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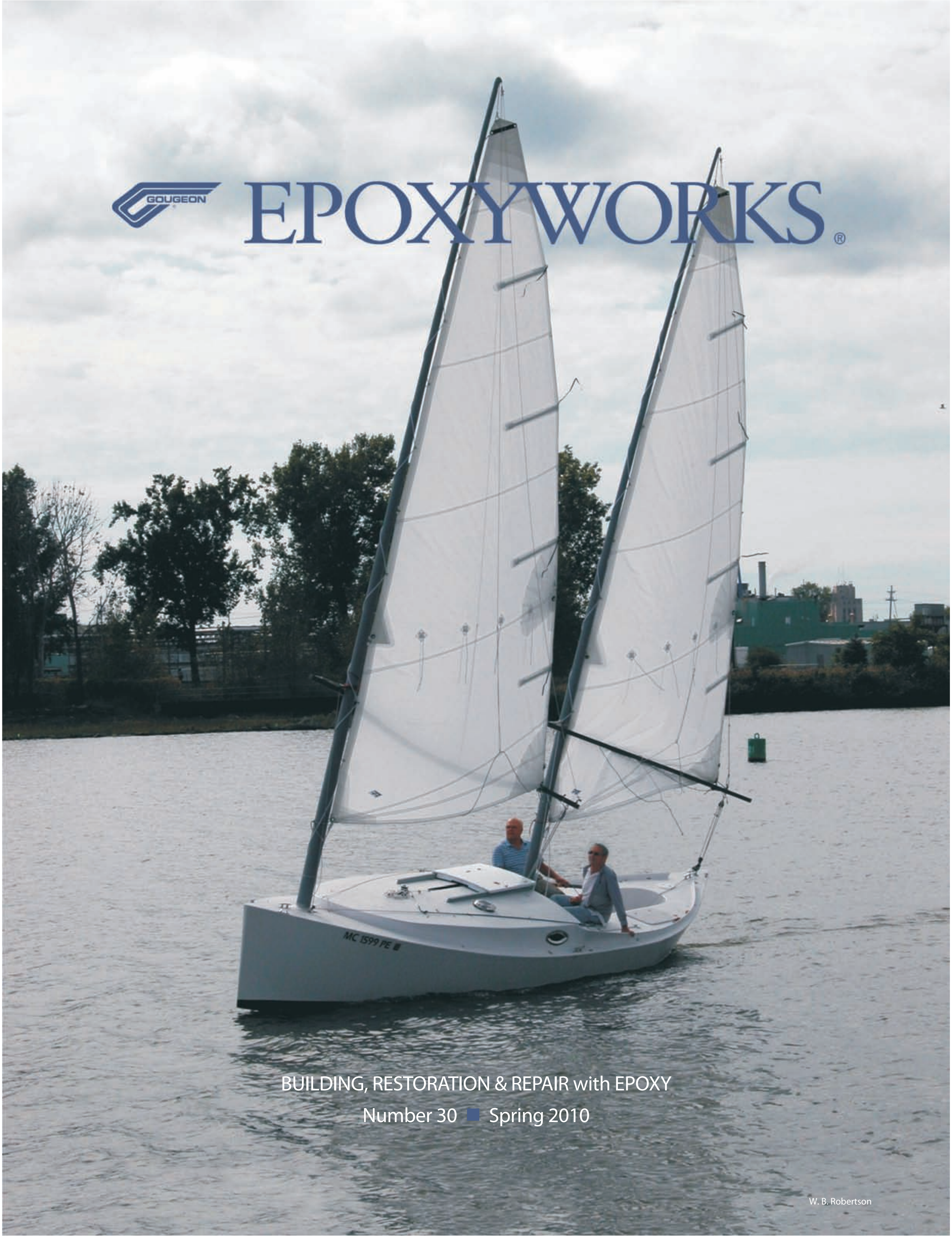

BUILDING, RESTORATION & REPAIR with EPOXY

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W. B. Robertson

In this issue

EPOXYWORKS®

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Reflecting on sailing days past

By Capt. James R. Watson

Lady B is a sailing sharpie I launched on August 20, 2009. On one of the first sails, I asked Jan Gougeon to come along with me to see what he thought of her. That sail brought back many memorable sailing moments that Jan and I have shared over our lifetimes.

Jan Gougeon grew up on Donahue Beach and I on nearby Aplin Beach. The two beaches were separated by Wenona Beach[1], a magnificent amusement park built at the turn of the century. We were in the same kindergarten class. It wasn't long before we were both in boats we'd built: Jan in his 13' Dart and I in my 8' pram, the *Pal*. Back in those days we built using bedding compound and lots of screws. We carried coffee cans to bail our leaky boats.

Around 1955, my two means of transportation were a bicycle and my boat. Similarly, Jan had a boat but he also had a car—a buggy he'd assembled of bicycle wheels, a wooden frame joined with nails, bolts and brazed metal parts. It was powered by a gasoline-fueled washing machine motor. The buggy's body was painted black and there was even a fringe on top. I could hear the *putt putt putt* of Jan coming from a long way off. I'd jump on my bicycle and we would head for our boats.

◄**Jan Gougeon driving the gasoline-powered buggy he designed and built around 1955.**

[1]**J. R. Watson authored the 1988 book, *Wenona Beach, a History of the Amusement Park*.**

Taylor's

A favorite excursion in our boats was up the Saginaw River to Jack Taylor's. He was a bohemian, an engineer, a voyager and a creator of all sorts of things. Taylor lived in an A-frame accessible only by water, amid a bunch of closely built, ramshackle, abandoned fishing shacks all adjoined with rickety docks. These were connected to the Coast Guard Station which was located within the Saginaw River Rear Range Light.

On a barge next to his A-frame Taylor was building *Teal*, a strip planked 22' yawl edge-nailed with ring-shanked boat nails. Gaps existed between the planks but when the craft was sheathed with fiberglass and polyester resin, the excess bonded the strips together. We were just learning about fiberglass and polyester resin; we had only heard about epoxy.

Taylor's was a wonderful place where we could explore the labyrinth of shacks and pester the Coast Guard personnel until they would let us climb the Saginaw River Rear Range Light tower (which was similar to a lighthouse). The whole experience inspired us both enormously. Taylor's enthusiasm for building was contagious. We would work for

Cover story

▲**One of *Lady B's* first sails on the Saginaw river near the Gougeon boat shop.**

◄**View of Jack Taylor's A-frame from the top of the Saginaw River Rear Range Light tower.**

▼**Looking back at Jack Taylor's with the Coast Guard Station and Saginaw River Rear Range Light in the background.**

him in exchange for old sails or hardware. A bronze gooseneck, for example, was a priceless piece of "boat jewelry" we coveted, for our simple craft were fitted with a plain, homemade fittings. We'd leave Taylor's full of ideas, solutions to boat-related problems and a zest for boats, design, building and adventure that would last throughout our lives. We never did earn enough credit to posses the gooseneck.

Presto

Around 1960, Jan's grandmother Ollie took us in her huge Buick Roadmaster about 30 miles from home to AuGres. There we boarded an 18' Corsair (a French designed and built class that exists today) that we were allowed to sail for the summer in exchange for repair and maintenance. We used epoxy for some of the repairs and learned a lot of repair strategies. She was a V-bottom, plywood boat. She had a cabin with bunks, a keel/centerboard configuration and for us was qualified as an offshore cruiser. It was our first experience with Dacron sails: all our boat's sails were made of cotton, and most of them we'd sewn on our mothers' sewing machines.

We named the Corsair *Presto* and sailed her all that summer, including a local long distance race to Gravely Shoals and back (about 60 miles). After we'd rounded the Gravelly Shoals Lighthouse and were headed home, the wind freshened from the north. We were surfing fast so to lighten the load we started jettisoning stuff. We threw all of our hard boiled eggs into the air and as they splashed behind, we were convinced that we would pass all of the competing boats, which were much larger than *Presto*. Unfortunately, the wind then went light and south. We had to beat all the way home to finish late in the night, far behind the others and quite hungry.

The 18' Corsair *Presto* sailing in the Gravely Shoals Race in 1960.

Wee Three

Jan's first trimaran, *Wee Three*, was 18' long and one of his own design. He now lived in town and built the boat outside in his back yard. She was made of 3mm thick plywood over light spruce stringers. All components were joined with epoxy that was poured and mixed from glass fruit jars; there were no calibrated pumps in those times. We did not coat surfaces with epoxy then, but the joints were tight: no more leaks. I was an altar boy then and recall the early morning, before mass, that we launched her. *Wee Three* was transported on the top of Grandma Ollie's Buick (Jan was now old enough to drive a real car) when one of the outriggers fell off on the way to the yacht club. Following in my dad's car, I picked up the outrigger and put it through the window into the back seat. We took turns sailing *Wee Three* with her DN iceboat rig. The non-skid surface was so aggressive we both had bloody knees and feet after sailing her. I had to go serve mass later and my socks stuck to my feet as the blood dried. But all through the mass all I could think about was what a thrill that boat was to sail.

Riddle

The next year I completed my William F. Crosby-designed Crosby 16, *Riddle*. I built her outside of plywood, oak, spruce and epoxy. Jan was there to help me install the centerboard case, a huge fitting and gluing job for us. As the night wore on we kept breaking light bulbs and eventually stole all of the bulbs from my mom's house. The oak-to-oak joints never gave any problems. Jan was with me on the first sail of *Riddle*. Many times *Riddle* and *Wee Three* would gallop along side-by-side over the waters of the Saginaw Bay.

Cruising in an OK dinghy

By the mid-sixties the United States draft board had contacted us both and together we boarded *Glider*, my 13' Knud Olsen-designed OK Dinghy I built in 1964. This was a high-performance planing dinghy with a free standing rig. Jan and I went on a three-day voyage in Canada's North Channel to contemplate our destiny. We had two dive masks but only one set of fins, thus we each wore one when diving in the crystal clear water. All we had was a few cans of beans, a loaf of bread and some peanut butter. We still talk about that cruise. Eventually, we both were drafted and served in Vietnam: Jan with the Army and I with the Marine Corps.

◄ *Firecracker* **looking clean and fast.**

▲ *Magic* **flying under tow.**

Hydrofoils

Some of our more daring failures were our ventures with hydrofoils. Jan's was the *Firecracker* and mine the *Magic*. By now we had learned the value of coating the interior and exterior of a structure with epoxy. Previously, we used the epoxy only as a glue. But formulation experimentation allowed the epoxy to be spread in a thin film so the structure remained lightweight yet protected from the harmful effects of moisture. The hydrofoils structure—beams, hulls and foils—were made of thin plywood. Talk about complicated to assemble and launch.

At first we did tow tests with a power boat and they flew—came out of the water. Once sailing they flew but were terribly slow due to excessive wetted area and drag from the large, fat foils. The projects were dismal failures but we still laugh that "there was nothing magic about *Magic* and *Firecracker* was a dud." Still we learned much, especially about fastener bonding and foil shapes. We discovered the zit staple, a fine wire staple that can be left in the structure. We used these to 'clamp' thin plywood. We discovered the value of bonded dowels and threaded rod as tension elements. We also began bonding wire and rope into the structure with great results—strong, clean and simple attachment.

Iceboats

We sailed iceboats for years. In 1975 Jan took first place and I took second in the DN iceboat Gold Cup World Championships. We beat the fierce sailing Russians, Poles, Dutch and Swiss. That was great fun and done with sails that we made ourselves. The DN iceboat is a plywood/spruce structure that is highly loaded and really served as a test platform for what could be done with epoxy. Jan's boat was beautifully varnished like a piece of fine furniture. Helping transport race committee equipment after the race, he had put among other things a can of bright orange spray paint in his cockpit. He accidentally punched a hole in the can with his foot spike, and, not realizing this, sailed in. What a mess the paint made of the nice woodwork.

Jan and brother Meade Gougeon went on to win many DN Championships. Meanwhile, I switched to downhill skiing.

Project X

Then there was the time we rendezvoused in North Channel. Jan was on his honeymoon aboard his new boat *Splinter*, so I show up out of nowhere in a 10' pram I borrowed. We snorkeled in the same waters as we did from the OK Dinghy back before the war.

Splinter was a 25' trimaran, wider than it was long and it utilized water ballast. This was Jan's first attempt at a self-righting multihull. Jan was about the only one in the world to pursue this concept. Other self-righting multihulls of Jan's design include the 35' tri-

Jan's 25' trimaran ***Splinter*** **under reefed main only.** ***Splinter*** **was wider than it was long and it utilized water ballast.**

maran *Ollie* and the production G32 catamaran. In fact, Jan and I sailed the prototype G32 in the Gravely Shoals race just as we did decades before in *Presto*, only this time we didn't throw our food away. Jan's newest boat is another self-righting design. For now, it's called Project X. (I know what the real name is gonna be, but I ain't telling.) I'm hoping I'll get a ride on her when she's launched this spring. Jan says, "Its probably the most complicated structure I've ever built." See the caption below.

Project X—A fast cruising catamaran under sail and power, 40' LOA, 14' BOA, accommodations for three, self righting, water ballast for lateral and longitudinal stability and trim, folds to trailerable width, light weight (under 2,000 lb)—can be pulled behind a mid-sized van. Construction—foam, carbon fiber, epoxy, also some thin plywood, spruce stringers and threaded rod as tension elements.

Lady B **on one of her first sails. You can see that the booms need trimming and the lazy jacks require adjustment as does some of the running rigging.**

Lady B

Lady B is a Howard I. Chapelle-designed sharpie he called *Dandy*, based on Commodore Monroe's Egret. I first saw this design when *Boats* magazine featured a series of articles titled *The American Sharpie Yacht 1958*. I kept those magazine articles and eventually built the boat with WEST SYSTEM® Epoxy. *Dandy* is a modification of Monroe's design, so I thought it fair enough to make few modifications myself. Composite chines work very well to round the corner. I also installed a dagger board instead of a centerboard thereby saving a lot of room below.

Accommodations below consist of two comfortable seats, toilet (with holding tank) and huge bunks, all with sitting headroom. I was going to have a modern rudder configuration with a turntable cassette and dagger-type rudder but that didn't work out. We were concerned about the shallow 'sharpie' rudder as designed, but were amazed at how well that works. I think this is due in part to careful shaping of the foil section and end plating to hull bottom. The rig is self-tending when tacking and this sprit configuration is self-vanging. I am still tweaking the split sprit rig configuration, which I had no previous experience with. It's working fine; fundamentally they're simply two free-standing masts not unlike the OK dinghy.

Lady B is more stable that you'd think and tacks within 90 degrees. The general rule regarding sharpies is to keep the top hamper—everything above the deck—as low as possible, so the higher I got in the structure the more effort I spent in saving weight. The cabin roof is thin plywood with a balsa core and carbon skins. The carbon fiber spars are by Composite Engineering/Ted Vandouzen in Concord, Massachusetts and are incredibly light. They can be raised via removable tabernacles (no outside assistance required) that double as rests when the boat is trailered or stored. The masts bend in puffs, thereby de-powering the rig. Sails, cut to match the bend of the spars, are by David Beirig of Erie, Pennsylvania. David Carnell of Wilmington, North Carolina, gave me the offsets and lines as the magazine article had only construction drawings. The craft nicely fits the definition of a trailerable, easily handled, smart sailing, thin water cruiser. It took about 1,000 hours to build.

I envision *Lady B* and, ahem, Project X sailing side by side next year, but not for long as I predict the latter to whiz by my little sharpie in no time.

Project X fairing technique

By John M. Thomas

Almost 40 years ago Meade and Jan Gougeon opened their doors to a fastener-less method of boat construction using epoxy and various clamping methods. Jan's newest boat is in the home stretch to completion, and he is addressing the fine tweaks of coaming and fairing.

To create a clean presentation to the wind and waves, Jan needed a way to create a fair surface in and around the structural support cross members exiting the main hull. Historically this was accomplished by using polyurethane foam core material for a buildup layer, covering the shaped core with an FRP skin for gross fairing and then finishing with a fairing compound. This method is not only labor and materials intensive, but also adds speed-killing weight. To combat this, Jan concocted the Project X fairing technique.

After the initial surface preparation using 80-grit sanding with a random-orbit sander, the rough shape of the fairing is drawn out onto the surface of the hull. This guideline will follow the curve of the hull and provide a sense of what the faired shape will look like.

An oversized swatch of carbon fabric is cut to this guideline. On Jan's boat, a 12 oz, 2 × 2 carbon twill fabric is used. The twill weave allows the fabric to drape better and accommodate compound curves with minimal effort.

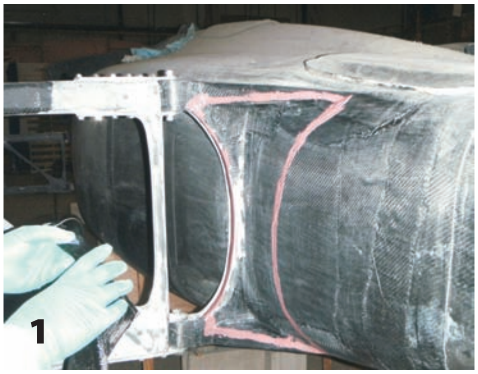
Most importantly in this technique, WEST SYSTEM® 105 Epoxy Resin® and 205 Fast Hardener® are mixed on ratio. Next, in a separate mixing pot, G/5® Five-Minute Adhesive is mixed on ratio and added to the 105/205 mixture at 30% by volume.[1]

After the two epoxy systems are well blended, 407 Low-Density fairing filler is added to increase the viscosity of the mixture to the consistency of ketchup. This faster-setting concoction is then applied with an 804 Glue Brush following the guideline pattern previously established *(Figure 1)*.

The carbon fiber fabric is then carefully tacked into place *(Figure 2)*. The leftover mixture of 105/205, G/5 and 407 is used as an indicator of when the mixture starts to gel. At this time, the carbon fabric is stretched gently in all directions to remove any slack and put the fabric slightly in tension *(Figure 3)*. While the epoxy mixture is tacking up, the excess fabric is trimmed off and then re-tensioned to the final shape. As the epoxy mixture begins its accelerated through cure, a final check of tension is performed and adjusted accordingly. After the epoxy has set up, a glue brush is used to is wet out the carbon skin with 105/205 and it is left to cure. When the fairing skin has cured it is faired into the hull with 410 Microlight® (*Figure 4*).

It may be necessary to drill a small hole to allow differential air pressure to equalize. If the entrapped air heats up it will expand. If the barometric pressure drops below the air pressure in the cavity, the fairing skin will expand. Likewise, during high-pressure conditions the skin may contract. ■

[1]All WEST SYSTEM epoxies may be combined to create hybrid formulas. This practice is not difficult, nor does one need to be a chemist to achieve great results. Just mix the individual systems at their proper ratios, and then combine by stirring well. In this case, the G/5 Five-Minute Adhesive accelerated the cure. This allowed the increasing holding power of the curing epoxy to maintain fabric tension during the stretching phase of this procedure.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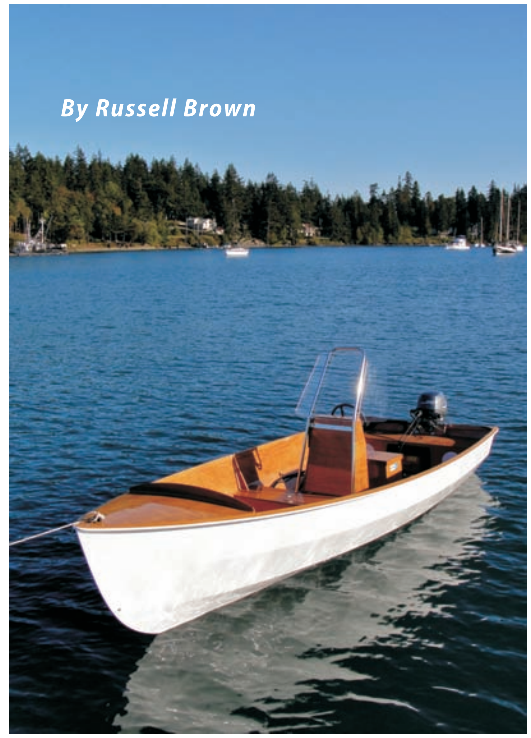
The PT Skiff

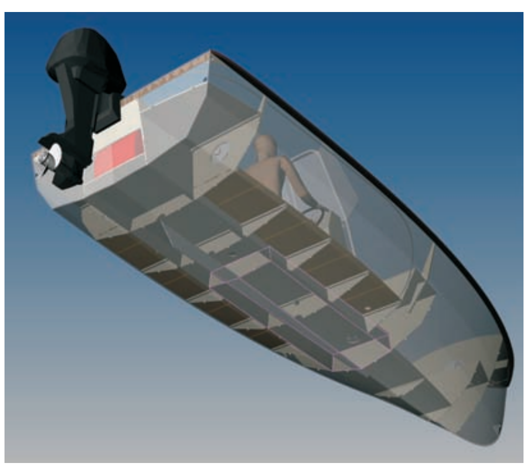


By Russell Brown

The PT skiff is a fuel-efficient center console runabout that is good looking, handles well and can carry a load. It is very quick with only 20 horsepower.

We studied the hull shape of the PT Skiff with the most advanced design tools seeking maximum fuel efficiency and good performance under various speeds, loads and conditions. The prototype proved to go 22 knots lightly loaded and made over 16 knots with four people and gear. The hull is fairly narrow, which allows for its uncommon efficiency and a more comfortable ride in rough weather.

Water ballast provides the option of extra weight to add stability in this light and relatively narrow boat. Ballast is used when at the dock and can also make the boat ride better in wind and chop. The tank is part of the structure of the boat. It fills and drains automatically. The ballast can either be kept in, or kept out by locking the air vent valve located near the steering wheel.



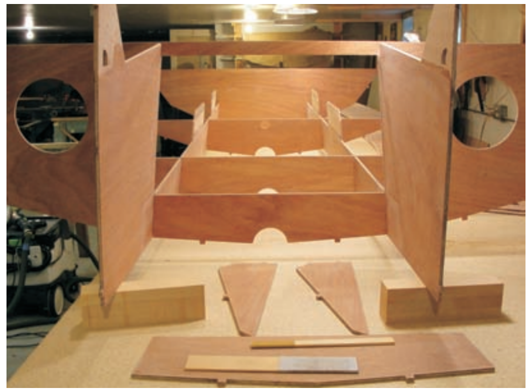
The tank is part of the structure of the boat. It fills and drains automatically. The ballast can either be kept in, or kept out by locking the air vent valve located near the steering wheel.

Other design features make this boat travel comfortably in rough weather. A fine entry to reduce pounding, high freeboard and lots of flare in the topsides helps to keep you dry. The deep forward cockpit is comfortable and feels secure.

To develop the PT Skiff as a kit boat for commercial sale, we modified it and built a second prototype. The original design needed foam flotation in many of the compartments in order to comply with USCG requirements.

Much of the flotation needed is to provide stability in the case of a swamped boat, so it made sense to put some of this buoyancy at the outer edges of the boat. While building the first boat we were already considering side decks as a way to simplify construction, so we chose to redesign the boat with side decks and allowed for 3" of foam to be fitted in the space underneath.

The PT Skiff is built from plywood and epoxy for light weight, longevity, ease of construction and minimal cost and waste. One would have to use materials such as carbon fiber and honeycomb to produce a boat that



The kit is cut from 12 sheets of Lloyds approved BS 1088 Okoume marine plywood. It is a high-quality wood and is the best product for the purpose.

...all 10 frames are located with tongues that fit into slots in the hull, so there is not much measuring.

weighs less, and these materials would only beat wood/epoxy in one of the four factors mentioned above.

Boatbuilding with wood and epoxy is not hard, but it is a science. To build a lightweight boat that is both strong and long lasting, one must understand the materials. This is why the manual that accompanies the kit is as much about the technology as it is about building the boat.

The kit is cut from 12 sheets of Lloyds approved BS 1088 Okoume marine plywood. It is a high-quality wood and is the best product for the purpose. The pieces go together quickly and perfectly. Longer pieces are joined with puzzle joints that align them both vertically and horizontally, and all 10 frames are located with tongues that fit into slots in the hull, so there is not much measuring. The kit also includes gluing cleats (inside corner reinforcement) that are pre-cut to size and length.

Building this boat is within the means of talented amateurs with general hand tool skills, as long as they carefully follow the manual. The resulting boat is very advanced. One was recently built by students at the Northwest School of Boat Building (*see page 24*) and is for sale through the school.

The manual for the PT Skiff is highly detailed, with step-by-step text and photos. Additional portions describe various construction techniques. To produce the manual, we built and tested the completed Mark II boat shown in the photos. We were as careful in composing the manual as we were in designing the boat and assembling the kits. These construction photos and images are of the skiff currently being offered by PT Watercraft, located in Port Townsend, Washington. There are performance videos and a blog with more on the website at **www.ptwatercraft.com**.

Specifications

LOA: 18'4" (5.6m)

Beam: 6' (1.63m)

Draft: 15" (.38m)

Water Ballast: 37.5 gal (142L) 321 lbs

Engine: 20hp 4-stroke

Fuel Capacity: 6 gal portable tank

The PT Skiff is built from plywood and epoxy for light weight, longevity, ease of construction and minimal cost and waste.

Why we like the PT Skiff

The easy-to-build, fuel-efficient PT Skiff.

By Meade A. Gougeon

While *Professional Boatbuilder's* Powerboat Design Challenge was underway, we followed one entry very closely: the PT Skiff from Bieker Boats in Seattle, Washington. The contest sought innovative designs for small (16' 6" to 18' 6"), fuel-efficient powerboats making the best use of modern boat design, materials and construction technology. What intrigued us about the competition is that all entries had to be designed around a maximum 25 horsepower outboard engine and consume no more than two gallons of gas per hour at 15 knots while carrying a 650 lb (four person) load. This represents 8.6 miles per gallon. The contest also required a trailerable weight of less than 2,700 lb and the ability to safely power home into 15-knot breezes and a 2' to 3' chop. Typically, a production runabout at this length will require three to six times as much horsepower and gets fewer miles per gallon.

The PT skiff was one of 73 designs submitted from 16 countries and 19 states.

Jan and I paid special attention when we heard that the high-powered trio of Paul Bieker, Eric Jolley and Russell Brown were putting their heads together on an entry. These gentlemen have produced all kinds of boats, from International 14 dinghies to high-tech America's Cup yachts. Beiker is on the BMW Oracle structural design team. In addition to designing boats, Russell Brown is one of the best builders we know when it comes to maximizing the potential of wood/epoxy construction.

We've always tried to build the lightest weight sailboats possible to promote maximum performance. Recently, Jan and I carried this philosophy into powerboat design when we developed and built our 32' Gougmarans which get 15 mpg at 12 knots (*Epoxyworks 25*). We were also highly impressed with a Ted Brewer designed 37' power cruiser that was built locally by owner Carl Puhl (*Epoxyworks 26*). Over a two-year period, Carl and his wife have cruised *Fifty Plus* over 2,700 miles averaging over 9 miles per gallon.

Of all the 73 entries, the PT Skiff was one of the few to be built and sea tested before judging took place. I was fortunate to see first hand the unique capabilities of this superb design. We were especially impressed with the following.

1. A rather slim hull with fine entry and appropriate flair that provides high fuel efficiency at both slow and high speeds. Most boats at this size range are designed to operate on a full plane and are very inefficient at displacement speeds.

2. A practical and simple water ballast option that is crucial to all around comfort and efficiency for this lightweight craft.

3. A unique structural design that maximizes the potential of wood/epoxy construction. The result is probably one of the lightest and strongest craft in this class.

4. The attempt from the very beginning to make this boat buildable for the talented amateur with a focus on clear instructions and efficient use of time a materials.

Professional Boatbuilder described this entry as "one of the best developed plans that took full advantage of advances in materials and construction technology." Although another boat (the RM 18 by Swedish designer Rolf Eliasson) was chosen the winner of this competition, the dynamic designers of the PT Skiff were undaunted. They proceeded to re-design the skiff with some upgrades to make her an even better boat. ■

Making custom wastebaskets

By Tom Pawlak

I don't know about you, but I have problems finding wastebaskets that fit the spaces I have in mind. The baskets are either way too small or a bit too large for the opening. It happened at a previous house we lived in and it happened again in our current home. My solution was to make my own baskets with 4 to 6mm (3⁄16" to ¼" thick) plywood sealed with and glued together with WEST SYSTEM® Epoxy.

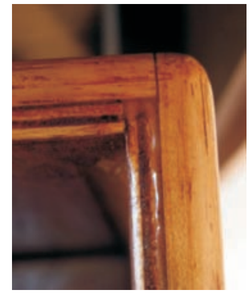
I made my last one several years ago after having new kitchen cabinets and countertops installed in our home. We had ordered a sliding wastebasket/recycle bin feature that was to be installed in one of the base cabinets. When the basket was installed, we were disappointed with how small and impractical it was. Small isn't necessarily bad if that is all the room available in a given area, but in this case there was so much more room inside the cabinet that I decided to make my own basket to utilize the remaining space.

I purchased a 4'×8' sheet of 4mm thick, three-ply plywood with face veneers that matched the hickory used to make the cabinets. Before laying out the pieces and cutting them, I gave the panel a light sanding with my palm sander and applied two coats of 105 Epoxy Resin®/207 Special Clear Hardener™. Once it cured, I cut out the four sides and bottom pieces. The mating edges were sanded with 80-grit before assembling with 105 Resin and 205 Fast Hardener® thickened with 406 Colloidal Silica Filler. Had Six10 Adhesive been available at the time this would have been the perfect project for it because the coaxial tube and static mixer tip allow you to lay a perfect bead of epoxy along the joints without drips or runs. As it was, I thickened the epoxy to a mayonnaise consistency, added sanding dust to color the epoxy to match the wood panels and applied it with a small, stiff brush.

While the epoxy cured, sliding bar clamps held the panels together. Bungee cords or duct tape would have worked as well given that epoxy does not require clamp pressure. I formed the excess glue that squeezed out of the joint inside the basket into a smooth fillet. Spring clamps were used to hold the wood lip that surrounds the top of the basket in place while the epoxy cured. I sealed the outside of the basket with two coats of 105 Resin/207 Special Clear Hardener.

The wastebasket perimeter was designed to fit a standard 30-gallon plastic bag so the bag stretches slightly at the corners when it is draped over the rounded lip of the basket.

The basket has served us well. It is lightweight and durable. The epoxy coated surfaces and smooth fillets look good and make cleanup a breeze. ■



The wooden lip being attached to the basket (left) and a detail of the finished lip (above).

The finished custom wastebasket fits perfectly in the drawer.

A 30-gallon trash bag fits perfectly over the 62.5" perimeter lip at the top of the basket.

The difference between a carbon fiber **bicycle frame repair** and wall art

By Randy Zajac

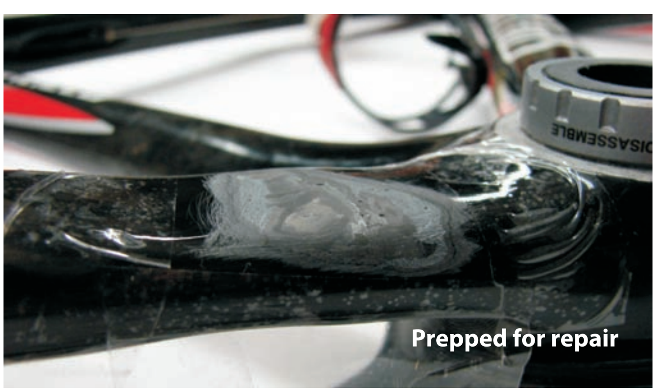
I will start by saying that, in my opinion, most carbon fiber bicycle frames that have sustained damage from an impact should not be repaired—there are too many damaged fibers that are typically unseen. The two repaired frames featured in this article had damage caused by operator error, not impact. The last two frames are prime examples of parts that should not be repaired for safety reasons.

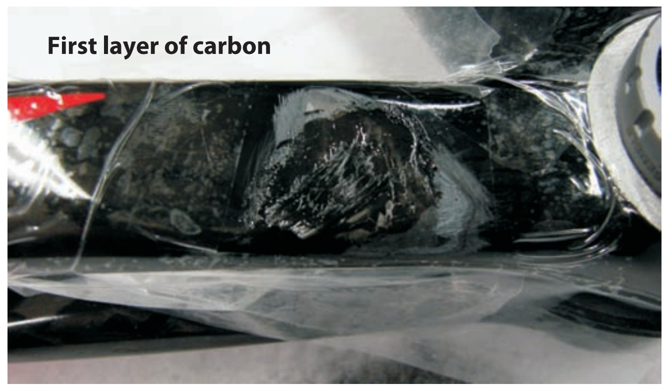
Bike #1 – Carbon Fiber Specialized® Tarmac

A good friend of mine who works at a Specialized bicycle shop in Saginaw, Michigan asked if I could repair a frame with chain stay damage caused by a customer-tuned front derailleur. After seeing the damage in person, I knew the frame was sound and definitely repairable. There was no major impact with hidden damage; it was simply a matter of replacing carbon fiber that had been ground away by a dropped chain.

The first step was to sand down the area by hand, taking note of any fibers and the orientations as I went until I reached good laminate. Luckily, this area had quite a thick layer of filled resin for cosmetic reasons and the damage barely went into the first layer of structural carbon fiber. I started the rebuilding process for the first layer using strands of carbon fiber oriented in the right direction laminated with WEST SYSTEM® 105 epoxy Resin®/205 Fast Hardener®. Although difficult to determine accurately, I estimated a 100:1 scarf ratio based on material removed. After this first layer cured, I sanded the area to take down any high/rough spots.


The damage


Prepped for repair


First layer of carbon

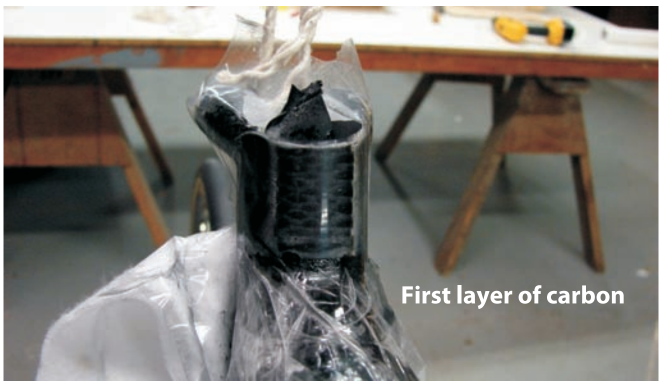

Finished repair

To take the place of the filled resin, I used a layer of 5.7oz/sq yd woven carbon fiber fabric. I used clear packaging tape both to mask the rest of the frame and get the fabric to lie down as smoothly as possible. Once this cured, I sanded it fair, blending it to the rest of the chain stay and polished it as it is a cosmetic, sacrificial layer.

Bike #2 – Carbon Fiber Track Bike

Shortly after I repaired the Specialized frame, I had an opportunity to repair a track bike. The owner had over torqued the seat post bolts, causing the front of the integrated seat post clamp to split. Once again, the damage was not caused by an impact and it was clear how far it went into the frame. To make it easier to work on, I hung the bike from the ceiling as there wasn't a round tube I could clamp into my bike stand.

Prepped for repair



First layer of carbon

Ready for paint

Finished repair

To start, I carefully drilled a crack stopper hole to prevent it from going any further. I then sanded the area and prepared it for bonding. I used 105 Resin/205 Fast Hardener with 703 Unidirectional Carbon Fiber Tape to reinforce the seat clamp in three layers/steps. I let the epoxy cure and sanded it fair between layers to better control the final shape. Once the final layer was on and shaped/faired, I prepped for paint. I covered the repair with two coats of black one-part polyurethane paint.

Bike #3 – Carbon Fiber Trek Fuel 98™

Wall art

This is an example of a frame you would not want to fix, but hang on your wall. I was riding home, a block from my house, and was hit by a minivan whose driver was looking over his left shoulder instead of around the corner where he was going. The frame collapsed under me with fractures at multiple points along each tube. Because this damage goes throughout and was caused by impact, it is highly unlikely that it would be a sound fix.

Bike #4 – Carbon Fiber mountain bike

Wall art

This is a frame that a friend of mine was riding for a few months. The design of the frame and the fact that he is a bigger guy lead to the bottom bracket shell breaking away from the laminate and causing a crack to form. This is one of the gray areas as the frame is repairable but not worth repairing. If it was a good design, lightweight, or a responsive part I would consider it, but this was one of the worst composite frames I have ever ridden. Bottom line: wall art.

Maynard Bray and Doug Hylan provided the plans for this sailboat originally designed by N.G. Herreshoff. Paul Wenner built it of marine plywood over steam bent white oak ribs with mahogany keel, transom and shear strakes. The boat has a LOA of 16' 8" with a beam of 5' 0" and weighs about 400 lb. The entire boat was constructed using WEST SYSTEM® 105 Epoxy Resin® with 205 Hardener® and 403 Microfibers. Paul tells us that the epoxy was very easy to work with and he appreciated the low odor because the construction was all done in the basement of his house. “It was a lot of work (about 1000 hours) and cost more than a good used boat of its size, but it was worth it, especially when I get compliments on the lake.” Paul lives in Cincinnati, Ohio. “Not exactly the sailing capital of the world,” he says, “but I find a few small lakes to sail.”

Bill Ling shows off the shrimping net he built of carbon and WEST SYSTEM Epoxy. It’s attached to a 10' handle for reaching the water from a pier as the tide flows by. The thin, ovalized cross section helps him hold the net against the tide. He says he recently caught a 7" shrimp with it near his home in New Smyrna Beach, Florida.

Readers’ projects

Captain Jeff Robinson of Rock Hall, Maryland, recently completed a replica of a 1890 Hooper Island (Chesapeake Bay, Maryland) crab/fishing skiff. Measurements were taken from original skiffs and sharpies. He first built a scale model to develop offsets and check measurements. The skiff is constructed of ½" marine plywood over oak and yellow pine frames using WEST SYSTEM Epoxy. Modifications were made to accommodate a small outboard. It is 20' 2", long with a 6' 1" beam and a 14" draft.

Greg Habas, of Georgetown, Texas, made this coffee table of black walnut and live oak. The central base is a section of a trunk, which developed a large crack as it dried. Rather than try to mask it, he decided to make it even more prominent with color. Greg phoned our tech department for advice, and was told that both Tempera paint powder or RIT™ fabric dye would work. He bought some RIT dye and says it worked perfectly! “It doesn't show in the photo, but some of the flakes of dye did not dissolve completely, leaving tiny flecks of darker blue. This gives the epoxy a rock-like appearance that looks very interesting.” Greg says, “My next project will be an 18' Catboat that will planked using the composite method with WEST SYSTEM products, of course!”

Joe Finn of Storm Port Boatworks, Homosassa, Florida, has launched the Oyster Cracker, a shallow draft, diesel powered flats boat. Joe says, "Lots of WEST SYSTEM® Epoxy went into this build. The rocks up here take their toll on props and boat bottoms." This design is based on W. Atkins Rescue Minor. She will run in 8" of water and gets 270 miles to a 9 gal tank of fuel. The boat was built right side up in a jig and is polished off with a yacht finish and mahogany trim. Storm Port Boatworks, 352-628-2983.

Making denim/epoxy knife handles

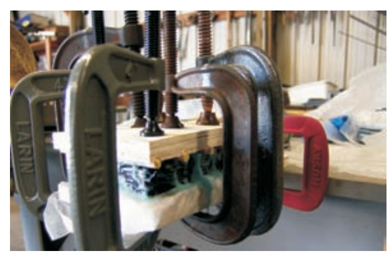
Photos: Mike Carter

Knife makers Cliff Fendley and Mike Carter decided to try their hand at making laminated denim handle material. After some research, they chose to use WEST SYSTEM® 105 Epoxy Resin® with 206 Slow Hardener® to laminate pieces of denim fabric into blocks from which they could machine knife handles. Mike first made a 5"×7" piece about ½" thick with alternating front and back layers of blue jean denim. Cliff made a 1" thick 5"×5" piece from faded blue jean and a 1" thick 1"×7" piece from alternating layers of tan and black denim which he twisted before pressing.

Mike mixed and poured epoxy into a baking pan while Cliff saturated the pieces and transferred them to the press block. Mike would then squeegee each layer as it was put on the block. Cliff would soak up the excess run-off epoxy with the next piece of material to be used and put it into the pan. This assembly line approach worked very well and they were able to quickly and efficiently saturate and stack the layers with very little waste.

After the material was saturated and stacked, they wrapped it in wax paper and clamped it between pieces of plywood . They measured the height of each corner as they tightened the clamps to assure uniform thickness across the piece.

After examining and machining the cured laminate they we very happy with the outcome. Cliff says on his website, "the laminate we made with the WEST SYSTEM Epoxy looks great and appears to be extremely tough. It cured crystal clear and we were impressed with how tough it was when we beat the heck out of a scrap piece with a hammer. It cuts, sands, and polishes very well." To see their finish products and more on how they were made, visit **www.fendleyknives.com**.



After the denim strips are saturated with epoxy (top), they are wrapped and clamped (middle). The block of cured denim/epoxy laminate (bottom) can then be cut and machined into knife handles (left).

From *Serendipity* to *Bufflehead*

By Hugh Horton

▲Meade Gougeon sailing *Serendipity,* from the cover of *Epoxyworks* 16, fall 2000.

▶*Bufflehead* with her gunter rig on an oyster bar off the Shell Mound, Cedar Key, Florida in 2008.

The cover of *Epoxyworks* 16 shows *Serendipity*, the sailing canoe I built for Meade Gougeon on a Bell "Starfire" hull after he had seen me sailing my Starfire-based *Puffin* in the summer of 1998. The Starfire hull was designed by Dave Yost.

Sitting at the lunch table in the Gougeon's boat shop in 2001, Meade said he was thinking of building a few Serendipity sisters and asked me if I'd like one too. I said no because I wanted to build the plywood hull I'd been sketching. But after glancing around the table at Jan and the others, I changed my mind.

We bought six carbon and Kevlar Starfire bare hulls. I built a plug for the Serendipity sisters' decks and we made a mold. All hands helped with vacuum bagging the decks. I molded the Kevlar™ coamings and built the seats. Meade organized and built the rigs.

Meade, Jan, Rob Monroe, my wife Kayann and I sail and paddle the Serendipity sisters mostly in the Great Lakes and along the west coast of Florida. Howard Rice sails *Sylph* at home in Micronesia. One Serendipity sister remains unfinished.

Bufflehead's development was helped immeasurably by refinements to the Serendipity sisters and Kayann has her *Walela*.

Bufflehead

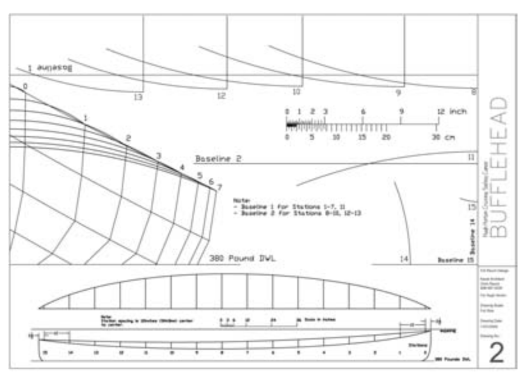
Bufflehead is 15' 6" by 33" and the Serendipities are 15' by 34". Bufflehead's displacement is 380 pounds while the Serendipity boats displace about 300. But these numbers do not show how much more full-ended Bufflehead is below the waterline, nor her great reserve buoyancy. Both qualities help fast sailing more than they hinder slow paddling and light air sailing. I've increased the sail area to 54 square feet from the sisters' 41 square feet or *Walela's* 44 square feet.

The Plans

Bufflehead's plan has no construction drawings. Rather than trying to offer a foolproof system for building, I caution that Buffleheads are for experienced builders and sailors who can choose their preferred construction method for building a lightweight boat.

Plywood and wood composite structures can be durable and light and are fully within the construction capacity of many garage boat builders. As a starting point in Bufflehead's plans, photos show how I and others have built our Buffleheads. A bibliography of building techniques is in the plan, too. Experienced builders know, though, it's still a sailboat and the hull and deck are just the beginning.

The Bufflehead plan has everything the experienced builder needs: full-sized stem profiles and body plan (*below*) for either ply or strip



construction, and patterns for the chined deck strakes. The deck sections for a strip built deck or for the jig for the chined deck come as a PDF. Critical dimensions are on hard copy sketches or JPG image files. Details are available from photos of the object being built, in use, or on a one-inch grid.

Small parts can be built on the kitchen table. I mold or glue components where the epoxy and I are most comfortable. Mast fittings, the rudder case, the leeboard tube and the seat parts can be built in your dining room. The sanding portion of any of this, much of which can be done by hand, I do outside in a breeze in good light.

Flotation

Flotation is important. You must have enough flotation, and it must be placed properly. Just not sinking isn't good enough; you must be able to rescue yourself, to right your boat and sail or paddle away.

I prefer a wide open hull with no obstructions, in which I've secured plenty of effectively placed flotation. Flotation held by nylon mesh can be proprietary kayak or canoe bags, dry gear bags, plastic bottles, box wine bladders, closed cell foam blocks, etc.

Nearly any flotation can keep your boat afloat in crisis. But it must be secured and placed widely enough to prevent the boat from rolling, not just high and not just low.

Others prefer full bulkheads and sealed chambers. Howard Rice wants his Bufflehead to be self-bailing, too, so he can proceed after capsize, using Elvstrom-style bailers to suck water out of the boat as he sails away.

Rigging

Will you be satisfied with a prototype rig? Is a piece of 6061 aluminum pipe okay for your mast instead of a carbon one? Or are you convinced you want to try a gunter and its advantages, in spite of reefing eccentricities waiting to be resolved? Or do you not care a whit about fine windward performance and prefer a traditional, low-tech rig?

I delivered Meade's *Serendipity* with a light, free standing, rotating gunter with a sprit boom, one reef and no battens. As Meade wrote in *Epoxyworks* 16, "Hugh challenged me to come up with a better rig, which I attempted nearly immediately."

Meade has evolved a series of fully battened sails, using full or half wishbones. Besides being the "patron saint" of cruising sailing canoes, Meade has led the way in rig development. His first mast was aluminum, the rest have been carbon spars. Each of us has experimented, too.

1,2,&3—Boat builder Skip Izon, of Grand Bend, Ontario, takes a Bufflehead hull from the cutout strakes and mold, to wetting out Kevlar on the interior of one Bufflehead and wetting out carbon fiber on the exterior of a second. This one will become Hugh's *Bufflehead*.

4—A deck being glued to a hull in Hugh Horton's shop. This bufflehead will be Jim Renouf's *Eden*.

The unique "batwing" gunter rig on Hugh Horton's *Bufflehead*.

Gunters had been my favorite for their unique advantage of the mast reefing with the sail. The gunter has neither extra windage nor mass swinging about above the reefed sail. The spars can be built more as a woodworking project than a molding project. For better upper sail shape, Stu Hopkins of Dabbler Sails helped me with a "batwing" gunter. A long batten springs from the heel of the yard, so the yard and batten lower and fold down as easily and reliably as any rig, and one can have a full, shapely roach. My first batwing gunter had a half wishbone boom, derived from Meade's design. The latest has a sprit boom.

The rig I recommend now is a Meade's style rig, a fathead, full length battened sail using external hoops and clips, set to shape by a sprit boom or full or half wishbone boom. It's shown with Stu's sail and Ron Sell's mast on Jim Renouf's Bufflehead *Eden* and in some photos on my *Bufflehead*.

The seat

Aye, mate, there's the rub. The seat must work for two disparate activities, paddling and sailing. I scoot the seat side-to-side a foot, and twice that fore and aft. For sailing I usually want to be low and slouchy, but high or low with kinetic and isometric action is much of it, too.

When paddling actively I want the seat firmly in place, but not more fixed than needed. The friction of the seat's bare teak corners with the scuffed Kevlar bottom is usually enough, along with my mass and feet holding or pushing. For either single-blade paddling or double, I want to sit inches higher than when sailing. For double-blade paddling I usually want to be centered. The harder I'm paddling, the more I want to be sitting upright.

My seat design is effective but time consuming to make. Some Bufflehead sailors use Legacy Paddlesports fishing kayak seats.

Paddles

I use both double-blade and a single-blade paddles. I tend to think of the double for going and the single for sightseeing or for a stroke here or there. Often I carry five paddles: two double-blades and three singles, one of which is a specialized deck paddle. I love mine, a straight shaft beaver tail which Ron Sell built to my sketch. It's only four feet overall because I sit low for sailing. The thin blade extends well up the shaft for low-seat Omering, a version of Northwoods or Canadian paddling in which the blade

▶Hugh Horton's custom, fully adjustable seat.

▼A sailor's eye view of one sailing canoe from another.

Hugh's Bufflehead, *Bufflehead* pulled up on the beach on Snake Key, Florida, with her single-reefed gunter rig in 2008.

stays underwater on the return stroke. It's silent and my hands are dry enough to change camera batteries. It stows smoothly on deck.

Our double-blades are longer than those used with white water kayaks or with narrow sea kayaks because our beam is wider with more freeboard, and we're usually paddling at lower angles. The leeboard is an NACA foil section from, say, 0007 to 0012. It pivots up and down from a horizontal tube on the port side, perpendicular to the boat's centerline. Its mount does not cross the cockpit. Its friction system by Jan Gougeon is by far the best I've seen. He has an evolution of it in mind using a tapered axle in a cone, rather than a cylindrical axle in a tube. Either way, friction is easily set as it's wanted for fingertip control, and it stays put.

The rudder blade is an eight-inch 6061 aluminum plate. The case is ply and carbon. Dual steering control sticks are lashed to a wood composite yoke.

If Buffleheads were not agile and easily turned due to their rocker, I'd think about a foiled rudder. But the low drag flat plate is effective, durable, and fool proof.

At the 25th annual Cedar Key small boat meet in May 2009, I watched Meade beach his *Yello Thing* among three Buffleheads. At the time, *Yello Thing* was borrowing his *Serendipity's* sail and rudder.

Those four boats were derived from *Puffin* through Meade's *Serendipity* and were much better because of the lunch table conversation nine years before. Now Meade is adapting *Serendipity's* seat back to support his head and shoulders for dozing. It's an idea I've wanted to develop too, and another one on which he's a step ahead. ■

For more information on Buffleheads contact Hugh at hortonsailcanoe@wowway.com or call Gougeon Brothers at 866-937-8797.

While there are a number of Buffleheads, there is one called *Bufflehead*. The one and only Hugh Horton at the helm of *Bufflehead* on Lower Saranac Lake, New York.

Photo: Bill Lind

Make your own soft pad eyes

By Tom Pawlak

If you look closely at some of the photos in the previous article, you will notice small pad eyes in strategic locations inside and outside of Hugh Horton's Bufflehead. Hugh makes these lightweight carbon or Twaron™ reinforced nylon line pad eyes for his sailing canoes.

He glues them onto the decks or inside his sailing canoes—wherever they're needed to hold supplies in place or hold flotation inside the hull. The pad eyes are easy to make and are amazingly strong.

Close up of a soft pad eye mounted to the deck of a Bufflehead. The pad eyes Hugh Horton used on the Bufflehead deck were made with Twaron™, an araimid fiber. The soft pad eyes are strong yet not as likey as a rigid pad eye to catch a knuckle or a knee cap.

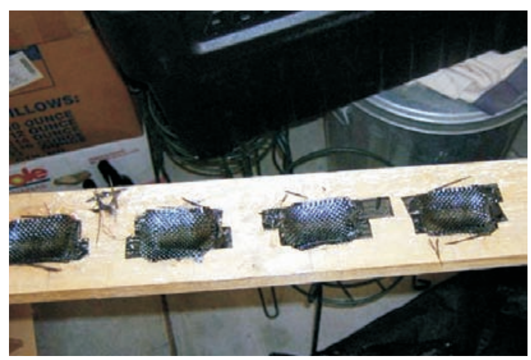
Hugh starts with simple cup-shaped molds about 3⁄16" deep by 1¼" wide by 2" long. (He employs several molds to make the process more efficient.) In the version shown in the photos, (*right*), he applies one layer of 5.8 oz carbon fiber fabric, wet out with 105 Epoxy Resin®/207 Special Clear Hardener™ into the molds and allows them to cure.

Next, Hugh releases the molded carbon fiber cups and drills two ⅛" diameter holes about an inch apart, centered and parallel to the 2" length. He cuts 3½" lengths of ⅛" nylon line and applies a couple wraps of narrow electricians tape about ½" in from each end. He feeds the lines through the drilled holes from the molded side of the cup until the tape touches the cup. He then frays the line ends in preparation for gluing. This results in something similar in appearance to a couple of cotton balls (*see photo right*.)

After wetting out the frayed nylon fibers with 105/205, he glues the line ends and fills the cups with the same epoxy thickened with 403 Microfibers. Before cure, he places them onto heavy, clear plastic film. While applying the glue, he tries to keep the frayed ends splayed out uniformly in all directions. When the cups have cured, Hugh removes them from the plastic and sands the bottom in preparation for gluing them onto his boats.

He recently experimented with making the pad eyes using our pre-thickened specialty epoxies: Six10® Thickened Epoxy Adhesive and G/flex® 655 Adhesive. The results have been excellent.

When we heard of Hugh's experiments, we offered to test the holding power of the soft pad eyes using an extraction device that incorporates a digital load cell. (See photo.)



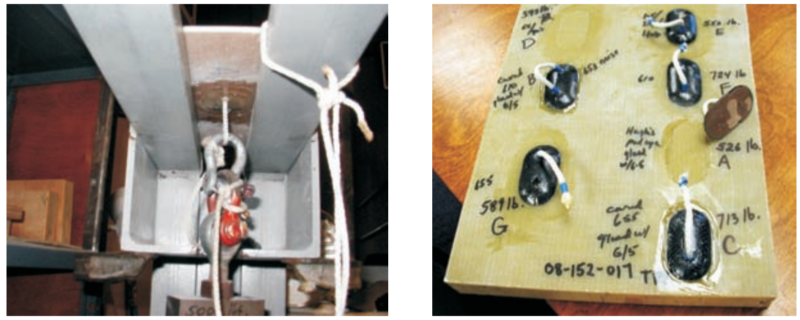
Right top—Cup shaped molds lined with plastic tape as a mold release.

Middle—The mold with wet-out carbon fiber. When cured the cups are removed from the mold and trimmed to shape.

Bottom—⅛" nylon line is passed though holes drilled in the cup and the ends are frayed and wet out.

For comparison purposes we tested some injection-molded plastic pad eyes that were glued down with G/flex 655 Adhesive and Six10 Adhesive. We even glued some of the soft pad eyes down with our G/5® Five-Minute Adhesive.

In the end, all the pull-off strengths fell between an impressive 526 pounds and 724 pounds. The soft pad eyes Hugh makes weigh 5.3 grams each while the molded plastic pad eyes, purchased through a marine supply catalog, weighed 21.25 grams each. ■



The extraction devise with a digital load cell (left) that recorded the pull off strength of soft pad eyes glued to a fiberglass laminate (right).

Treading lightly with *Zogo*

Photo: Billy Black

Stephens, Waring & White Yacht Design of Brooklin, Maine, designed *Zogo* to meet their clients' concern for treading lightly on their environment. Her owners are longtime summer residents of Stonington, Maine who enjoy low-impact kayaking and rowing around the pristine islands of Merchants Row. They wanted a quiet powerboat with a low carbon footprint to reflect their respect for the waters around Stonington.

The 29' hybrid launch has graceful, classic proportions and modern aesthetic appeal. The boat was designed around a 75hp integrated diesel/electric propulsion engine from European manufacture Steyr-Motors. *Zogo's* narrow beam and light displacement allow for this relatively small engine to push her to a maximum speed of about 14 knots. She burns only 1.5 gallons of fuel per hour at a cruising speed of 10.5 knots.

Under electric power, *Zogo* draws a 48 volt DC current from eight batteries which will take her to a maximum 7 knots in virtual silence. The cockpit is sheltered by a lightweight carbon fiber canopy which also provides a mounting platform for a sizeable array of solar panels to help recharge the battery bank.

Both WEST SYSTEM® and PRO-SET® epoxy were used by the fine craftsmen at French & Webb of Belfast, Maine, in the boat's construction. Her cedar strip plank hull was vacuum bagged and sheathed with unidirectional carbon fiber. She will be proudly exhibited at the Maine Boat Builders' Show in March, 2010.

Zogo may be only the tip of the iceberg in high-efficiency, low-impact power boating. The technology can be applied to both pleasure boating and commercial watercraft. Stephens, Waring & White plan to continue leading the way in the development and promotion of greener watercraft.—*Grace Ombry*

Using Google® SketchUp™ to design a new cooler

By Jeff Wright

My personal boat is a 1986 Formula 242 LS. With a soft riding deep V hull, good performance and a small but well appointed cuddy cabin, it is a great boat for me, my wife and our dog to use for a whole weekend. One shortcoming, besides not having standing headroom in the cabin, is the built-in cooler located in the cuddy cabin. The cooler had a side door and was styled to look like a refrigerator. This may have looked "cool" in the mid 1980s but was impractical. We couldn't put ice in the cooler without having the water leak out through the door. For any trip longer than one night I had to use a standard cooler strapped to the swim platform. This was inconvenient and limited the use of the platform at the beach.

The captain and 1st mate contemplate ways to free up the swim platform and keep the 1st mate's soft drinks cold.

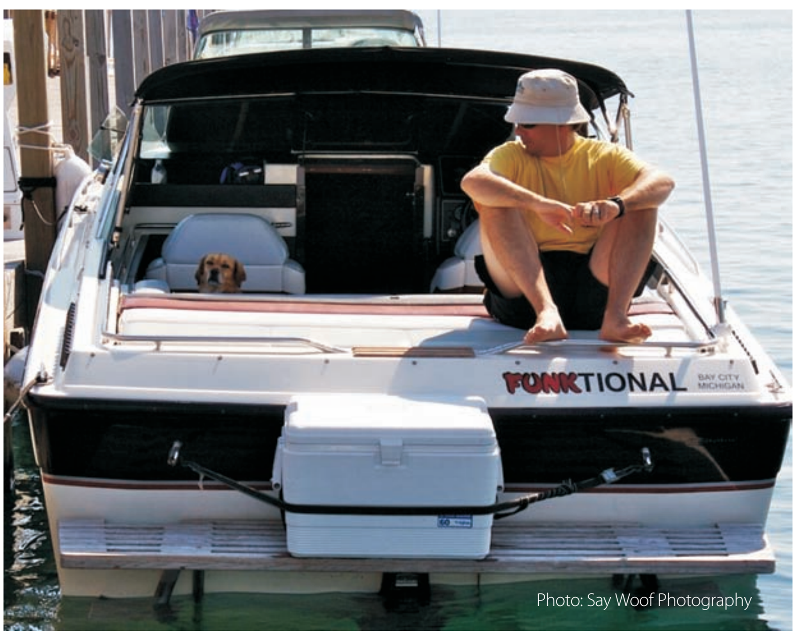


Photo: Say Woof Photography

As I investigated the possibility of building a new cooler, I discovered unused space behind the original cooler that I could take advantage of by optimizing my design. Since I was doing this project during the cold Michigan winter, the thought of spending hours measuring and fitting a cooler into the compartment, and making a mess in my cuddy cabin, was not appealing. Thinking back to my work as an engineer at a boatbuilder, I remembered how nice it was to have CAD (Computer Aided Design) software to model, or draw, in three dimensions on a computer screen. Just a decade ago this software was generally expensive and required a fairly high-performance computer. Recently, I discovered that Google™ offers a free modeling program called SketchUp. Although SketchUp has some limitations, it was more than powerful enough for my cooler project and ran well on my 8-year-old home PC. And did I mention it's free?

Special computer skills are not required to use this computer program. Google offers easy to follow tutorials. Just give yourself a few hours to learn the commands and you'll be able to create just about anything on the screen.

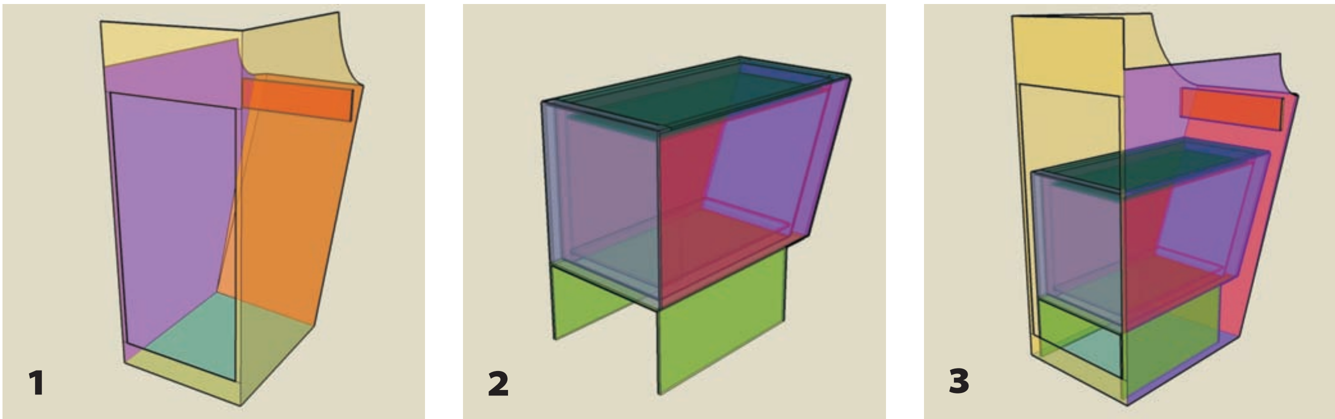
Creating the Model

The first step in the project was to remove the existing cooler and measure the inside dimensions of the compartment. With this information, I created a three dimensional computer model of the compartment that I could use to "build" my cooler on the computer screen. To further optimize the space I removed a few unnecessary wooden parts that held the original cooler.

The Design

Sitting in my warm house, I considered what cooler dimensions would allow room to access the through-hull drain, enable the cooler to be easily removed, and how well certain food and beverage containers will fit inside. You may get an odd look from your spouse when measuring a half gallon of milk from the refrigerator. The method of construction I decided on was ¼" plywood on each side of 1" insulating foam. This combination was a good compromise, maximizing insulation and interior volume.

The outside and inside pieces of plywood on each panel are different sizes. The computer was a great help in deciding how to have all of the pieces join. Another powerful feature of CAD is the ability to measure the clearance between the cooler, hull side and bulkheads.



CAD models of the proposed cooler. 1—The existing compartment. 2—The new cooler design. 3—The new cooler in position in the compartment.

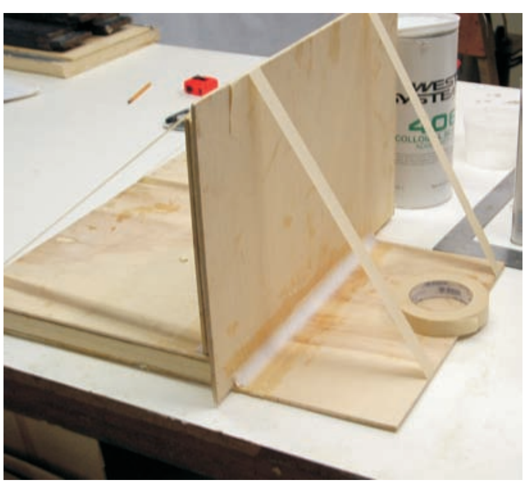
From the screen to the shop

I used the Layer tool in SketchUp when I created the computer model. This allowed me to print out a drawing of each wood piece individually with dimensions. I chose ¼" birch veneered plywood from my local big box lumber yard. After multiple coats of WEST SYSTEM® Epoxy the plywood would be durable enough for this application. I cut all of my wood parts, then used them to make patterns for my foam pieces. I chose standard Dow® insulation foam, and peeled off its blue plastic film vapor barrier to ensure good adhesion to the aluminum face below. I sanded the side that had a bright aluminum finish lightly with 180-grit sandpaper so I would not actually sand through to the foam.

Preparing the foam insulation by removing the film vapor barrier.

I bonded each panel together by first coating the plywood and foam with a layer of 105 Epoxy Resin® and 206 Slow Hardener® to ensure the surfaces were saturated with epoxy. While the initial coat of epoxy was still uncured, I used a notched trowel to apply a layer of 105 Resin and 206 Slow Hardener thickened with 406 Colloidal Silica. I then placed both sheets of plywood onto the foam and used simple weights to clamp the pieces together. The plywood had warped while sitting in the shop so the weight was required to create a flat panel. If the panel had an exposed edge, I removed the foam from between the plywood to a depth of about ½" and then filled with 105 Resin/206 Hardener and 410 Microlight®.

Bonding plywood to the prepared foam to make panels.

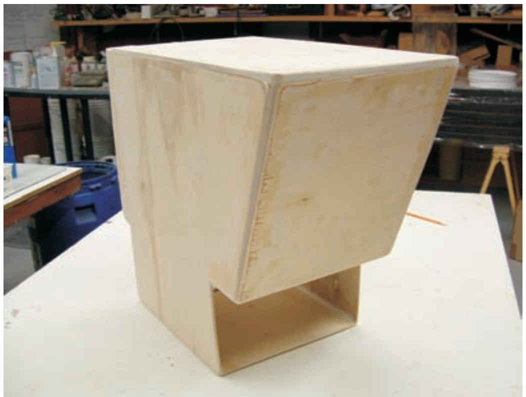


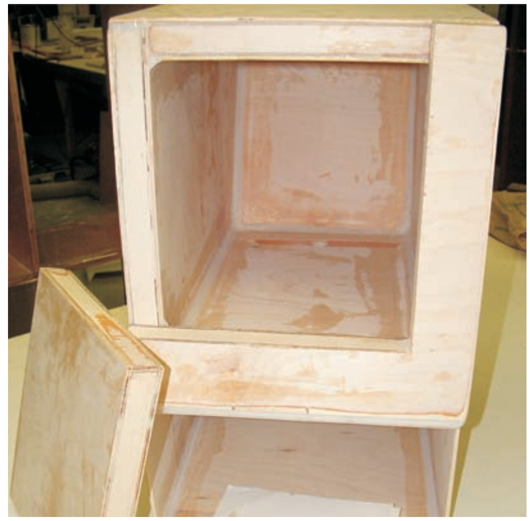
Far left—Using fillets to glue panels together. Masking tape provides enough pressure to "clamp" the panels in place.

Epoxy/410 Microlight is used to fill and finish the edges.

Back view of the cooler. All of the cooler parts are bonded together.

Far right—Front view of the cooler. The door is ready to be mounted once everything is painted.





Assembling

After the panels were all glued together it was time to create the box which would become the cooler. Since I don't have cabinetmaker woodworking skills, using fillets of thickened epoxy to bond the panels made up nicely for joints that didn't fit as perfectly as I had hoped. This was also good time to work on the door. I made a very simple cut out of the front panel and then used flat hinges for attachment. Unsure if I would need a gasket, I placed small pieces of plywood inside the opening to create a landing for the door to seat against in case I wanted to add gasket material later. To prevent liquids from spilling out, the opening doesn't go all the way to the bottom.

When all the panels were bonded together, I coated the inside with several heavy coats of 105/206 and 501 White Pigment. Since the inside will be very wet and containers will bang around inside, a coat of pigmented epoxy was ideal. I then coated the entire exterior. I waited until it was assembled because I knew I would have to sand the outside to improve the appearance at the joints as well as imperfections in the plywood. After the epoxy cured, I painted the exterior with a white oil-based paint, then installed the hardware.

The painted cooler is bolted in place, ready for the 1st mate's drinks. The interior is coated with epoxy tinted with 501 White Pigment, giving it a tough, easy-to-clean surface.

Fastener Bonding

To hold the cooler down in the cabin I bonded ¼" nuts in the floor. I accomplished this by drilling oversized holes and then threading the nuts on to waxed ¼" bolts. After the epoxy cured, I had a stainless steel nut glued into the floor that I could easily bolt the cooler to repeatedly.

Installation

Once I had the cooler painted and the fasteners in the floor, I placed the cooler and installed the bolts. Although I had accounted for the dimensions of this compartment accurately and the cooler fit great, I did not model the wet bar on the opposite side of the cabin which made it difficult to turn the cooler 90 degrees after carrying it through the companionway. By tilting the cooler upward I could put in place easily. I was very relieved that my oversight did not force me to redesign the cooler.

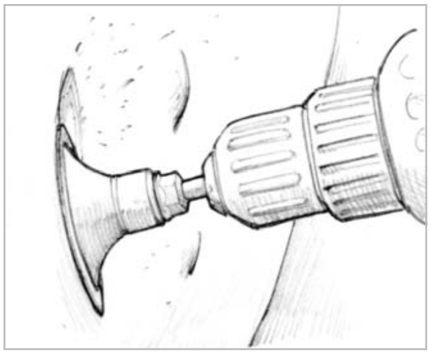
New Cooler, Old Boat

The new cooler now lets the ice water drain overboard and provides a whole new storage area above the cooler. In rough water, the bolts hold it in place without any problems. This was a great project that made a small improvement in an older boat which is just the type of thing that keeps "two foot-itis" (the desire to buy a boat two feet longer) away for another boating season. ■

Fast blister repair with Six10®

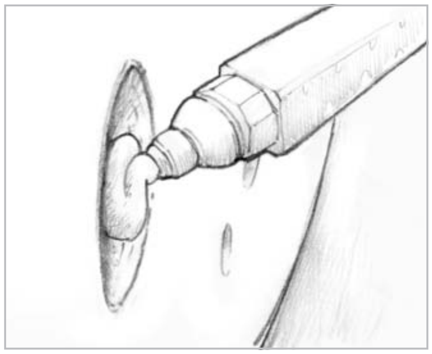
By Tom Pawlak

This repair method is tailored to fixing individual gelcoat blisters prior to bottom painting. The advantage of this method is it can repair blisters on hulls recently pulled from the water or hulls that have been out for some time.

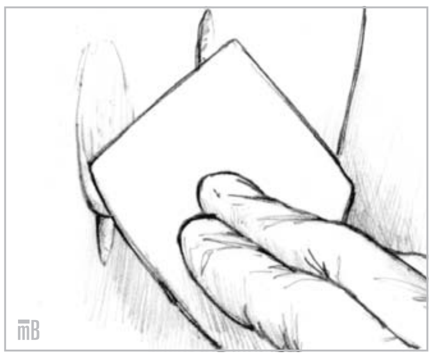


1. Open blisters with a small abrasive tool like 3M's Rolock™ 2" diameter sanding disk with 60-grit sandpaper. Make sure you have removed the entire blister, including the edges of the blister dome.

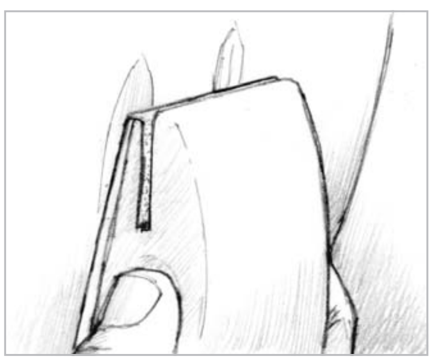
2. Wipe the cavity clean with an alcohol prep pad or paper towels that have been soaked in rubbing (isopropyl) alcohol. Be generous with the alcohol and change towels frequently so the contaminants are removed rather than spread. Repeat the alcohol wipe process and allow the laminate to dry to the touch. It is particularly important to repeat the alcohol-wipe on blisters that were fluid filled at the time they were ground away.



3. Fill the cavities with Six10 Thickened Epoxy Adhesive dispensed through the static mixing wand.



4. Spread the Six10 Adhesive flush with the surrounding hull with a wide putty knife or plastic spreader. Avoid overfilling the cavities because Six10 is difficult to sand.



5. Wet sand with 80–120-grit wet/dry sandpaper or wash with water (no soap, no ammonia) and sand dull with 100-grit sandpaper. If you are using Six10 in warm conditions, you should be able to wet sand and bottom paint later the same day. If working in cooler temperatures, allow the epoxy to cure overnight before sanding.

6. Apply your bottom paint of choice.

Why this method works

Six10 Adhesive is epoxy thickened with fumed silica, which allows the epoxy to remain an excellent moisture barrier. When the static mixer is used to dispense it the blister cavity is filled with air free epoxy. This is important because small bubbles in coatings and putties degrade moisture barrier potential by creating short cuts for moisture to permeate the hull. In the end, Six10 produces a moisture barrier that is better than the original gelcoat.

In our Gelcoat Blister manual, we recommend filling and fairing extensively blistered hulls with WEST SYSTEM® Epoxy thickened with one of our low-density fillers (407 Low Density or 410 Microlight®). The hollow microscopic spheres used to make low-density fillers easy to sand, make them poor moisture barriers. So, the blister manual requires that an effective epoxy barrier coat be applied over the filled and faired surface.

Six10 Adhesive is an excellent option for filling ground out blister cavities—especially if you don't plan to barrier coat to your hull.

More good reasons for using Six10.

Six10 is simple to use. No stirring is required when the epoxy is dispensed through the static mixer.

The Six10 cartridge fits any standard caulking gun and always dispenses epoxy at the perfect mix ratio.

Six10 makes filling blisters easy and efficient. This is comforting to know whether doing the job yourself or paying someone else to do it. ■

Northwest School of Wooden Boat Building

Student builders

Students of the Northwest School of Wooden Boat Building in Port Townsend, Washington, recently built the Caledonia Yawl, an Ian Oughtred design. The boat was commissioned by the Four Winds Camp on Orcas Island in Puget Sound and is the second one the school has built for them. Instructor Bruce Batchely believes this is the best built boat to come out of the shop so far.

They modified the boat to suit the camp's need for buoyancy and storage, and made the spars hollow to keep the rig light.

Master shipwright Bob Prothero worked for fifty years in the wooden boatbuilding industry before founding the Northwest School of Wooden Boat Building. Prothero established the school in 1981 to teach and preserve the skills and crafts associated with traditional wooden boatbuilding techniques unique to Puget Sound. Over a thousand students have graduated from the school's vocational programs, and thousands more have studied traditional maritime arts at the school's summer and community workshops. Classes are filled to capacity with students from around the world.

Proceeds from the sale of boats like the Caledonia Yawl help to maintain the Northwest School of Boat Building's diverse programming and devotion to craftsmanship. For more information, visit www.nwboatschool.org.

Caledonia Yawl Specifications

Construction	Glued lapstrake plywood
LOA	19' 6"
Beam	6' 2"
Draft/centerboard up	11"
Draft/centerboard down	3' 6"
Displacement	340 lb
Balanced lug sail area	164 sq ft

◂ Students of the Northwest School of Wooden Boat Building and the recently built Caledonia Yawl.

▾ The "Excelsior" was originally designed by William Atkin as an inexpensive, flat-bottomed cruising canoe. Visit www.atkinboatplans.com.

This Atkin sailing canoe design was a real eye catcher for the owner. He commissioned the school to update the boat's construction by strip planking with ⅜" × 2" red cedar, sheathed in 6 oz cloth. The decks were done with 6 mm marine ply, also sheathed in 6 oz cloth and WEST SYSTEM® Epoxy. Both marconi sails were made at the sail loft at the school, Northwest Sails. The standing rigging is S.S. wire by P.T. Rigging. The boat was found to be moderately light and stiff and the owner, who sails the lakes of Colorado and Arizona, was very pleased with it.

Atkins Sailing Canoe Specifications

LOA	21'
LWL	20' 11"
Beam	5' 6"
Draft	8" board up

For information about WEST SYSTEM® products or technical information for a building or repair project, Gougeon Brothers offers a range of detailed publications that can help you get started. These publications are available at your local WEST SYSTEM dealer or by contacting Gougeon Brothers.

Information/contact

Free literature (US and Canada only)

Visit www.westsystem.info to order online or call 866-937-8797 for the WEST SYSTEM free literature pack. It includes:

002-950 ***WEST SYSTEM User Manual & Product Guide***—The primary guide to safety, handling and the basic techniques of epoxy use. Includes a complete description of all WEST SYSTEM products.

000-425 ***Other Uses–Suggestions for Household Repair***—Repairs and restoration in an architectural environment. Many useful tips for solving problems around your house and shop with epoxy.

Also included are the current price list, stocking dealer directory, and the *Fiberglass Boat Repair* brochure.

How-to publications

For sale at WEST SYSTEM dealers, from the WEST SYSTEM Info Store at www.westsystem.info, or by calling our order department, 866-937-8797.

002 ***The Gougeon Brothers on Boat Construction***—A must for anyone building a wooden boat or working with wood and WEST SYSTEM epoxy. Fully illustrated composite construction techniques, materials, lofting, safety and tools. 5th Edition, revised in 2005.*

002-970 ***Wooden Boat Restoration & Repair***—Illustrated guide to restore the structure, improve the appearance, reduce the maintenance and prolong the life of wooden boats with WEST SYSTEM epoxy. Includes dry rot repair, structural framework repair, hull and deck planking repair, and hardware installation with epoxy.*

002-550 ***Fiberglass Boat Repair & Maintenance***—Illustrated guide to repair fiberglass boats with WEST SYSTEM epoxy. Procedures for structural reinforcement, deck and hull repair, hardware installation, keel repair and teak deck installation.*

002-650 ***Gelcoat Blisters-Diagnosis, Repair & Prevention***—A guide for repairing and preventing gelcoat blisters in fiberglass boats with WEST SYSTEM epoxy.*

002-150 ***Vacuum Bagging Techniques***—Step-by-step guide to vacuum bag laminating, a technique for clamping wood, core materials and synthetic composites bonded with WEST SYSTEM epoxy.*

002-740 ***Final Fairing & Finishing***—Techniques for fairing wood, fiberglass and metal surfaces. Includes fairing tools, materials and a general guide to finish coatings.*

002-898 ***WEST SYSTEM Epoxy How-To DVD***—Basic epoxy application techniques, fiberglass boat repair and gelcoat blister repair in one DVD.

*Available as a free downloadable PDF at www.westsystem.com/ss/use-guides.

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EPOXYWORKS®

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The life-sized Artistador under near completion in the studio.

The artist applying the finishing touches to the sculpture's patina.

The Artistador

Claudia Toutain-Dorbec is a multi-media artist living in northern New Mexico. The Downey Gallery in Santa Fe asked Claudia to create a life-size sculpture in preparation for the city's 400th birthday celebration which began Labor Day weekend 2009, and runs for a year. She created the Artistador, a conquistador who is also an artist, seeking his treasure in art. He stands with his arm extended pointing at his treasure, with brushes in hand, and a palette at his feet.

The sculpture, displayed on the Downey Gallery's roof, had to be lightweight, but strong enough to withstand high winds and all kinds of severe weather.

The basic body form was created with wire, plastic, Styrofoam™ and other materials bonded with 105 Epoxy Resin® and 207 Special Clear Hardener™. Because epoxy does not dissolve foam it is ideal for this kind of bonding. Claudia used heavy gauge canvas, various found objects, and created molds for the armor, which were poured and applied. Three more layers consisting of hundreds and hundreds of small cut pieces of thick and thin fiberglass fabric were applied with epoxy, much the same way paper mache is applied. Texture was applied using various grades of sand, dirt, pigments and gravel. It was sealed, then received 3 to 4 coats of antique patina. To protect the resin from UV exposure, a heavy coat of exterior urethane completed the process. ■

Claudia Toutain-Dorbec
505-747-1177
Website: www.claudiatoutain.com

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225 Canyon Road
Santa Fe, New Mexico 87501
505-982-6701

The Artistador on display on the roof of the Downy Gallery in Santa Fe, New Mexico.

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