PROFESSIONAL BOATBUILDER

The magazine for those working in design, construction, refit, and repair

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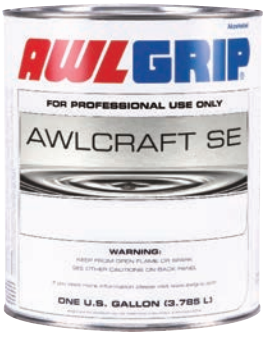

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COURTESY SCARANO BOAT BUILDING

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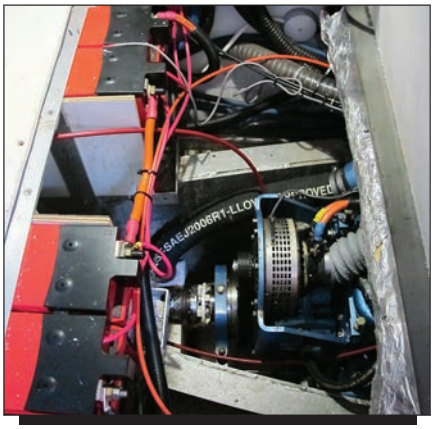

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Building at Precision Boat Works. Page 46.

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On the cover: The 65′ (20m) schooner *Adirondack*, hauled at the Scarano yard in Port Albany, New York, for maintenance. She's one of a nine-vessel fleet the company designed, built, owns, and operates in running day excursions from Manhattan, Key West, Boston, and Newport, Rhode Island, to supplement revenues from boat construction. Story on page 22. *Photograph by Robert Mazza.*

PROFESSIONAL BOATBUILDER MAGAZINE

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Not Just for Show

As a magazine editor tied to an office in the remote reaches of eastern Maine I find myself—like most boatbuilders working diligently on their own projects in their own shops—at constant risk of being out of touch and behind the times. The remedy is the annual six-month ultramarathon of marine consumer and trade shows that starts in September and ends sometime before the end of February. Attending any one of those events is my best chance to reconnect directly with boat designers and builders from around the world, to touch new laminate materials, to heft a machined shaft bearing or a laser-sintered titanium batten socket, or to discuss the challenges and rewards of refining a yard's purchasing department or quality-assurance protocols. But as welcome as the opportunity to connect with the right people and products may be, walking the miles of docks at the Fort Lauderdale International Boat Show or the acres of convention center floor space at boot Düsseldorf, the International BoatBuilders' Exhibition and Conference (IBEX), or the Marine Equipment Trade Show (METS) can be numbing. I fly home plagued by a vague dread that I have missed something or someone who could have improved my business and my future, and I might never have a chance to find it or them again.

In our largely unconsolidated industry, where new problems and solutions evolve behind the doors of every building and repair yard, no central institute accumulates and disseminates all this knowledge or experience. Unlike the corporate giants in the highly consolidated automobile or aerospace industries, few boatbuilding companies are large enough to have staff whose job it is to keep current on emerging materials, production technologies, or even relevant regulatory constraints. That's why our shows have evolved to be the sites for meaningful professional development as well as for business advancement and marketing. Builders and other marine professionals arrive expecting to hear not just sales pitches from materials and components manufacturers and suppliers, but also advice from some of the best minds in the industry about what seems promising, what seems threatening, and what products or trends are just snake oil.

Professional BoatBuilder magazine has been committed to fostering this open exchange of industry experience and innovation since before we founded IBEX in 1992, and that will not change following the recent sale of our ownership interest in the show. Our printed pages, show-based live seminars, and website are all built around the understanding that partly because of the industry's diversity, we need places and events where boat designers, builders, and repairers can hear from colleagues and competitors and then reassess their own performances and ambitions in order to stay sharp and competitive.

Since 2010, expanding business and growing technical needs in the yacht refit and repair sector have left many yards and subcontractors underserved, which prompted us to start the Refit International Exhibition and Conference in 2016. On the strength of the enthusiastic industry response to that very focused first show, we'll be hosting our second Refit, scheduled for January 26–27, 2017, in Fort Lauderdale, Florida. As always, delivering practical information to designers, builders, captains, surveyors, yacht managers, and refit technicians is at the heart of our mission for the show. You'll see familiar names from the pages of the magazine presenting Refit seminars and demonstrating the innovative technical skills and materials specific to cutting-edge yacht repairs. It promises to be an essential professional gathering for the refit and repair community at a time and place that best serve all of us.

Aaron S. Porter

Parting Shots and Letters about Marine Surveyors

To the Editor:

The Parting Shot essay by Mike Telleria (*Professional BoatBuilder* No. 161), the letter responses by Hugo Carver and Dr. Virginia Harper (PBB No. 162, pages 6–9), and the Parting Shot by Dr. Harper (PBB No. 163) finally motivated me to write. During my 40-year career I have had the privilege and honor of working with some of the finest and most knowledgeable marine surveyors in the industry. Over the last 25 years or so I also had the distinct displeasure of observing the profession I loved sink to levels of ineptitude and unprofessionalism I never thought possible. Based on my opportunity to review in excess of 20,000 yacht-survey reports (Condition & Valuation and damage) during my career, I believe I have the right to make the following observations.

Mr. Telleria is correct when he quoted a question from one owner of his company: "What is it with these marine surveyors? Don't they have to meet some minimum level of qualifications or code of ethics?" The answer is an unequivocal "no" to "minimum level of qualifications," and a probable "yes" to "code of ethics."

In his letter Mr. Carver is in error when he states, "Your survey is always acceptable to your insurance company if done by a NAMS or SAMS surveyor." That is not true and never has been. The company I retired from did not accept many so-called surveyors who were members of NAMS, SAMS, USSA, etc. Simply being credentialed did not ipso facto make their knowledge and work product acceptable—at least not by a company that values its professional integrity and has a staff with the professional knowledge, experience, and expertise to discern the good survey from the bad.

NAMS and SAMS include minimal ethics testing as part of their membership criteria. Most of their testing has to do with professional competence and technical knowledge, as it should be. (I am not familiar with the Navtech/USSA test but would imagine it is similar.) The companies I worked for received thousands of unprofessional, poorly documented, poorly written, improperly cited, and subsequently determined-to-border-on fraud reports from "credentialed" surveyors. These reports "documenting" the alleged factual conditions and valuation of a vessel or the proximate cause of a loss seem to validate the concerns that the owner of Mr. Telleria's company had about professional knowledge and competence among surveyors.

Dr. Harper's comments and Mr. Telleria's response to USSA are noted. Suffice it to say that in my experience not all the credentialed Navtech/USSA individuals had the ability to perform surveys and

write reports that were acceptable to senior surveyors (not just the author) associated with NAMS, INA, CIGNA, or ACE. If there is a pattern of poor work product from a particular group of individuals holding membership, it is not a company's responsibility to vet every single member. Refusing to accept surveys from that group, be it NAMS, SAMS, USSA, etc., is the company's responsibility to their goal of profitability. It is not "blackballing, interference with business, and restriction of trade" but a business decision based on documented experience and professional knowledge.

Which gets me to reports. I believe it was Steve Knox who I once heard say, "The only thing tangible a surveyor provides is his report." To be acceptable, a survey report must show an absolute bias toward the only thing that can't speak for itself: the vessel. The builder, the broker, the buyer, the mortgage company, and the insurance company all have their own interests. A 23-page inventory is of little use unless it details the major items on that inventory *and* their compliance with current accepted standards as noted in the survey preamble. It is up to the reader, *not* the surveyor, to determine what is important. I know Steve D'Antonio has gone to great detail about the horror stories he has found when surveying a recently NAMS/SAMS/USSA–"surveyed" vessel. When a claims adjuster has to repeatedly send their assigned surveyor or, even worse, another surveyor to gather the facts to determine the proximate cause of a loss, pretty soon the insured gets nervous, hires an attorney, and the real fun begins. While it may seem like the adjusters are just looking for a way to deny the claim, in reality it is the incompetence of their initially selected surveyor—who does not provide them with a proximate cause of loss—that prevents them from properly adjusting the claim.

So how did the profession get to this point? In my opinion, one has to look no further than the marine insurance companies. When I started with INA in 1976, there were 52(!) field surveyors, and one who came five years before me is still a member of NAMS. The other major marine companies also had their own field surveyors. Fireman's Fund, Travelers, MOAC (hull and cargo), etc., had staff surveyors (many were members of NAMS) to provide technical advice to their underwriters and claims adjusters when they were not adding to their technical knowledge and professional competencies by doing field surveys.

How many insurance companies today have a staff of surveyors or even one surveyor? Who is providing their underwriters and claims adjusters with the technical knowledge they need to properly assess the risks and the

damages they are being asked to respond to based on survey reports? In a constantly shrinking market, underwriters are being asked to meet premium goals, and claims adjusters are being advised it is not in their best interest to make an insured unhappy. But if the insurance companies don't have technical support with years of professional knowledge and competence, these vessels get underwritten, the claims paid, and the surveyor believes his report is acceptable.

To wrap up, I would say: If you are a surveyor, hold yourself to the highest standard attainable, and that may not necessarily include membership in NAMS/SAMS/USSA/ABS/etc. Get certified for the American Boat & Yacht Council standards and become a member of ABYC technical committees. Know the standards (including ABYC and NFPA 302, 303, and section 555 of 70), Federal Regulations, ABS rules, etc., inside and out, and make sure you apply the right standards. It never ceased to amaze me how often surveyors improperly cited 33 CFR for vessels and equipment that the regulations did not apply to or cited outdated NFPA and ABYC standards.

If you don't stay current and prove it in your report, your work product is worthless. Make certain that *every* survey report represents the absolute best you can provide, and that your reports help to educate the boat owner, an underwriter, or a claims adjuster, and are not just something they routinely file. Make sure that every day you learn something new you can use or pass along. Always remember you are a member of the second oldest profession in the world; make sure your performances don't move you to the oldest profession.

Kim MacCartney
Marine Surveyor (retired)
Yorktown, Virginia

Surveyors According to a Surveyors' Association

To the Editor:

Great Parting Shot by Dr. Harper. I have not had a real surveyor here in 15 years or so who really knew or cared about what they were supposed to do for the client we were building for (clients choose their own surveyors).

Most surveyors today want to fluff their feathers and convince you they know more than designers or builders, and 99.9% bleed the clients. They will show up late and have to spend the night, as the travel (usually 2 hours) is too much for them, so they can eat out with the friend they usually bring and spend the night on the oceanfront. One of the first questions they ask is where they can buy fresh seafood, then convince the clients they need to return frequently and do the same. One even brought a "captain" who wanted an extra $1,000 for special training to cross the Willapa Bay bar that the 16′ fishing boats go over.

The good surveyors who used to come here are all retired, and now we are stuck with these who are "listed with an organization."

Most clients are here because they know that we have 41 years of experience, and the designers have sent them to us because they know we build as designed with quality products and follow American Boat & Yacht Council, U.S. Coast Guard, and EC [European Recreational Craft Directive] guidelines.

Gary Habersetzer
Vice President
Pedigree Catamarans Inc.
Raymond, Washington

Frequencies of Fouling

To the Editor:

I read with interest Nigel Calder's article about a new system using high-frequency sound to keep barnacles at bay ("Frequencies of Fouling," PBB No. 161). I am just wondering if the manufacturer of this system has done any reading on the effect of high-frequency sound on marine mammals such as whales, dolphins, seals, sea lions, and manatees. Current research has shown that such emitted sound can have severe and lasting effects on exposed animals. The author states that he read a posting on the Internet by a devotee of the technology who dove under his boat to "test" the system on himself. When closer than 8″ (20cm) to the transducer, he heard "an ear-splitting high-pitched sound," and the aftereffect was a ringing in both ears for 24 hours. Imagine the effect on, say, a group of porpoise that come up to your boat under way and receive even a short-range dose of this ultrasound. Exponentially more sensitive than human hearing, their systems are vital to their navigation, group communication, and food locating. Or imagine the effect on the manatee in the narrow channels of the Florida coast with docked boats emitting a constant "wall" of pain into waters.

I think there should be a rethink on whether this technology is a step ahead of antifouling coatings or a step backward into something potentially more harmful.

Steve Anderosov
Deep Bay Marine Repair
Bowser, British Columbia, Canada

Nigel Calder responds:

I have wondered the exact same thing—what may be the effect of these ultrasonic antifouling systems on marine life. I don't know if there has been any research at the frequencies used. I do know it is very different from the ultra-low frequencies the Navy uses for long-distance transmission (which have been shown to be decidedly harmful). We have quite a bit of anecdotal evidence that there is little to no impact, at least on dolphins. This past summer we spent three months cruising between southwest England and the southern and southwestern Irish coastlines. As many dolphins as we have ever seen anywhere in our travels joined us, frequently playing in the bow wave for extended periods of time when the antifouling system was operating. It seems to me the dolphins would have immediately shied away if the system was bothering them in any way. My conclusion is that the signal gets attenuated to such an extent within inches of the hull that it is not a problem. We have to set against this the known harmful effects of traditional antifouling paints. My sense is that an objective study would likely conclude that the ultrasonic systems are, from an environmental perspective, a significant advance.

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The Foil Fix

To the Editor:

The responses of your readers to my article "Foil Fix" (PBB No. 160) focus on two points I would like to address:

Martin Klygsman was rightly concerned that a reduction in maneuverability could be unsafe if the boat is in inexperienced hands (Letters, Etc., PBB No. 162, page 6). I would like to point out that although maneuverability at speed is reduced with the foils I described, it is still possible to turn at high speed but with about double the turning radius of the vessel without the hydrofoil. As soon as the speed is reduced, normal maneuverability returns. I admit that this is a disadvantage, but it *does* prevent sharp swerving that can result in people falling out of the boat.

As test driver as well as designer, I did not feel that this was ever dangerous, but it required a good lookout, anticipation, and reduced speed in restricted water, all of which should, in any case, be applied when driving a fast motor vessel.

The prototype application was on a 40′ (12.2m) motoryacht fitted with Volvo Penta IPS units. An outboard-powered or conventionally propelled boat might behave differently, as it applies the steering force farther aft than the IPS and is likely to steer better.

The second point, made by Kiko Villalon, was that it is better to deal with the problem (overweight boats) than to devise a solution (Letters, Etc., PBB No. 163, page 6).

I cannot argue with that, but "the hundreds of 40-footers out there that plane perfectly and go faster than 30 knots" that he mentions do *not* generally make the pages of *Professional BoatBuilder* magazine. It's the same reason *The BMJ* (formerly the *British Medical Journal*) and *The American Journal of Medicine* do not have many articles on healthy people. Articles in PBB are not restricted to troublefree boats, because you generally learn more from failures than from successes.

The excess weight of the boat in question arose because the boat was built by a company while it was going bankrupt, so quality control was compromised. More powerful but heavier engines had been installed to compensate for the extra weight of the cabin and flybridge on a hull originally designed as an open boat. Despite our warnings, a larger generator, watermaker, hydraulic tender platform on the stern, and several other tempting additions were also installed, resulting in the observed 4-ton obesity and stern-down static trim.

After experiencing the performance during the first sea trials, the owner's project manager, who had recommended all the additional equipment, disappeared with no good-bye. He apparently moved to Hong Kong.

We received useful help and support from the boat's original designer, and I proposed the foil fix only after all other

modifications (short of stripping out all the extras) had proved to be ineffective.

Most boats of this type perform well enough, but there are still many underpowered or overweight boats on the water that struggle to get on plane. *All* boats seem to become heavier with age, and engines seldom get more powerful with time. The foil fix is there to help.

The foil fix may not be as good as having a lightweight, lively boat in the first place, but when you are stuck with a weight problem, that solution works and costs a lot less than bigger engines or a replacement hull.

And remember, it reduces pitching, too.

Butch Dalrymple-Smith
La Ciotat, France

To the Editor:

No engineer here, I'm substantially innumerate. My dad, Kenneth R. Lung, was an engineer designing windmills in the 1920s, and spoke to me in formulas. I also sail and build small skiffs, so I was able to understand and appreciate the excellent article "Foil Fix."

My question is: Would an arc-shaped foil work? Would it have fewer of the "negatives" mentioned in the article? It would seem that the foil could be designed so as to achieve constant lift (at least closer to constant) as the boat rocked.

James W. Lung Sr.
Greensboro, North Carolina

Butch Dalrymple-Smith responds:

This is an interesting idea; an arc-shaped foil would probably work okay. It would reduce interference drag between the supporting strut and the wing, but I selected a straight, horizontal foil for the following reasons:

1. It is easier to build.

2. Any hydrofoil has reduced lift near the surface, so I wanted to get as much of the foil as possible as deep as possible without exceeding maximum draft.

3. I was interested in generating vertical force, and a horizontal foil would not waste any surface in achieving it.

4. If the tips of the foil break the surface, you will get ventilation, which destroys lift across the entire wing. A horizontal foil is less likely to breach the surface. The vertical struts do not cause ventilation because they do not create much hydrodynamic lift.

I do not think an arc-shaped foil would help steering at speed. In fact, it would increase the boat's tendency to heel toward the center of the turn, and so might make the steering problem worse. In the trials, the boat did not roll appreciably, so it was not a problem, while the effect of the foil on pitching was that it greatly reduced pitch, as the moment the bow went up, the foil incidence would increase, causing the stern to rise also, hence reducing pitching. This would not be affected by making the foil curved. PBB

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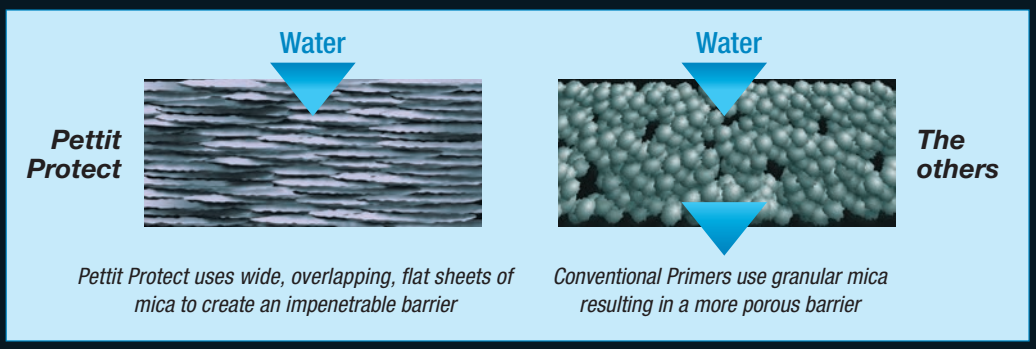

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Rapid Expansion

About 16 years ago Kristi Benwell had just completed her fabricator's certificate at Armstrong Marine in Sidney, British Columbia, when the company relocated to Port Angeles, Washington. Benwell and two other employees decided to form their own company in the same facility and call it Liquid Metal Marine. Tragically, before opening, one partner was killed in an accident, and within a year the other opted to follow Armstrong and work for the company in the United States. Undaunted, Benwell continued on her own, as she felt she had a great team working for her. She was soon joined by fabricator Dave Scott, who oversees operations on the shop floor.

DAN SPURR (BOTH)

Left—*Kristi Benwell founded Liquid Metal Marine in 2000 on her own after losing her two planned partners.* ***Above—****Dave Scott, now a partner in the business, installs a low-voltage distributed electrical power system on the company's recreational 28-footer (8.5m).*

In the beginning, Liquid Metal Marine Ltd did refits for the Armstrong Marine boats originally built in Sidney. Then Benwell asked Cory Armstrong (see "The Strong Stuff," *Professional BoatBuilder* No. 152) to come to Sidney and help her start production of an 18′ (5.5m) runabout. Liquid Metal Marine grew from there into building custom boats, but it's also working on a line of production vessels. Benwell: "By offering a production line, we can make available a base package from which customers can get into a welded aluminum boat at a more attractive price point. Our production line is just a building base; customers can always add custom features if desired."

To that end, she has commissioned work from three designers: Bruce Cope (www.aluminumboatdesigns.com), located in Qualicum Beach, B.C., for boats under 16′ (4.9m); TEKnaval, in Victoria, B.C., for boats 18′–24′ (5.5m–7.9m); and Gregory C. Marshall Naval Architect Ltd, also in Victoria, for the larger vessels. Currently in the shop are two Gregory Marshall designs, a 28′ (8.5m) recreational boat as well as a custom 60′ (18.3m) catamaran that will be used by Eagle Wing Tours, a local whale- and wildlife-watching company.

Partnering and cooperation are prevalent between marine businesses on Vancouver Island. This is apparent in Liquid Metal Marine's fabrication of a custom 60′ catamaran. The company is completing the hull, but the cabin and aluminum components are being completed by All Keeler Metals, another area business. Two other local companies, Sea Power Marine Center supplies the engines, and Polar Bear Equipment completes all the upholstery. Finishwork is being completed by industry professionals alongside Eagle Wing's own staff.

Liquid Metal Marine has averaged about 10 on staff, including fabricators, welders, apprentices, a diesel mechanic, an ABYC-certified marine electrician, a purchasing specialist, and a general office manager. When there are increases in work, qualified staff are not always easy to find; the company is looking at the possibility of working with Quadrant Marine Institute's apprenticeship program (see "Developing a Strong Boatbuilding Community," Rovings, PBB No. 162). Benwell says, "It's a big challenge to find and hire staff that are capable along with having the specific marine industry background necessary.

"When we take on an apprentice, they're committed to being here while completing the training courses; [we are] hoping that in the end we've developed a qualified

COURTESY LIQUID METAL MARINE

This 27'6" (8.3m) model in the Salish recreational series, distinctively black, is set up for fishing.

Liquid Metal Marine employee, which benefits both the employee and the company."

As a qualified fabricator, Benwell often floats between the office and the shop, helping keep projects and production on time and on budget. That work includes managing vendors to her best advantage. Whereas Liquid Metal has generally cut parts in-house, now it is outsourcing more jobs. By having naval architects and designers draw boats, CAD cutting files can be generated and e-mailed to the subcontractor, which Benwell considers more efficient and cost-effective. "We're just making the shift from our cutting them," she says. "Now K&K Industries, in Bellingham [Washington], and CJM Technologies Ltd, in Delta, B.C., do that for us. It saves labor costs and layout time and makes more sense to do router cutting. But [dealing with U.S. vendors] we have to be really careful because of the exchange rate." At this writing, $1 USD equals $1.30 CAD. That difference, however, also works to Benwell's and other Canadian builders' advantage, with U.S. buyers "coming north" to expand their purchasing power.

Liquid Metal Marine builds with standard aluminum alloys—5086 and some 5083 for hull plates, and the 6000 series for extrusions. Several vendors supply the bulk of material: Wilkinson Steel and Metals (wilkinsonsteel.ca), with a warehouse in nearby Victoria, is favored for same-day deliveries, and Alaskan Copper & Brass Co. (www.alascop.com) based in Kent, Washington, for delivery direct to K&K in Bellingham (kkindustries.com).

COURTESY LIQUID METAL MARINE

A 30' (9.1m) RHIB in the Knight series can be configured for various applications, including search and rescue. The forward-raked windshield is the preferred style in the Pacific Northwest.

And while Liquid Metal Marine has its own shear and press brake, it is finding efficiencies in having at least one supplier "kit" prebent panels. The shop that cuts panels for the Cope-designed production boats is now bending, too, saving Liquid Metal Marine time.

As Benwell develops models and processes for building and marketing lines of production designs, sales become an issue. Whereas customers for custom designs might always have been handled in-house, increasing sales of production models might now require developing a dealer network. Benwell points to another aluminum builder, Silver Streak Boats, at the south end of Vancouver Island in Sooke, which has successfully developed a dealer network. "We're interested in that option as well," she says. "We're watching how Silver Streak manages this area of business, which so far appears to be successful."

One thing is certain: Benwell is committed to building in aluminum. While private and government contracts seem to favor composites on the East Coast, the Pacific Northwest has always preferred aluminum. Workboats there have traditionally been aluminum. "You can beat 'em up, and throw 'em on the beach, which aren't always sandy here," she says. "We're moving more into recreational design. Choosing an aluminum boat doesn't mean you have to have a cold, uncomfortable workboat; it can be the kind of boat your wife and family will also enjoy. You can have the best of both worlds."

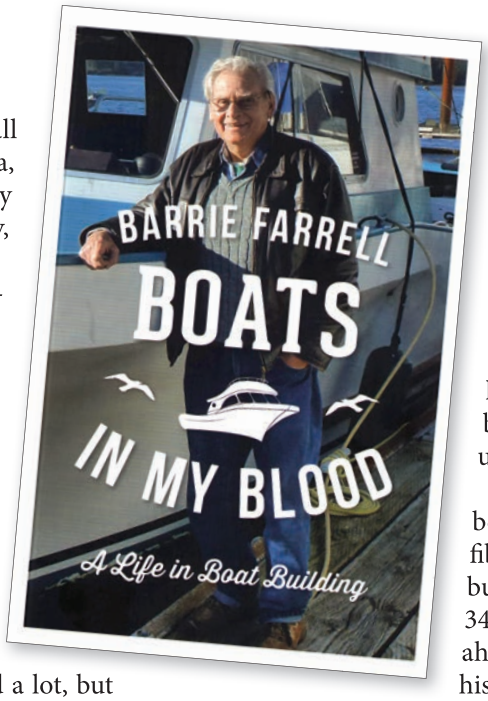
Liquid Metal Marine, 2057 Mills Rd. W, Sidney, B.C., V8L 5X2, Canada, tel. +1 250–656–9298, website www.liquidmetalmarine.com.

—Dan Spurr

Welders work outside and inside the bow sections of the 60' (18.3m) Greg Marshall–designed whale-watcher catamaran.

DAN SPURR (BOTH)

A Builder's Life



Barrie Farrell, longtime boatbuilder in British Columbia, tells his life story.

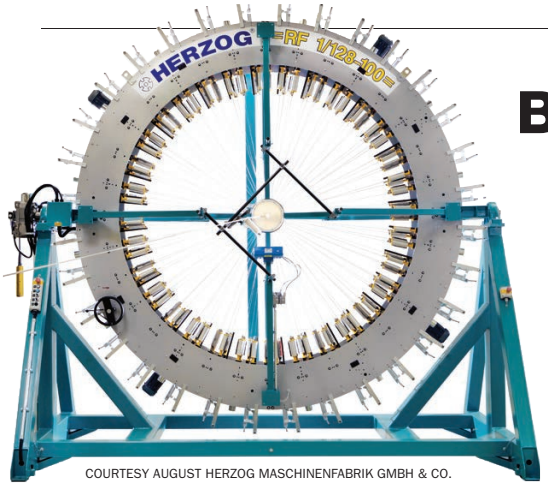
Barrie Farrell is a lifelong builder of boats—all manner of boats—in British Columbia, Canada, with a thousand stories to tell, which he mightily recalls in a recently published autobiography, *Boats in My Blood*.

Farrell's father and mother divorced when Barrie and his brother, Jerry, were young; dad hooked up with another woman, built a boat on the beach, and sailed off to Fiji. His mother took up with a decent fellow, who moved the family around the province, changing homes and schools seemingly with the wind. Farrell's last school year was sixth grade, when he built his first boat with alternate red and yellow cedar deck planks, which became a trademark. When there wasn't a boat to build—mostly small plywood craft—there was always work to be found logging.

The narrative, like Farrell's life, jumps around a lot, but humor and a dose of luck—good, bad, and indifferent—seem to prevail, as in this anecdote:

"I was working on and sometimes running a little tug called *Red Wing*. I lived on the tug and we were tied up at Doug's float in Dingman Bay near Irvines Landing. When Doug came back from Vancouver late one night, he was pretty drunk and I guess he didn't want to go into the house, so he came down to the boat and told me to run up to St. Vincent Bay and wake him up when we got there. It was light when we arrived. I called Doug and he got up, rubbing his eyes and looking out the back window. He said, 'Where's the barge?' He hadn't told me to pick up the barge in Pender and bring it up, so it was a wasted trip."

As years passed, Farrell began sheathing his boats in fiberglass, until 1968, when he built his first all-glass boat, a 34′ (10.4m) gillnetter. Jumping ahead on the Farrell timeline, his last boat was a 40′ (12.2m) Chinese junk for personal family cruising, one of an estimated 40 he built on a beach with only hand tools. Never afraid of hard work, and never, as he says, "short on balls," Barrie Farrell is something of a legend around Pender Harbour and ports up and down the B.C. coast. *Boats in My Blood* is a charming personal story of a life in boats, one that will resonate with most any builder, especially those who made the journey from wood to glass. Paperback. 208 pages. $24.95 CAD. www.harbourpublishing.com. —*D.S.*



COURTESY AUGUST HERZOG MASCHINENFABRIK GMBH & CO.

Braid My Rig

Future Fibres, a division of Southern Spars, and parent company North Sails Group recently purchased a new Herzog braiding machine to enhance its capabilities in making multi-strand carbon fiber rigging for large sailing yachts. Installed at its service base in the Marina Real Juan Carlos I in Valencia, Spain, the braiding machine will improve delivery and service times to its global customers, says the company CEO. A recent project was a full set of Future Fibre's ECsix carbon standing rigging for the 279′ (85m) Bill Tripp–designed ketch *Aquijo*, built by Oceanco and Vitters Shipyard. Other applications include architectural, aerospace, civil engineering, and motorsports.

Above—*Future Fibres, the Valencia, Spain–based maker of nonmetal rigging, recently made a major investment in this radial braiding machine built by August Herzog Maschinenfabrik.*

The radial braiding machine, model RF 1/128-100, was made by August Herzog Maschinenfabrik GmbH & Co. in Oldenburg, Germany. The company, founded in 1861 to braid a variety of products from ropes to shoelaces, was completely "bombed out" during World War II. Its processes have advanced to handle not only textiles but also modern composites such as carbon fiber. The RF 1/128-100 has 128 carriers, a 265cm^3 (16-cu-in) bobbin, is powered by four motors, turns at 150 rpm, and represents a major capital investment.

Future Fibres, Base No. 3, Marina Real Juan Carlos I, 46024 Valencia, ES, tel. +34 961 452 135, website www.futurefibres.com. In the U.S., 449 Thames St., Suite 200, Newport, RI 02840, tel. 401–268–3972. —*D.S.*

Julie *was a 56′ (17m) wood sloop designed and built by Luders in 1950. Paul Campbell bought the boat in 1954, named her after his wife, and cruised and raced her for 18 years with his family.*

Part of the Family

None of us would make a dime in this business if it weren't for the fact that lots of people go wacky for boats. Rovings isn't the place to try explaining the siren song of the sea (think John Masefield's poem "Sea Fever"), but it's true: a good, favored boat—power or sail—often becomes an esteemed member of the family. A good friend, on selling his beloved ketch, removed the carved name board from the transom and mounted it above his fireplace mantle.

Such was the tender story of *Julie*, a 56′ (17m) wood sloop designed by Bill Luders and built by his Luders Marine Construction Co. in 1950. Originally named *Storm*, she was bought "pre-owned" at the 1954 New York Motor Boat Show by Paul Campbell, a yachtsman of some repute. Over the course of his ownership of *Julie* (named after his wife), Campbell cared for her like a thoroughbred racehorse, and took meticulous notes on her condition, equipment, performance, and even, you could say, her temperament. In 1984, after it was over, he wrote a book for his family and the crew who'd served aboard her. It begins:

"This is the story of a romance—a romance of a family and a sailing vessel…. As we walked into the Luders booth [at the New York show], facing us was a large photograph of the 56-foot blue *Storm*, designed and built by Luders, and probably the most beautiful boat they ever built. We both exclaimed at the picture, and Ken Rockwell, who worked with Luders, said, 'She's for sale, you know.' We said we didn't know.

"Within a week we owned her.

COURTESY GORDIE VILLALON (BOTH)

Gordie (now married to "Kiko" Villalon), who sits on her father Paul's lap, grew up sailing Julie.

"If there was ever a case of love at first sight, this was it. Our judgment turned out to be not only excellent, but superb. The romance lasted 18 years, almost a generation.

"When we bought her our children were, Paul Jr., age 14, Melanie, age 12, and Gordie, age 8. The boat became another member of the family."

Gordie (you can do the math on her current age) is now wife of longtime boatbuilder "Kiko" Villalon, founder of Marine Concepts and an industry activist (see "Out of Cuba," PBB No. 114). During an outing on their new Monk-designed trawler last spring, Gordie loaned me her copy of her father's book, which is typed, double spaced, and organized into nine chapters. There are copious notes on races, reporting whether certain rigging changes led to improvements in speed or handling; and humorous anecdotes include the time they were trying to work past another boat in light air and Paul had the entire crew point to the top of the competitors' rig and exclaim, "Too bad!" The other skipper "started gazing intently at the top of his mast, and yawed all over, and his spinnaker broke. We sailed right through him." And news clippings. In the 1950s, yacht racing was real sporting news: On September 4, 1955, the *New York Herald Tribune* Sunday edition printed the headline "Julie Leads Vineyard Sail at Half Mark." Half mark? My goodness! Newspapers today wouldn't care whether the winner of a yacht race came out of the fog with the reincarnation of Sir Thomas Lipton at the helm.

But those were different times, in the '50s, and actually, all those Corinthian times before commercialization of the sport began transforming it in the 1980s. Paul Campbell was a sterling example of the competent, caring, amateur yachtsman who raced and cruised with family and friends as long as he could stand behind the wheel. He donated *Julie* to the Naval Reserve and Militia Foundation of Chicago in 1972. She sank off the coast of Georgia three years later. Paul died in 1998. And Gordie remembers. After all, they were family. —*D.S.*

Super Power

COURTESY WIDER YACHTS

Minnesota-based Emerson Industrial Automation partnered with Italian builder Wider to develop a diesel-electric propulsion system for a 150' (46m) motoryacht using its Powerdrive MD2 modular drives coupled with azimuth pods. Four MAN engines are connected to alternators, producing 350 kW of power stored in lithium-polymer-battery banks. Variable-speed generators are computer-controlled by a management system that improves efficiency over constant-speed generators. The yacht has a cruising range of 4,200 nm at 11 knots on a fuel capacity of 11,890 gal (45,000 l), and can operate for a full night on battery power alone. Emerson claims fuel savings of up to 20%. The aluminum yacht is said to be the largest so equipped. Websites www.wider-yachts.com, www.emersonindustrial.com.

Finding Where the Fault Lies in ELCI Tripping

When a boat owner complains about frequent tripping of an equipment leakage circuit interrupter (ELCI), a marine electrician's first thought should be: "I must treat this as a genuine electrical fault," rather than dismiss it as faulty hardware or nuisance tripping.

ELCIs, also known as residual current devices, or RCDs, have been used industrially for many years, gaining popularity aboard boats only in the last decade. The American Boat & Yacht Council's (ABYC) first introduction of a standard that included ELCIs was in 2008; however, its implementation date was postponed because reliable ELCI circuit breakers were not yet readily available. With that problem resolved, ELCIs are now installed on most new ABYC-compliant vessels, though the tripping—nuisance and genuine—issue remains. Unlike ground fault circuit interrupter (GFCI) receptacles, ELCIs provide whole-boat protection. To account for cumulative small leakage and prevent nuisance tripping, the threshold for an ABYC-compliant model is 30 mA. (In comparison, a GFCI has a threshold of 5 mA, and as such is considered in North America to be appropriate for protecting people.)

It's worth reviewing how these devices work. Much like a common GFCI receptacle, ELCIs remain in a state of equilibrium, allowing energy to flow as long as the current on the hot and neutral wires remains the same. As soon as current finds an alternative path back to its source—through a ground wire, the water, or a human—the imbalance trips the ELCI's circuit breaker, and the power is turned off. While ELCIs are technically deemed "equipment protection" because of their 30-mA trip threshold, the goal of ELCIs is to interrupt current flow quickly enough to prevent electrocution, electric shock drowning, or fire; and for the most part they do so very effectively, saving many lives every year.

COURTESY BLUE SEA SYSTEMS

Unlike a GFCI (ground fault circuit interrupter), an ELCI, or residual current device, circuit breaker, such as this one from Blue Sea Systems, offers whole-boat protection.

However, that ELCI trip threshold of 30 mA is still comparatively and necessarily low, which means it doesn't take much of a fault or collective smaller faults to open the circuit. When confronted with frequent tripping, the challenge is to find the fault and determine if the ELCI is defective. Common faults or sources for tripping include appliances whose internal insulation is failing, electric ranges, water heaters, and self-testing galvanic isolators, as well as genuine miswiring, such as interconnection of ground and neutral aboard the vessel (for more on that subject, see "Demystifying the Neutral-to-Ground Connection" on www.proboat.com). In the majority of cases, the fault lies aboard the vessel rather than in the ELCI itself.

To assist with troubleshooting such tripping scenarios, Blue Sea Systems, of Bellingham, Washington, has developed a simple Field Test Kit that quickly identifies the source of the problem as either the ELCI or the boat. If the leak source turns out to be a genuine fault aboard the boat, the technician may have to do a lot of investigation, but at least time and money aren't being wasted in replacing the ELCI. The ELCI Test Kits are easy to use, and the average test takes just 10 minutes. The testers are available free of charge to ABYC-certified marine electricians, as well as to other qualified individuals on a case-by-case basis. For more information or to obtain a Field Test Kit, contact Blue Sea Systems technical support at 1–800–222–7617 or e-mail techsupport @bluesea.com.

—Steve D'Antonio

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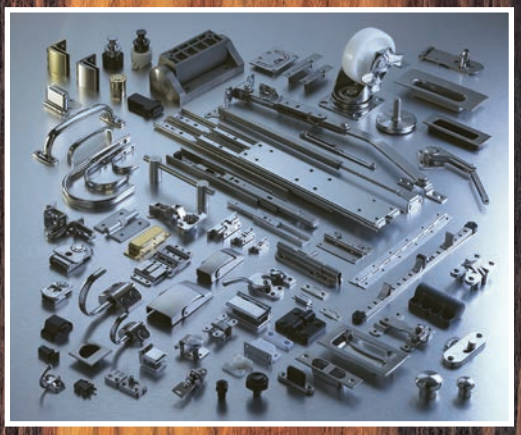

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COURTESY VRIPACK

Perhaps the largest private naval architecture firm in the world, Vripack, announced its first patent of a hullform—the Slide Hull. This after 55 years in business and more than 7,300 projects. (See "Vripack," PBB No. 108, for more on the company, based in Sneek, The Netherlands.)

The hullform was developed not (at least initially) by computer analysis or tow-tank testing, but by tireless trial and error conducted by a longtime Vripack customer, Capt. Jaap de Bruijn, who owns a 45-ton commercial ship. Over the years, he cut and reshaped the hull many times over, aiming for the best fuel performance possible. Eventually de Bruijn shared his insights with Vripack architects, who initially ▶

Get Ready for *Your* Day in Court

In our persistently decentralized industry it's common for most independent boat builders, repairers, surveyors, yards, and related consultants to ignore the prospect of a brush with the law. Like it or loathe it, the institutionalized blame game of legal liability in all areas of life and commerce has become an industry in its own right. For unprepared players who get caught up in it, the outcomes can be crippling. Or, for experts with sound reputations, relevant technical knowledge, and experience, a call to court can be a lucrative business opportunity. With those potential extremes in mind, the American Boat & Yacht Council (ABYC) will include a full-day Marine Law Symposium on January 10 in Charleston, South Carolina, in its 2017 Standards Week.

The legal conference is geared to serve expert witnesses such as surveyors and materials and systems consultants, as well as insurance underwriters contracting with experts to inform critical decisions. Also served will be the compliance staff of boat or component manufacturers who would be responsible for defending their company's compliance with a range of standards. The track for builders and ▶▶

***Facing page**—Commercial ship captain/owner Jaap de Bruijn continually reshaped the hull of his 45-ton* SC Amethyst *to improve fuel economy. Refined by naval architects at Vripack and named the Slide Hull, it became the company's first patented hullform.*

scoffed at his assertions. But they pursued research with their own sea trials and empirical studies, validating the concept and improving efficiency another 15%. According to Vripack's Peter Bouma, "The comfort of this hull is described by her sailors like the boat is riding on cushions. The damping in waves is beyond unique and thus prevents seasickness. Next to that, indeed the fuel consumption of our Slide Hull outperforms any other vessel that I have ever seen." Fuel consumption of de Bruijn's *SC Amethyst* is said to be just 47.6 gal (180 l) per hour at 21 knots cruising speed. Bouma says the hull form was named Slide Hull because "the water flows in a way that resembles how you go down a slide."

Marnix Hoekstra, Vripack's managing partner, explains that the so-called slide effect is the result of air traveling in the channel between the wide chine and hull bottom, effectively reducing the "18° real deadrise to 13° virtual deadrise." Other distinctive features include wide chine flats, a deep forefoot, large load-carrying bottom surface, and a second chine just inboard of the chine flat.

New construction of two vessels with the Slide Hull is under way.

Vripack, Zwolsmanweg 16, 8606 KD Sneek, NL, tel. + 31 (0) 515 436 600, website www.vripack.com. —*D.S.*

manufacturers includes a presentation by David Marlow, director of product integrity at boatbuilding giant Brunswick Corp., exploring how decisions made at time of manufacture sound when you're testifying in court. Marcia Kull of Volvo Penta will follow with a look at the often-fraught relationship between marketing and compliance during product design, and the potential legal consequences of compromises. Attorney Christina Paul will present case studies of product manufacturers who successfully defended themselves based on engineering knowledge and adherence to proper manufacturing practices and standards.

The track for expert witnesses focuses on honestly and effectively marketing yourself as an expert, preparation for deposition or trial, and case studies of expert-witness work done right and gone wrong. A track on expert witnesses will focus on matching experts to a claim or case, what to pay, how to interpret technical language in professional reports, how to apply the information gathered, and how the opposition can discredit your expert witness.

It's all material that most of us in the boatbuilding trade don't like to think about but can't afford not to. For registration, visit www.abycinc.org or call ABYC at 410–990–4460.

—*Aaron Porter*

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- **D** ___ Boat repair/Maintenance
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- **G** ___ Marine consulting
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- **I** ___ Marine surveying
- **J** ___ Fabricator/Laminator
- **K** ___ Government/Military/Academic/Marine association
- **L** ___ Wholesaler/Distributor/Manufacturer's representative
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- **Z** ___ Other—please specify:_____

3. How many employees at this location (including yourself)?

- **A** ___ 1
- **B** ___ 2–10
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- **D** ___ 26–100
- **E** ___ 101–500
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4. If you are a **BOATBUILDER**, what do you build in? Please check ALL that apply:

- **A** ___ Fiberglass-Solid
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5. If you are a **BOATBUILDER**, which of the following do you build? Please check ALL that apply.

- **A** ___ Pleasure
- **B** ___ Commercial
- **C** ___ Military
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THE SCARANO FLEET:
Design, Build, Sail, Repeat

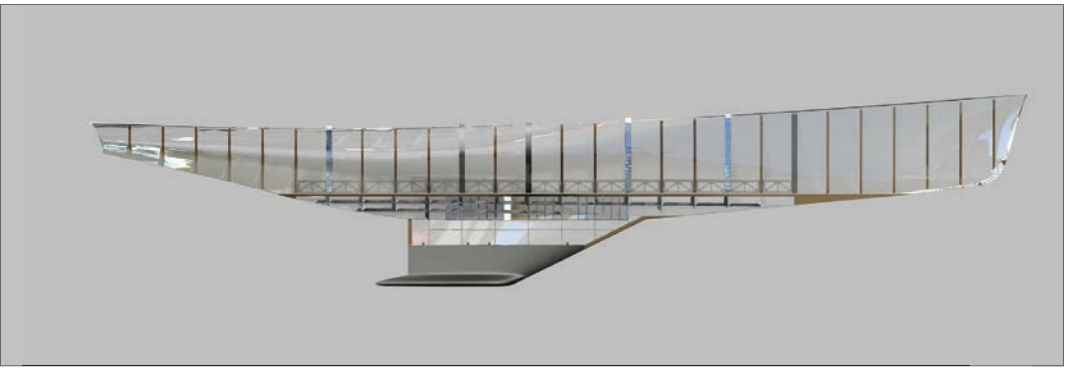
A custom boat builder in Port Albany, New York, creates its own network of excursion-boat businesses to keep its shop full and income steady.

Text by Robert Mazza
Photographs courtesy Scarano Boat Building (except where noted)

A year ago while my wife and I were in Key West, Florida, escaping a Canadian winter, we stumbled on a replica of the famous schooner *America*, sailing day charters. Despite my wife's misgivings, we booked two tickets for a morning excursion, and with a dozen other vacationers cast off for a pleasant cruise aboard *America 2.0*.

It didn't take long to realize that this was not a true replica of the great yacht. *America 2.0* is more accurately described as a homage to *America*—thus the *2.0* designation. For instance, the two highly raked masts of her schooner rig are freestanding carbon fiber spars painted to look like wood. And the hull, I discovered, was balsa-cored cedar. Skipper Andrew Neuhauser informed me that at 79′ (24m), the *2.0* version is about 20′ (6m) shorter than the original *America,* and although similar in shape above the waterline, she's entirely different below, with a long fin keel and freestanding rudder, which give her a good turn of speed and great maneuverability.

Neuhauser took me below to view her construction and showed me the drawings of her aluminum bottom and keel sump. The boat was a revelation, and I was surprised to learn that she was built in Albany, New York, by Scarano Boat Building for its own charter businesses in Key West in the winter and New York City's Chelsea Piers in



Facing page—*America 2.0, a 79′ (24m) homage to the original 1851-vintage schooner-yacht* America, *was built for the excursion-boat trade by Scarano Boat Building in Port Albany, New York, in 2011.* ***Left—****Drawings of* 2.0 *reveal the extent to which the laminated-wood hull relies on a strong aluminum framework and an all-aluminum fin keel and sump fitted with internal tanks.*

the summer. When I lived in New Jersey for eight years I had often seen the charter schooners sailing on the lower Hudson River, as well as the large 1920s-style excursion cruisers circling Manhattan. I had just accepted them as part of the New York background experience, little knowing that a good many of these apparent "classics" were designed, built, owned, and operated by John and Rick Scarano out of their sprawling shop on the shores of the upper Hudson River.

Aside from the Scaranos' unique business model of building and then chartering boats, which allowed the builder to continue deriving income from a boat long after it left the yard, I was fascinated by the boats' obvious quality of design and construction. The wide variety of materials, including laminated wood, composites, steel, and aluminum, were often in the same boat, all coming out of an unlikely Albany address. I needed to know more about this family.

The Scaranos Start Up

John Scarano and his younger brother Rick are equal partners. John is president and lead designer, in charge of design and construction. Rick is vice president, overseeing business development and management, systems installations, as well as quality control and production. Rick also manages their expanding day-excursion businesses—Adirondack Sailing Excursions out of Newport, Rhode Island, and Classic Harbor Lines out of New York, Boston, and Key West.

It was John who got the family into boatbuilding. His interest started during a childhood sail with the family on Kinderhook Lake, near the Catskill Mountains of upstate New York. It wasn't long before John got involved with the very active and innovative International 14 Dinghy fleet sailing on Saratoga Lake, which prompted him to design and build a couple of International 14s of his own. He enrolled for a year at SUNY Maritime College in its naval architecture program, but the lure of hands-on boat building and repair prompted him to open his own shop at the age of 19 in Half Moon, New York, in 1971. Those early years, he primarily dealt with the repair and optimization of cold-molded racing dinghies, so popular and competitive in the 1960s, and then the newer fiberglass racing dinghies that followed.

In 1974, he moved to a larger shop in nearby Waterford, where he designed and built larger cold-molded racing sailboats. The Scarano 21 (6.4m), a 1976 design that resembled an International 14 on steroids, soon dominated MORC and PHRF racing on New York's Lake George, where it still sails today.

Rick joined his brother in the business in the early 1980s. The brothers' material of choice remained laminated wood, and they displayed the cold-molded Scarano 22 (6.7m) at the 1984 Newport International Sailboat Show.

The company's largest design and build was a 33-footer (9.75m) until 1985, when they fielded an inquiry for a 65′ (20m) excursion vessel. It was bigger than the Waterford shop could handle, so Scarano Boat Building moved to Port Albany. The brothers rented space in a much larger facility, which their growing company acquired in segments over the next several years.

The Scaranos built their first large Coast Guard–certified passenger vessels out of wood and epoxy, like most of the smaller models they had built before. But instead of ⅛″ (3mm) plies of cold-molded cedar, they laminated

The 65′ (20m) Dutch Apple II *was the company's first experience with an excursion boat. Built in 1989 of laminated wood, the project spurred John and Rick Scarano to move to a larger shop to accommodate the hull and superstructure.*

Left—*In 1992 Rhode Island–based Newport Schooner Tours commissioned the first sailing-excursion boat from Scarano, the 57' (17m) marconi schooner* Madeleine. *She was followed the next year by* Woodwind, ***above,*** *built for another client to sail excursions from the Annapolis, Maryland, waterfront.*

multiple layers of ¾″ (19mm) Port Orford cedar, their wood of choice. The first excursion vessel, *Dutch Apple II*, launched them into building a series of these traditionally styled plumb-stem Hudson River excursion boats—the 60′ (18m) *Carillon* and 65′ (19.8m) *Seneca Chief* in 1990, followed by the 47′ (14m) *Cambridge Lady* in 1992.

Also in 1992 the owners of the Newport Schooner Tours in Rhode Island approached the Scaranos to design and build a sailing vessel that matched the 19th-century aesthetics of the yard's recently built powerboats. Building this first large sailing-excursion vessel, the 57′ (17m) *Madeleine* (all lengths are length on deck), returned the brothers to their first love, sail, in a big way. The 62′ (19m) *Woodwind* followed in 1993, delivered to Running Free Inc., a charter business on the Annapolis, Maryland, waterfront. The staysail schooner was John's first design with a more modern spoon bow, and *Woodwind* proved her superior sailing ability by dominating the annual Chesapeake Schooner races. She was soon followed by a second order from Running Free for a near sister.

The Builder/Operator Model

When the brothers built *Madeleine* and *Woodwind*, not only did they return to sail, they also experienced a boatbuilding epiphany. For the past six years of designing and building large excursion vessels for a variety of customers at a closely negotiated fixed cost, they had barely made a profit, and in some cases delivered the boat at a loss. The owners who received them put those new boats to work generating steady income over many years of operation. Why couldn't they do something like that, too?

In 1994 the Scaranos initiated a similar business plan with *Adirondack*, their own 65′ passenger-carrying schooner sailing out of Newport. In the winter of 1994, while she was being delivered south to charter out of Fort Lauderdale, *Adirondack* caught the eye

ROBERT MAZZA

The success of the excursion boats the Scaranos had delivered to others prompted them to build the 65' Adirondack *in 1994 to sail out of Newport. Here, she is moored to the company's dock on the Hudson River on a maintenance run in 2015.*

True Replicas?

The whole question of what a "true" replica is came to a head in a series of articles in *WoodenBoat* magazine in 2003, where a competitor criticized Scarano Boat Building's reproduction of the 140′ (42.7m) *Friendship of Salem,* which was designed to be a static display at a historic wharf as well as a possible sail-training vessel. The competitor had said, "It's one of those boats that I think was designed and built by people who don't believe that wooden boats actually ever sailed, because behind every piece of wood is a metal bracket that actually takes the load that the wood is supposed to be taking…there is metal almost everywhere in the structure of the boat."

The Scaranos took exception to this statement on two grounds. First, the design was a federal contract "built to print," where all the construction details were specified in the contract and were not designed or engineered by Scarano. Second, the company's record of past performance was clear: At the time, Scarano had designed and built 25 wooden sailing vessels from 58′ to 105′ (17.7m to 32m), nine of which were historic "replicas," that all sailed quite handily.

John Scarano remains skeptical about the concept of there ever being a true replica, since the vast majority of these vessels are built without the benefit of complete original plans, or, as in the case of *America* and others, they have to meet modern U.S. Coast Guard passenger-carrying regulations.

—Robert Mazza

of a prominent restaurant owner in Alexandria, Virginia. Although not a sailor himself, he felt strongly that building a replica of the famous schooner *America* would be fun, and would promote American pride and expertise in the marine trades. (A previous replica of *America* had been built by Goudy & Stevens, in East Boothbay, Maine, and launched in 1967 for Rudolph Schaefer Jr. of F. & M. Schaefer Brewing Co.)

John Scarano knew how difficult it would be to build a true replica of a vessel of the original *America*'s vintage that would also meet the very stringent U.S. Coast Guard certification for passenger-carrying sailing vessels. His design dilemma was this: if he accurately duplicated the hull lines, he would have to greatly reduce the sail area to meet the Coast Guard stability requirements. On the other hand, if he maintained the same sail plan, he would have to substantially increase stability by altering the hull lines. The customer wanted the replica to be as accurate as possible above the waterline and really wasn't that interested in "what the fish saw." Filling out the hull at the turn of the bilge to achieve more stability also allowed standing headroom in the outboard heads. The resulting 105′ (32m) hull is slightly longer and wider than the original *America*, with firmer bilges, and is substantially lighter, which results in excellent performance under sail. This "replica" of *America* now sails out of the Maritime Museum of San Diego, California. *America 2.0* came later.

In 1999 the Scaranos launched the 65′ *Adirondack II,* the second excursion sailing vessel in their fleet. The new boat, which had slightly larger passenger capacity than the first *Adirondack*, was stationed in Newport, where the excursion business was already well established. The first *Adirondack* relocated to their new venture operating out of Chelsea Piers in New York City. John describes the opening of the New York operation as "scary expensive," with the underlying question "If we build it, will they come?" The answer was yes; passenger business increased in both locations.

Metal and Mobility

Early Scarano projects were all built of laminated wood, either Douglas-fir or Port Orford cedar over yellow pine, screwed and glued with epoxy. But in the early 1990s the company began construction of a series of replica canal boats with aluminum rather than

In 1999 the Scaranos expanded their day-charter business into New York City, sailing from the Chelsea Piers, and built the 65′ Adirondack II *to allow the transfer of* Adirondack *from Newport to meet the demand of the growing passenger trade.*

The Design Office

When John Scarano, president and lead designer of Scarano Boat Building, set out to design and build his first passenger-carrying vessel, the 65′ (20m) *Dutch Apple II*, in 1986, it was a leap into a whole other level of regulation and administrative oversight. Initially, he took full advantage of his father's expertise as a civil engineer and sought help from his older brother Robert, who was a mechanical engineer. But John soon developed the required expertise, and he designs all his vessels to American Bureau of Shipping requirements, and all passenger vessels are certified by the U.S. Coast Guard. (In 2003 Robert joined John and brother Rick at Scarano Boat Building as operations manager, focusing on plant and product engineering.)

Like most designers who began their careers in the 1960s, John started on a drawing board using ducks and splines and favorite ships curves, beginning each design with a profile, a plan view, and a midships section. Although he considered the drawing of a lines plan by hand a true art and was reluctant to embrace the lines development software programs being marketed at the time, in the mid-1980s he acquired a copy of MAXSURF and used it to develop a lines plan from which the full-size frames for a new boat were directly plotted. Much to his amazement, the resultant hull was perfectly fair, and he saw the economic advantages of computer design. He moved from surface modeling into solid modeling in the early '90s with a system supplied by SDRC (Structural Dynamics Research Corporation). Today, most of the day-to-day CAD work in SolidWorks now falls to design manager Keith Duffy, who joined the company in 2004.

—*R.M.*

Company president and lead designer John Scarano started with ducks and splines, but in the late 1980s transitioned to a variety of design software, including surface- and solid-modeling programs, to create and refine his boats.

traditional wooden hulls. Their crew had developed skills in welding steel and aluminum, and so were well prepared when the Lake Champlain Transportation Co. commissioned the design and build of a 115′ (35m) excursion boat in 2003. *Northern Lights* was built with a welded steel hull to handle winter ice on the lake, and a welded aluminum superstructure. She was too large to be delivered in one piece to Lake Champlain, so her steel hull was delivered first, with the aluminum superstructure added afterward.

In 2004 the brothers expanded their own charter excursion business into power with the design and build of the all-aluminum 115′ triple-deck *Adirondac* for service on Lake George. If getting *Northern Lights* to Lake Champlain wasn't challenge enough, getting *Adirondac* to Lake George was even more so; the boat's several pieces had to voyage over water and land before being assembled on Lake George.

Out of necessity, this skill in building boats in one location and reassembling them someplace else had become another specialty of Scarano Boat Building. It started when a group in Columbus, Ohio, commissioned the construction of a replica of Columbus's *Santa Maria* for the 500th anniversary

Returning to powerboats and sticking with variations on a successful name, the Scaranos built the 115′ (35m) aluminum Adirondac *to run excursions on Lake George in Upstate New York. The boat had to be delivered over land in large pieces that were then assembled at the lake.*

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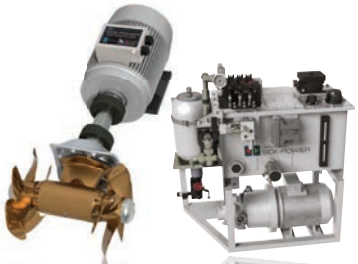

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Quoting the 1920s-vintage commuter yachts that once frequented lower Manhattan, John Scarano designed an all-aluminum excursion boat to ply the same waters, and named it Manhattan.

of his first trip to America. The Scaranos built the boat at their plant in Albany and then cut it in half longitudinally before shipping it to Ohio to be reassembled for a static, out-of-water display.

To expand their excursion business in New York City, the brothers increased their powerboat fleet by designing and building the 80′ (24m) 1920s-commuter-style *Manhattan* in 2006. Like all their boats, power and sail, *Manhattan* incorporated a design aesthetic evocative of a past era. Although built primarily in welded aluminum, *Manhattan* is finished with enough quality woodwork that Walter Cronkite, when christening her, expressed his gratitude for the preservation of wooden boat building in the country.

The name of the charter company that handles the New York, Boston, and Key West excursion business, Classic Harbor Line, reflects this conscious corporate branding of traditionally styled vessels, sail and power. The Newport operation is technically a separate division but is listed and booked through the Classic Harbor Line website.

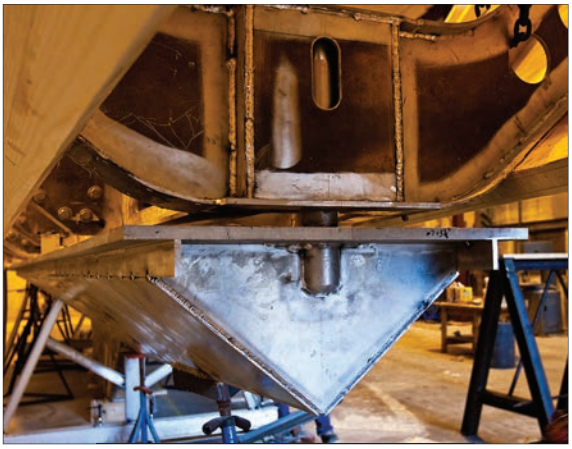
Lessons from the Charter Trade

The Scaranos were exposed to the excursion business by building powerboats for others, but when they started carrying passengers themselves, they chose sail, even taking a loss on their first boats to establish a market niche. However, many years in the business have reinforced the indisputable fact that powered vessels generate a more

The 47′ (14.3m) Eleanor, *launched in 2016 to sail out of Newport, is not far removed in design concept from the successful Scarano 21 (6.4m), a recreational model John designed in 1976.*

reliable income and are often preferred by their customers since they can generally run in conditions that would make sailboat passengers uncomfortable, especially in the congested and often confused waters of New York Harbor. As Rick put it, in a powerboat "you're not always watching the clouds." It is not a coincidence that their largest and most recent vessels in service are the 100′ (30.5m) *Manhattan II*, as well as the reacquired 115′ *Northern Lights*.

Not all their customers find success in the excursion business. The original owners of the 65′ *Imagine*, built in 1996, set her up as a team-building platform for executives, sailing out of Annapolis. It soon fell on hard times when this specialized business plan faltered. She was put on the market, and the Scarano brothers, seeing an opportunity to expand their excursion operations to Boston, bought her back and renamed her *Adirondack III*. The same fate also befell *Northern Lights*. In 2015, after 12 years of service on Lake Champlain, her owners finally concluded that running an excursion business was not compatible with their ferry business and put her on the market. The Scaranos bought her back and moved her to Boston. To date the brothers have bought back four boats to put into their growing charter fleet.



Left—*Construction details of the forward sections of* America 2.0. *Note the marriage of the balsa-cored laminated-cedar hull skin to the aluminum ring frames and keel structure.* ***Right—****The welded aluminum lower section of* America 2.0*'s hull and keel sump await attachment to the rest of the wood-and-aluminum hull. Note the massive threaded studs protruding from the flange that will secure the two structures to one another.*

Then there's *America 2.0*, the boat I met in Key West. She was added in 2011 for their New York and Key West operations, and built to be large enough to better handle the long annual deliveries from New York to Key West and back. With *America 2.0* they took the concept of a replica to a whole new level of interpretation, freely admitting that *2.0* was conceived of as a tribute to the original vessel, with modern speed, performance, construction, and passenger comfort and enjoyment being their primary design goals. As mentioned previously, the hull structure is laminated balsa-cored Port Orford cedar over laminated wood frames, but with *2.0* they took a concept developed in earlier excursion sailing vessels and incorporated a welded aluminum bottom and keel-sump structure bonded to aluminum ring frames. Those not only distribute the keel loading over a large area of hull and lower the CG of the ballast but also provide large volumes of fuel and black-water tankage below the cabin sole, contributing to stability.

America 2.0 also incorporated a dual sail-drive electric-propulsion system.

John explained that they based *America 2.0*'s structural design primarily on a first principles analysis and the American Bureau of Shipping (ABS) Rules for Offshore Racing Yachts, since there can be no question that she is more yacht-like than commercial in performance and construction. The carbon fiber masts were engineered by what was then Gurit/High Modulus, and fabricated by Forte Carbon Fiber Products.

Asked, "Would you prefer to build for others or for your own excursion business?" John paused and reflected. All the company's work for outside customers is based on a fixed price, he explained. The majority of customers are working to tight budgets, so getting the price right early and sticking to it until delivery are extremely important, despite the many changes and alterations that inevitably occur during construction.

That contract process usually involves three phases. It starts with several weeks of back-and-forth with the customer to define the desired size and

The 47' (14m) excursion daysailer Eleanor *under construction in cedar-strip planks at the Scarano shop in 2015. John Scarano characterizes her as a giant vintage International 14.*

appearance of the boat. This involves some preliminary drawings of profiles and plans, a few pages of preliminary specifications, and a price estimate. If the price-and-concept package is agreeable to the customer, they enter the contract's second phase, putting together a more formal preliminary design package for which the customer pays a fee in the range of 2% of the previously established price estimate. This is essentially equivalent to a bidding package if the design is shopped around to other builders. Hull lines are defined, interior arrangements established, construction sections defined, several pages of specifications drafted, and a final "bid price" established. If this is again agreeable to the customer, they enter the contract's third phase, in which the final design is completed and construction begins, with a payment schedule based on preset milestones in construction. Once that final price is fixed, both parties are committed, and at the end of the project the brothers hope there is a small profit for the company.

Once a boat is launched, they are ready for the next build. But faced with an empty shop and no contract, they will look at adding a boat to their own successful excursion fleet. So, yes, it is an interesting question whether it is better to build for others or for themselves. Rick points out that in the last five years, by adding four boats to their fleet—*America 2.0* in 2011; the 100′ *Manhattan II* in 2015; a 47-footer named *Eleanor,* which John describes as a giant vintage International 14; and most recently *Northern Lights*—they now have nine boats in service at four different sites. They will probably stand pat for a couple of years to let things settle a bit. With the excursion business currently generating twice the revenue of the boatbuilding operation, standing pat sounds like a safe bet.

I cannot think of any other builder who designs and builds boats not only for others but also extensively for self-ownership and -operation. Add the use of such a wide range of building materials, including laminated wood, steel, aluminum, and advanced composites—often combined in the same vessel—and it's clear that this is a unique operation that almost always has a full shop and a steady revenue stream that's not dependant on the next build contract.

How many other boatbuilders can claim that? PBB

About the Author: *Robert Mazza is a naval architect and professional engineer with a long background with C&C Yachts, Mark Ellis Design, and Hunter Marine. More recently, he was involved with structural core materials with ATC Chemicals (Corecell) and Baltek.*

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SAR 60

A new high-speed boat is designed to rescue refugees in the Mediterranean Sea.

Text by Fabio Buzzi
Graphics courtesy FB Design

Editor's Note: *We recently corresponded with Fabio Buzzi, the well-known designer and builder of high-performance powerboats. (For* Professional BoatBuilder*'s most recent coverage of his activities, see "Buzzi," No. 133.) He told us that his firm, FB Design, has designed a new boat to rescue refugees fleeing the Middle East for Europe, many of whom drown when overcrowded vessels sink in the Mediterranean Sea trying to reach Greece. The SAR 60, described by Buzzi here, was developed specifically to save the lives of those in jeopardy at sea.*

Many organizations worldwide have requested from us a new type of search and rescue (SAR) boat to meet the demands of missions nowadays. All over the world the migration problem is day by day more dire, often ending in tragic situations, especially in rough waters—and the sea is rough most of the time.

The FB 60′ SAR (18.3m) was generated after a careful analysis of all existing SAR boats, which were deemed too slow, expensive, and limited in onboard space.

Here are some basic points of the SAR 60.

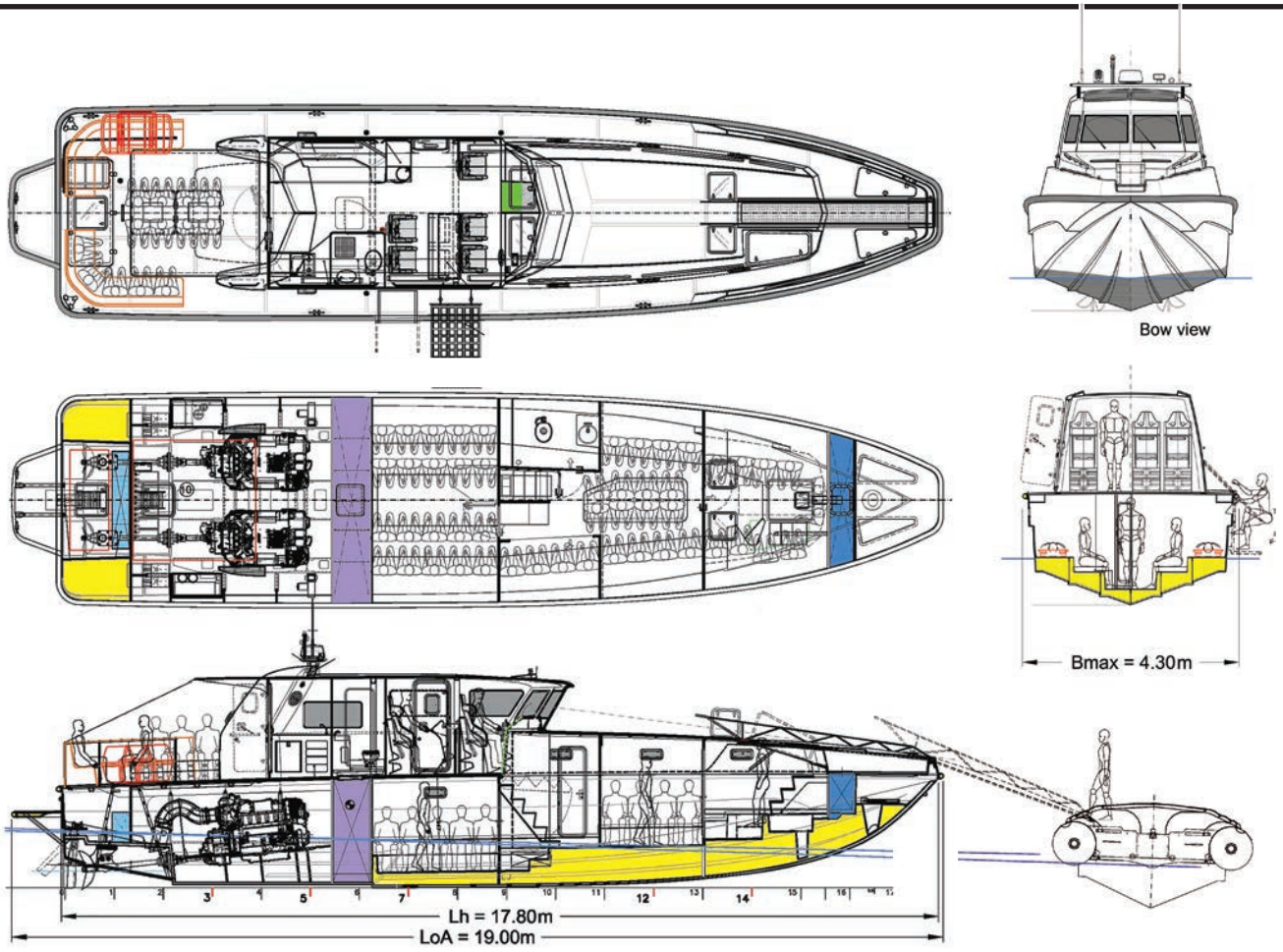
Principal Considerations

The typical length of a search and rescue boat is 50′ (15.2m), as bigger boats are difficult to make self-righting and are generally slower. In this new project, because of the need for space to accommodate rescued people, we extended the length to 60′. Typical beam of a 50′ SAR boat is 13.1′ (4m). Even though the SAR 60 is a bigger boat, we maintained the 13.1′ beam for a more correct L/B ratio for superior navigation in rough waters.

The SAR 60, like all FB Design boats, is totally unsinkable, thanks to the Structural Foam system (structural fiberglass skins injected with 75-kg/m^3 [4.68-lb/cu ft] closed-cell polyurethane foam), shaded yellow in the drawings.

The new, patented FB Design Safety Rudders can pivot back upon impact with rocks and heavy floating objects, to protect the boat.

Above—*FB Design developed the search and rescue (SAR) 60-footer (18.3m) in response to requests from various organizations around the world, including those dealing with the crisis on the Mediterranean Sea, where refugees are fleeing the war-torn Middle East and Africa.*



The deck is based on a large walkaround, without outside handrails that could cause problems when the boat is rolling alongside another vessel. Newly patented by FB, the extremely robust fender system is built around a special neoprene pipe, reinforced with a strong polyester fabric, filled with elastic foam, and supported by a dedicated polyurethane base. It is manufactured in 8.2′-long (2.5m) interchangeable segments.

For superior vision at night, the pilothouse has the same reverse windshield as on the FB 32′, 38′, 41′, 43′, and 52′ (9.8m, 11.6m, 12.5m, 13.1m, 15.8m); and the bow is the usual anti-stuff shape of all FB Design boats. For the crew, there are six Tecno G12 seats, with suspension systems up to 12 g and safety belts, indispensable in case of capsizing. Two top hatches introduce fresh air, but they can be quickly closed in case of rough seas. Different accommodations are also available.

The Raft patented sofa is a completely new safety device, based on four different parts—two inflatable and two filled with closed-cell polyethylene foam. Normally used as a sofa in the upper cabin or transformed into a bed for two, it can be quickly disassembled

***Top**—The drawings show where up to 100 people can be accommodated for short durations—roughly 60 sitting down in the lower bridge, and 40 on the upper bridge. **Right (inset)**—The patented combination sofa/raft performs double duty as a comfortable seat and a rescue device. **Right**—In this demonstration, the Hypalon raft has been deployed to retrieve a young woman.*

The SAR 60 is self-righting, as confirmed by testing here, and it is unsinkable owing to the closed-cell-polyurethane Structural Foam system employed in the hull's construction.

and thrown into the water, one piece after the other, to rescue up to 100 people in a few seconds. It is built of strong Hypalon, like all good RIBs. It is comfortable as well as versatile.

What could be called the "shipwrecked compartment" is a big lower central cabin, 1.95m (6.4′) high, directly below the upper cabin, which can accommodate up to 20 people, with a dedicated toilet, A/C, and two opening windows. It can be key-locked if necessary. The lower bridge can accommodate up to 60 passengers sitting down, and 40 more on the upper bridge, for a total of 100.

The boat is self-righting, thanks to the large-volume cabin and the high freeboard, and doors, hatches, and windows are all watertight; a pneumatic system can close all hatches, exhausts, and air intakes. The engine can restart immediately after a capsize.

Boarding and Arms

The "nose footbridge" allows the SAR to approach other boats in difficult situations and safely take people on board. It is normally operated by only two crew members, while the driver has a perfect forward view of the whole operation.

It is possible to perform rescue operations from the stern platform or from an optional side-lowered

level, where a small electric crane can be mounted on the side to rescue people one at a time from the water, thanks to a Jason's Cradle man-overboard net.

In addition, different weapons can be installed, from a remote-controlled machine gun to a mini-gun in a cockpit with entrance from inside.

Systems

Engines are the best and most reliable on the market: MTU V10 of 1,620 hp (1,215 kW), in a special version called Rough Kit. It is offered for high-performance SAR boats and has stronger supports, a special oil pan, and special oil breathers. The drive system is the well-proven ZF Trimax 3500 Surface Drive, extremely reliable, fast, and directionally stable.

An "asset control system" is based on FB Design's new, patented 3TAB System, capable of planing the boat

Right—*Injured or otherwise incapacitated people can be lifted from the water and onto the deck in a Jason's Cradle net.* ***Below***—*To transfer people, the "nose footbridge" connects two boats positioned bow to bow.*

quickly and keeping it on plane at low speed even in rough waters. Also, a 264-gal (1,000-l) water-ballast tank is built into the bow. Seawater, pumped by one of the two engines, is controlled by the driver to balance the boat at any speed.

Performance analysis: the boat weighs 45,100 lbs (20,500 kg) light displacement and 50,820 lbs (23,100 kg) at full load; top speed is more than 60 knots, but with the right propellers the boat is capable of planing with an extra payload of 5 tons, still with a speed of more than 50 knots—thanks to the 3TAB System, the bow ballast tank, and the sequential turbocharging system of the MTU engine. In July, the SAR 60 set a new UIM speed record from Monte Carlo to Venice, averaging 52 knots over the 1,200 nm, with only one refueling.

Night vision, via a new generation of instruments by Starlight Italia, is extremely efficient, controlled from the main bridge, and displayed on a dedicated 12″, 15″ or 17″ (305mm, 381mm, or 432mm) LED touch monitor. It is designed for best performance in the high-density configuration, offering a powerful two-axis gyro-stabilized multi-sensor solution. The system has an integrated pan/tilt mechanism that can rotate continuously 360° horizontally and vertically. Rotation speed is controllable within a wide range by the proportional-touch joystick; and on the same screen it is possible to see two horizontal lines simultaneously, one with thermal vision and the other with light amplification.

Navigation instruments include multifunction radar, an echo sounder, a chart plotter, automatic identification system (AIS) with recorded target surface (mini automatic radar plotting aid, or MARPA), autopilot, weather station, and 8″, 12″, or 19″ (203mm, 305mm, or 483mm) displays with a data exchange system via satellite. For communication there is a marine VHF radio, more radios (encrypted) on demand, and GMDSS (Global Maritime Distress and Safety System) equipment on demand.

Conclusion

The FB 60′ SAR is arguably the most-advanced modern boat for search and rescue. Capable of 60 knots, it is unsinkable and directionally stable, can accommodate up to 100 passengers, and is offered at a competitive price, with many different layout solutions possible specific to its mission. PBB

About the Author: *Fabio Buzzi, 73, is a UIM World Champion powerboat racer, designer, and builder of high-performance boats. A graduate of the Polytechnic University of Turin, he founded FB Design, based in Annone Brianza, Italy, in 1971.*

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Thermal-Imaging G-10 Laminates

A gallery of infrared images illustrates that thermography is a perfect tool for inspecting G-10 thermoset fiberglass laminate components.

Editor's Note: *The numerous applications of thermography as a nondestructive examination tool in new builds and damage assessment have been explored at some length in past issues of* Professional BoatBuilder. *Similarly, the magazine has noted multiple boatbuilding applications for G-10, a grade of manufactured reinforced thermoset plastic (fiberglass and epoxy) available in varying thicknesses and stock shapes—sheet, rods, and tubes. This brief article reminds readers it's a good idea to test G-10 installations to ensure quality bonding to adjacent structures, and the suitability of thermography to that task.*

Text and photographs by Charles J. Hazouri

In the simplest terms, thermal imaging applies heat-sensitive instruments to measure thermal patterns and temperatures across an object's surface. It can reveal changes in materials and temperatures, which, for example, can identify moisture intrusions, voids, or bond failures in FRP laminates. Because the technology is noncontact, two-dimensional, and shows things in real time, it can reduce the time and cost of troubleshooting a specific anomaly or deficiency.

G-10 is continuous-filament woven fiberglass, thermo-laminated with epoxy—either difunctional (diglycidyl ether of bisphenol A/DGEBA) or trifunctional (triglycidyl para-aminophenol/TGPAP)—into a range of stock shapes. It has excellent mechanical and physical properties, including great strength, good electrical insulation, resistance to high temperatures (up to 266°F/130°C), low moisture absorption, and good chemical resistance. If you've worked with G-10, you know that it's among the most versatile laminates available today. It has been employed in marine applications as backing for carbon fiber sheeting, as structural frames and stiffeners, in backing plates for various onboard systems, and for a variety of repairs.

After inspecting construction and repairs on many vessels with infrared thermography, I have come to the conclusion that it is a superior tool for anyone working with G-10 laminates (along with other FRP composites)—whether you're a contractor, marine surveyor, or laminate specialist.

Hatteras Inspection

To demonstrate this, I inspected sections of an 80′ (24m) Hatteras motoryacht, and then made a series of lab tests on two panels with G-10 laminate, one of which was created with a distinctive nonconformity. The test samples were 0.375″ x 12″ x 12″ (9.5mm x 305mm x 305mm) Epoxyglas G-10 sheets with 1708 biaxial ±45° cloth and Adtech epoxy resin, which were then painted with Interlux white polyurethane. My inspection also shows that thermal imaging of G-10 laminates is comparable to imaging other solid materials such as aluminium and steel structural frames. The inspection and tests were conducted in 2015 using a FLIR T440bx thermal imager.

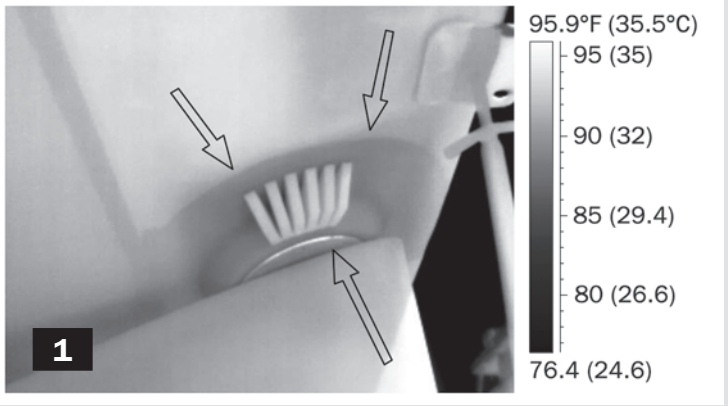
The author thermographically inspected sections of this 80' (24m) Hatteras motoryacht at All Points Boats, in Fort Lauderdale, Florida.

The G-10 laminate I inspected on the Hatteras was being applied as structural mounting and backing for a swim platform and for stabilizer fin installations.

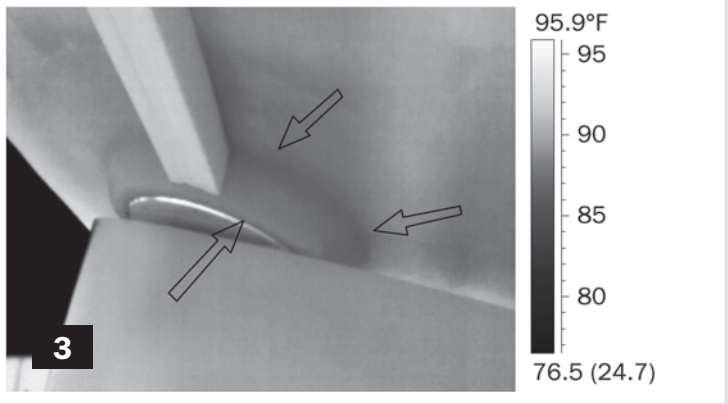
Figures 1, 3, and **5** are thermographic images of the stabilizer mounting and backing areas where the G-10 has already been installed. As indicated by arrows, the material's well-defined edges appear darker and more distinct than surrounding composite hull laminates. **Figures 2, 4,** and **6** are color images of the same features.

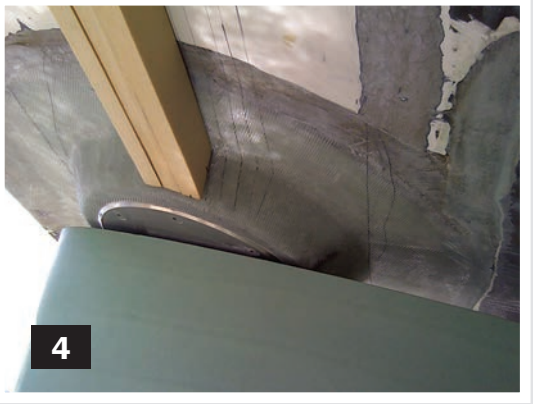
These paired thermographic and photographic images of the stabilizer mounting and backing areas show G-10 already incorporated in the underlying FRP laminates. Thermography reveals the G-10 as much darker than regular laminates, with distinct edges indicated by the arrows.

***Figures 1** and **2**—Looking aft at the lead portion of the stabilizer system's mounting and backing installation.*

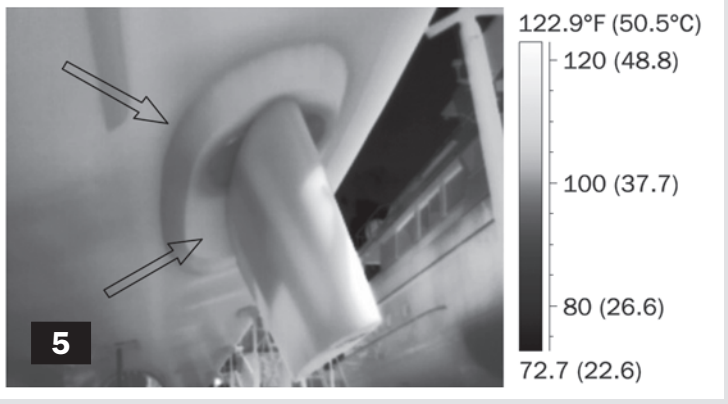


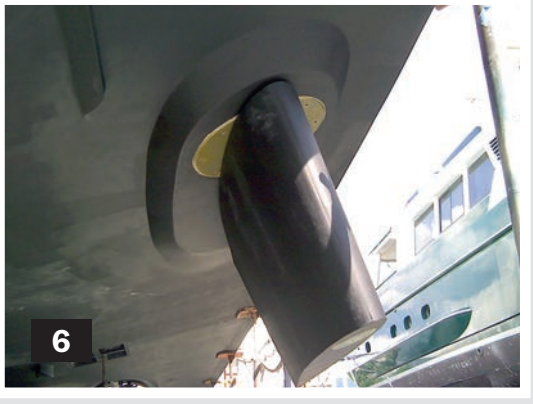
***Figures 3** and **4**—Looking forward at the stabilizer installation from aft during reconstruction.*





***Figures 5** and **6**—G-10 is still visible in the completed repairs. Note that the dark stainless steel collar of the stabilizer in Figure 5 looks very similar to the dense G-10 laminates in Figure 1.*





The thermal image in **Figure 7** reveals the structural framing and stiffeners in the swim platform in **Figure 8**, before installation. Also visible is the destinctive delineation between the G-10 and other laminates.

Figures 9–12 show the underside of the platform during and after installation. Thermal imaging makes it easy to determine the location of the G-10 structure and to identify any nonconformities or deficiencies in the laminate.

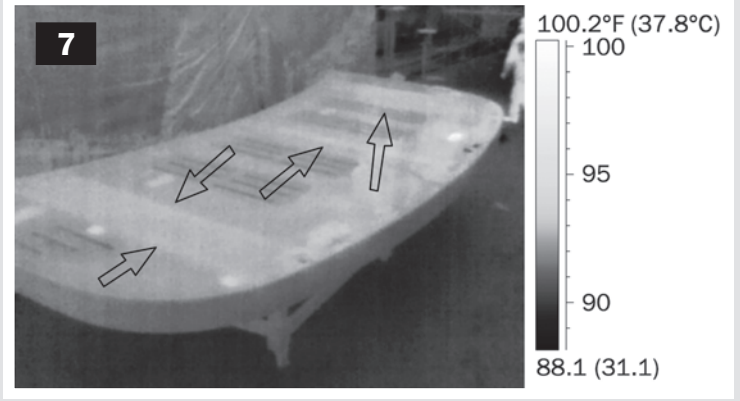
The arrows indicate G-10 framing and stiffeners.

G-10 Lab Test

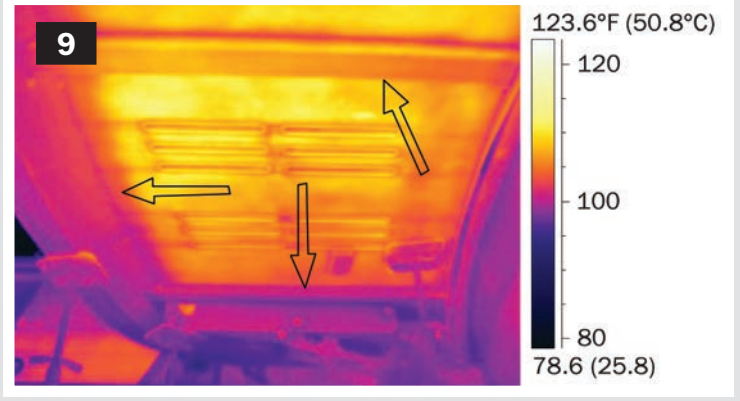
In this test series, I independently heated and took thermographic images of two samples, A and B (**Figures 13** and **14**). Sample A is a standard piece of G-10 and 1708 biaxial in epoxy with no anomalies. Sample B, as

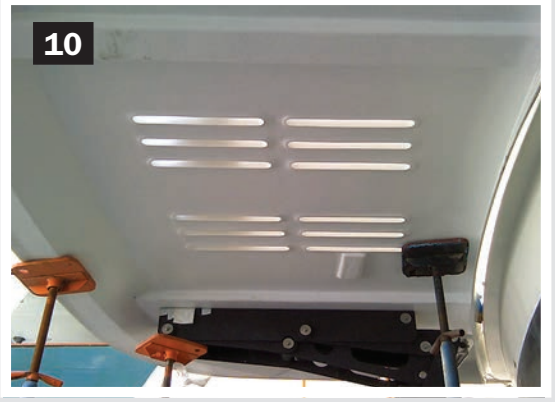
Paired thermographic and photographic images of the Hatteras swim platform reveal the G-10 reinforcements embedded in the structure.

***Figures 7** and **8**—The top of the platform prior to installation.*

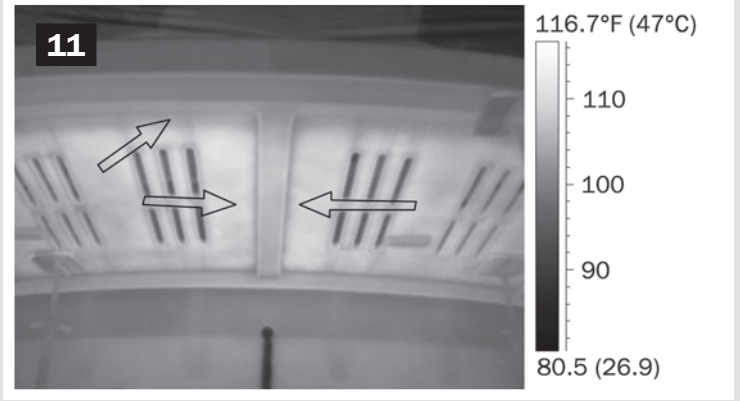


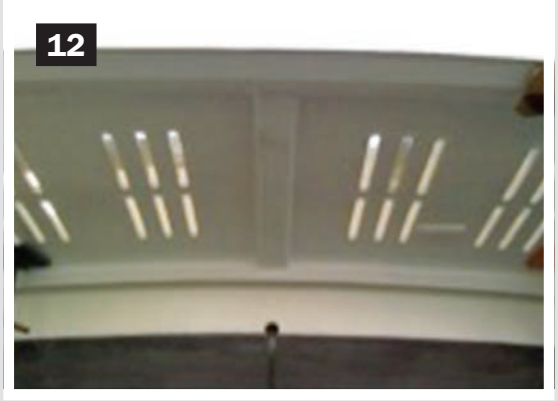
***Figures 9** and **10**—The underside of the port section of the platform.*





***Figures 11** and **12**—The underside of the center portion of the platform after installation.*





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Right—*The inspection and tests of panels A and B were conducted in August and October 2015 with a FLIR T440bx infrared thermal imaging camera, a device capable of detecting, displaying, and recording thermal patterns across the surface of an object.*

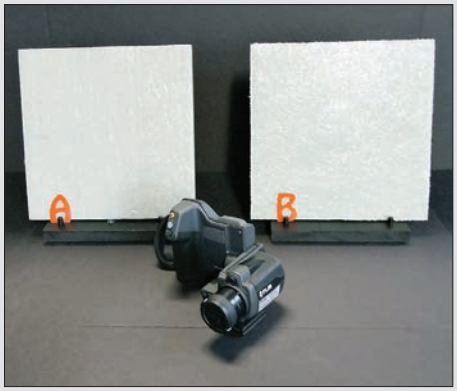
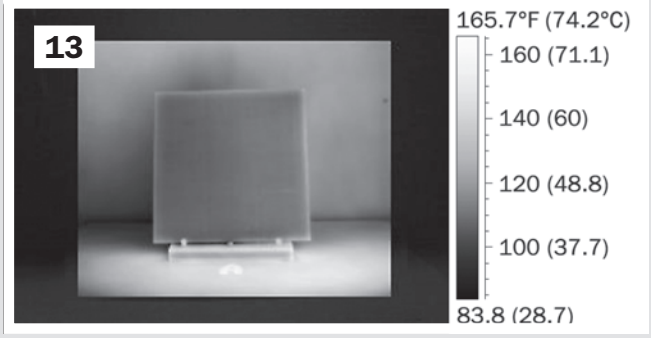
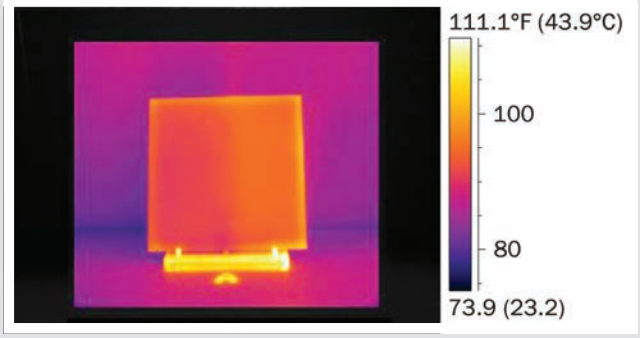


Figure 13—*Sample A, in gray scale (left) and iron scale (right) images, shows the distinct pattern of the G-10 laminate. There were no nonconformities in this sample.*





you can clearly see in **Figure 14**, shows that the G-10 sample contains an anomaly consistent with an area of delamination and/or a small void.

Delamination is a separation within or between two plies in a laminate or within a bonded joint, caused by contamination, improper adhesion during processing, or damaging interlaminar stresses. A small void refers to an area of trapped air or gas that was cured in a laminate during manufacturing.

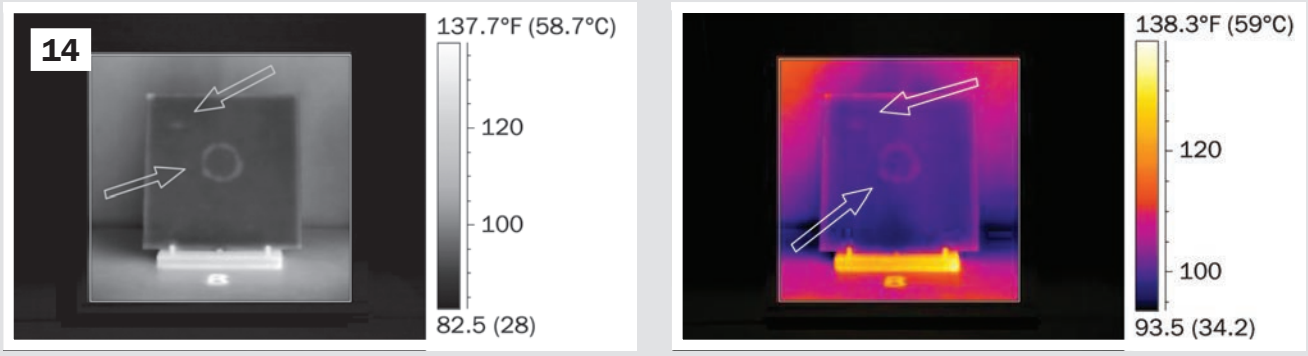


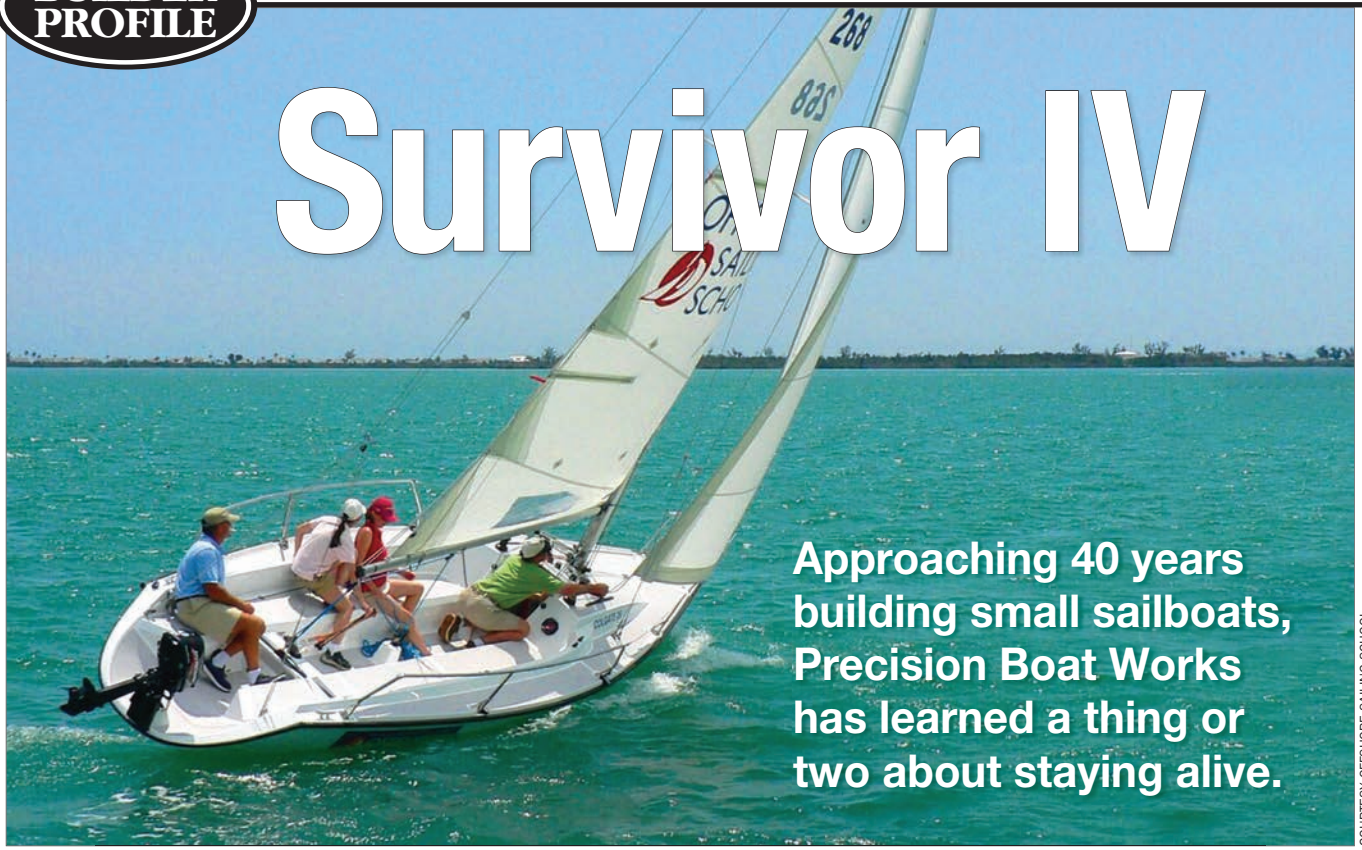
Figure 14—*Sample B, imaged in gray and iron scales, shows a distinct and pronounced nonconformity within this G-10 laminate sample. The nonconformity is consistent with an area of delamination and/or a small void.*

These inspections and tests indicate that infrared thermography can clearly identify and document the thermal patterns of G-10 laminates. When used in the structural capacity of vessel repair and/or construction, it can detect G-10 bond failure or unexpected flaws such as moisture intrusion, delamination, and voids.

With such failures in mind, all G-10 installations should be tested with thermography in a new build. Similar testing and documentation should be carried out in areas repaired using G-10 or other fiberglass laminates prior to repair, as a baseline for comparison, and again after the repairs are completed. PBB

About the Author: *Charles Hazouri's company, Offshore Marine Inspections, in New Orleans, Louisiana, offers marine inspections, including thermal imaging, NDT, audits, and consultation. With more than 25 years in the industry, Hazouri is a licensed captain, project manager, surveyor, and Level III infrared thermographer.*

Survivor IV



Approaching 40 years building small sailboats, Precision Boat Works has learned a thing or two about staying alive.

COURTESY OFFSHORE SAILING SCHOOL

Since the Great Recession of 2008, we've profiled several boatbuilders who have managed to stay in business through ingenuity, hard work, and grit: Dennis Choate, "Survivor," Professional BoatBuilder *No. 126; Jim Betts, "Survivor II," PBB No. 129; and Mark Bruckmann, "Survivor III," PBB No. 139. Long entrenched in South Florida, the Porter brothers further demonstrate that the strong (and sometimes the lucky) can survive.*

by Dan Spurr

Here's the short version: Brothers Richard and Bill Porter grew up in southeastern Michigan, worked in the automobile plants, moved one after the other to Florida because it was warmer and cooler (climatically and culturally), found work with a succession of boatbuilders, and then, in 1978, decided they'd seen enough of the good, the bad, and the ugly, and learned enough about all three to start their own company.

Precision Boat Works builds small sailboats in the outlying countryside of Palmetto, about an hour's drive south of Tampa, on Florida's west coast. There's a long history of fiberglass boat building in this general area: Morgan Yachts, Island Packet, Wellcraft, and many others, including Durbeck's, where both brothers worked for a while in the '70s.

I visited their Precision Boat Works shop last winter. The brothers share office space with sales manager Barton Bleil. Nine or 10 others build the boats in the 15,500-sq-ft (1,440m^2) warehouse facility. In a small business, just about everyone has to be able to do more than one thing; cross-training sounds too formal for how tasks are organized at Precision, but it happens and it works. A 2013 news article quoted a 26-year employee as saying, "We do whatever we have to do to get the job done." Loosely arranged, Richard and Bill handle purchasing, tend to the equipment, and oversee the shop. Bleil sells the product and is the main contact with retail customers and their authorized Precision dealers.

Above—*In addition to its half-dozen models of trailerable sailboats, Precision Boat Works, in Palmetto, Florida, builds the Colgate 26 (7.9m) for Steve and Doris Colgate's Offshore Sailing School as well as for the U.S. Naval Academy's sail-training program.*

Coming into Florida

The Porter brothers are playful with one another, engaging in respectful repartee usually initiated by Richard's

Precision's founders, Bill Porter, left, and his brother Richard, grew up in Michigan, working in automobile plants, where they learned early on about production and assembly of parts. They moved to Florida separately in the 1970s.

dry humor. In the mid-1960s Richard worked at the Ford Wixom Assembly Plant. "I started at $2.71 per hour and got a nickel raise up to $2.76 and that pay rate lasted forever. I moved down to Sarasota in 1970. There were few companies around here that had more than 12 employees at that time. One was Tropicana orange juice, one was Miller Trailers, and one was Wellcraft Marine. I just happened to end up at Wellcraft. Bill moved down a year later, also to work at Wellcraft. We both liked working in the boat business.

"Bill worked as a final finisher for $2.25 an hour. Best I've ever seen. I was a rigger because I could use a hammer and a saw."

Richard made supervisor, earning $200 a week, but put in so much time he figured he made pennies an hour.

"We were building 15 boats a day," he says. "Dick Genth managed many powerboat companies around here [including Wellcraft at that time]. He was an amazing character. You stayed until the fifteenth boat was done. Dick was in the building before you got there and was there after you left. Not only a great businessman but a great storyteller as well. A lot of guys followed him around from company to company. Then we went to Durbeck's, the custom builder in Bradenton. Mainly built custom trawlers. He [Win Durbeck] came to Florida and started with Morgan Yachts. He was a casket maker in New England and had all the woodworking tools. Bill and I worked for two or three other companies before starting our own."

Richard says that while at Durbeck's, in addition to custom trawlers, they made multiple boat plugs and molds for other companies such as Tartan and CSY. That experience gave them the skills needed to create plugs and molds for their own boats years later. The brothers continued to browse the area builders, including Hidden Harbor in Sarasota, and Seaforth, which was later to become their entrée into a business for themselves.

Starting Up

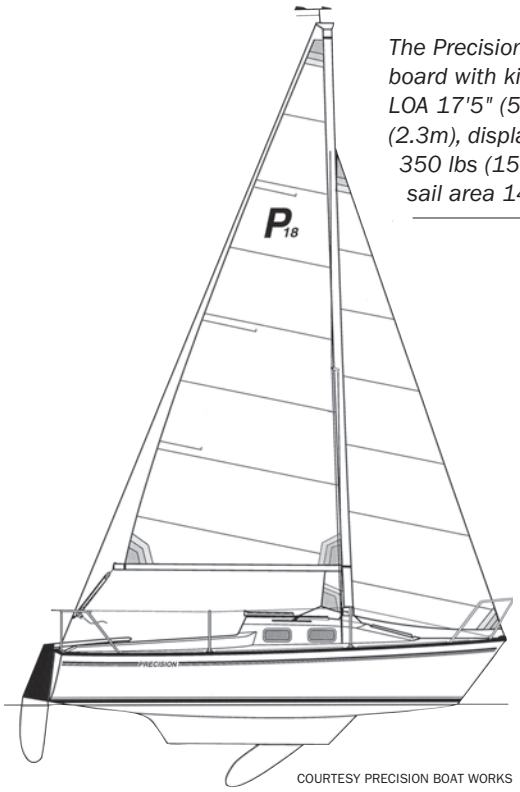
In the late '70s, Steve Belack was building a 22′ (6.7m) sailboat called the Seaforth, a Steve Seaton design. Seaton, better known today for his classically styled motoryachts, had also designed 13′, 14′, and 16′ (4m, 4.3m, and 4.9m) daysailers for Belack. Richard had worked at Seaforth and Bill had worked for the company that built Belack's tooling, so when the brothers deemed it time to strike out on their own, a partnership with Belack seemed sensible. In 1978, the new business was capitalized with just $5,000. Before long, they bought out Belack and continued on their own. The brothers estimate they built 120–130 Seaforths over the next few years.

"We were the only two people there," says Bill. "We cleaned the bilges and cleaned the toilets."

When it was apparent that they needed more models, they contacted Seaton, who not only had designed the Seaforth but was well known to them as the designer of the Durbeck custom trawlers and the 46′ (14m) ketch they'd helped build. After Seaton, the Porters

DAN SPURR (BOTH)

Precision has occupied the same building outside Palmetto nearly since the company's inception in 1978. The crew is adaptable: tooling a 100′ (30.5m) custom project required removal of the back wall to get the mold out.



COURTESY PRECISION BOAT WORKS

The Precision 18 features a stub keel and centerboard with kick-up rudder. Principal specifications: LOA 17'5" (5.3m), LWL 15'5" (4.7m), beam 7'5" (2.3m), displacement 1,100 lbs (498 kg), ballast 350 lbs (159 kg), draft 1'6"–4'3" (0.45m–1.3m), sail area 145 sq ft (13.5m²).

decided to work with designer Jim Taylor, beginning with the Precision 18 (5.5m) in 1984–85. Over the next four to five years they eased away from the older Seaton designs and began adding Taylor's designs exclusively, next being the Precision 15 (4.6m) in 1989. Richard explained what they liked about Taylor: "He designed the new Starwind 19 [5.8m; built by the sailboat division of Wellcraft, called Starwind]. We were watching the progress with that boat and saw it being tooled up and really liked the boat, the way it was designed and built. All of Taylor's boats sail so very well. He's the best designer to work with because even when he says you can't have *that*, he will explain why you cannot do something as opposed to just saying no. But he will then work with you and your ideas to add in even more features than you had thought of. You go back and forth until you agree. Jim is easy to work with, and he always delivers more than you wanted."

Layup and Assembly

Focusing on assembly, Bill countered: "We liked the Starwind 19 design, but the way it went together was *difficult*, so we thought we could be competitive in that market building a slightly smaller boat less expensively. All our boats go together really well."

Richard: "A lot of thought goes into how to build them efficiently. The hull

DAN SPURR (BOTH)

***Above**—A prewired deck is suspended by overhead chain hoists before it is lowered onto the hull. **Right**—A shop crew member with a buffing wheel details a hull before moving the boat outside and onto a trailer for delivery.*

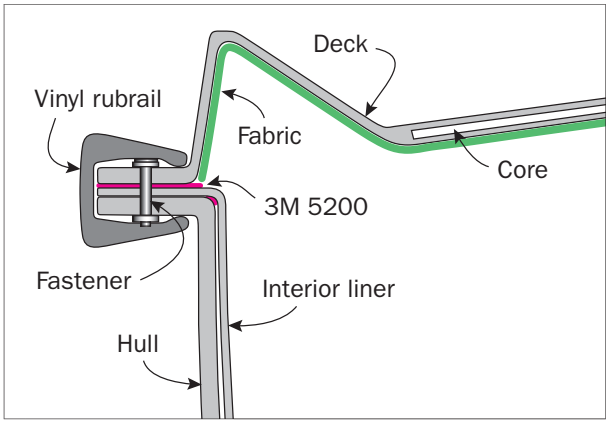
liners are structural. A lot of people are building furniture and then stick them together and hope it supports the boat. Part of our scheme is Jim Taylor and part of it is us."

Bill: "The liner is also incorporated in the hull–deck joint. No trimming of the liner when you drop it in. We save all of that energy. With our system there's only one way it can go in. You can push in the side of a bare hull, but once you put the liner in, it's like a tank. It's like pushing against the side of a building. When you put the deck on it's really strong, and then you bolt

the hull, deck, and liner all together at one time. It doesn't leak, it's strong, and really light."

The liner is locked into the hull vertically by the hull–deck joint and horizontally by indents. Richard: "Drop the deck in, drop the pin through the hole, and it's all lined up." The Precision 28 (no longer in production) had a companionway that locked into the hull. "Some liners [made by others] require shifting and shims," says Bill. "Our parts only go together one way."

"Bill and I did 99% of the labor on the first 75 or 100 boats we built," Richard says. "And a lot of conversation in between. Like accommodation compromises inside and out." They'd taken a hard look at the Starwind 19 tooling and believed they could improve on it, specifically to expedite assembly and thereby reduce man-hours. "It doesn't cost us anything to make a better build," Richard says. "It's easier and less expensive."



COURTESY PRECISION BOAT WORKS (BOTH)

Left—*The hull, liner, and deck are fastened together and covered with a vinyl rubrail.* ***Right***—*A pin inserted into holes in the flanges locates and aligns all three parts prior to fastening.*

Bill: "For the hull–deck joint we through-bolt the hull, the deck, and the liner. All three of them. This system is simple and strong. No way to break the joint; you'll break the boat first. We use 3M 5200 all the way around the hull and deck. Then the hull and deck joint is covered with vinyl rubrail. We purchase the rubrail from Prototype Plastics in Clearwater. We own the dies for all of our rubrails. Our rubrail…we stretch the hell out of it. Held at two points with screws at

the stern. No intermediate fasteners or adhesives. Three guys pull it tight to stretch it firmly against the hull–deck joint. It has to be stretched to stay."

The hulls (solid fiberglass) and decks (PVC closed-cell foam core with plywood inserts) are a hand layup. "Never had a chopper gun in our operation," says Richard. "Low tech, high quality. Nothing exotic. We're not doing anything now we didn't do 35 years ago. The materials have improved though: the polyester and vinylester resins, mat and woven roving. About 15 years ago we adopted vinylester resin for the hull skincoat. Straight vinylester. No blend. We've had no blistering problems."

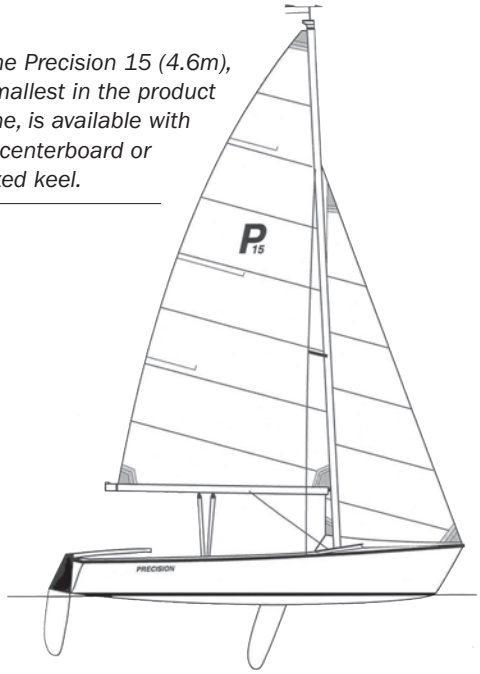
Strategic Decisions

As Richard stated above, the first of the Porters' maxims for survival, *their* survival at least, is low tech, high quality. What follows from that early-on decision is the size of boats Precision builds.

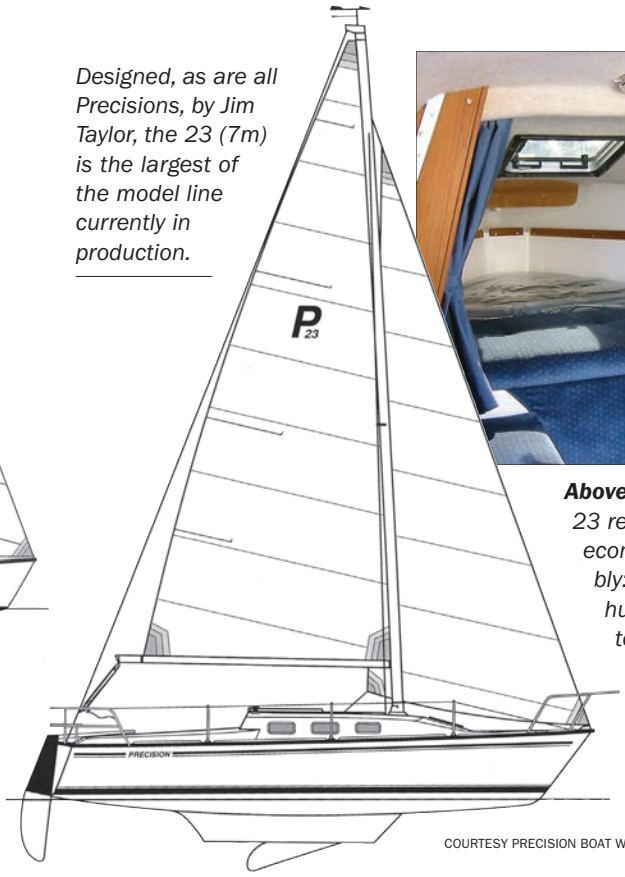
Richard: "We started with the 18, 21, 23, and built up to the 27 and 28, which was a really nice boat, but we couldn't get enough stocking dealers to make it a long-term success. We built the 27 and 28 during the winter months, when small-boat sales were slower. The boat was a bit different for us with its inboard power, wheel steering, pressure water, and shore power. We were used to building 15-footers and all of a sudden we're building a boat with *systems*. While the 27 and 28 worked well for us, it was just too expensive for our dealers to inventory without hurting their efforts in small-boat inventory and sales. We decided trailerable boats were what we were known for, and what our dealers could sell."

They also decided to resist the feeling they needed to continually develop new models. "We'd like to replace models quicker, but the economic reality is . . . you spend x dollars developing a model and what does it actually do to your bottom line?" Richard asks. "Does it really improve us? We're building the same boats, though we have made many updates over the years. Our newest model is the 185, and it's 13 years old. It's not like we have 15,000 Catalina 22s to compete against. We only have 500 Precision 23s to compete against. We do look at our competition every year with each of our eight models and evaluate how we stack up. So far, we feel we still have some great boat models that have withstood the test of time."

The Porters have taken on some specialty and one-off projects over the years, such as tooling a 100′ (30.5m) Ron Holland design (to get the mold out of the shop, the end of the building had to be removed), and tooling for Wellcraft, Starwind/Spindrift, a



The Precision 15 (4.6m), smallest in the product line, is available with a centerboard or fixed keel.



Designed, as are all Precisions, by Jim Taylor, the 23 (7m) is the largest of the model line currently in production.

Above—*Interior of the Precision 23 reveals the emphasis on economy and ease of assembly: liner with berth flats and hull sides, bulkheads fitted to liner and bolted to deckbeam, and fabric overhead.*

COURTESY PRECISION BOAT WORKS (ALL)

Swedish 11m (36′), and a one-off 42′ (12.8m) trawler. But this sporadic work has never led them too far astray from their small-sailboat foothold. Stick with what you know and are good at—*and can sell.*

A periodic constant, if you will, has been building the Colgate 26 (7.9m) for Steve and Doris Colgate's Offshore Sailing School, which commissions the boat for several schools it has in Florida (headquartered in Fort Myers), New York, and New Jersey. The same boat is employed by the U.S. Naval Academy sail-training program in Annapolis, Maryland; in fact, Precision had just delivered 12 to the program prior to my visit. That yields a total of 42 Colgate 26s at the Naval Academy, and 15 at the U.S. Coast Guard Academy in New London, Connecticut.

Selling only through its dealer network over the years has become increasingly problematic. Richard laments that it's difficult to get stocking dealers: "We could have as many dealers as we want if we want 'brochure dealers.' If you have the requirement that they have to buy a boat or three boats to be a dealer, it gets harder and harder. But we and the dealers know, the dealers that have boats to show are the dealers that actually are selling boats. We don't sell factory-direct, but we are very involved in assisting the dealer with selling a boat. Originally we didn't want to have that much direct conversation with the potential buyer, as that is what dealers do, but now find we have to be much

COURTESY OFFSHORE SAILING SCHOOL

The Colgate 26 was developed specifically for teaching beginners how to sail; it features a ballasted keel, a large cockpit, and a simple rig with 100% foretriangle jib.

PROFESSIONAL BOATBUILDER MAGAZINE

Statement required by the Act of August 12, 1970, Section 3685, Title 39, United States Code. Showing the ownership, management, and circulation:

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B) Paid and/or requested circulation:
1) Sales through dealers and carriers, street vendors, and counter sales: .6,256
2) Mail subscriptions: 11,949
C) Total paid and/or requested circulation: 18,205
D) Free distribution by mail, carrier, or other means: sample, complimentary, and other free copies: 1,960
E) Total distribution: 20,165
F) Copies not distributed:
1) Office use, left over, unaccounted, spoiled after printing and returns from news agents: 71
G) Total: 20,236

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1) Sales through dealers and carriers, street vendors, and counter sales: .6,315
2) Mail subscriptions: 12,176
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Office use, left over, unaccounted, spoiled after printing and returns from news agents: 35
G) Total: 20,085

I certify that the above statements made by me are correct and complete.

James E. Miller, Publisher
WoodenBoat Publications, Inc.

COURTESY PRECISION BOAT WORKS

The Precision 185 (18'5"/5.6m) is built of hand-laminated fiberglass with a vinylester resin skincoat for improved blister protection.

more involved to assist the dealer and boat buyer."

All details of the sale, however, including the actual transaction, are handled by the dealer. Most dealers are located in the Great Lakes region and Northeast, with others ranging as far west as Texas, but none on the West Coast. As Richard points out, shipping from Florida to the West Coast adds a bit more to the final cost of the boat. An additional issue in appointing a stocking dealer out West is the higher cost of display space.

Scheduling

Despite their many years in business, the Porters find it difficult to anticipate consumer/dealer demand. Richard says, "Ideally, in this business you'd like to build the same number year round. Everyone wants their boat in the middle of April. We used to keep a fair amount of inventory—up to 50 in December and zero in April. But the market's not that big anymore."

During my February/March visit he said they still had 15 to 20 in stock. "We don't necessarily follow the trends. We don't know why. We're such a tiny part of a tiny market. This time of year, when we start building boats for stock, we always guess wrong what's going to sell in the spring. Last year it was little boats, so you start building little boats, but the dealers want big boats. No logical pattern to it. Fortunately, while the model mix changes, the dollar volume stays about the same. As the dealers

have cut back on their stock boat inventory, we have stepped up our finished and in-process inventory to help the dealer and retail buyer take delivery of a new Precision in a short period of time. This is a large additional cost for our company, but it is something that had to be done to react to the current market situation."

Vendors

Precision works with a core group of suppliers and tries to keep the numbers few and manageable. Though boat model sizes range from 15′ to 23′, there is a lot of commonality between models. For example, the same cleats, from the same hardware manufacturer, are fitted to all models. Same for windows and other parts. "So," Richard says, "purchasing is relatively easy, considering the complexity of the business." He estimates that 10 suppliers provide 95% of what Precision buys: almost all hardware is from Harken (Pawaukee, Wisconsin); Seco South (Largo, Florida) for running and standing rigging; sails from Rolly Tasker (Phuket, Thailand), except for the more performance-oriented Precision 185; trailers from Magic-Tilt (Clearwater, Florida); and over the decades, masts and booms from Dwyer Aluminum Mast Company (Branford, Connecticut).

A Changing Market

The brothers say they've never done much national advertising. But in the 1980s they exhibited at four to five national sailboat shows, and supported their dealers at the U.S. Sailboat Show in Annapolis, Maryland. That show, the country's largest, no longer draws as many small-boat dealers from around the country. Meeting potential new dealers is no longer common, Richard says. "Years ago, we had a dealer in Pennsylvania that would charter buses and bring their customers to Annapolis."

Miami and Chicago were also on their short list of shows attended as a factory effort.

"We used to spend $10K a year on brochures," Richard says. "You don't do that anymore. Everybody's online. That's been a good thing for cost containment. You used to go to Annapolis and see your brochures lying all over the ground. People would grab them and throw them. I'd say, 'There's 50 cents. There's 50 cents.'

"We started at the top of the market back in 1978. We started during the Arab Oil Embargo, when people couldn't afford gas to put in their powerboats. We had a Sarasota dealer who'd sell 13 daysailers in a weekend. Those days are gone. The embargo was great for sailing, but then the next year they discovered they couldn't waterski behind their sailboat or fish or get to their restaurant in half an hour. But with our low overhead and ability to

react almost daily to the market demands, we supply our dealers and retail buyers promptly. Most of our current boat buyers tend to be 50 years old or older and are either getting back into sailing after a long absence from the sport, or they are fulfilling the sailing dream now that they have more time."

Cruise Control

It's not difficult to see why Precision Boat Works is still in business 38 years after starting at the top of a market that then went south. The company has no debt; it has no "huge fixed costs." No heat. No A/C.

The workforce is experienced, with zero layers of management. "We don't really need a supervisor on the shop floor," Richard says, "because everyone knows what they're doing. They all come to work."

DAN SPURR

Teak boards are cut and planed to the specified thickness in the wood shop, located at one end of the building. All crew are capable of performing multiple jobs.

Warranty claims? "Over the last 10 years, we've spent less than an average of $600 per year for legitimate and processed warranty claims encompassing hundreds of boats. While we are all human, when an issue arises, we put in a process to eliminate that issue in the future," says Richard.

"We can survive where a lot of our competitors can't," he adds. "Some won't survive in this market. We'll survive as long as we want to survive . . . as long as they can wheel us into the factory." PBB

About the Author: *Dan Spurr is* Professional BoatBuilder*'s editor-at-large.*

PBB Read the "Survivor" series at ProBoat.com.

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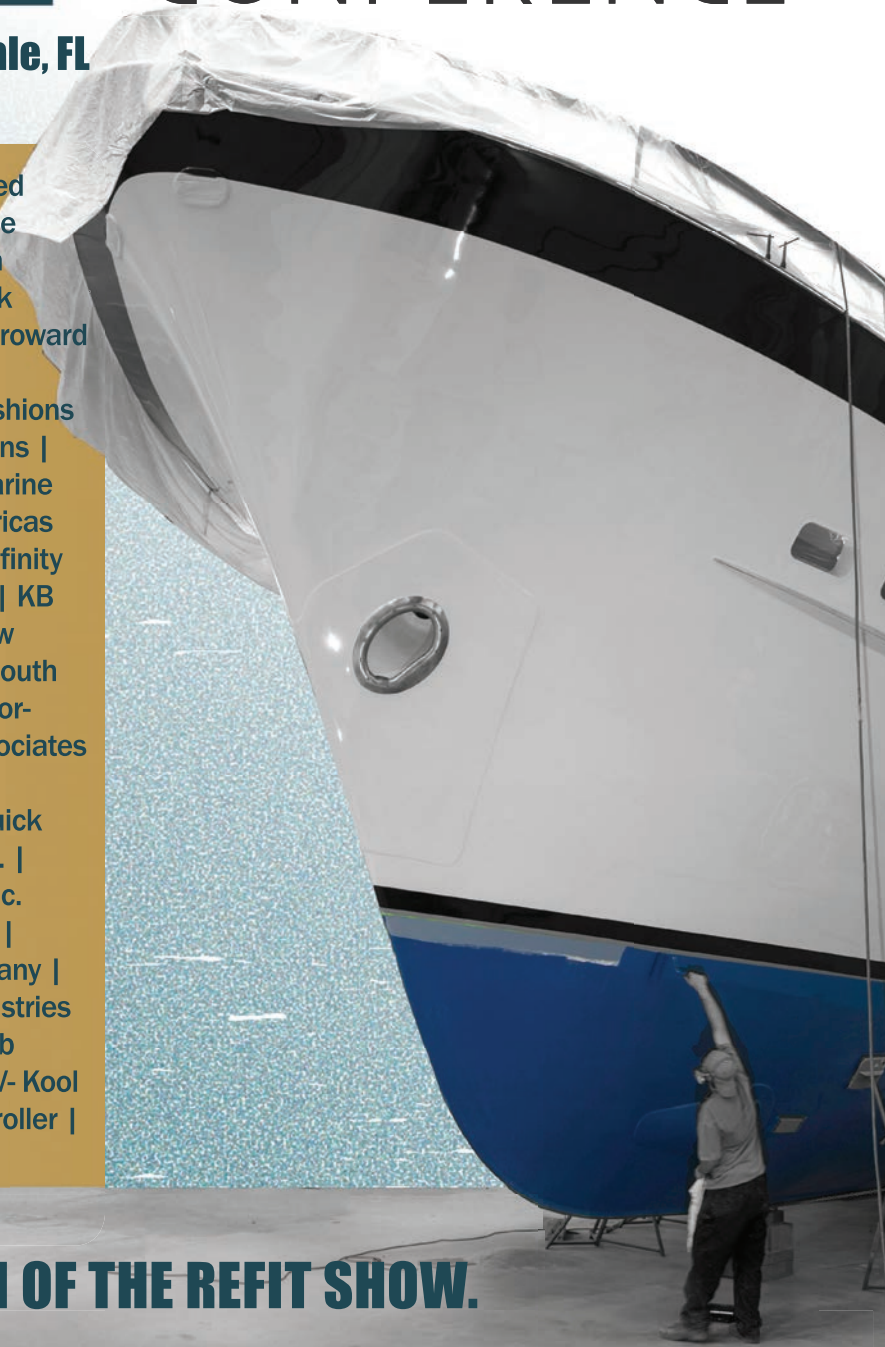

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WE CAN HAVE HYBRID

COURTESY WHISPERPOWER

Though the hype around marine hybrids died down after early failures, the development of these systems has persisted. The results include some viable and almost-viable power choices for the recreational marine market.

by Nigel Calder

Above—*Hybrid propulsion systems are being consistently refined by multiple equipment manufacturers looking to deliver cleaner, more efficient onboard powering options. This superyacht-scale hybrid system is being tested at the WhisperPower factory in The Netherlands.*

It has been almost a decade since Groupe Bénéteau (www.beneteau-group.com) launched the Lagoon 420 catamaran with a hybrid propulsion and energy system. The concept was an instant hit with buyers, and dozens were sold before it was discovered that the boats had insufficient power to make headway against wind and seas in rough conditions. Bénéteau subsequently retrofitted almost all the boats with conventional diesel drives. Bénéteau has experimented with several hybrids since then but has not brought another system to market.

Back in those days, hybrid propulsion was a hot topic. I received far more e-mails from people interested in putting a system into their boats than on any other subject I have ever written about (see "Marine Hybrids Come of Age," *Professional BoatBuilder* No. 127). My response was always the same: "Don't do it now. Wait for the technology to mature. Ask me again next year."

Over the next few years, we had a series of high-profile failures of hybrid or electrical propulsion systems on recreational boats, including from such giants of industry as Siemens, which thought its well-tested hybrid bus technology could be readily adapted to marine applications. Unfortunately,

although hybrid systems are conceptually simple, the duty cycle in boats is much tougher than in most other applications; the control systems are more complex, and the environment is particularly harsh. Even Siemens did not get it right. (Note that this is not the case in the commercial world, where we are seeing an increasing number of successful hybrid applications, notably among ferries and offshore workboats for oil fields and wind farms; unfortunately the scale of these systems is such that the technology does not readily transfer into the recreational marketplace.)

Successive inventors and boatbuilders, most with severely limited resources but some with million-dollar budgets, have wrecked on the technical rocks. There have been hundreds of underperforming and failed hybrid boats. The boat-buying public gradually got the message, and the hybrid e-mails dried up. Today I get very few inquiries.

Below the Radar

In the interim, the effort to create viable marine hybrids has never ceased. Although most of the early developers were enthusiasts with little funding and without the resources to solve the problems that emerged during the development process, one or two hardy companies are still around. These now have more recent competitors with deeper pockets and greater technical resources.

There are two possible architectures for the resulting hybrid-propulsion systems: serial and parallel. In a *serial system*, the boat is driven by an electric motor that in turn is powered by a diesel generator and/or batteries, with no mechanical connection between the diesel engine and the propeller. In a *parallel system*, the boat has a conventional diesel installation directly connected to the propeller with an auxiliary electric "machine" operating as an electric motor and also as a generator connected to the propeller shaft. A series of clutches enables the propeller to be driven by either the diesel engine or the electric machine, or both; the electric machine in turn can be driven by the engine as a generator. In serial and parallel applications, a freewheeling propeller on a boat under sail can drive the electric machine as a generator.

Serial Misunderstandings

Most early attempts at marine hybrids were serial systems. The Lagoon 420 was one. The core problem here is that because the only thing connected to the propeller is the electric motor, it must be powerful enough to keep the boat moving in the worst possible conditions. In those days of serial development, a lot of nonsense was spoken and written about 1 electric horsepower being the effective equivalent of up to 4 diesel horsepower. This was partly responsible for the underpowering of the Lagoons and other vessels. Unfortunately, it simply doesn't work like this. Although an electric motor offers some potentially significant gains (the discussion of which is beyond the scope of this article), if a serial hybrid is to have the equivalent performance under power of a conventional installation, it still needs a powerful electric motor, with a powerful generator, both of which are expensive.

The other critical problem with serial systems is the nature of duty cycles on a boat. When a car reaches cruising speeds on the highway, the relatively light propulsion loads make it feasible to provide a range under battery power of 100 miles (161 km) or more. When a boat gets up to cruising speeds, the loads are continuously high, especially with displacement-type hulls. In most applications it is not practicable to put enough batteries

NIGEL CALDER

Seaweed, *a fast cruising yacht fitted with a parallel hybrid system from Hybrid Marine, has just completed a six-year circumnavigation of the North Atlantic, from the Hebrides to Madeira and Nova Scotia to the West Indies; the owner was very pleased with the system.*

in the boat to maintain this speed for even an hour, let alone several hours; and as such, at traditional cruising speeds the range under batteries is typically only a few miles. Of course, you can always choose to go slower, which dramatically reduces the load with a displacement hull and concomitantly increases the range under electric power, but then you are not comparing apples to apples. Once the batteries are discharged, the generator must be cranked, but now instead of the diesel engine directly driving the propeller, it is driving a generator that is sending power through cables and a motor controller to an electric motor driving the propeller. The additional hybrid system components cause efficiency losses in the system along with a significant level of complexity and, in many systems to date, a greater number of potential failure points.

Although at low speeds there can be significant improvements in system efficiency over a conventional installation, if the normal duty cycle includes sustained powering at cruising speeds, it is next to impossible to make a serial system in propulsion mode even as efficient as a conventional drive. That's not to say a serial hybrid makes no sense; other good reasons for this approach are mostly related to lifestyle issues. Timo Jaakkola of serial hybrid manufacturer OceanVolt notes: "Efficiency is not the first criteria for selecting an electric motor system. More important are silent propulsion, less maintenance, no vibration, no exhaust fumes, the ability to regenerate power under sail, and sleeping silently overnight without a generator running."

The higher the house loads relative to the propulsion loads, the better a serial system looks, as it can almost always dramatically improve the efficiency with which the house energy is created. An ideal application for a serial system is a fast cruising catamaran with high air-conditioning loads: the propulsion loads are relatively light; the house loads are relatively high, and the vessel can regenerate significant amounts of energy under sail.

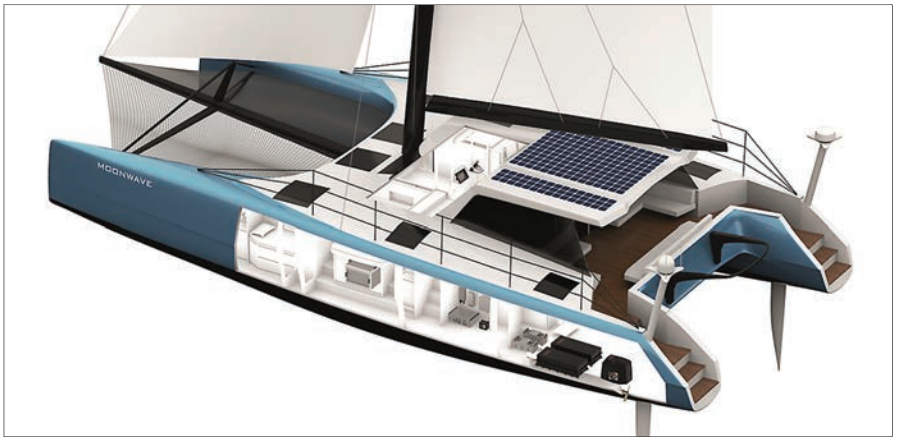
From Electric Boats to Serial Hybrids

For years, the issues of cost, efficiency, and complexity nearly ended attempts to create viable serial systems. In the meantime, a considerable development around pure electric boats (no generator) has resulted in thousands of installations, which are very effective for short-distance operation if shore power is available to recharge the batteries. If you want more range on occasion, you can put a small generator in the boat to charge the batteries, but operation is considerably less efficient than with a conventional installation. So, if the generator must be run on a regular basis, it makes little sense.

An electric motor with a range-extending generator is not a hybrid system. The hybrid system comes in when you add complex control systems that manage the generator and batteries to optimize system operation and efficiencies. It is a significant technical leap to go from a range-extending generator to an integrated serial hybrid system. In the field today, one company in particular, Fischer-Panda (www.fischer-panda.de), has been developing these systems for more than a decade. Two other companies that I believe have the staying power to make this step are Torqeedo (www.torqeedo.com) at the high-powered end of the marketplace and OceanVolt (www.oceanvolt.com) at the relatively low-powered end. Torqeedo is still in the development phase, while OceanVolt is delivering systems.

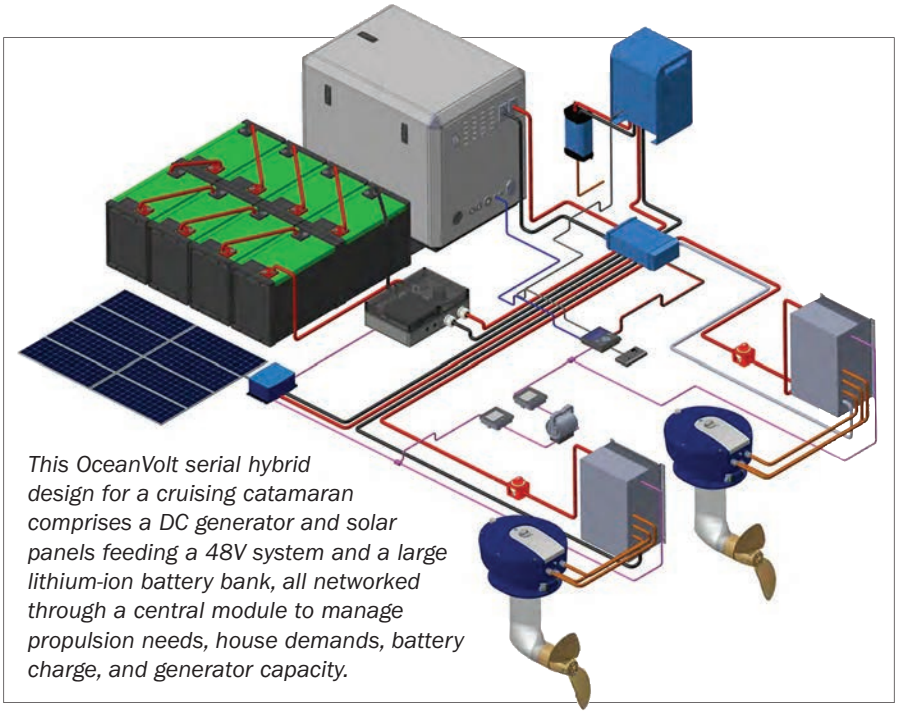
Torqeedo. Best known for its electric outboards, Torqeedo is building a serial hybrid around a common control system that provides whole-boat energy management, delivering electric power at any desired standard voltage, AC or DC, to all electrical loads on the boat. This control system can be applied to a series of standardized electric machine, generator, and other modules. The idea is to have a system scalable from 27 kW up to 55 kW (35 hp up to 74 hp) continuous, including twin-propulsion systems for catamarans, using the same controllers, software, and building blocks. These systems run at hundreds of volts; the high power levels require high voltages to keep cable sizes within bounds.

Todd Sims, Torqeedo's global sales manager, states, "The standardization of components allows for consistent performance, a high level of safety, and easier service and support." Torqeedo is investing heavily in this system, including massive lithium-ion battery packs from top-tier manufacturers. If the 60,000 electric outboards it has sold to date are anything to go by, the finished product will be beautifully engineered.



COURTESY TORQEEDO

Electric outboard manufacturer Torqeedo is developing a serial hybrid system built around an energy-control module that can be applied to standardized inputs from electric machines, generators, solar, and other sources. This schematic is for a serial hybrid catamaran.



This OceanVolt serial hybrid design for a cruising catamaran comprises a DC generator and solar panels feeding a 48V system and a large lithium-ion battery bank, all networked through a central module to manage propulsion needs, house demands, battery charge, and generator capacity.

OceanVolt. This Finnish company also has well-engineered electric machines up to 15 kW and operating at a nominal 48 volts. To date, these have been used almost exclusively in electric boats, with more than 200 systems delivered, powered by lithium-ion battery packs. OceanVolt has been investigating serial options, initially in a range-extending fashion but evolving into a full-fledged serial hybrid system: the OceanVolt SEA (Silent Electric Autonomy). The system runs at a nominal 48 volts using DC generators from Fischer-Panda and Polar Power.

Timo Jaakkola: "Generator operation is controlled with a central unit that communicates on the same CAN-bus as the propulsion and battery system. The batteries send their state of charge [SoC] information and other

OceanVolt Calculator

Project: **Voyage 45 DC**

Hull data:

Length wl	12.3m
Width wl	7.65m

Displacement:

Weight	9,200 kg
Lwl/Vol$^{1/3}$)	7.396

Environmental properties:

Gravity	9.807m/s^2
Kinem. visc.	1.2E+06m^2/s
Coefficient of drag	0.0029
Density	1,025 kg/m^3

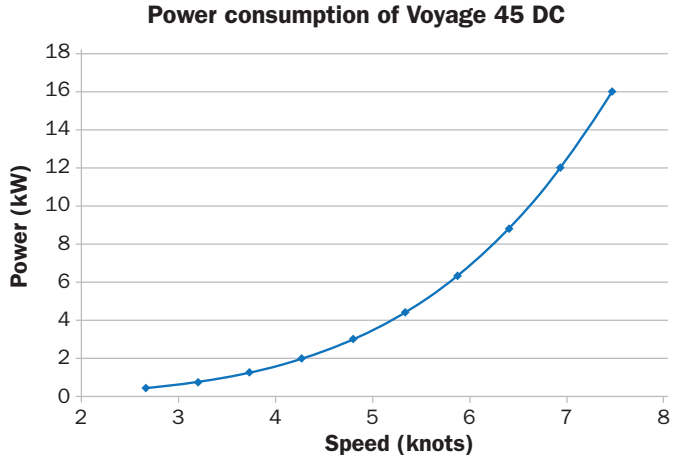
Customer factors: Battery capacity 21 kW

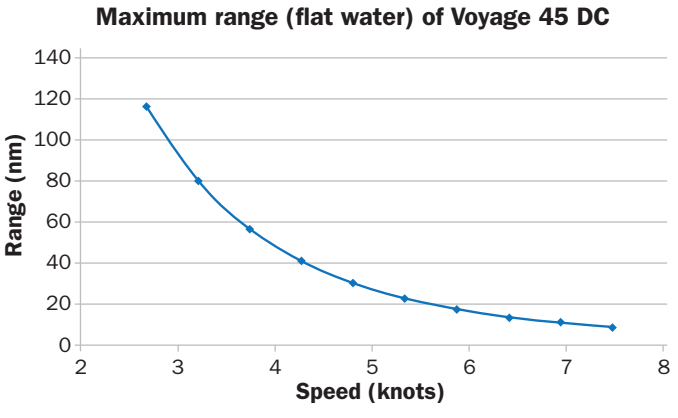
Speed		Resistance	Power	Range	
m/s	kts	N	Total	Flat sea	Sea margin
1.37	2.67	137	0.43	116.5	87.3
1.92	3.74	282	1.25	56.5	42.4
2.47	4.80	528	3.01	30.2	22.6
3.02	5.87	908	6.33	17.5	13.2
3.57	6.94	1457	12.00	10.9	8.2

Legend:

Flat sea = range in flat water, [nm] capacity * Battery margin/Pbat
Sea marg = range with sea margin, [nm] Rflt * Sea margin (25%)

The calculations give an estimate of resistance and power consumption for conventional catamarans (30'–60'/9.1m–18.2m) with a length–weight–ratio of 6.5–9.3 at displacement speeds. Results are not contractual.





COURTESY OCEANVOLT (ALL)

OceanVolt's generic calculation of speed and range in flat water for a serial hybrid system in a cruising catamaran illustrates the significant increases in range efficiency to be gained by moderating speeds. Note that results in the real world will vary significantly, especially in headwinds or adverse seas.

COURTESY OCEANVOLT

This electric propulsion installation from OceanVolt includes the electric motor (center), white motor controller box (lower left), lithium-ion battery pack strapped down (mid-left), and a bank of Victron inverters and chargers (top left to right).

important data to the central module, which automatically starts and stops the generator at low and high SoC." There are additional settings for starting the generator if, for example, a predetermined motor power is to be used for a predetermined time. The central module can be connected to the Internet for remote diagnostics, updates, control, and communication.

To date, OceanVolt has delivered 30 of these systems.

Fischer-Panda. Fischer-Panda has been at this longer than anyone else still in the business. (I tested one of its serial hybrid boats a decade or more ago.) The company is now on its fourth generation of submersible, pod-type, electric machines together with the controllers and software that integrate these with Fischer-Panda generators. Packages are designed for easy installation, with the cables for the electric machine, the battery cables, the joystick, and the helm display all plugging into a central control box, operating at a nominal 48 volts. Power levels are 10 kW and 20 kW. Given that boats rarely operate at wide-open throttle for any length of time, and the fact that once you throttle back, the load reduces dramatically, Fischer-Panda recommends sizing generators at half the kW rating of the electric motor.

Parallel Hybrids

Recently, Fischer-Panda has begun adapting its electric machine technology to parallel hybrid applications. The electric machine is connected via a belt

drive to the propeller shaft in a conventional installation, providing low-speed maneuvering. The systems have been added to boats up to superyacht size. In calm conditions, the 20-kW electric motor is adequate to move these large boats at slow speeds in harbor.

This low-power, low-speed capability is a defining feature of parallel systems; no attempt is made to provide sustained electric propulsion at anywhere near cruising speeds. The goal is to have sufficient electric power from, and electric storage capacity of, batteries to handle low-power situations, notably maneuvering in harbor or motorsailing in a sailboat. When operating as a generator (i.e., driven by the propulsion engine), the electric machine will be powerful enough to recharge the batteries rapidly, resulting in a house electrical system that will support the comforts of home without running a generator for long hours.

Greenline. By far the most successful implementation of the parallel approach is to be found in the Greenline series of powerboats, built in Slovenia (www.greenlinehybrid.si); more than 600 have now been built, with approximately 70% of these as parallel hybrids, in sizes from 33′ to 48′/10m to 14.6m (for more on the Greenline 33 Hybrid, see Rovings,

COURTESY J&J MARINE

The Greenline 36 (10.9m), the latest in the Greenline family of parallel hybrid cruisers, relies on an integrated flywheel electric machine built into a Volvo Penta D3, and a simple manual selector for electric or diesel propulsion.

PBB No. 147, page 10). A 65′ (19.8m) version is on its way. The electric machine provides 15 kW of propulsive power and 10 kW of generating capability (in earlier models it was 10 kW and 7 kW, respectively), operating at a nominal 48 volts. The Greenlines include sizable lithium-ion battery packs, soon to be provided by Torqeedo, enabling the use of overnight air-conditioning without running a generator—an important consideration in the Mediterranean, where many of these boats operate.

The Greenline approach is based on an integrated flywheel electric machine, initially built into a Volkswagen marine engine but now into the Volvo Penta D3. Note that a very similar approach has been adopted at one time or another by Steyr and Nanni (two European marine-diesel-engine manufacturers), but neither appears to be making much effort at the moment to improve or promote this technology. Part of the secret to success for the Greenlines has been eliminating many of the complex software and control issues associated with fully integrated parallel hybrids. Instead, the operator uses a switch to select electric propulsion or diesel propulsion.

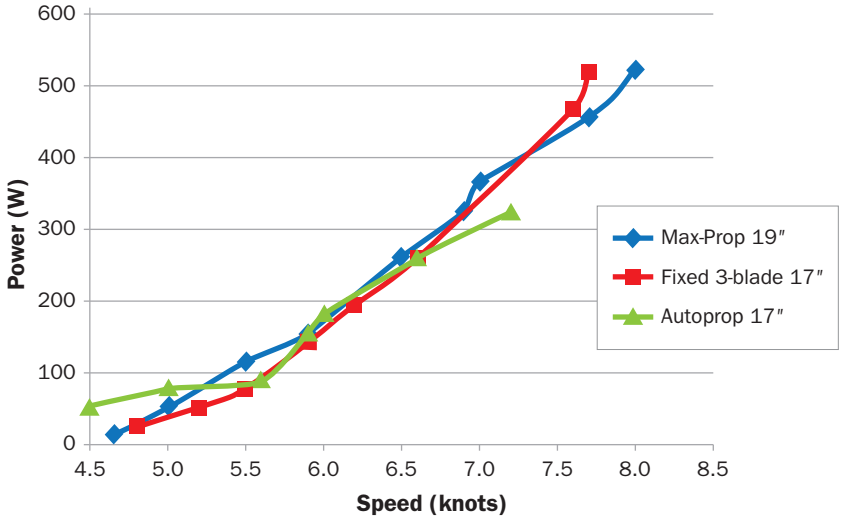
Hybrid Marine. So far as fully integrated parallel hybrids for recreational boats are concerned, the only well-tested system of which I am aware comes

NIGEL CALDER

A tidy installation of Hybrid Marine's parallel hybrid on Seaweed, *with the motor and clutches center right, the batteries to the left, and various control devices in the background.*

One great benefit of hybrid systems to cruising sailboats is the ability to generate power through a freewheeling prop while under sail. Data for the Hybrid Marine system were collected aboard Seaweed *using three different propellers—folding, fixed, and the Bruntons Autoprop.*

Regeneration Using Low Power Circuit



COURTESY HYBRID MARINE

from Hybrid Marine in the U.K. (www.hybrid-marine.co.uk). This system has been continuously developed and tested for 12 years. It uses a 10-kW electric machine (or multiples of 10 kW) operating at a nominal 48 volts.

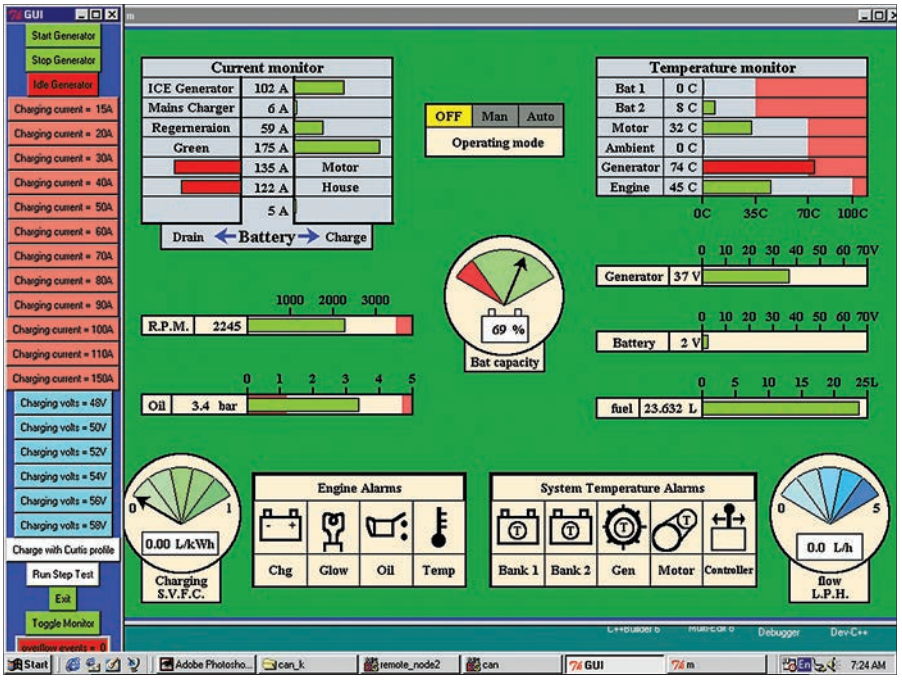
I was recently aboard *Seaweed*, a 40′ (12.2m) offshore cruising boat with a Hybrid Marine system, immediately after the owner returned from six years of cruising on both sides of the Atlantic. *Seaweed* had been sailed from the Hebrides to the Madeira Islands and from Nova Scotia to the West Indies. The owner was delighted with the hybrid performance, especially his ability to maneuver in harbor under electric power, to regenerate from a freewheeling propeller when under sail ("I often used the electric kettle on passage when sailing at 6 knots or over and reckoned to recover the energy for my large mug of tea in about 40 minutes"), and the ability to

NIGEL CALDER

Graeme Hawksley, the founder and owner of Hybrid Marine, tests one of his systems in the Beta Marine factory in the U.K.

add a kilowatt or two of electric power to the propeller shaft when sailing in light winds, substantially boosting the boat's speed with only a limited impact on the batteries.

Hybrid Marine has also installed systems in a number of recreational canal boats in the U.K. The canals have a speed limit of 4 mph (6.4 kmh), but occasional river sections may have considerable currents. These boats have relatively large engines to handle the river sections but are then effectively overpowered for most of the time they are under way. This is a chronically inefficient duty cycle for a conventional installation but ideally suited to a parallel hybrid. Enough battery power can be provided to run all day in the canals under electric power. If it is not possible to plug in and recharge overnight, a relatively short run under conventional power will recharge the batteries. The battery-charging adds sufficient load to the engine to create a reasonably efficient duty cycle even at low cruising speeds.



COURTESY HYBRID MARINE

This detailed system data display and diagnostic tool from Hybrid Marine is representative of those being created by all the hybrid developers. It monitors a lot more than the rpm, temperature, oil pressure, and voltage of a conventional system.

Superyachts

Superyachts have seen a lot of sophisticated and expensive experimentation with serial and parallel systems, and some that incorporate both approaches. As early as 2008, *Ethereal*, built by Royal Huisman (www.royalhuisman.com/en/yacht936.html) with a hybrid system from HYPS (www.hyps.nl), garnered considerable attention. WhisperPower (www.whisperpower.com) has several large yachts in its portfolio, two of them being part of the J-class fleet (www.hollandjachtbouw.nl/). A recent launching is *Savannah*, a 274′ (83.5m) yacht completed by Feadship in 2015 (www.feadship.nl/en/fleet/yacht/savannah). All these companies are based in Holland, which seems to be the epicenter for large recreational vessel hybrid development. In Italy, Ferretti has also done one or two boats. Andrea Frabetti, formerly with Ferretti and now the CEO with Diesel Center S.p.A, working in collaboration with WhisperPower, has installed an interesting twin-shaft parallel hybrid in a 106′ (32m) motoryacht. Graeme Hawksley has implemented similar ideas in low-power applications. (For a description of both, see proboat.com.) Every one of these systems is individually engineered. Given the complexity of these large boats, I believe we are still some way from "generic" systems that can be dropped into practically any boat with little customization.

An emerging concept in the superyacht world known as the "hour of power" may change this situation. The idea is to provide these boats with sufficient battery-powered electric propulsion to enable operating at up to 10 knots for one hour to get in and out of harbors and anchorages, resulting in zero emissions. A battery pack large enough to do this will also support overnight air-conditioning without running a generator. There may also be a significant market for hybrid superyacht tenders that eliminate emissions when under way and when alongside the mother ship.

If the hour of power concept gains

Hybrid propulsion systems and the associated electrical installations on large yachts are far more complex than anything on smaller recreational boats. Superyacht applications are individually designed and engineered, cleanly installed, and closely monitored.

COURTESY WHISPERPOWER

traction, we can expect to see considerable investment in hybrid systems for larger recreational boats. This may also be driven by legislation as more harbors look at the feasibility of implementing zero-emissions rules. Amsterdam, for example, has set a deadline of 2025.

Software and Battery Challenges

To be successful, any hybrid system, whether serial or parallel, needs a control system that is, in effect, a whole-boat energy-management system. On all but the simplest systems, this involves balancing and optimizing a mind-boggling number of possible permutations of, and interactions between, the components in the energy system: electric machines and their controllers, batteries, generators, other energy sources (shore power, solar, wind, regeneration, maybe fuel cells), various voltage converters (DC-to-DC, DC-to-AC, AC-to-DC), and all the loads on the boat. At all times, the system must ensure a safe mode of operation, often when moving extremely high-current levels around the boat.

It takes years of experimentation and research, with a great deal of

COURTESY OCEANVOLT

This neat OceanVolt serial hybrid installation includes a large bank of lithium-ion batteries at right and a Fischer-Panda generator in a box at center rear.

practical on-the-water experience, to evolve market-ready systems. We are now seeing some of these developed as part of a finished system from a single supplier and also as embryonic control systems that can be applied to the systems of other companies (e.g., www.triskelmarine.co.uk).

The other principal challenge is an old one: battery technology. Effective hybrid systems on boats require the ability to store considerable amounts of electrical energy, with the only practical way of doing this still being batteries. Lithium-ion is currently by far the most capable technology, but it is prohibitively expensive in many applications. It also requires highly sophisticated battery management systems (BMS) to ensure its safe operation, especially where high discharge and recharge rates are concerned, as is the norm with hybrid systems.

A great deal of research to improve

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the performance of lead-acid batteries has mostly focused on variants of absorbed glass mat (AGM) chemistries, with some promising results. Notable are the combination of the thin plate technology introduced by EnerSys and Northstar some years ago with various permutations of adding carbon to the negative plates (Northstar www.northstarbattery.com/batteries/nsbblue/index.php), or making the plate grids from a carbon foam (Firefly www.firefly energy.com). The effect is to substantially increase:

- the rate at which these batteries can be charged and discharged
- the depth of discharge the batteries can routinely handle
- cycle life
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The performance is still nowhere near that of lithium-ion but is considerably better than anything we have seen in the past. What's not to like about this?

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About the Author: *A contributing editor of* Professional BoatBuilder, *Nigel Calder is the author of* Boatowner's Mechanical and Electrical Manual *and other marine titles (including, earlier in his career,* Marine Diesel Engines), *and is a member of the American Boat & Yacht Council's Electrical Project Technical Committee.*

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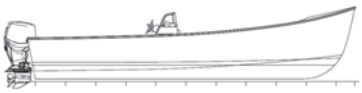

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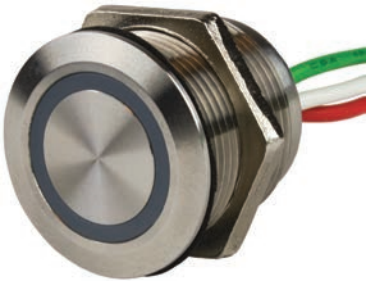

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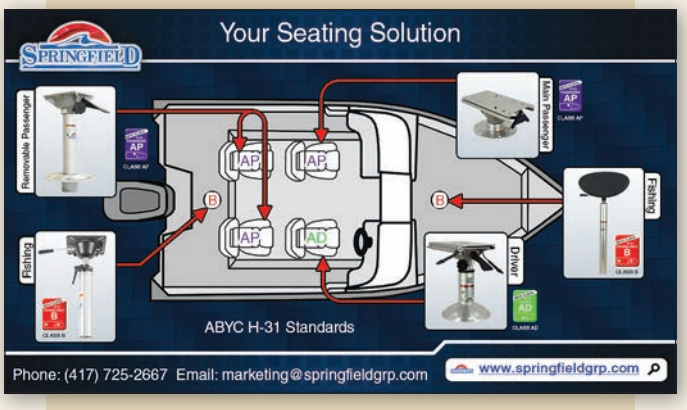

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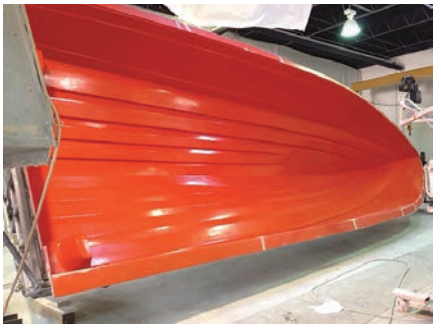

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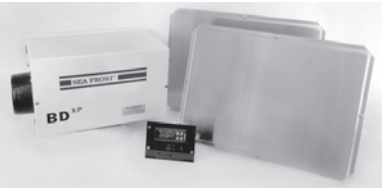

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PARTING SHOT

The Smart Answer

by Mike Telleria

I don't want you to think I'm incompetent or, even worse, stupid. Incompetence is bad for sure, but at least it can often be fixed with training, knowledge, and experience. Stupidity is different. No amount of reading, instruction, or hand-holding is going to overcome genuine stupidity. Either way, the extreme and immediate fear of being thought incompetent or stupid is what makes saying the words *I don't know* so incredibly hard.

Here's an example from a conversation I had some time ago with a technician servicing one of our boats miles away in another state. There were some issues with the house batteries not showing good voltage (on a boat with about $10,000 worth of house batteries). He wanted to know what the charging voltage settings should be for the alternator and inverter/charger. I'm the electrical designer, so I should absolutely know this right off the top of my head, but for some reason I just couldn't remember right then. I actually felt a little panic forming in the pit of my stomach—the classic feeling you get when faced with an I-don't-know situation. Instead of admitting I couldn't remember exactly and needed to look it up, I gave an unsure answer, figuring I'd probably get it right. I didn't.

He said it looked like the equipment was set to charge at 25.5 volts or so for the 24V system. I said that sounded about right to me—and in that moment I pounded the final nail in my coffin. His one-word response was withering:

"Really?"

He might as well have said, "What?! Only someone who doesn't have a clue about what we're talking about would say that."

Right then, my brain decided to work again. Of course, a charging setting of 25.5V was not right—not even close; that would just be *stupid*! Sure, 25.5V would be great if checking for state of charge without any loads or charging sources present, but the actual charging voltage should be set higher—like 28V+ for bulk charging. But it was too late; the damage had been done. Even after I backpedaled and got him the correct information, I could tell he had already decided I was not the sharpest tool in the shed—and there was nothing I could do to walk it back. Talk about a great example of the famous Mark Twain quote "It's better to keep your mouth shut and appear stupid than open it and remove all doubt."

This was a good lesson for me. While it's pretty easy to design systems and look up engineering rules and standards to ensure all is good on paper, it's another thing to be put on the spot and immediately be able to respond to complex, technical questions that require precise answers. Some days can feel like a minefield when questions like these come from every direction, with boat owners, factory workers, project managers, surveyors, and others calling for guidance. The pressure to be right and always know every little detail can be tremendous—particularly if it is your job to know such things.

Sometimes it can become downright maddening. For example, an owner might post a question online about battery maintenance, fuel management, or one of the many other "religious" topics boaters tend to have strong, often contrary opinions about. This is usually followed by long-winded responses from know-it-all pundits who love to swoop in with their expert analysis. Eventually the powers that be ask someone like me to articulate a response establishing our position as a manufacturer, which can feel like being thrust onto a battlefield where the main objective is to just stand there getting shot at until the enemy gets bored or runs out of bullets.

Even then, it's important to stay within the confines of one's own knowledge. I've never forgotten the sting of the "Really?" response from that technician, who, to this day, probably still thinks I'm an idiot. So now I'm much more willing to say those three harsh words *I don't know*. Actually, I usually camouflage it with the more proactive "I'll find out."

I've also come to embrace a more positive attitude toward these dreaded I-don't-know moments. While they can feel like torture, they actually present opportunities for growth. One of the keys to learning is finding out what you don't know. So when people ask something they obviously think you *should* know, because you're an engineer, project manager, or surveyor, just relax. Tell them you understand the question and will get back with the right answer as soon as possible. (I keep Nigel Calder's book *Boatowner's Mechanical and Electrical Manual* within arm's reach for just such occasions.)

These folks are doing you a favor. By exposing the gaps in your knowledge, they give you the opportunity to fill those gaps and become an even more well-rounded boating-industry expert. Saying "I don't know" (or "I'll find out") doesn't make you incompetent or stupid—it just gives you a chance to get even smarter and to deliver the right answer. PBB

About the Author: *Mike Telleria is an engineer and technical writer at Nordhavn Yachts, in Dana Point, California.*

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