner and the power level at which it is operating, that is to say, with the rate at which fuel is being injected. The smaller Espar Airtronic models might not be as tolerant of biodiesel as Ben Hempstead's Hydronic D10W.

I still find the benefits of using a biodiesel blend in our diesel engine attractive and would like to be able to continue its use. But, before doing so, I would have to be confident I had found a long-term fix for the fuel-oil contamination problem.

Durkee Richards learned to sail in the Sea Scouts on the Columbia River. His first date with Mary Jeanne, his sail-mate, was on a 15-foot 6-inch Snipe. They spent nearly 40 years in the Midwest where they cruised Lake Superior on chartered boats until they bought their J/32, Sirius, *in 1999. After Durkee retired, they moved to the Olympic Peninsula and are now exploring the waters of Puget Sound and British Columbia.*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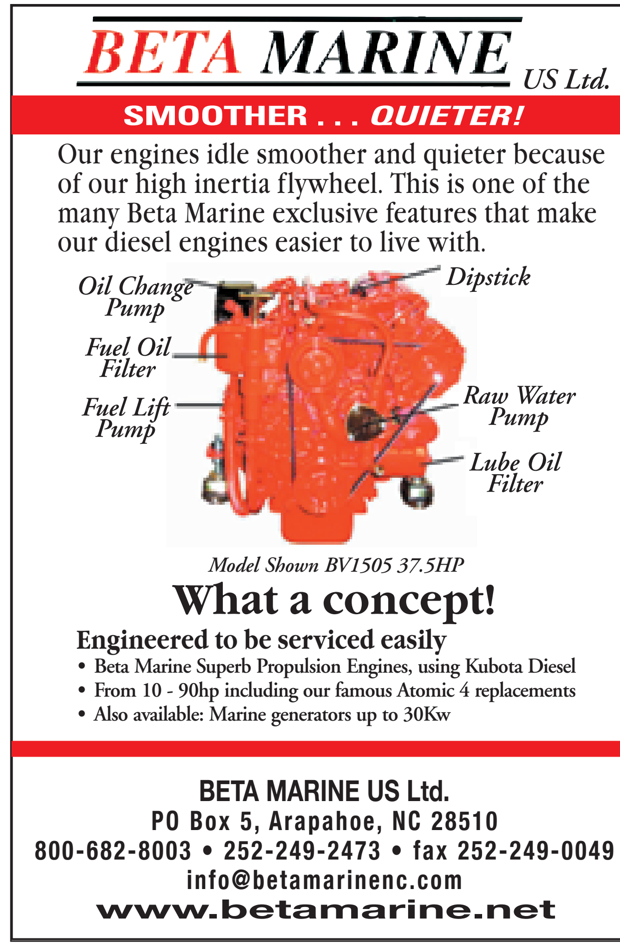
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Poor man's halyard winch

Make your own handy-billy

by Henry Rodriguez

Most good old boats have all the mechanical muscle a person could want in the form of powerful winches. Boats at the smaller end of the scale, however, may have a pair of sheet winches on the cockpit coamings but often have no mechanical means to pull the head of the sail that last inch or two necessary to get the desired tautness.

The time-honored way to accomplish this has been to "sweat up" or "swig up" the halyard. To do this, pull the sail up as far as possible and then take a turn around the base of a mast cleat, holding on to the halyard tail. Reach up a few feet above the cleat with your other hand and grab the halyard. Pull it straight out from the mast as though you were pulling a bow string to shoot an arrow. This will pull the sail up a little bit more. Take in the slack with your other hand. Repeat as often as necessary to get the halyard to the tension you want.

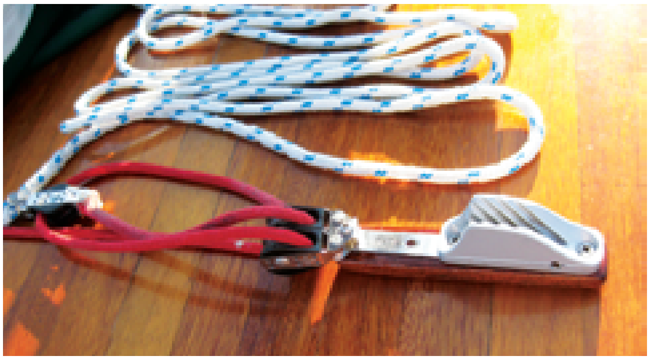
But what if your halyards don't terminate at the mast and are instead led to the cockpit? Enter the poor man's halyard winch. This is a modern version of a piece of gear found on almost all boats in days gone by: the handy-billy. This device was a portable 3- or 4-part tackle, often with a hook on each end, that could be used anywhere a little extra muscle was needed . . . sort of an early-version come-along.

In my version, an aluminum Clamcleat replaces the hook at one end. This makes it easy to grab the halyard even when it has tension on it. (It can also be used to undo a winch override. Grab the sheet ahead of the winch with the Clamcleat, make the handy-billy fast to something solid, and take up on the tackle to relieve tension on the jammed winch.)

The other end of the tackle has a line with a loop that I can drop over a convenient cleat. Even though it's nominally a 3-part tackle, it has a 4:1 mechanical advantage because the tail leads from the load, adding to the purchase. Using two double blocks or fiddle blocks in a 4-part tackle can give you a 5:1 advantage.

Made up from the parts drawer

To assemble my handy-billy, I used parts and blocks from my I-might-need-that-someday collection. I fastened the Clamcleat and one of the tackle blocks to a 6¼-inch length of 1¼ x ½-inch hardwood cut from a piece of leftover Brazilian teak, which is very dense and perfect for this application. I didn't trust the strength of the wood alone so I added a ⅝ x 3-inch stainless-steel tang to structurally tie the tackle block to the Clamcleat. You could use a straightened-out eye strap instead. The Clamcleat will handle up to ½-inch line and is made of aluminum; the plastic ones tend to slip under load. Three #10 x 24 machine screws and nuts fasten everything to the wooden base. I used screws short enough that they wouldn't extend beyond the underside of the wood and counterbored the screw holes on the underside to recess the nuts.



The signature feature of Henry's handy-billy is the Clamcleat, above, with which he can easily grab onto a halyard or any other line that's already under load. The handy-billy is portable, easy to set up, and gives youngsters pulling power beyond their years, at right.

A little sanding and a couple of coats of varnish before final assembly will make the poor man's halyard winch an elegant addition to your boat's toolkit. Just as I have, you'll no doubt find many other uses for this modern twist on the handy-billy.

Henry Rodriguez has written how-to articles for several publications and has been sailing his 23-foot 1974 Venture of Newport cutter, Chiquita, *since buying her in 1978. Over the years, he has replaced or rebuilt every rope, line, wire, spar, and stick of wood on her and she, in turn, has taken Henry and his family on many cruises in the Great Lakes.*

New part prices

In order to fully qualify your handy-billy as a "poor man's gadget," check your junk box for viable substitutes before buying any of the parts. If you don't have an I-might-need-that-someday collection, here are prices for new parts from Annapolis Performance Sailing (APS) <www.apsltd.com>:

Clamcleat C219	$26.06
Harken double bullet block H084	$29.33
Harken single bullet with becket H083	$12.88
Stainless-steel tang/chainplate RF219	$3.55

Velcro turnbuckle locks

Security without using pliers or rigging tape

by Joe Orinko

I was in a fabric store buying sticky-back Velcro tape for use on insect screens when I saw a Velcro product named One-Wrap. This is a double-sided Velcro strip ¾-inch wide and 12 feet long. It has hooks on one side and loops on the other so, when wrapped around something, it can stick to itself.

By attaching stainless-steel cotter pins to strips of One-Wrap, I created reusable devices that allow me to lock the turnbuckles on my boat without bending cotter pins or using rigging tape.

To fashion my turnbuckle locks, I took 3⁄32-inch-diameter stainless-steel cotter pins (costing 23 cents each) and, with the help of a bench grinder, reduced their length to about ¾ inch.

I cut the One-Wrap Velcro into 8-inch lengths and laid the pieces out hook-side-down on a scrap of carpet to prevent them from coiling up. I used a dab of hot glue to position the head of a shortened cotter pin at one end of each Velcro strip, on the fuzzy side.

I then mixed up a small batch of epoxy. I daubed the epoxy mix around the heads of the cotter pins and let it dry.

It occurred to me later that I could have daubed a little black enamel paint on the epoxy to provide some UV protection, but I have not done this. Even without this step, we've used our Velcro turnbuckle locks for a couple years and they have lasted through rain, snow, and 60-mph winds.

If you were crossing an ocean, cotter pins bent in the traditional way and covered with rigging tape would no doubt be more secure and permanent. But for recreational coastal cruising and round-the-buoys racing, these work fine.

Joe Orinko has sailed the waters of Presque Isle Bay and Lake Erie for more than 25 years, 20 of them in his O'Day 23, Unicorn, *and for seven seasons on his second* Unicorn, *a Catalina 30. Because the love of his life, Sue, shares his passion for sailing, he says it's easy to find time to sail.*

A few yards of Velcro One-Wrap, a handful of cotter pins, and a tube of epoxy, at left, are all it takes to make a slew of handy locks, center above, that fit in a jiffy to keep turnbuckles secure, at right.

The "green" lantern

Turn, turn, turn on the lights

by Rich Finzer

Do you remember the Green Lantern, the DC Comics superhero of the 1950s? This article isn't about him; it's about my multi-function, crank-powered LED lantern that has no bulbs and uses no batteries. Kinetic energy provides the power for this gizmo. So, even though the plastic housing is yellow, I call it my "green" lantern because it's environmentally benign.

It operates using the principle of electromagnetic induction. When I turn the crank, a magnet passes through a copper coil and generates electricity. The lantern also functions as a capacitor and stores this energy. When I push the button, the stored power is discharged and fires up the LEDs. The result is pure white light. On average, a minute or two spent cranking yields about an hour of illumination.

I acquired the one pictured at a big-box store. It measures 3 inches in diameter and is nearly a foot tall. It's got bells and whistles out the wazoo: 15 LEDs plus many more features. A two-way switch lights up either three or all nine of the white LEDs, and it has an AM-FM radio, a cell-phone charger, an external speaker that will accommodate your iPod or MP3 player, six blinking red LEDs, a compass, an alarm, and a bail. An AC/DC adapter is even available as an option. This is handy if you're in a location where you have a power source, but no light. Most of these features are quite useful although, on balance, some do strike me as pointless.

For example, the compass is mounted at the top of the unit. To read it, you need another light. Besides, you don't need a compass to determine your location. You already know that: you're sitting in the dark! Additionally, the six-blinking-red-LED emergency light and alarm aren't very functional as neither is detectable until you're within 10 feet — the electronic equivalent of one-hand clapping. However, with its built-in reflector and all-around plastic lens, the device emits an amazing amount of light.

Crank-powered lanterns can be found in the outdoor sections of many retailers or purchased over the Internet. Google "LED crank light." You can begin your search at the Life+Gear website: <www.lifegear.com>.

With this technology, sailors with smaller vessels lacking house batteries and cabin lighting can illuminate their below-deck spaces without using stinky oil lamps. Cruisers anchored in a remote cove can enjoy the same benefits without depleting their house bank or running the engine or generator. Best of all, when it's not needed aboard, you can take your LED lantern home in case there's a power failure.

Rich Finzer earned his power boat operator's license in 1960 at age 11 and began sailing in 1966. He also runs a boat-storage business, has worked as a commercial fisherman, and is an accomplished racing sailor. Currently, he cruises aboard his Hunter 34, Pleiades.

Although it has a few superfluous functions, the best feature of this lantern is that it uses no batteries . . . just crank it up and turn it on.

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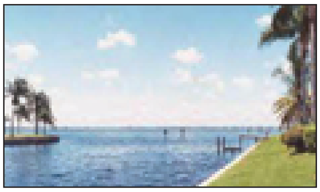

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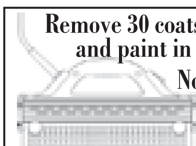

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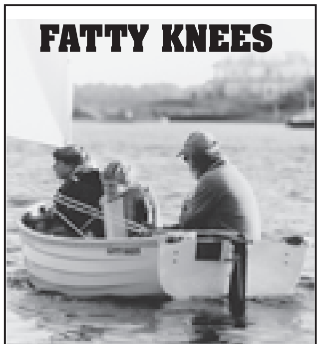

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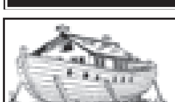

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FRITZ SEEGERS

Memories of an innocent world

February awakens nostalgia and a yen for the scend of the sea

by Matthew Goldman

There was a time — perhaps a half century ago last Tuesday morning — when all seemed right with the world, even though I had glimmerings of what I might become. And because I was fool and idiot enough not to drown myself in the brook out back of the barn, I went on to become what maybe I am today.

It was also the day that I got my first real boat. The two-oil-drum raft that I kept on the cow pond never quite, quite qualified as a really, truly boat. I mean, it floated, and it didn't tip too awfully much when I stood my 60 pounds of scrawn on any of the corners, and it never capsized completely when I shoved on my punting pole — me, Mike Fink, ascending the mighty Ohio back to Pittsburgh.

My first real boat was an 8-foot pram that resembled an Opti or a Sea Shell, except it hadn't a mast or sail or rudder or daggerboard, and how would I have known what to do with all of that arcane and explicit and wonderful paraphernalia, anyhow?

Now that the hair that I haven't got left is a beautiful badger grey, I've finally figured out some of what is meant to be done with some, if not all, of the gear and rigging and rags and rods that came with my current love, *MoonWind*.

You mustn't let on to *MoonWind* that I'm a novice at this sport. She's confident that I know how to sail, even when I use the tiller to fend off giggling mermaids, use the lazy-jacks to hold up my trousers. Not everyone needs 50 years to discover the subtle intricacies of the boom vang. Not everyone spends months wondering what those little turning blocks by the fantail signify.

The reason me and *MoonWind* get along so well is neither of us much cares that the mainsail's flying upside down. Neither of us can be bothered to count how many reefs I've taken in the keel. Neither of us is much impressed with how her anchor never drags until I go ashore.

MoonWind is much like other gals I've dated: she knows I ain't too bright but loves me for my gaiety, my wit, and my choice of coffee.

Innocence lost

And I didn't write this to impress you with my knowledge of seamanship. I wrote this 'cause I was pining for an innocent world when water and air and ice and sky were a part of me not prone to faded grandeur. When I traced the track of the moon upon the river with my canoe. When taxes, insurance, and mooring fees had nothing to do with rollicking upon the water, knowing one's self to be sufficient to make it home, perhaps in time for supper. It's what I intend to enjoy again before Lord Neptune demands I give up the helm forever and deep-six my dreams in that dreariest of havens.

So here, during a February deep, the temperature at 18, *MoonWind* propped up by the shore, I ponder that inevitability scarfed to the stem of my mortal vessel. For, while I have the will to wet my keel, I would run before this world's wind to learn the creed of the wave, warm my soul at the molten sun while yet I have flesh to feel, take the helm in my willful fist while yet my arm responds. There are not many, nay, not many fair days left to the likes of me, an old waterman, to roil and glide and lean to the sensuous sea. And my joy of *MoonWind* will be my chantey all the while I scrape and paint her bottom, all the while I reeve her running rigging, all the while I stow her bushel of rode.

And when I'm away upon the wind, don't look for me on your calm fetch of this world. I'll be, perhaps, in the lee of that island, yonder; be, perhaps, on the far side of that billow; be, perhaps, behind that faintest of stars that lifts from the sea.

Matthew Goldman writes as Constant Waterman in Messing About in Boats. *He lives with his wife, Paula, in Stonington, Connecticut, and keeps his 26-foot Chris-Craft sloop,* MoonWind, *in nearby Noank, where he works repairing boats.*

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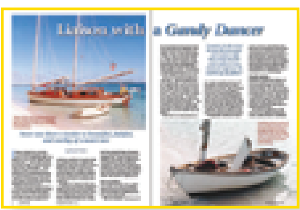


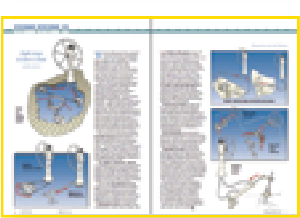


Here are some hightlights from the 2004 and 2005 issues of *Good Old Boat*. The CDs include each issue in its entirety for that year.

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Building a skipjack
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March 2004
Choosing the right boat
Replacing the boom
Building a cockpit grating
Pacific Seacraft 25 review
Sirius 21 review

May 2004
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Replacing a fuel tank
Watkins 29 feature boat
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July 2004
Replacing the cabin sole
Converting to LEDs
Brewer on engine selection
Precision 23 review
Nimble 24 review

September 2004
Finding an affordable voyager
Restoring non-skid
From weekender to cruiser
Spencer 35 feature boat
Corsair 24 review

November 2004
Sealants and adhesives
Winter boat enclosure
Pearson Vanguard review
Venture 25 review
Pacific Seacraft 37 feature boat

January 2005
Spiffing up the spars
Dinghy dilemma
Shaft Log 101
Cheoy Lee 32 review
CS 36 review

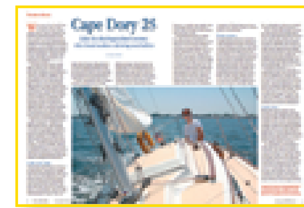
March 2005
Adding a deck wash
Dinette conversion
C&C 33 review
American 23 review
Tayana 37 feature boat

May 2005
Portlight replacement
New overhead
Blister repair
Aloha 32 review
Rhodes 22 review

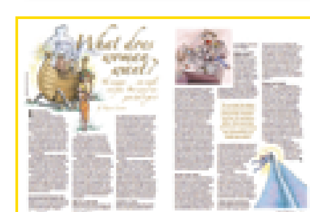
July 2005
Surviving capsize
Island Packet history
Adding a boom gallows
Bristol 29.9 feature boat
Drascombe Lugger review

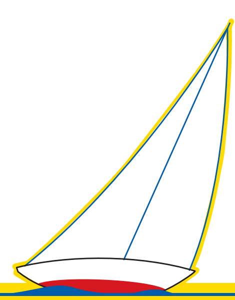
September 2005
Fixing a corroded mast
Pardeys on sailing without an engine
Yankee Dolphin feature boat
Whitby 42 review
Pearson 28-2 review

November 2005
Repairing a hole in the hull
Building a double bed
Cape Dory 25 feature boat
Tartan 30 review
Seaward 22 review





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